CIRCULAR BUSINESS MODEL INNOVATION

A process framework and a tool for business model innovation in a circular economy

BAS MENTINK

MSc thesis Industrial Ecology

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For the degree of Master of Science in Industrial Ecology at
Delft University of Technology & Leiden University

Date of submission: April 29, 2014

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This research was supported by Royal HaskoningDHV. Their support is hereby gratefully acknowledged.

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Those who initiate change will have a better opportunity to manage the change that is inevitable
– William Pollard

Executive summary

The continuing growth of global resource consumption challenges today's resource-intensive economies and companies. Companies are confronted with an uncertain supply of (critical) resources, due to scarcities on the market, increased governmental intervention and geopolitical tension to secure resources and increased damage to global ecosystems. The concept of circular economy (CE) describes an economy with closed material loops and. Moreover, beyond risk mitigation, implementation of CE may reveal new profit pools or result in innovations which create new business opportunities. CE can also facilitate business to benefit from societal changes towards collaborative consumption and towards new ways of organization, higher levels of collaboration throughout the supply chain and new ways of creating value.

To implement CE companies often require new business models (BM). Closing material loops often affects multiple, if not all aspects of their current BMs. Notable changes include different products or services, different (relationships with) customers, different production processes and different revenue models, sometimes including other types of values than financial profit. Managing these changes requires companies to engage in a process of circular business model innovation (CBMI), which starts with the design of CBM concepts.

This thesis investigates the extent to which new methods or tools for business model innovation (BMI) can be used to improve circular business model (CBM) concepts. To do so first the CE, BM and subsequently the CBM are defined and described (Chapter 3). Then problems or challenges of CBMI are identified (Chapter 3) and the extent to which existing methods for BMI already offer solutions or guidance is analysed (Chapter 4). Finally, a new method and tool complementing the rest are developed and tested (Chapter 5 and 6).

Before starting to design CBM concepts, several things should be taken into account for any strategy involving CE. First, both 100% linear and 100% circular economies or business models do not exist due to practical limitations (leakages, growth, energy). Second, business, government and other societal (citizen) actors usually have different interest in CE, e.g. securing profits, protecting the environment or changing lifestyle. Third, different interpretations of what CE is cause debate and sometimes confusion. The narrow interpretation of EMF (2013) and this thesis focuses on closing material loops and does not fundamentally aim for sustainability. Broader interpretations do relate CE to sustainable development by including goals or principles, or relate CE to societal trends which seek to create other values than financial profit and organize things differently, for example on a community basis or in cooperations. It is important to understand different interests and interpretations and align goals of a CBMI process. Fourth, the risks or barriers to implement a CBM should not be underestimated. The complexity of organization and management often increases, new information of material, components and products is needed and above all the current system of legislation, consumer behaviour, financing, etc. is still to the advantage of the current dominant linear models. A system transition is needed.

Engaging in a CBMI process requires to plan a process and specific activities. This master thesis has developed the *CBMI framework*, which outlines a process of five phases. After a preparation phase, the innovation team goes through an initiation (analysis of the system), ideation (generation of ideas), integration (conceptualization) and implementation phase several times over in iterative cycles. Also, eighteen key challenges are identified which companies normally encounter. Knowing and understanding these challenges helps companies to gather and prepare the right people, knowledge and tools and improve the speed and/or quality of the CBMI process. Existing methods and tools for BMI in general, and for CBMI specifically, can be used to cope with the key challenges.

However, many are not tuned to the different characteristics of a CE (compared to a 'linear' economy), or are only in an early stage of development. Analysis of existing sustainable or circular BMI methods based on

the CBMI framework revealed several gaps in (practical) guidance. The Business Cycle Canvas (BCC) has been developed to fill a gap of support to both professionals and non-professionals to think in business systems. For the research a new list of criteria to assess CBM concepts has been developed and used. The main categories of criteria are circularity, business rationale, innovation and presentation & communication. The results of the research experiments show that using a BCC for CBMI improves the quality of CBM concepts considerably. However, the results are i.a. heavily dependent on weight factors of the criteria. Further research is required to determine success factors and the usefulness of the BCC.

Despite the need for further research, the following potential benefits for using the BCC have been identified in this research:

- Organization of information by visualisation of the *business cycle*, a closed chain of economic activities which together close a material loop. This explicitly drives users to think in business systems, by taking into account and integrating the BMs of multiple stakeholders;
- Additional benefits of thinking in business systems include an understanding of the needs of other stakeholders, of the structure and dynamics of a business system (supply chain) and support for designing and developing new governance structures;
- Development of an integrated business model for the whole supply chain. This enables all stakeholders to innovate or optimize on the level of the supply chain and (together) yield additional profits or other values which were previously – on the level of individual BMs – out of reach;
- A visualized business cycle supports users to communicate the CBM better to other stakeholders (most notably key decision makers) in order to achieve tangible commitment and/or to coordinate collaboration;
- Improved insight in stakeholders, activities and relations supports the identification of risks (or barriers) in the business system;
- The method around the BCC explicitly confronts practitioners with the implications of a closed material loop for all BMs in the business cycle. This increases understanding of the CE concept and what is needed to actually (begin to) 'go circular'.

This study recommends to use the CBMI framework and BCC for future CBMI processes and recommends to further research the following topics to cope with other CBMI challenges (see Chapter 9 for a longer list):

- Existing strategies, methods and practical experiences for implementing new BMs and transition management;
- Support to shared innovation from the fields of open innovation and co-creation;
- Improved methods or tools to describe functional needs or performances;
- Practical guidance on how to determine the evolution stage of both the industry and product or component;
- New modelling methods, digital design tools or critical success factors for CBM design to manage increasing complexity quantities of information;
- How to support organizational processes towards the optimization of supply chains;
- The use of creative ideation techniques and patterns for CBMs during a CBMI process (e.g. in meetings, workshops).

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List of Abbreviations

BCC	Business Cycle Canvas (tool)
BM	business model
BMC	Business Model Canvas (tool)
BMG	*Business Model Generation* (book)
BMI	business model innovation
CBM	circular business model
CBMI	circular business model innovation
CDI	critical design issue
CRM	critical raw material
CSF	critical success factor
CE	circular economy
EC	European Commission
EMF	Ellen MacArthur Foundation
KPI	key performance indicator
LCA	life cycle assessment
MFA	material flow analysis
PSS	product-service system

1. Introduction

1.1. Problem context and motivation

The concept of circular economy (CE) describes an economy with closed material loops. Closing material loops can be a solution to economic, environmental (and social) problems caused by the (rate of) extraction of raw materials from nature. The concept is rooted to a large extent in earlier and similar concepts or fields of study such as Cradle to Cradle, Biomimicry and Industrial Ecology. CE therefore is not a new concept, however has enjoyed successful propagation, most notably from the Ellen MacArthur Foundation (EMF). EMF has been able (supported by strategy consultants of McKinsey & Company) to draw new attention from business, government, academics and other organizations by a recent series of reports, which describe a variety of economic and environmental opportunities of a CE (EMF 2012, 2013, 2014).

The interest of the opportunities of a CE is observed from different angles. The European Commission has committed itself to a *Roadmap to a resource efficient Europe*, which involves various incentives for reuse, recycling and other recovery activities (EC, 2011). The Dutch national government runs the programme *Van Afval Naar Grondstof* ("from waste to resource"), stimulating a transition to a CE (MinI&M, 2014). EMF has gathered some 50 companies, governments and innovators including Philips, The Coca Cola Company, the Scottish Government, Renault and Unilever. The Circle Economy, a platform for CE in the Netherlands, managed to do the same in the Netherlands. VNO-NCW (Confederation of Netherlands Industry and Employers) has organized several conferences on supply security for the Dutch economy, focussing on CE and circular business models (CBM) (VNO-NCW, 2012).

One of the main challenges for the concept is the experimentation, implementation and dissemination of new business models which support the CE (Kok, Wurpel, & Ten Wolde, 2013). Closing material loops often affects multiple, if not all aspects of current business models (BM) (W. Stahel, 2014). Managing these changes requires companies to engage in a process of business model innovation (BMI) (Sempels, 2014). The BMI process starts with the design of CBM concepts, based on an analysis of the present and future business environment (Frankenberger, Weiblen, Csik, & Gassmann, 2013). Designing a CBM concept is more than generating a new idea and requires to integrate multiple ideas and solutions into a coherent whole. All aspects of the BM have to match each other (e.g. a new product requires a new process). Interestingly, the young field of BMI has developed new frameworks, methods and tools[1] recently to support companies in this process. Also, BMI has gained much attention by business as a means to achieve superior performance. The now widely used Business Model Canvas (BMC) by Osterwalder and Pigneur (2010) is the most widespread proponent of this field and illustrative to the increase in attention to BMI (for instance, googling images of 'business model' results in a massive amount of elaborated or adapted BMCs).

The increased attention for CE stresses the (growing) need for new BMs. Frameworks, methods and tools from the field of BMI could offer a possible solution and therefore their potential support to the development and implementation of CE will be investigated. This master thesis aims to further develop existing methods for BMI to improve the innovation process of companies towards a CBM.

[1] Throughout literature and other documentation there is no consistent use of the words 'framework', 'method' and 'tool'. See Section 1.2 for an explanation of how the words are used in this thesis.

1.2. Research questions & scope

The possibility of applying BMI frameworks, methods and tools for new CBMs leads to the following research question:

How can new or existing methods for business model innovation be used to improve circular business model concepts?

This main research question is subdivided in seven sub questions:

1. What is CE? (And what is it not)
2. What is a BM and a CBM?
3. What are the opportunities of a CE for business?
4. To what extent is BMI needed?
5. What are the key challenges for CBMI?
6. To what extent do existing methods for BMI and CBMI cope with these challenges?
7. What new, modified or extended methods or tools can be used in education and/or practice to improve CBM concepts?

Due to limited availability of time, the answers to these questions are limited on several aspects. Hereafter the most important aspect of the scope of this thesis will be stated.

- This thesis will focus on technical materials (the 'technocycle') and will not regard biological nutrients (the 'biocycle'). The techno- and the biocycle contain very different processes, which could not be all regarded. The author furthermore is more acquainted with the technocycle. This scope concerns all sub questions.
- The limits of energy use to CBMs is not considered in this thesis. Large quantities of energy are needed to close material loops, especially for faster, more or longer cycling[2] and energy limits could be an important restriction for the implementation of a CE.
- For explaining the concept of CE (sub question 1) only literature and documentation which explicitly treats 'circular economy' will be regarded. Although literature and documentation on preceding schools of thought, like Biomimicry or Industrial Ecology, provide extensive explanation of aspects of the CE concept, it cannot be concluded from these sources what should be considered part of the CE concept and what not. For example, in Section 2.1 will be explained why CE does not fundamentally aim for sustainability, although many of its conceptual roots do.
- Only general business opportunities of a CE are treated (sub question 3). This thesis does not aim to detail or quantify opportunities for a specific sector. Only several 'hotspots for a CE' based on general characteristics of various sectors are mentioned (Section 2.3).
- The key challenges for CBMI are derived only from theory (sub question 5). The quantity of literature on documentation is considerable, however a study in practice might encounter many other larger and smaller obstacles before successful implementation of a (circular) BM.
- For CBMI only aspects of the BM are considered (sub question 4, 5 and 6). This includes aspects of all BMs in the supply chain. However, for successful implementation of radically new CBMs a system transition is needed, with changes financial, organizational, institutional, technological and societal aspects of our current sociotechnical system (see e.g. (Tukker & Tischner, 2006a)). Also the dominant governance mode has to be taken into account (Tukker & Butter, 2007). Both are beyond the scope of this research. The field of transition management is mentioned (Section 2.4 and Chapter 3), as it has developed strategies for business to proactively engage with a required system transition, but not further elaborated.

[2] 'Long cycles' refer to long distances of transport, e.g. sending mobile phones to Africa and return the material after reuse.

1.3. Research methodology

For sub question 1-6 a literature review is done. Literature and documentation has been searched by a combination of search strings in academic search engines (see e.g. (Tukker, 2013)), 'snowball sampling' (going through reference lists of key documentation) and consultation of several academic and practical experts. The combination of searches was necessary to find a reasonable amount of relevant literature and documentation. For example, there is hardly any academic literature on "circular business model innovation" or on conceptual descriptions of CE from Europe[3].

For the description of the concept of CE (sub question 1) the report of EMF (2013) is taken as a starting point, since particularly this and other reports of EMF have been responsible for the increased attention of business, government and other actors for the concept CE. Nevertheless, for a broader consensus other studies which have separately defined CE have been regarded as well (Appendix A). To answer sub question 2-4 the literature and documentation has been analysed and summarized.

To find key challenges for CBMI (sub question 5) literature on BMI has been reviewed and evaluated against the description of CE (sub question 1) and additional literature and documentation on CE. This has resulted in the *CBMI framework*. How this has been done is further explained in Chapter 3 (*Adapting the 4I-framework*, p.41).

Subsequently, the CBMI framework has been used for an analysis of existing CBMI methods. The goal is to validate existing methods and identify gaps (sub question 6). This has been done by comparing the content of existing methods with the list of challenges in the CBMI framework and an assessment of the researcher to what extent the existing methods offer guidance, tools, steps, etc. to cope with the challenges. The results have been discussed with several experts in practice.

For sub question 7 a new tool and a method of use are designed and tested. For the design theory on CE and on the BM have been integrated. Existing methods and tools used widely in practice (most notably the Business Model Canvas) have been used to further improve the design. The research and experiments to verify the usefulness of the design have been based in general on the framework for research design of Kumar (2005) and specifically on studies researching (design) methodologies[4] and business model innovation[5] in a workshop setting. The research design includes a workshop session protocol, design criteria for CBMs which are used as variables for assessments, guidelines for assessment (measuring), descriptions of instruments of data collection and selection criteria for experiment participants. The data collection exists of posters and pitches of the CBM concepts, pre- and post-questionnaires, observations, and (transcriptions of) an evaluation if possible. A full elaboration on the research design is given in Section 6.1.

1.4. Structure of the report

The problem context of CBMI and the motivation for this research are given in this chapter. Chapter 2 treats the concept of CE and its relation to BM and BMI (sub questions 1-4). The chapter (re)introduces the concept of CE, gives definitions of a BM and CBM and describes general opportunities and difficulties of a CE for business. Finally, the need for new BMs and BMI is explained and illustrated. In Chapter 3 key challenges for CBMI are found by adapting and extending a current process framework (the 4I-framework) to a new CBMI framework. This framework describes the phases of the process which companies go through and challenges they encounter when innovating their BM (sub question 5). Chapter 4 present several methods

[3] Many Chinese articles on the concept of CE have a specific focus resource productivity, eco-efficiency and the application of the "3R principles". See further Appendix A.
[4] (De Pauw, Karana, & Kandachar, 2012; Goemans, 2013; Whalen, 2013)
[5] (Bragg & Bragg, 2005; Eppler & Hoffmann, 2012; Frankenberger et al., 2013; Osterwalder & Pigneur, 2010; Zott & Amit, 2010)

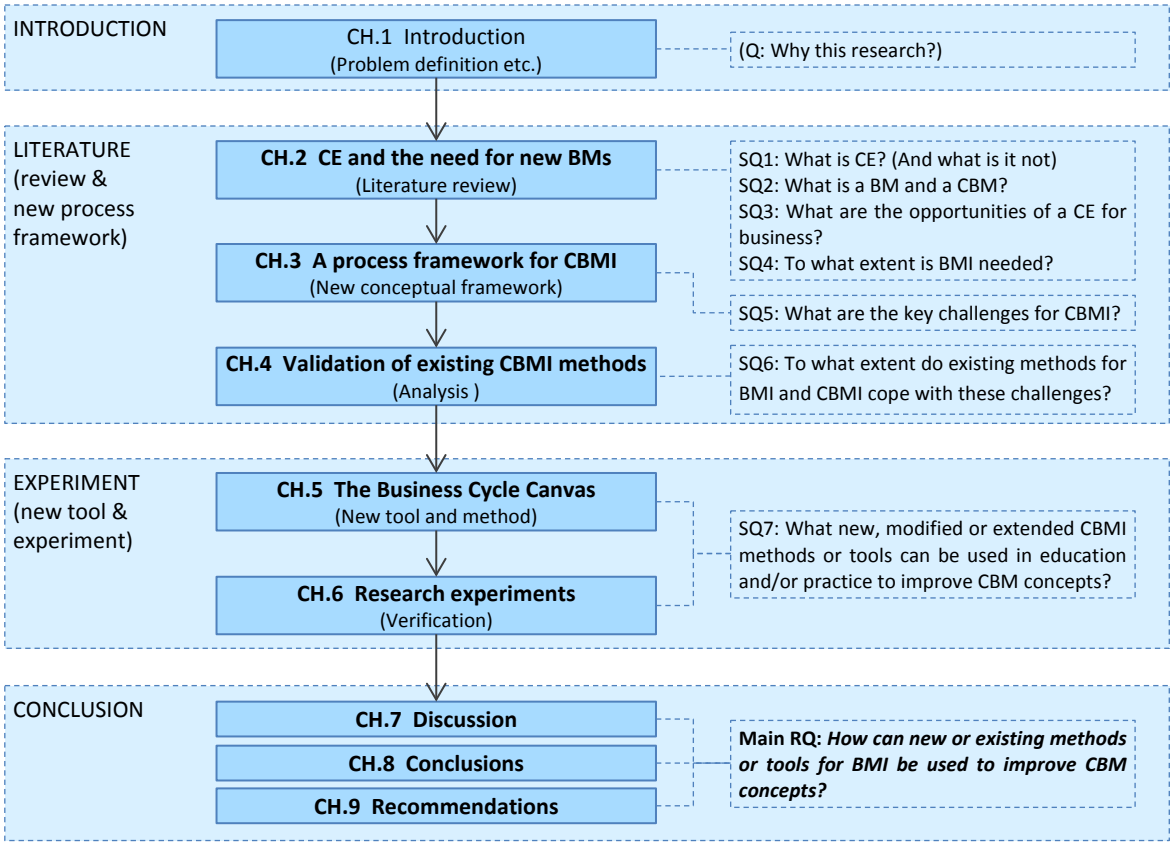


***Figure 1** – Structure of thesis report*

and tools for BMI, or CBMI specifically, which can be used to cope with these challenges. Also, the CBMI framework is used as a conceptual framework to analyse these methods and tools. The extent to which they cope with the CBMI challenges and the gaps they leave for new methods or tools are investigated (sub question 6). Note the difference in Chapter 3 and 4 between a framework on the one hand and methods or tools on the other hand. The CBMI framework describes problems (challenges) for which several methods and tools offer solutions (concrete guidance, artefacts, objects, etc.).

Chapter 5 introduces a new tool called the Business Cycle Canvas which could fill one of these gaps. The tool is accompanied by a method of use (sub question 7). In Chapter 6 the results of workshops (research experiments) are presented to verify the improvement brought by the new tool. Chapter 7 interprets the results of the experiments to see whether the expected usefulness of the tool can be verified. Chapter 8 concludes with an answer to the main research question and other key messages of this thesis report. Finally, Chapter 9 gives an outlook for further research on CBMI.

Figure 1 presents a visual overview of the chapters and corresponding sub questions.

1.5. Relevance

As mentioned previously, CE receives interest from business, government, academics and other organizations and this thesis is therefore relevant to all of these different groups, although in different ways.

To business and industry

Business developers, strategic designers, innovation or sustainability managers and others concerned with business strategies find a revision of business opportunities of CE, but more important may be helped by the theory on BMs and BMI and its adaptation to a CE context to improve their strategic innovation processes. On a general level, the CBMI framework organizes eighteen key challenges in five phases, which can be used to organize and improve the success, speed and/or quality of the innovation processes on a general level. More specifically and practically, the Business Cycle Canvas and accompanying method can be used with little elaboration in strategic workshops. The research design for the experiments, including protocol, design criteria, BM patterns and creativity techniques, can be used with little adaptation as session plan and content for this workshop.

For businesses working with biological nutrients further development of the contents of this thesis would be needed, as most text and figures focus on the technocycle.

To education

Education developers, teachers and others involved in higher educational programmes find inspiration and guidance to develop (parts of) courses about CE and/or BMI. On CE itself, this thesis creates new overview of the ample concept (and rather wordy EMF reports) which may help to organize, clarify and transfer knowledge. More importantly, the Business Cycle Canvas and accompanying method can also be used as part of educational programmes. Both the tool and the method have been tested in an experiment with 44 students. The research design of the experiment, including protocol (session plan), design criteria, BM patterns and creativity techniques, can therefore be used as course material with little adaptation. Posters made by students during the experiment are included in Appendix Q and illustrate the outcomes of the workshop. Contents of this thesis have been used for two courses on circular business modelling at TU Delft (both 3 ECTS).

To government and NGOs

Policy makers at governments or NGOs who want to stimulate and facilitate a transition to a CE can get a more thorough understanding of the innovation processes at companies. BM theory in general helps to understand 'how business thinks' and the key challenges of the CBMI framework illustrate what specific obstacles business needs to overcome. Also, the description of CE may increase understanding of the concept itself and of different interpretations. Especially with respect to sustainable development some important conclusions can be drawn (Section *CE and sustainability*, p.20).

To industrial ecology and other academic fields

The field of Industrial Ecology focuses on analysing physical flows in our economies and developing redesigns of industrial processes in order to solve sustainability problems. In order to do so, IE is a broad, multidisciplinary field using a systems perspective and integrating aspects of engineering, economics, sociology, toxicology and the natural sciences. However, the link between IE and the BM, or more general between sustainable innovation and BM is underexplored (Frank Boons & Lüdeke-Freund, 2012). This thesis is of interest to IE, because it shows. The thesis offers interesting insights into how physical flows are strongly related a company's BM and and how companies can adopt a systems perspective when innovating their BM.

Likewise, for other academic fields developing solutions for a CE and for sustainability in general, this thesis of interest to understand and take into account the importance of (a company's) BM and the process of BMI.

2. The Circular Economy and the need for new business models

2.1. The concept of Circular Economy

The concept of CE combines and builds upon several preceding concepts and therefore has a wide scope, but does not have an articulated definition reflecting its essence. In this section a definition of a CE is given based upon several studies and a new overview is created of all sub concepts and aspects. Practical implications of the definition and other interpretations will be treated as well, especially in relation to sustainability.

A definition of CE

The work of the EMF (2013b) is used as a core reference to define CE, since it has been adopted extensively by professionals and referred to frequently, if not standard, in Dutch academic and non-academic debates on CE. Significant illustrations of this extensive adoption and presence in debate and development of the concept are the recent report *Opportunities for the Circular Economy in the Netherlands* by TNO[6] (Bastein, Roelofs, Rietveld, & Hoogendoorn, 2013) for the Dutch ministry of Infrastructure and the Environment, and *Unleashing the Power of the Circular Economy* by IMSA for the Circle Economy platform[7] (Kok et al., 2013), who use EMF's work as main or even sole reference to describe the concept of CE.

EMF (2013) describes the concept as "an industrial economy that is restorative by intention" aiming to "enable effective flows of materials, energy, labour and information so that natural and social capital can be rebuilt" (EMF, 2013b, p. 26). The meaning of the word 'restorative' refers to the post-consumer or post-use material flows which are fed back into original economic activities and therefore must be able to *restore* the original material sources of these economic activities. However, reports of EMF themselves lack an articulated definition of CE

Parallel studies to CE neither define CE is one or two sentences, but do provide nuances on what CE is and what it's not. The most important common characteristic throughout the studies is the closure of resource loops (Damen, 2012; Preston, 2012; Yuan, Bi, & Moriguichi, 2006). Thinking in systems, or pursuing change on a systems level, is mentioned by all as well. However, an important difference is that in Chinese literature the "3R" principle of 'reduce, reuse & recycle' is related to CE (Yuan et al., 2006). *Reduction* of material use is not named by the other parallel studies, but is "crucial to reduce the environmental impact of our economy" (Kok et al., 2013). See Appendix A for more details on similarities and differences among parallel studies.

Predominantly based on the work of the EMF (2013b), and substantiated by contributions including (Bastein et al., 2013; Bechtel, Bojko, & Völkel, 2013; Damen, 2012; Kok et al., 2013; Preston, 2012; Schulte, 2013), the following definition of CE is given:

A circular economy is an economic system with closed material loops

This definition implies that the concept of CE should be considered an economic concept, with 'closed material loops' as an important prerequisite. 'Closed material loops' implies that material is reused again, either as bulk material, as products or as components. Specific processes (or economic activities) are

[6] TNO is the largest independent and non-profit knowledge institute of the Netherlands that focuses on applied science.
[7] The Circle Economy is the most active platform in the Netherlands for CE proponents from practice

needed to facilitate this, such as refurbishment or recycling. EMF (2013) and other sources comment widely on how closed loops influence the essence of an economy, the production, distribution and consumption of goods and services. How these economic activities are influences is well visible in the BM (see Section 2.4).

One of the most important implications of closing material loops is the potential minimization of extraction of material from nature and the emission of waste to nature. Problems with extraction, such as resource scarcity, and with emissions, such as environmental impact, can potentially be solved. The opportunities from the business perspective are elaborated in Section 2.3.

Figure 2, referred to as the 'butterfly diagram', visualizes a CE. Several archetypes of closed material loops are visible, such as reuse, recycling and soil restoration (fertilizing soil with organic waste). Important to note is that **Figure 2** gives the impression that material loops should be closed literally, in the sense that materials or components must go back to the original parts or product manufacturer. However, material can be used by another manufacturer, as long as the materials can flow back in the *original* material pool. In that case the original manufacturer can use the material again and *downcycling* is prevented[8]. This is called **open loop recycling**.

The same should be noted about **product life extension** (PLE) or strategies for increased durability of products, enabling to use products longer. These strategies are often related to CE (Bakker & Hollander, 2013; Evans, 2013) and indeed support a CE when for example a product is made more durable to enable reuse (and thus closes a loop). However, making a product durable to bring it to the dump a few years later does not support a CE.

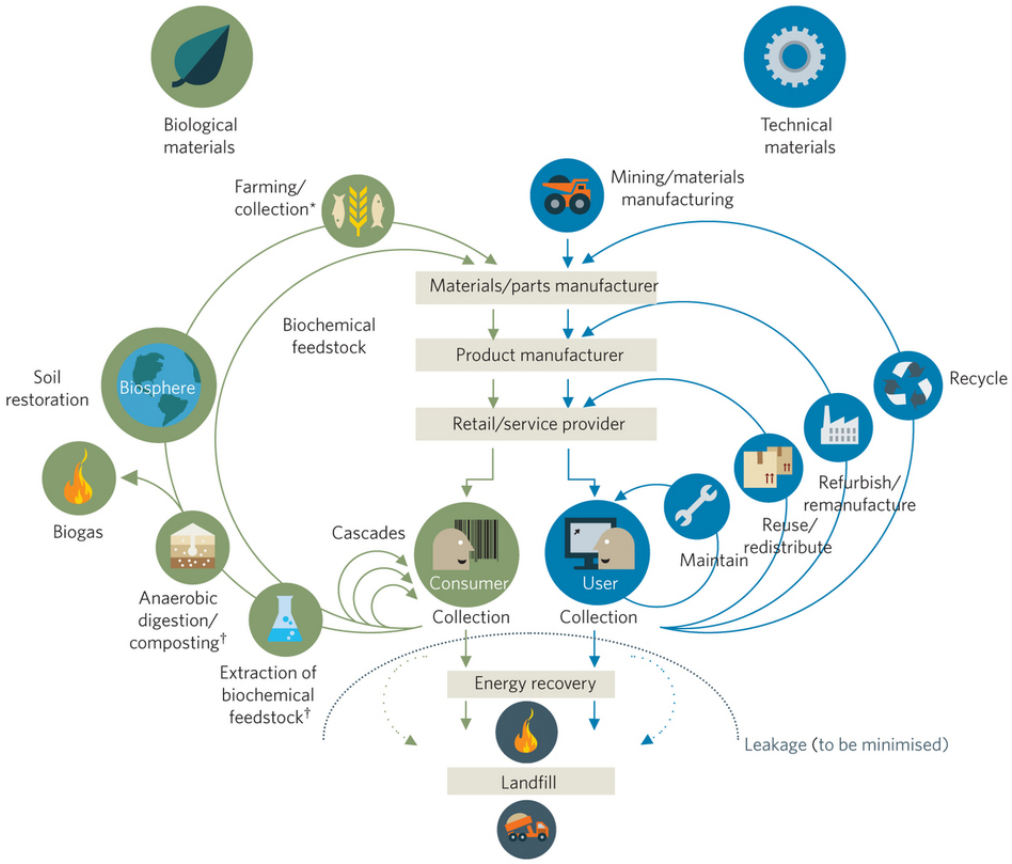


Figure 2 – *Schematic overview of circular economy activities. Material should cycle as long as possible through these activities. Mining, energy recovery and landfill should be minimized to zero (EMF, 2013b).*

[8] In today´s practice downcycling is often defended as a better alternative than using raw virgin materials twice. In a transitional situation towards a CE this indeed is a good argument, as long as it is emphasized that downcycling needs to be replaced by a better practice as soon as possible.

Five principles and schools of thought

EMF presents five CE principles (pp. 26-28) to operationalize the concept of CE:

1. Design out waste
2. Build resilience through diversity (balance efficiency with adaptability)
3. Shift to renewable energy sources
4. Think in systems
5. Think in cascades

The five generic principles are based upon several preceding 'schools of thought' in which EMF (2013) has rooted its description of CE.

Table 1 links these principles to the schools of thought.

Building upon this many elaborated schools of thought makes CE a very ample concept. **Figure 3** aims to reorganize all content of the CE concept as presented by EMF (2013) and creates a new visual overview, in order to increase understanding of what CE is (what follows out of the definition) and what it's not (delineations of the ample concept).

School of thought	Key terms	CE principles
Permaculture (Mollison & Holmgren, 1978)	Diversity, stability & resilience	2. Build resilience
Performance Economy (W. R. Stahel & Reday-Mulvey, 1981)	Performance-based, functional service (from ownership to use) Product-service systems	4. Think in systems (1. Design out waste)
Industrial Ecology (Frosch & Gallopoulos, 1989)[9]	Systems perspective, thinking in systems Minimize energy use, consumption of scarce materials, and environmental impacts including waste generation Industrial Symbiosis Life cycle assessment and material flow analysis (LCA and MFA)	All principles
Regenerative design (Lyle, 1996)	Regeneration, regenerative process (process that renews its sources of energy and material	1. Design out waste
Biomimicry (Benyus, 1997)	Nature as a model (imitation, learning) Nature as a measure (norms) Nature as a mentor (valuing) 6 *Life's principles*	All principles
Cradle to Cradle (McDonough & Braungart, 2005)	Waste equals food Celebrate diversity Use current solar income Distinguish bio- and technocycle Eco-effectiveness over eco-efficiency	All principles
Blue Economy (Pauli, 2010)	Cascading, one's waste is another's income	5. Think in cascades

Table 1 – *Key terms of schools of thought in chronological order in which the concept of CE is rooted (EMF, 2013). The key terms are related to CE principles.*

[9] Unlike other schools of thought, Industrial Ecology knows not one or two, but several key contributors (including Robert Ayres, Thomas Graedel, John Ehrenfeld and more).

Figure 3 – *Visual overview of the concept of CE. EMF's original CE principles are displayed in red*

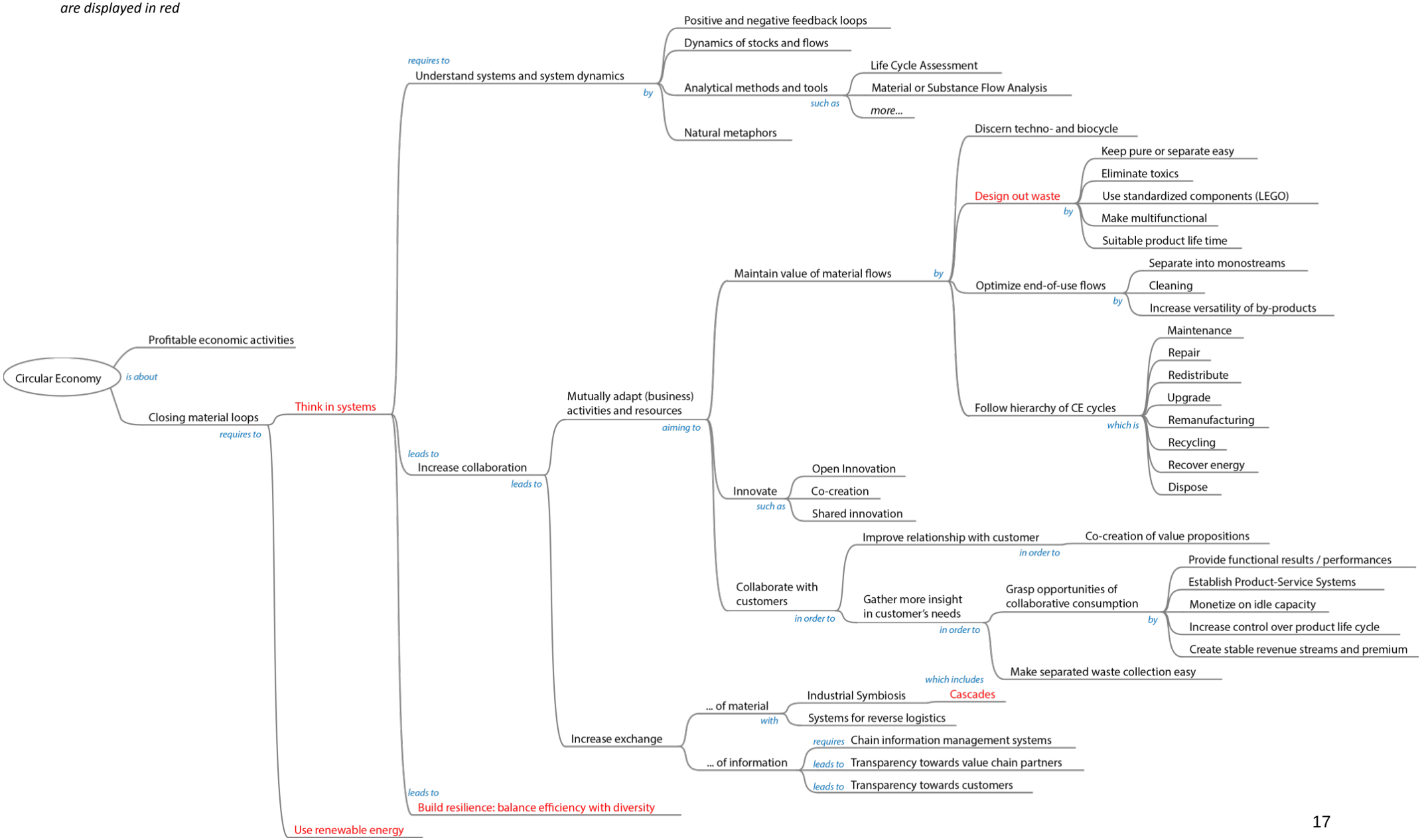


Figure 3 departs from the definition of CE. CE primarily is about closing material loops in an economy with profitable (including subsidies for social values) economic activities (unprofitable activities cease to exist). Subsequently, more fundamental aspects are presented higher up (to the left) in the hierarchy and more detailed or specific ones at the bottom (to the right). What is remarkable above all is the uneven substantiation of EMF's orginal CE principles (see unequal degree of ramifications of aspects in red). For example, the principle 'Think in systems' is much more fundamental to CE than 'Think in cascades' or 'Design out waste' and is the basis of many other principles or concepts, whereas 'Use renewable energy' and 'Build resilience' are much less embedded in other concepts mentioned by EMF (2013).

The conclusion which can be drawn from this is that some CE principles are more fundamental than others and could receive more attention or priority when implementing CE. However, this does not mean other principles are not important and can be skipped. For example, the use of renewable energy indeed is not vital in early stages of (a transition to) a CE, since material loops can be closed with any form of energy. However, energy also has a material footprint (see e.g. (Kleijn, 2012)). Fossil fuels and other non-renewable energy sources cannot (yet) restore their original sources. On the contrary, wind mills or PV panels can be restored to elementary material flows to be used for other energy production systems in the future, which explains the need to shift sooner or later to **renewable energy use**.

The fundamental importance of **systems thinking** is well illustrated in **Figure 2** (CE butterfly diagram). Closing a material loop involves some five to six economic activities, which includes several stages of production, the consumer, and one or more recovery activities. In reality this can increase to tens or hundreds of activities for very complex products. To successfully close a loop one has to regard the whole supply chain at once to make sure there is no missing or broken link in the cycle. Understanding the whole supply chain requires understanding the parts – the individual companies – and their relations, because they influence the whole. Regarding the whole, the parts and the relations all together is the essence of systems thinking (Meadows & Wright, 2008).

Thinking in systems leads to the recognition of the important yet not vital aspect of **building resilience**. Briefly, resilience is the capacity of a system to recover from perturbations or disturbances. A closed loop which relies on one link is not resilient, since the whole circular system collapses once the link is gone. Having alternative routes or back up processes are solutions to this risk. Although it is possible to close a loop without these back up processes, again sooner or later a perturbation might come which lets the whole system collapse.

Further elaborations to the energy issue and the resilience issue are beyond the scope of this thesis.

Explanation of several aspects

Many aspects named in **Figure 3** are treated with detail by EMF (2013) or other sources. For some aspects some additional explanations or special references are given in **Table 2**.

Table 2 – *Additional explanation of special references of several aspects of CE*

Aspect	Additional explanation and/or references
Positive and negative feedback loops	(Economic) activities can reinforce or brake each other, directly and indirectly. When aiming for changes in a system, making use of positive feedback loops is recommended. See further the *system dynamics map* in Appendix F
Dynamics of stocks and flows	Such as accumulation, leakage and delayed discharge of stocks. Especially for a system as a whole this is important. For example, if a remanufacture plant can handle 1.2 million phones a year, but all 1 million sold remanufactured phones per year are returned on the same day, the remanufacture plant is overloaded and the shops can't sell enough phones
Industrial symbiosis	IS is a collective approach for a new competitive advantage of traditionally separate industries involving the physical exchange of materials, energy water or by-products (Chertow, 2000). 14 key principles for successful collaboration in industrial symbiosis have been identified, such as trust, dependency, risk and proximity (Van Houten, 2013).

Cascading (original CE principle)	Can be regarded as a specific type of industrial symbiosis which involves the *consecutive* use of materials in multiple economic activities before restoring the material flow to its original sources (Damen, 2012; EMF, 2013b; Pauli, 2010).
Product-service systems (PSS)	There are 8 types of PSS (Tukker & Tischner, 2006b). The use-oriented PSS (rent, lease, hire) fit well with the trend of collaborative consumption. Result-oriented PSS require abstract performance indicators in order to give service providers more freedom to fulfil the actual needs of customers.
Separating monostreams	(Such as PET bottles) is best done at at the source of waste production (Valstar, 2013)
Reverse logistics	Reclamation of end-of-use or end-of-life products. Efficient and high-quality collection (see also below 'Optimize end-of-use flows') and information management systems play a key role.
Maintain value of material flows	Exchanges and collaborations in an economic system are facilitated by high value material flows. Only when enough value is maintained in material flows, the waste becomes food for another economic activity, additional revenues can be created and waste production (or leakages to energy recovery and landfills) can be minimized. See also (W. Stahel, 2014)
Design out waste (original CE principle)	Waste can be regarded as negative value. Therefore designing out waste can be regarded as waste prevention and one of the strategies to maintain value of material flows.
Techno- vs biocycle	*Biological nutrients* (**Figure 2,** green cycle) must be distinguished from *technical materials* (blue), since technical materials can be reused, but biological nutrients can only be consumed. Hence we speak of 'consumers' in the biological and of 'users' in the technical loop. Furthermore, the restoration of technical materials requires energy consuming industrial processes, whereas biological nutrients can be restored through the regenerative capacity of natural systems. Elaborately explained in (McDonough & Braungart, 2005)
Keeping materials pure or easy to separate	No adhesives, welds or other difficult to separate joints of materials, but instead snap fits, fasteners, etc. which are easy to access (see further Poppelaars (2014, p. 40) and (Visser, 2014)).
Suitable product life time	Shorter than 25 years, or it is likely the product does not fit the future dominant circular technologies, and longer than 6 months to be suitable for reuse (recycling will still be possible) (Bastein et al., 2013).
Increase versatility of by-products	Create more possibilities for use in other economic activities, for example the removal of toxics to make the by-products acceptable for use in another process.
Hierarchy of CE cycles	Some CE cycles are preferred over others due to energy efficiency or preservation of material value. For example, a laptop is worth more after repair than after recycling.[10] In general, the preferred cycles are the smaller or 'inner cycles' of **Figure 2**. However, due to typical products characteristics, technological maturity or market demands 'lower' cycles can be preferred (Bakker, Wang, Huisman, & Den Hollander, 2014). The hierarchy for technical materials is as follows (Bakker, 2014; Damen, 2012; EMF, 2013b): 1. **Maintenance** extends the product's lifetime by *preventing* faults or break down. Since faults are not present yet and cannot be seen, maintenance is often done a scheduled activity or routine. Maintenance can also involve cleaning or other aesthetic measures. 2. **Repair** extends the product's lifetime *after* a fault or break down and restores to the original performance of use state, or less (Parlikad, McFarlane, Fleisch, & Gross, 2003). Therefore warranty is often not restored. Repair can also involve cleaning or other aesthetic measures. 3. **Redistribution** (or reuse without treatments) can be done when a product reaches an end-of-need phase. It capitalizes longer on the product's value by finding users with different needs which (still) match the original product. Usually a platform is needed to connect products to users (web marketplace, second hand shop). 4. **Upgrading** replaces outdated modules or components with technologically superior ones (Parlikad et al., 2003).[11] 5. **Remanufacturing** replaces or repairs broken or outdated components of a product. Remanufactured products have equal or higher performance than the original the same warranty and therefore customers can consider them the same as new product (Bakker & Hollander, 2013). 6. **Recycling** wins back base materials from used products, but loses much of the added (or embodied) value (energy, labour and use of capital). 7. **Energy recovery** wins back part of the energy content of used products in the form of heat, electricity or fuel before disposal. 8. **Disposal** must be regarded as the last resort for a material flow. It is recommended to have considered all other CE loops for possibilities to capture value. * The much used term **refurbishment** does not appear in this list, because it can be seen as combination of maintenance and repair (Bakker, 2014)

[10] After repair: 1/4 to 2/3 of initial value (€150-250). After recycling: €3-5 (Kimmel, 2013).

[11] **Refurbishment** is a term under debate and left out the hierarchy due to overlap with other definitions, since most sources refer to refurbishment as a combination of maintenance, repair and upgrade (Bakker & Hollander, 2013; Damen, 2012; Poppelaars, 2014)

Practical limitations of CE

The natural metaphor is used by many schools of thought, like Biomimicry, Cradle to Cradle and Industrial Ecology, to envision an economy without wastes. In nature there is no waste, and if our economy abides the laws of nature, such as Life's Principles (Benyus, 1997), we might achieve an economy with fully closed material loops. However, there several reasons why raw technical material inputs into our economy continue to be necessary and thus why **a 100% circular economy is practically impossible**, at least for the time being.

First, fully closed material loops imply not minimal, but ***zero* losses of technical material**. An ideal recollection system would be needed to gather every last bit of material, e.g. small chips after cutting processes, the last drops in tanks and tubes and a plastic bottle discarded deep in a forest. Apart from technological difficulties, such systems would be practically impossible to organize perfectly, if not just very expensive. **Alternatively, <u>all</u> materials have to be biodegradable**, so nature can handle our waste. After all, nature is everywhere. Note that this would mean the end of the technocycle.

Second, fully closed material loops also imply ***zero* material inputs**. Theoretically this is possible if the outputs, or losses of material are also zero. Input equals output in a steady state system. However, the current system is not steady. Instead, the absolute consumption rate of the global economy is expected to continue to grow, driven by population growth and rising income (Lee, Preston, Kooroshy, Bailey, & Lahn, 2012). Technological innovation is not expected to compensate.

Third, fully closed material loops imply endless loops, but **many technical materials can only be reused or recycled a number of times**. For example, the recycling of aluminium is limited to a number of times due to material fatigue (Bathias, 1999), and with today's technology the addition of at least 5 % pure virgin aluminium is required to ensure the composition meets quality standards (Allwood et al., 2012, p. 110).

Fourth, endless loops also requires endless energy to *drive* the loops. Especially recycling processes consume much energy. However, in principle there is infinite renewable energy. But, renewable energy systems need material to be built and in some scenarios the **required energy systems are practically unachievable** (Kleijn, 2012). A radical increase of energy efficiency is needed for a (close to fully) CE.

CE and sustainability

The concept of CE has a wide scope, not only because combines and build upon many preceding schools of thought, but also because out of its systems perspective it aims to address all aspects of a CE. This includes technology, legislation, consumer behaviour, the environment and its limited resources, education, economics and of course BMs. Due to the wide scope many actors from business, government, universities and other organizations have been able to reflect their specific goals and interests in the concept and emphasize or focus on different aspects. **Figure 4** explains visually how different actors all want to implement CE, but have reasons and underlying interests to do so. What is remarkable is that none of the actors covers the full circle, although after all sustainable development requires to (re)balance social, ecological and economic values (Frank Boons & Lüdeke-Freund, 2012). This does not say that none of the actors aim for sustainable development. However, it does indicate that the concept of CE does not support them very well to set goals to balance the three sustainability values (People, Planet, Profit).

Business goals and interests are probably the richest area of opportunity for CE (hence the thicker red line), as the private sector is a large part of the economy and possesses much innovation capacity (capital, skill, experience). Business's main goal with implementing a CE is to reduce risks of continued (long term) supply of resources (VNO-NCW, 2012). However, current polls among CEOs do not project large investments, despite the perceived risk of rising energy- and resource costs (Schoolderman, Van den Dungen, & Van den Beukel, 2014). Rather the focus remains on acquiring new customers and improving operational

effectiveness (ibid), i.e. economic growth and more profit. For them these aims should be integrated with implementing CE.

Government shares the concern of the long term security of supply of critical resources (see e.g. (EC, 2012) and (MinEZ, 2013)). Also foreign affairs and diplomacy are involved due to international tensions and bilateral agreements related to resources (VNO-NCW, 2013). Environmental grounds are as pursued only by e.g. the Dutch Ministry of Infrastructure and Environmental Affairs (MinI&M, 2013) and much less by business or other Ministries.

The bottom-up initiatives of new BMs come closest to covering all three sustainability values. The initiatives originate mostly from societal changes in needs and behaviour and new opportunities thanks to IT and internet. People want create and focus on other values than financial profit and who want to organize things differently, for example on a community basis or in cooperations (the 'Weconomy', Jonker 2013). These trends are new opportunities to which some businesses respond as well.

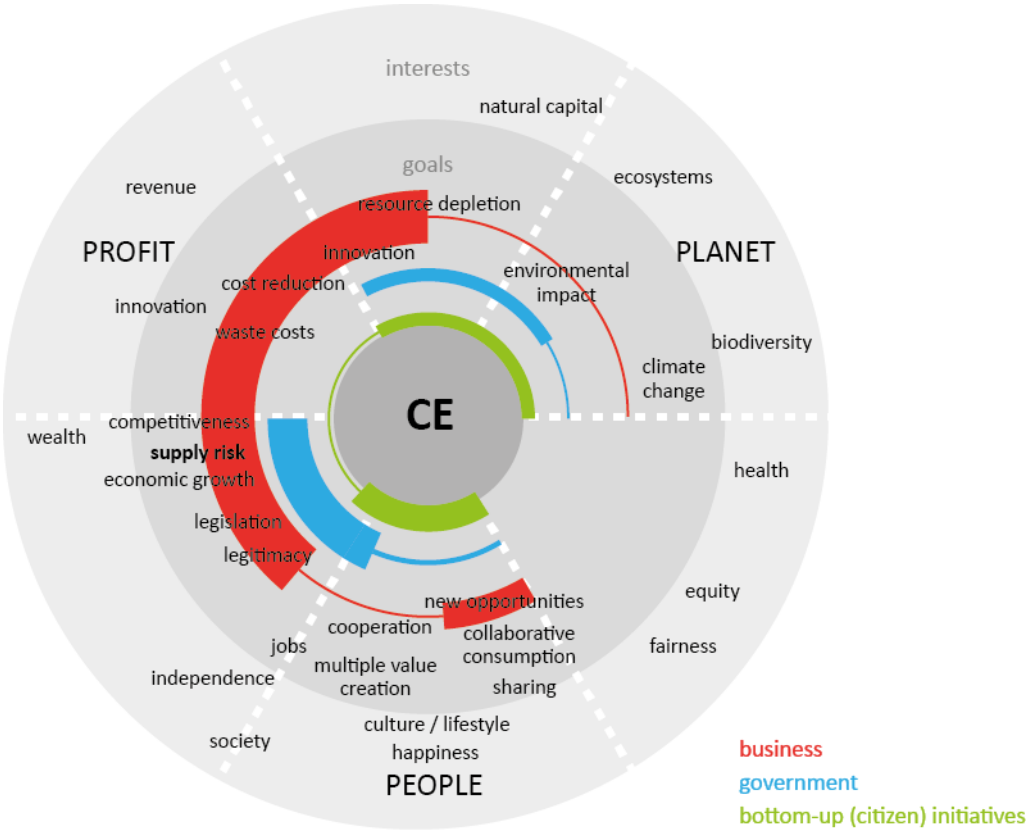


Figure 4 *– Radar of differences in goals and interests in the concept of CE.*

The limited support to balance People, Planet, Profit is remarkable, since almost all preceding schools of thought do aim for sustainable development. Furthermore, CE has an evident link with decreasing environmental impact, since "the goals of the system [a CE] are to counteract the depletion of natural resources; phase out waste, greenhouse gas emissions and the use of hazardous substances; and make a complete transition to renewable and sustainable energy supplies" (Bastein et al., 2013). However, in the documentation of EMF itself the word 'sustainabilty' is almost absent[12], seemingly because of "semantics reasons" (Ken Webster, Head of Innovation at EMF, quoted in Poppelaars, 2014). But more importantly, as presented by EMF (2013) CE does not introduce any norms, requirements or otherwise means to do so. To

[12] Search item 'sustainab*' (includes sustainability, sustainable). Not counted: side-line text boxes, names and references.

illustrate, CE does not mention social issues such as equality, fairness or health. Also, the necessity of a factor 10 decrease of environmental impact is not mentioned, in contrast to e.g. Tukker and Tischner (2006b). The need to decouple environmental impact from human well-being (beyond economic development) and to reflect all externalities in prices are not named (Kok et al., 2013; WBCSD, 2011). Proposals to decouple material needs from social well-being and become "ecologically literate" (Jackson, 2009) or to aim for 'sufficiency' (Lüdeke-Freund, 2010) do not resonate. In fact, some sources advise to market circular products not as sustainable or green alternatives, but on other advantages (Kok et al., 2013, p. 22). Therefore, **CE does not fundamentally aim for sustainable development** as presented by EMF (2013) and defined in this thesis.

However, broader interpretations of CE which go beyond the narrow focus closing material loops exist as well. For example, as mentioned previously, Chinese literature includes reduction of material use to CE (the 3R principle). Or according to UNEP (2010) CE balances economic and ecological value, i.a. by putting emphasis on environmental protection and efficient use material, and featuring low use of energy. Tukker et al. (2014) combine these two interpretations with the description by EMF and then classify CE as 'weak sustainability'. This means that the concept does aim for sustainable development, but focuses on market-based solutions. In contrast, 'strong sustainability' focuses on government intervention to protect the common goods against economic processes (e.g. (Rockström et al., 2009)) and 'paradigmatic change' aims at a fundamental change of our socio-economic system, such as new focus on spiritual instead of on material growth (e.g. Jackson, 2009). As a final example, Jonker (2013) has a broader interpretation from a different angle: "CE is absolutely not a synonym for material cycles or Cradle to Cradle, but above all an economic model where value chain partners find each other on the basis of mutually strengthening relations and services". Based on this observation he relates CE to certain changes in society, usually bottom-up, where people want create and focus on other values than financial profit and who want to organize things differently, for example on a community basis or in cooperations (the 'Weconomy').

From the perspective of EMF (2013) or this thesis, neither of these interpretations is wrong or right. Moreover, all interpretations support the implementation of a CE. However, different interpretations can cause debate, misunderstanding or hamper fruitful collaboration and partnerships. **Since CE often depends on collaboration between different parties, it is important to understand the differences between interpretations and align goals of a CBMI process**.

2.2. The circular business model

In this section a definition of a circular business model (CBM) is given and explained, based upon a definition of a business model (BM) and of a CE (see previous section).

The business model

Different views exist on what a BM exactly is, what components it has, what is should be used for and how (Bouwman, de Vos, & Haaker, 2008; H. Chesbrough, 2010; El Sawy & Pereira, 2013; Johnson, Christensen, & Kagermann, 2008; Teece, 2010; Zott & Amit, 2010). This thesis uses the definition of the business model (BM) by Osterwalder and Pigneur (2010):

The business model is the rationale of how an organization creates, delivers and captures value.

This definition is reflected in an ontology of the business model in four pillars. This breakdown is most widely accepted in literature (Frank Boons & Lüdeke-Freund, 2012; Heikkilä & Heikkilä, 2013)[13]:

1. Value proposition: **what** value does a company create with its product/service;
2. Infrastructure management or Supply chain: **how** is the value proposition created, including the structuring and management of upstream relationships with;
3. Customer interface: **who** are the customers, including the structuring and management of downstream relationships with these customers (delivery of value);
4. Financial model: costs and benefits from 1), 2) and 3) and their distribution across BM stakeholders (**why** is the value proposition created, or how is value captured)?

The four words printed in bold refer to a further simplification of the BM to *four basic BM questions* of Frankenberger et al. (2013). Interestingly, Osterwalder and Pigneur (2010) prefer to expand rather than simplify the number of pillars and propose 9 "buildings blocks" (see Figure 19, p. 52). See **Table 3** for a comparison of different ontologies.

From definition of BM	Frank Boons and Lüdeke-Freund (2012)	Osterwalder and Pigneur (2010)	Frankenberger et al. (2013)
Create value	Value proposition	Value Proposition	What? – the value proposition
Create value	Supply chain	Key Activities Key Resources Key Partners	How? – activities, processes, resources and capabilities
Deliver value	Customer interface	Customer Segments Channels Customer Relationships	Who? – customer segments
Capture value	Financial model	Cost Structure Revenue Streams	Why? – revenue model

***Table 3** – Comparison of BM ontologies of three (key) contributions to the field.*

The following observations add further understanding of what a BM is (and what it's not):

- BMs are models of a company, and not of an entire sector or industry (Baden-Fuller & Morgan, 2010). Nevertheless, industries can be characterized by companies having common elements of their BMs.
- BMs are at an "intermediary" or abstract level and don't explain details of a company (Baden-Fuller & Morgan, 2010)
- BMs are systems of interrelated components (Sempels, 2014; Wicki, 2013). If one component changes, others often (have to) change as well. For example, making a new product (Value proposition) may require new processes and resources (Infrastructure management).

[13] "Literature is rather consistent in the list of main components" (Heikkilä & Heikkilä, 2013). More important, Frank Boons and Lüdeke-Freund (2012) have reviewed 87 journal articles with 'business model' in the article title from between 1990 and 2010.

- BMs are a “market device” (Doganova & Eyquem-Renault, 2009), as BMs are used by entrepreneurs as a communication tool to describe their ventures and construct markets and explain for different actors in their network, e.g. other companies, financiers, research institutions, etc. (Frank Boons & Lüdeke-Freund, 2012).
- BMs are no business strategies. Strategies are plans to create and defend a unique and valuable position in the market (e.g. finding a virtuous cycle for a self-reinforcing BM) and BMs are a set of choices to carry out the strategy. So strategies dictate which BMs are possible to use and BM explain how the strategy is executed. Choices on the smallest scale are tactics (Casadesus-Masanell & Ricart, 2011)
- BMs are not static, but dynamic and evolve over time as they are under constant pressure to change because of drivers from the business environment (Linder & Cantrell, 2001)

A definition for a circular business model

Based on the literature review and following definition of CE (Section 2.1) and the BM (see above) a circular business model is defined as follows:

A circular business model is the rationale of how an organization creates, delivers and captures value with and within closed material loops

Compared to the definition of the BM, the CBM should be regarded as a subcategory of BMs which fit in an economic system of restorative or closed material loops. This entails that a CBM does not need to close material loops by itself (within its internal system boundaries), but can also be part of a system of BMs which together close a material loop in order to be called circular. For example, BM 1, 2, 3 and 4 in **Figure 5** together close the blue material cycle and could all be regarded as CBMs (other material flows left aside). BM 6 and 7 are regarded as non-circular, because they are not part of any material cycle.

CBMs keep materials in the economy and also enable other companies to do so. The latter means that if a company makes products out of recycled materials, but in such a way that it is too difficult to recycle the materials again, the company in fact impedes a closed material loop. BM 6 in **Figure 5** could represent such a company. Therefore, **regarding the system is indispensable to determine whether a BM is circular or not.**

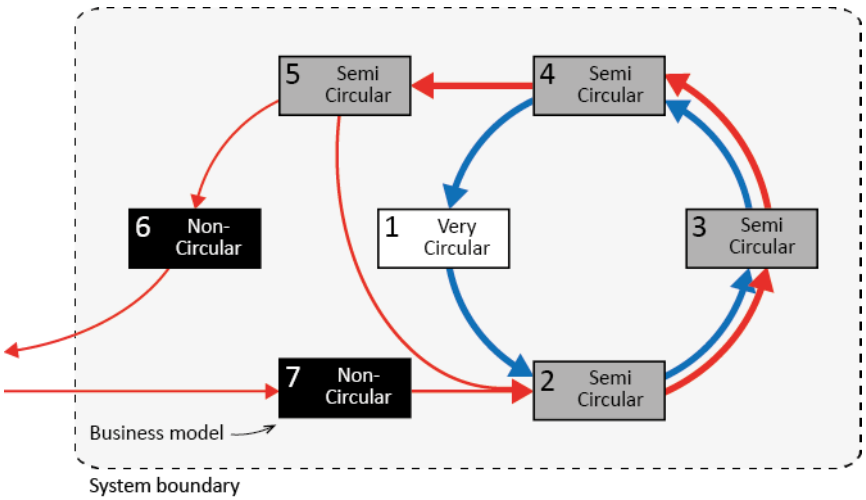


Figure 5 – *A system with circular, semi- and non-circular business models.*

BM 2, 3, 4 and 5 are part of the large transitional or ‘grey area’ of BMs which are circular to a certain extent. In reality, every BM is part of this grey area, since 100% circular BMs (like BM 1) do not exist due to both physical (thermodynamic) and practical reasons (see Section 2.1). **Depending on the system boundary and**

time scale, 100% linear BMs also do not exist. Food for example can only be consumed, not reused. However, after flushing the toilet the nutrients will eventually flow back to nature where the same food can grow again. Also, plastics are often *downcycled* because it is difficult to reuse it for the same purpose. (Valstar, 2013). However, technological and advantageous economic developments could improve this and for some plastics, like PET bottles, a system without loss of quality already functions.

2.3. General opportunities of a Circular Economy for business

In this section general drivers and barriers for business to implement a CE are treated following the structure of a SWOT analysis. On a general level, the most important identified drivers for business to consider CBMs are (EMF, 2013a; Van Raak & Loorbach, 2014):

- Increased price volatility of resources and associated supply risk;
- Societal trends towards sharing products and other forms of collaborative consumption;
- Increasing legislation on resource efficiency and circular economy (Northern European countries and the EU above all);
- Increased and new collaboration in the supply chain (co-creation, new bottom-up cooperations, etc.).

These drivers are a mix of threats of the current (linear) business environment and genuine strengths or opportunities of a CE. However, the linear model remains to have other strengths in today's business environment and changing to a CE also comes with barriers, obstacles and costs which should be regarded as weaknesses or threats. Over 20 obstacles "to accomplish a breakthrough to a circular economy" have been identified (see Appendix D) The most important strengths, weaknesses, opportunities and threats are summarized in. The content of **Figure 6** is explained further in the following sections.

Linear threats are circular opportunities

The most important category of circular opportunities is the **supply risk** of critical resources experienced by current 'linear' BMs. This is the primary concern of most businesses interested in CE (VNO-NCW, 2012). The amount of risk however is rather complex and rooted in several mechanisms:

- **Price volatilities** of several types of commodities have increased steeply the past decade (see **Figure 7**). These are mainly due to short term scarcities, as supply chains are unable to keep up with increasing demand of a growing population, average consumption and urbanization (EMF, 2013).
- This may prelude longer term scarcity as well, but there remains to be absolute uncertainty about **resource depletion** and **absolute scarcity** as is has been demonstrated that "there are no obvious resource limits" (Tukker et al., 2014) and "reserve data for energy and metals are a flawed guide to what is available. Policy, price and technological innovation all influence what counts as a 'proven' reserve, while poor data availability in some of the major producer countries hampers any assessment" (Lee et al., 2012, p. 35). Others nevertheless urge or take action (e.g. (Damen, 2012; EC, 2011; EMF, 2013b).
- General **price increase** (see **Figure 8**) on top of higher price volatility, caused by an equally "complex mix of factors, from differing lead times and market structures to substitutability and varying political and environmental constraints" (Lee et al., 2012, p. 53).
- **Geopolitics** (protectionism, boycotts) and **political instability** pose a risk on the supply of those materials which are extracted in large to very large percentages in those particular countries (see **Figure 9**).
- **Interconnectedness of resources** and scarcity. For example scarcity and high prices in fuels fall over to food, as food production relies on energy (machinery, artificial fertilizer, etc.) (EMF, 2013b; Graedel & van der Voet, 2010).

Figure 6 – *SWOT of CE for business. Weakness and threats can be related to remaining strengths and opportunities of the current 'linear' economy.*

A second category of circular opportunities is **increased governmental intervention**. Environmental regulations put on production processes are expected to grow (see e.g. **Figure 10**). Especially in Europe plans and legislation is (being) adopted to increase resource efficiency, and thus make legislation on waste production stricter or stimulate circular models (Joustra & Schuurman, 2014). A list of the most important policy and regulatory developments:

- The EU Waste Framework Directive aims at the implementation of 'the polluter pays' principle and 'extended producer responsbility' (EC, 2008a).
- The EU *Raw Material Initiative* has a strategy with three pillars to "ensure a sustainable supply of non-energy raw materials […] to ensure European competitiveness". One of the pillars aims at a "reduced consumption of primary raw materials by increasing resource efficiency and promoting recycling". See (EC, 2008b) for an overview of high level responses by EC, member states and industry.
- The *Roadmap to a resource efficient Europe* (EC, 2011) involves various incentives for reuse, recycling and other recovery activities. Goals to limit energy recovery to non-recyclable material and eliminate landfills to (almost) zero are included.
- The EU *Manifesto for a Resource-efficient Europe* (EC, 2012) lists high level, but full scale goals on stimulating a transition to a "circular, resource-efficient and resilient economy". The Manifesto is a product of the *EU Resource Efficiency Platform* (EREP), whose main objective is to "provide high-level guidance to the EC, member states and private actors on the transition to a more resource-efficient economy" (EREP).
- The *Van Afval Naar Grondstof* programme ("from waste to resource", (MinI&M, 2014)) wants to stimulate a transition to a CE in the Netherlands.

Interventions of this type are expected to increase considerably in many other parts of the world as well. In countries such as China and South Africa problems with landfills continue to grow and raise the pressure on environmental measures, such as increased costs of waste handling or taxes on wastes and emissions (EMF, 2013b).

A third category is **legitimacy**. Increasingly, consumers are concerned about the production methods of companies and include the mitigation of environmental and social harm, and the social responsibility or companies in decisions over their purchases. These concerns and decisions are fostered by increases in availability of information, due to labels and quality marks of third parties, transparency of production processes, reporting (external or internal) and public activities of NGOs. Consequently, expectations and pressures arise for companies to comply to certain social and environmental standards (Prakash, 2001).

By closing or enabling closed material loops, the principle characteristic of CE, a company can mitigate these three categories of risk and potentially turn the risk in a new competitive advantage. First, closing material loops allows those businesses which are dependent on scarce raw materials, or materials from politically uncertain regions, to realize a new source of materials. These businesses can install models where they retain ownership of the products and/or materials of concern. Second, by realizing closed loop systems, wastes and emissions can be drawn back dramatically. For first movers, higher social and environmental performances may result in a higher reputation and attract or retain customers (Prakash, 2001). Third, companies can expect substantial **savings on net material costs** and deal with general price increases of resources, as EMF (2013) foresees a saving opportunity of USD 595 – 706 billion per year at a global level if a circular setup is adopted in relevant fast-moving consumer goods sectors. Value preservation strategies such as Industrial Symbiosis and Cascading (see Section 2.1) create dual benefits as additional value is extracted from material flows which otherwise would have caused waste costs.

Genuine strengths of the CE concept

Beyond the mitigation of various risks or 'linear threats', CE also offers opportunities associated to genuine strengths of the concept. First, there are **plain opportunities in new profit pools.** These opportunities are estimated to account for $ 630 billion (McKinsey in EMF, 2013) or € 604 billion (EC, 2013) annually. Possibly € 572 million market value in the Dutch electronics and electrical equipment (EEE) sector can be created by exploiting opportunities named by stakeholders and experts and € 1 billion can be added to the circular economy by using biorefinery technology, exploitation of biogas and more intensive separation of household wastes. (Bastein et al., 2013)

More concretely, waste collectors SITA and Van Gansewinkel Group for example are developing new strategies to extract more value from waste and turn their original role as waste processor into a new role as resource supplier, and aim to turn waste into products at a new level (VNO-NCW, 2012). Also, Philips is exploring new business models for lighting with their Pay-per-Lux project (Philips, 2013), or Kingfisher investigating opportunities of new revenue models for their power tools (WEF, 2014). Such **system optimizations**, where more value is created on the level of supply chain, can result in further increase of efficiency or the creation of new or additional values (EMF, 2013b; Jonker, 2013). Many of today's supply chains are rather suboptimal, due to inefficiency, uneven distribution of profits or high transaction costs (Kimmel, 2013). Achieving such system optimization is supported by CE's focus on cross-sectoral and cross-cycle collaboration.

Furthermore, several governmental bodies and some front running companies want to stimulate a (transition to a) CE by implementing **circular procurement**. They position themselves as launching customers, such as recently in the Netherlands with the *Green Deal Circulair Inkopen* (MVO Nederland, 2013).

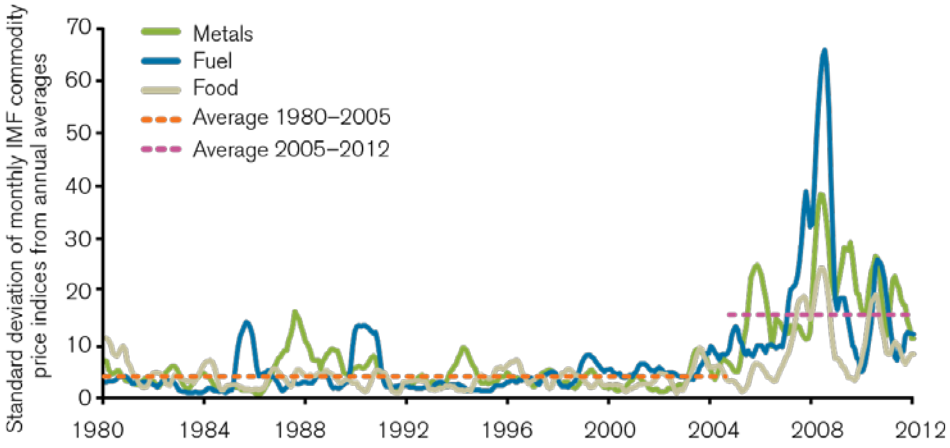


Figure 7 – *Volatility in commodity markets, 1980–2012 (Lee et al., 2012). Increased volatilities cause short term scarcity, which may temporarily shut down production processes and put pressure on the producer's margins.*

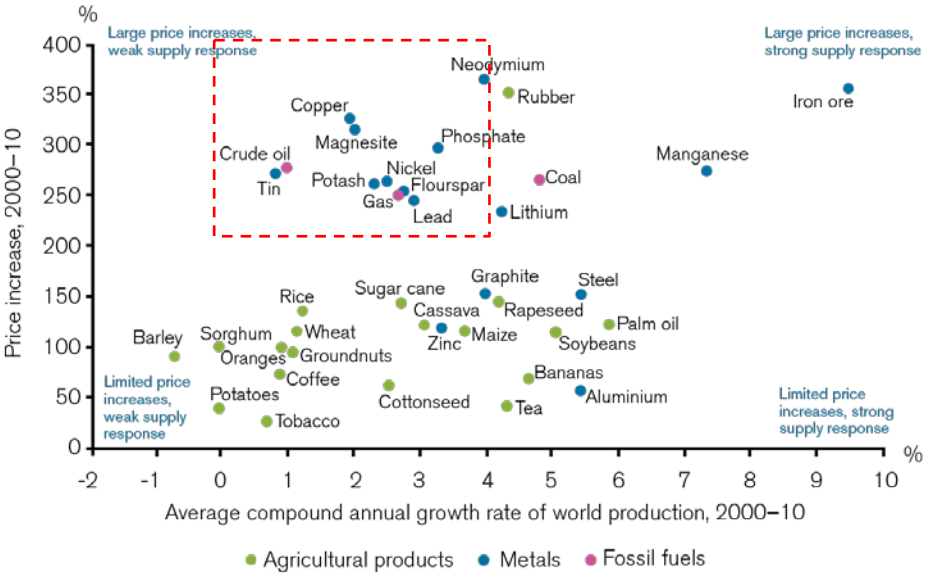


Figure 8 – *Price increases and supply growth for various commodities, 2000–2010. The red dotted rectangle highlights highest risk area. Adapted from (Lee et al., 2012). Supply cannot keep up with demand of several resources leading to short term scarcity. When capacity cannot be expanded, e.g. by physical limitation of sources, scarcity will extend to the long term.*

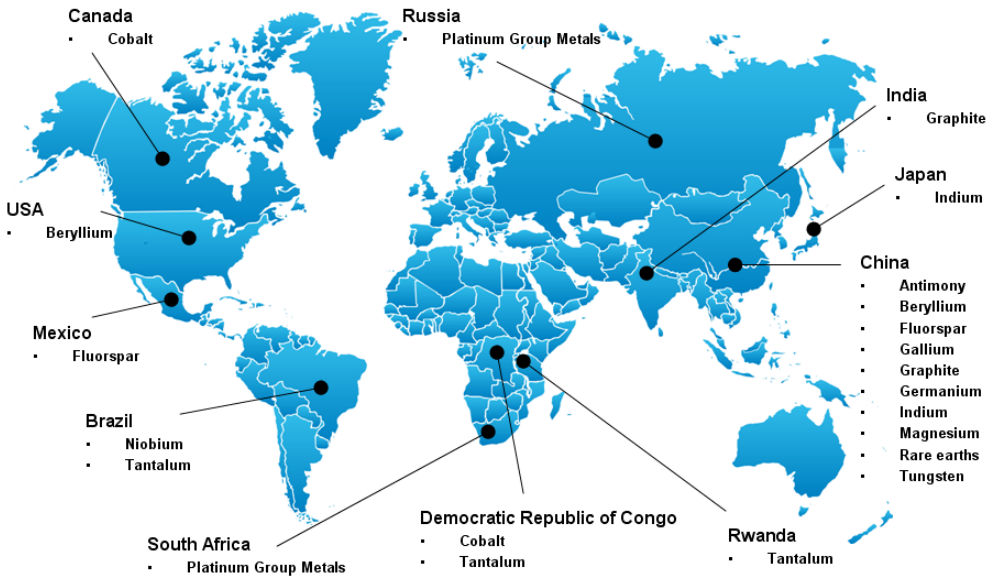


Figure 9 – *Production concentration of critical raw materials (EC, 2010). Most critical is the fact that there is a large dependence on politically unstable regions (Africa) or regions with frequent geopolitical issues.*

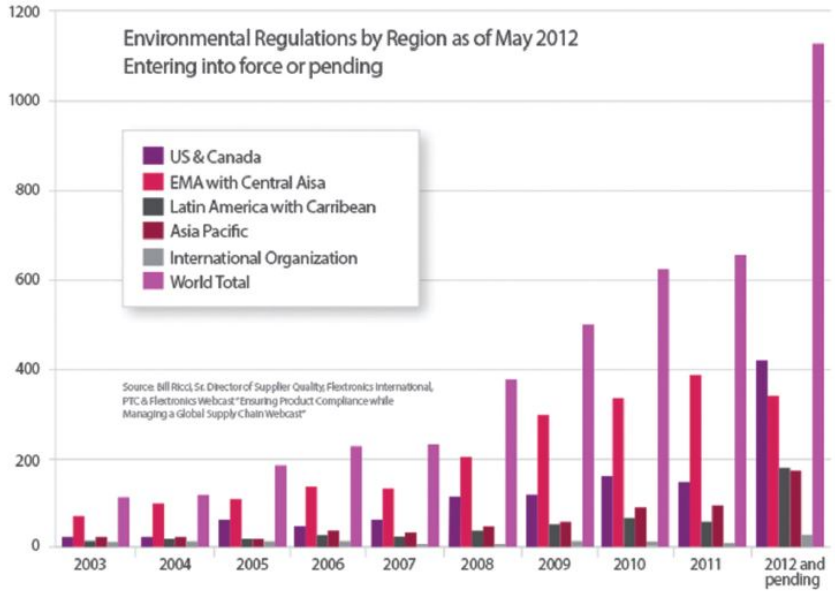


Figure 10 – *Increase of environmental regulations by regions, 2003-2012. It is estimated that regulation and other government intervention will continue to expand, also in developing regions such as China. Strategies for environmental performance beyond regulatory norms therefore become interesting to assure continuity of market outlets or to gain market share when competitors (temporarily) do not comply.*
Image retrieved from: http://www.medicaldesignbriefs.com/component/content/article/16809

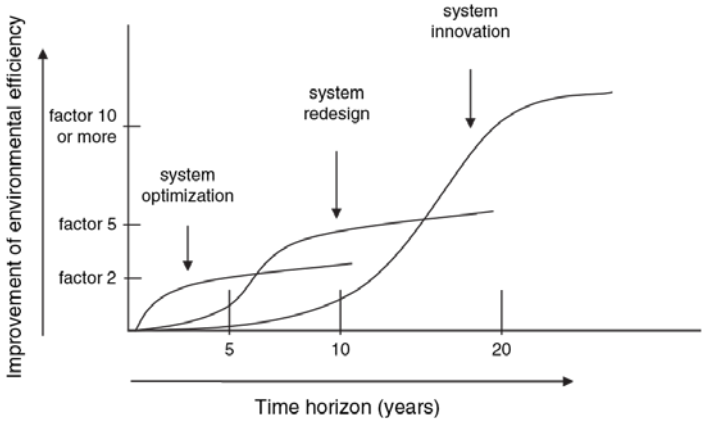


Figure 11 – *Potential of system optimization, redesign and innovation for environmental efficiency (Tukker & Butter, 2007)*

Beyond system optimization, further increase of performance (efficiency, profit, value creation, etc.) and larger opportunities can be achieved by a system redesign or **system innovation**. Especially the latter has the highest potential of improvements (**Figure 11**). To illustrate the differences, system optimization involves more efficient use of fossil fuels in cars (better engines, lighter vehicles), redesign includes new fuels (hydrogen) and innovation departs from societal needs and function which perhaps could also be fulfilled with totally new ways of transport (Tukker & Butter, 2007).

By introducing radical new ways of creating value, either by radical new products, processes or collaborations, new markets can be entered or created. First movers successfully innovating the system have the benefit of changing the rules of the game in their favour (Jonker, 2013).

Moreover, applying the concept of CE in business "has proved to be a powerful new framework, capable of sparking new creative solutions and boosting innovation rates" (EMF 2013).For example, the development of Herman Miller's chair according to C2C principles required a decrease in number of components to make the processing of returned chairs viable. Although not aimed for initially, the decrease realized considerable cost reductions as well (M. Visser, 2013).

Societal trends match CE

A growing trend of **collaborative consumption** is seen throughout society (Botsman & Rogers, 2011; Hulshof & Van der Veen, 2013; Van Raak & Loorbach, 2014). Sharing products may reduce **total cost of ownership** or **increase utility** for customers. This involves the establishment of PSS (describe above). For example, in wardrobes the rate of obsolescence can be greatly reduced (barely worn or out-of-fashion items). Customers have access to higher-quality experiences without trading up to higher-priced propositions, e.g. rental of prom dresses. Companies on the other hand remain in control over the products and are better able to close material loops. Moreover, by focusing more on functional needs, companies gain more consumer insights for improved personalisation and customisation. This enables the company build long-term relationships and increase **customer loyalty**.

Furthermore, CE's focus on the system level opens up the opportunity to support new trends seeking for **multiple value creation** (Jonker, 2013). Companies can be beneficial to themselves by being beneficial to the system and start creating value outside the traditional boundaries (or business model) of an organization. They create '**shared value**' (Porter & Kramer, 2011), which may include societal and ecological next to financial value (Jonker, 2013).

Collaboration with customers, beyond companies in general, introduces the opportunities found in **co-creation** of products and services (Jonker, 2013; José de Vries, Kleinsmann, & Mooij, 2011). This inclusion of customers in the design process brings in new perspectives and increases the value created as products are tuned better to customer's desires. This may lead to radical innovations companies themselves could not have thought of (e.g. the Senseo coffee machine by Douwe Egberts and Philips).

Linear opportunities are circular threats

One of the most important circular threats is the **efficiency and competitiveness of current linear business models**. Many companies and supply chains have improved and adapted their products and processes over several decades. Also, external costs (environmental and social impacts) are not reflected in the prices, which is why **raw materials are relatively cheap**. Materials therefore often comprise only a small share of total production costs, keeping the most important benefits of circular models *relatively* low (although in absolute terms numbers can add up to hundreds of billions for the global economy, as has been quantified by EMF (2013) above). On top of that, **cheaper and less scarce material substitutes are often preferred**. Circular models and systems have to compete with high 'linear' performance, but are often behind on financial, organizational, institutional, technological and societal aspects (Kok et al., 2013). Due to various aspects, yielding 5 grams from 1000 kg of ore from a gold mine is still more competitive than yielding the same amount of gold present in less than 35 kg of discarded mobile phones (Yoshikawa, 2008).

The example of gold mining illustrates how CBMs require a supporting circular system around them in order to outcompete the currently dominant linear models (although some CBMs already function today, such as recycling companies; see Section 2.4). **A *system transition*[14] is needed** from a linear to a (more) circular economy, either incremental or radical (evolution or revolution). Large and often opposing forces in the current *sociotechnical system* have to be dealt with (Geels, 2002), such as vested interests, sunken costs (path dependency) and (psychological, social and economic) resistance to change of the current sociotechnical regime.

More than 20 (specific) obstacles in the current system have been identified in Appendix D. These obstacles favour current linear models and can be regarded as threats to CBMs and a CE. Some of the most important threats are explained below (for the rest, see Appendix D and references).

Financially, changing to a service model often causes **higher up-front investment costs** and **longer time horizons of revenue generation** (spread income instead of one, early transaction). Both can cause large or insurmountable problems to the cash flow of a company. Companies need larger capital reserves to 'wait for their money' (causing costs of interest rate). Also, the longer time horizon often does not fit with the **short term horizon of many shareholders**. Moreover, a company's capital is stored in their leased or rented products, which could be damaged by users (risks). This also may change a company's position towards a bank. For example, would a bank accept apparel distributed over hundreds of wardrobes as a valid pledge?

Many **institutions (legislation and policies) still inhibit circular models**, such as limitations on waste transport (e.g. the European Regulation on Shipment of Waste), obstructions to collaboration (competition legislation) or (too) strict regulations on possible contaminations of secondary resources (Kimmel, 2014). But apart from inhibiting institutions, **required legislation for CBMs is still infant or absent**, especially the service models (Zuidema, 2013). Contracts for the delivery of a performance a very costly make and require standardization (Tukker & Tischner, 2006b) and scenarios of problems and consequences of poor payment of services (e.g. users not being able to pay a particular month) are not elaborated in law. For example, should a company be allowed to remove the façade of your house if you don't pay for a month? Is that fair towards your neighbours who live in the same building?

[14] "Transitions are major, non-linear changes in societal cultures, structures and practices (Grin et al., 2010) that arise from the coevolution between economy, society and ecology. Transitions can be viewed as a shift from one dynamic equilibrium (e.g. a fossilbased centralized energy system) to another (say a renewable energy-based, decentralized system)" (Loorbach & Wijsman, 2013).

The **awareness and urgency of linear threats is still relatively low**, in both society and business. The motivation and incentives for the trend towards collaborative consumption are estimated to be more economic than circular. That means, sharing a recyclable or non-recyclable car probably does not make an important difference to consumers. Also, initiatives of circular procurement as introduced above are still comparatively small. Main stream market demand for 'circular performance' (e.g. degree of closed material loops) is still unarticulated and it is uncertain when (or whether!) a large take off will happen (Van Raak & Loorbach, 2014). Also the awareness and urgency among business of the linear threats described above is still considerably low. The summary of the 2013 conference of Dutch employers (VNO-NCW) on resource security is rather clear on the urgency: "There is no general shortage of resources and perhaps also not in the future, but certain resources will face (considerable) shortages" (VNO-NCW, 2013). Also the awareness is problematic. The conference concludes that response of many companies is too low and inadequate (ibid). Current incentives due to price increases are still low, but companies should expect prices to rise further in the future and that a long term strategy is needed to prevent losing competition against international competitors who do have secured (cheap) resources.

Weaknesses and other barriers to a CE

There are some aspects of CE which could be regarded as *intrinsically* problematic or weak. Most important, the higher levels of collaboration associated with a CE cause costs next to benefits. The **complexity of organization and management** of a supply chain will increase even further than supply chain management already is in a 'linear' economy. Organizational activity, structures and routines, supported by management and information systems, all have to be expanded (and paid), as more stakeholders have to be taken into account and more information needs to be generated, exchanged and processed. Next to the costs of collaboration by these aspects, Van Houten (2013) has identified **14 key principles** for collaboration (e.g. Dependency, Urgency, Confidentiality and Transparency) which all can impede proper functioning of a circular model and cause costs. They are potential weaknesses of a circular system compared to a 'linear'. Some examples:

- The increased need for information exchange (Section 2.1) can conflict with **confidentiality** and related competitive position of an individual business.
- Closer collaboration increasingly builds on **trust** among partners, because not every detail of the collaboration can and should be defined in contracts (to maintain a flexible collaboration and keep transaction costs low)(see also (Berglund & Sandström, 2013)).
- The collaboration must seek for **mutual benefits**. If not, the urgency and priority of the collaboration among stakeholders will decay and possibly frustrate the functioning of a circular model.
- Closer collaboration increases the **dependency** of partners on each other, which is often regarded as a risk which needs to be controlled or diminished (see also (F. Boons & Baas, 1997)).

See (Van Houten, 2013) for further explanations of the role of each principle. Most principles are also integrated as key challenges in the CBMI framework, introduced in the next chapter.

Furthermore, **companies need new information,** beyond what is inaccessible due to confidentiality, to ensure an effective production process. In order to rely on resources 'mined' from the economy (instead of the environment), companies need to know how much material is circulating in the economy, when it comes available (depending on product lifetime, product return processes, etc.) and when it comes available to *them*, instead of to a competitor (Kimmel, 2014). Aspects like price, supply risk of materials, maturity, reparability and expected lifetime need to be determined (Joustra, Jong, & Engelaer, 2013; Poppelaars, 2014). To know this, new dynamic models of the economy and new insights on development (and obsoleting) of technology are needed, such as S-curve innovation models (see **Figure 12**). Predictions of material flows have to be made up to a decade or more in the future (e.g. recycling of cars), which are subject to all kinds of influences. For example, new policies can ban certain products, components or materials and new needs, often driven by new technologies, can make them obsolete.

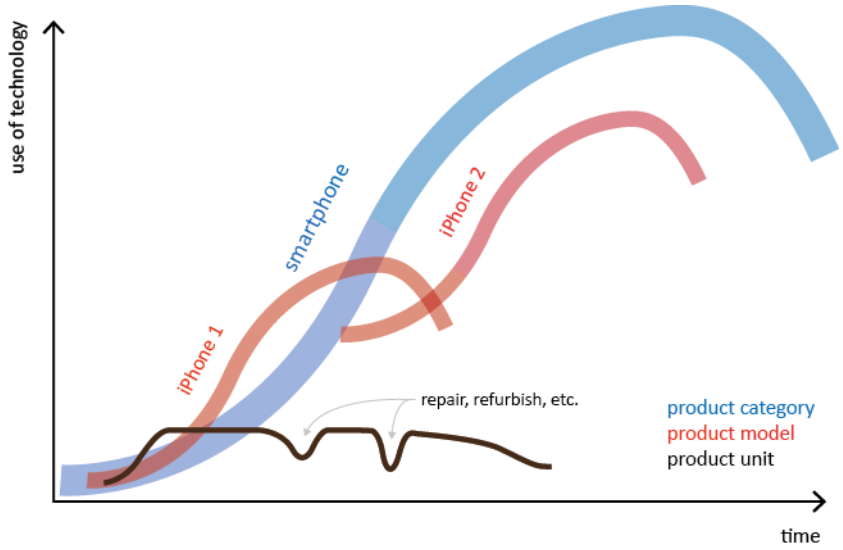


***Figure 12** – S-curve of use of technology over time for a product category, model and unit (with credits to Marcel Den Hollander)*

Furthermore, **business risks of service models** (or PSS) specifically have been shown elaborately by (Tukker & Tischner, 2006b). Most importantly:

- Owning a product is preferred over renting or leasing when the users feels a certain **emotional attachment** to the product, or when owning the product has **intangible value** ('priceless value') to the user (e.g. a person's status for owning instead renting a car).
- A result- or function-oriented services is fulfilled most efficiently when the need is described abstractly ("watch television programme" instead of "have television"). However, to ensure good explanation and interpretation by the service provider, an elaborate description of how a need may and may not be fulfilled might be necessary (e.g. a long list of performance indicators). This can **increase transaction costs** significantly.
- By promising a result, the service provider on its turn needs to predict and **control the risks**, uncertainties and responsibilities that otherwise would be the problem of the user. Selling products is easier, as responsibilities and liabilities are transferred along with the transaction.

CBMs and opportunities for sustainability

The lack of fundaments in CE for sustainable development (Section 2.1) is also observable on the level of the BM. *Sustainable business models* (SBM), as they are defined or described in literature, aim to "balance ecological, social and ecological needs" (see Appendix C or Frank Boons and Lüdeke-Freund (2012)). CBMs focus on value creation with and within closed loops does not necessarily aim for this. Balancing ecological, social and ecological needs nevertheless is a troublesome challenge for SBMs, as "transferring [this] principle to the growth-driven business world seems hardly possible" and requires at least overcoming further psychological barriers (Huber, 1995; Lüdeke-Freund, 2010).

Nevertheless, CBMs still can serve sustainability goals. "Selling performance means that economic actors retain ownership of goods and embodied resources, and internalize the cost of risk and waste" (W. Stahel, 2014). By internalization businesses have an economic incentive to reduce waste production and other negative impacts, previously shifted to the costs of the customer or society (externalities). However, this incentive does not guarantee closed material loops, as dealing with wastes in another (non-circular) way could still be more profitable. Moreover, the potential for sustainability largely depends on the specific type of *Product Service System* (PSS) and on the focused effort of the company to design PSS as sustainable as possible. The potential to decrease environmental impact with factor 10 or more ("Factor X") can in general only be attributed to one specific type of PSS: functional result (or selling performances) (Tukker & Tischner,

2006b). Other PSS have potential as well, but not factor 10. However, result-oriented services also bear the largest disadvantages for business (see above). Therefore, for successful and sustainable PSS (or CBMs in general) "business developers and strategic designers must **use all their creativity to find smart solutions for apparently unsolvable contradictions**" (Tukker & Tischner, 2006b, p. 364).

Conclusion: where is the hotspot for CE?

Sectors or areas in today's economy where the strengths and opportunities are largest, and weaknesses or threats are smallest or best tackled, are most opportune for implementation of CE and a CBM. The exact determination of most promising sectors or areas however is beyond the scope of this research, and each CE driver or constraint should be revised and specified for each case separately. Still, some general things can be said with respect to hotspots for CE:

- The largest urgency of supply risk (price increase and limited growth of suppy) are expected for metals (**Figure 8**);
- EMF (2013) selected the sectors fast moving consumer goods, more specifically food and beverages, clothing and packaging as examples for CE "for their relevance as measured by the share of consumer spending they represent, the resources they use, and the waste they generate";
- Promising areas according to Dutch CE policy are concrete, textile, plastics, electronics and food (MinI&M, 2013);
- Opportunities the electronics and biowaste sector furthermore have been selected for an economic study in detail (Bastein et al., 2013);
- The trend of collaborative consumption (sharing) is observed most for capital intensive products and services (people's time), most notable cars and chores around the house (
- **Table** 4), and;
- Most companies of the EMF's CE100 and the Circle Economy's members originate from the sectors ICT/Electronics and Food & Beverages (apart from consultancies, see Appendix E).

Product	Platforms
Car	Snappcar, MyWheels, WeGo, Toogethr
Accomodation	AirBnB (appartments), Couchsurfing (bed/couch), Huizenruil (exchange houses), Deelstoel (work space)
Household tools	Peerby, Deelit
Skills and services	Konnektid, Croqqer, Klusup, Timebank
Food	Thuisafgehaald
Care	WeHelpen, Oudermatch
Machinery	Floow2
General	Noppes
Other	3D Hubs (find local 3D printer), Crowdroaming (share wifi), Studieboekendelen.nl (study books)

Table 4 – *Overview of Dutch platforms for collaborative consumption, expanding (ShareNL, 2014)*

2.4. The need for new business models

In this section the extent to which new BMs are required to implement CE is described. Specific changes required to change a BM to a service model will be treated in depth.

It depends...

The need for new BMs in order to implement CE has been widely expressed (EMF, 2013b; Sempels, 2014) and is regarded as one of the key obstacles for successful implementation of CE (Kok et al., 2013). Indeed, implementing a CBM almost always has direct or indirect consequences to one or more of the four BM pillars (Sempels, 2014). This is because many BMs depend on virgin materials. Some of them are able to switch to recycled materials, or reused components or products with minor changes. Others have to thoroughly adapt their products, processes. Moreover, to effectively close material loops, in many cases another revenue model is better, e.g. by providing services and stay owner of the product. Managing these changes requires companies to engage in a process of BMI (Sempels, 2014).

However, there are several reasons why the 'newness' of the BM may vary heavily. First, in the previous sections it has been explained that 100% linear and 100% circular business models do not exist. So in practice, implementation of a CE is rather about becoming *more circular*. Moreover, many *less circular* BMs already exist. For example, recycling happens a lot already in today's economy, especially in the Northern European countries (see **Figure 13**). The BM of some recycling companies already fits well in a circular system without further change. Other BMs might need only little change to fit a CE. For example, an electronics store can start selling other types of products, e.g. made out of recycled material, without having to change much of his BM. But if the store wants to *servicize* its products (providing a service by renting or leasing products instead of selling), it might need to radically change all aspects of its BM.

Second, 90% of BM innovations are found to be recombinations of existing BMs (Gassmann, Frankenberger, & Csik, 2013), which puts the newness of BMs into perspective. This is the case for many BM innovations involving *servicization* of products. Renting, hiring or leasing a product is no new concept and is already used on a regular basis for expensive products such as houses, cars and construction equipment. So this revenue model is not new in itself. However, other parts of a company's BM still may need innovative change, such as InterfaceFlor (disassembling carpet tiles) and Mudjeans (convincing customers to lease jeans) who had to convince their customers to agree with a leasing model through marketing and other means.

Third, a company can have strategic reasons to not adopt a radical CBM and rather go for a transitional, semi-circular BM first or not go circular at all (due to weaknesses or threats of a CBM, see previous section). Being a frontrunner or a late follower in a transition to a CE both has specific benefits (Van Raak & Loorbach, 2014).

So the need for new BMs depends on 'how circular' a BM already is, how circular others already are (which can copied) and 'how much more circular' it needs or wants to be. To determine 'how circular' a BM is (economic) performance indicators are required. These indicators should be related to material use (the main thing where CE is about), e.g. the percentage of recycled material or reused components, or the percentage of revenues from repairs (see (Schoolderman et al., 2014) for 15 exemplary KPIs for CBMs). **Figure 14** visualizes such as scale.

Equal to the varying 'newness' of the BM, the goals and scope of a CBMI process may vary, i.e. how much more circular does a company need or want to become. Some companies might only need to implement some minor and simple changes, decided in one or two regular meetings. Although this is a CBMI process as well, it is very short and informal. Other companies might need or want thorough change of their BM, for example to maximally grasp the opportunities of a CBM. Then a long, formal and challenging CBMI process

is needed. Beyond innovating the BM innovating the system might be required in order to successfully implement a CBM (see below Section *The need for a new system*), which further increases the size of the CBMI process.

Required changes of BM components for a service model

The performance indicators shown in **Figure 14** are rather abstract. For example, increasing the 'product value after period X' can be done in many ways. An important and much mentioned example is a service model (EMF, 2013b; Jonker, 2013; Joustra et al., 2013; Sempels, 2014). The following sections illustrate such a change on a more concrete level than the abstract indicators of Figure 14. **Table 5** gives an overview of several key differences between a selling products and providing services.

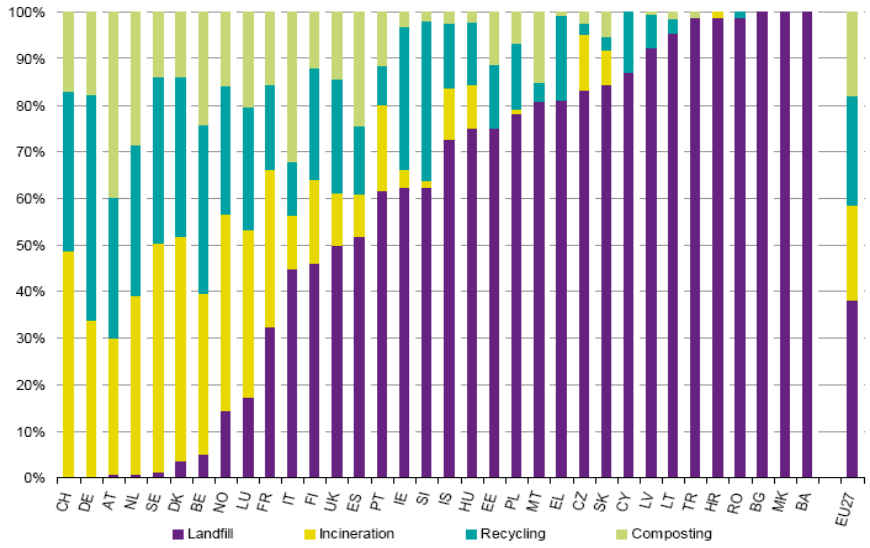


***Figure 13** – Municipal waste treated in 2009 by country and treatment category (Eurostat, 2009)*

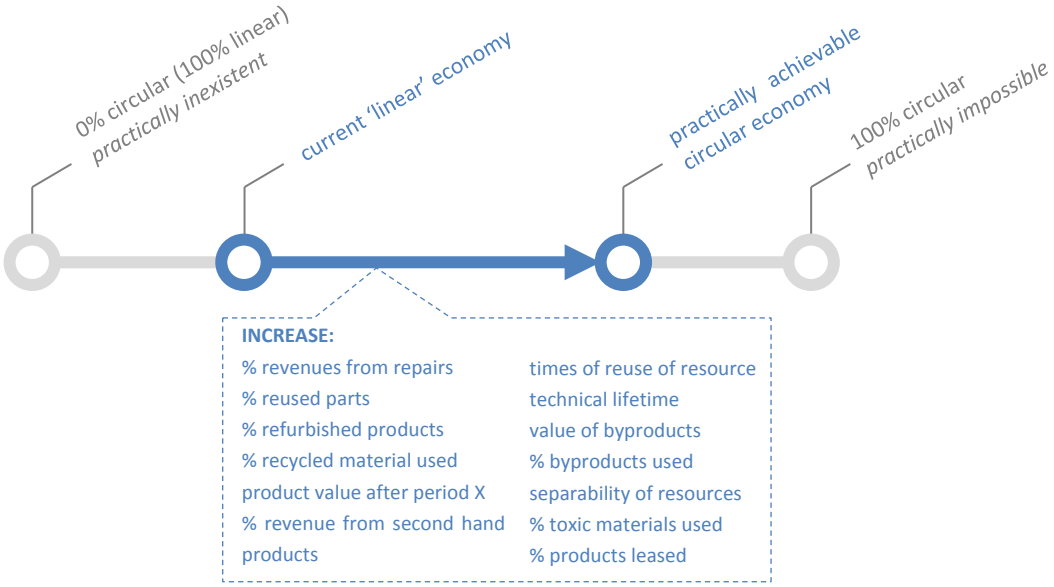


***Figure 14** – The 'scale of circularity'. It can be used to determine how circular a CBM is. The need of new BMs depends among other things on which of these (or other) KPIs are selected for improvement.*

BM pillar	Selling products (usually less circular)	Providing services (usually more circular)
What? – the offer	Products.	Services.
	Cheap, quick, easy, dump.	Cheap, quick, easy, reuse or recycle.
	Volume-based.	Performance-based, performance indicators.
How – activities, processes, resources, capabilities	Take, make, waste.	Take, make, remake
	KPIs on production of units (make more = sell more; volume based).	KPIs on performance and service efficiency
	Limited role and influence of customer.	Customers become partners.
	End-of-pipe waste treatment solutions.	Setup of reverse logistics
	Supply chain management several tiers up (and maybe down)	Supply chain management of the whole system
Why? – revenue model	Pay per product.	Pay per use or performance (hours, km, sheets, etc.)
	Make more = sell more.	Make better = sell/gain more
	Negative value creation at some stages (material with negative value → waste)	Positive value creation at all stages needed (possibly redistribution of revenues required)
	Responsibility stops after point of sale	Shared responsibility throughout the chain
Who? – customer segments and interface	Transfer ownership.	Access over ownership.
	Products aren't taken back, especially after warranty.	Product take back or service/performance provision.
	One size fits all	More intense customer relationship (unique customer profile, customization, co-creation)

Table 5 – *General characteristics of traditional (or linear) and circular BMs.*

Changing value propositions ('what')

The vast majority of today's BMs is volume-based (Sempels, 2014), focussing on selling more products. In principle this is not a problem in a CE, as long as products can be (fully) reused or recycled. Still, in many cases this will affect their physical specifications and/or aesthetics (e.g. modular mobile phones or recycled soap bottles). In order to close the material loop, products need to be bought back or collected in *reverse logistics systems* (see next section).

But, since "selling performance is the most profitable and most material-efficient CBM" (W. Stahel, 2014), companies who want to grasp the benefits of a circular model should consider to servicize their products (Joustra et al., 2013). There are eight types of *Product Service Systems* which can be set up around the service provision (Tukker & Tischner, 2006b), with all due BM changes. Some types of PSS come with specific business risks which could damage the profitability of selling performances (ibid).

Changing activities, processes, resources and capabilities ('how')

Either by remaining to sell products or by (changing to) provide services, business activities and accompanying processes, resources and capabilities have to change. Products which fit the CE have to be made differently (with recycled materials), in different processes (e.g. in remanufacture plants, see *Ricoh* in **Table 6**), using different resources (e.g. recyclates, see *InterfaceFlor*) and requiring different capabilities (e.g. testing the performance of reused components, see *Caterpillar*). The implementation of *reverse logistics systems* furthermore is often a completely new extension to existing activities, where products ´going back up´ in the supply chain is unheard of. Also, key performance indicators (KPIs) shift from units per hour (sell more) to performance and/or efficiency of services provided (e.g. Rolls Royce's 'power by the hour', the number of hours a jet engine generates thrust). New KPIs can also be tuned to specific CE activities (repairing, recycling, etc.) (Joustra & Schuurman, 2014).

Figure 15 – The modularity of the Phonebloks concept. It increases reusability, but also changes its physical specifications (e.g. the thickness of the phone). Image from www.phonebloks.com

***Figure 16** – Soap bottle made out of plastic recovered from the ocean (see Plastic soup). The quality of the plastic does not allow to make transparent soap bottles. Image from www.gogreenplus.com*

Furthermore, the required increase in collaboration on the system level and exchange of information and material (see **Figure 3**) involve much change as well. Companies need to manage other (more intense) relationships with other companies and with customers. Extended governance structures need to be set up on the level of the supply chain to coordinate activities and exchange information (and make material flow visible in and for the full supply chain) in order to close material loops. This is accompanied with more feedback from and adaptation to other BMs. Additionally, companies may need to look for new players if activities to close the material loop are missing.

The successful implementation of reverse logistic systems are often dependent on this as well. Moreover, all CE activities need to sufficiently present in the system in the end, since products cannot be repaired or remanufactured endlessly. New products come which may require entirely new component or materials. Also, recycling is usually not infinitely possible (Section 2.1). So a mature CE consists of a whole ecosystem of CBMs in order to achieve the goal of closing material loops.

Changing revenue models ('why')

The shift to services inescapably involves changes in revenue models, which illustrates once again the interrelatedness of BM components. Services cannot be sold per unit and must be charged according to use. Still, there are different possibilities to charge for use. For example, you can charge cars statically on hours, or kilometres, or dynamically with price increases during rush hours or at undesired roads[15].

Changed modes of revenue require changes in financial structures of companies. As revenue is gained over a longer period of time, in contrast to one point of sale, the capital requirement for services is higher at the beginning (Sempels, 2014). Administration and structures of cash flow need to be adjusted accordingly (Joustra et al., 2013).

Changing customers or customer interfaces ('who')

Other products or services may cause changes in customers, as traditional customers are not receptive yet for circular products (Kok et al., 2013). People might be used to buying products and transferring ownership,

[15] Think of this as a way for governments to stimulate traffic to use alternative routes, e.g. not roads crossing residential areas.

circular products or services need to be accompanied by new marketing activities to create and educate new markets (Sempels, 2014). Collaboration with launching customers is therefore recommended. Especially public procurement can be interesting for circular products or services, as governments can be interested in leading by example (EMF, 2013).

Selling services and performances furthermore requires deeper customer insights and stronger customer relationships. This enables providers to improve their services, fulfil needs better and outcompete competitors. Also, in the more advanced service models (result-oriented PSS, see (Tukker & Tischner, 2006b)) a new role of customers is required. Customers need to think more deeply about their own needs when agreeing upon (abstract) performance indicators with the provider. For example choosing between paying for a car per driven kilometres or per hour. Furthermore, agreeing upon a services entails a long term relationship of periodical payments, but also monitoring of the product (e.g. provider retains ownership and might need to monitor the customer's use (Joustra et al., 2013)).

The relation a company has with its customer must be able to facilitate this. Where Philips has managed to sell quantities of light instead of lamps ('Pay per Lux' project), concrete producers in the buildings sector still struggle with the new type of transaction they have to establish with their customers (Bolder, 2013). On the other hand, trends of collaborative consumption support the increase of service models (Hulshof & Van der Veen, 2013; Pakhuis de Zwijger, 2013).

As collaboration increases, also with customers to better fulfil their needs with services, the traditional differentiation between producer and customer fades away. Especially in co-creation processes with customers they become partners, which turns traditional BM upside down (see e.g. the separated 'Key Partners' and 'Customer Segments' in the BMC, Figure 19, p.52). Also, when aiming to create value for the entire system, new win-win situations become possible. Businesses might now create value for parties they didn't used to, which may lead to new kinds of partnerships (e.g. an electronics manufacturer with an environmental organization both combating waste production).

Examples of CBMs

The examples of CBMs in **Table 6** illustrate the need for new BMs as described above. Although it remains unclear to what extend the companies make sure (all) their material flows enable closed loops, every example serves as a good illustration and offers inspiration for those who want to apply CE and shift towards CBMs. To improve comparison, the four basic BM questions have been applied to all examples. Note that the content of the BM components is massively simplified, concentrating on key CBM characteristics which illustrate the typical difference described above. Further information can be found in named sources or in company documentation (annual reports, communiques, etc.) and websites.

The need for a new system

Section 2.3 explained the need for a system transition towards a CE to support CBMs. 'More circular' BMs, such as a service model explained in the previous sections, are more dependent on this than 'less circular' BMs such as today's recycling companies. The fact that they exist today prove that they are supported by the system. For desired CBMs which do not fit, determining how the financial, organizational, institutional, technological and societal aspects of our current system need to change is indispensable (see e.g. (Tukker & Tischner, 2006a)). Also the dominant governance mode has to be taken into account (Tukker & Butter, 2007). Both however are beyond the scope of this research. This thesis focusses on how to improve the concepts for CBMs during a CBMI processes. However, the field of transition management has developed strategies for business to proactively engage with a required system transition in their direct context (Loorbach & Wijsman, 2013), which could be an important aspect of successful CBMI (see next chapter). Nevertheless, examples of suggested systems changes are switching from labour to material tax (e.g. www.ex-tax.com) and the introduction of a resources passport (Damen, 2012).

Organization ***(CE activity)***	**What? – the offer**	**Who? – customer segments and interface**	**How? – key activities, processes, resources and capabilities**	**Why? – revenue model**
Interface Flor *(remanufacture, recycle)* (Frank Boons & Lüdeke-Freund, 2012; InterfaceFlor)	Carpet tiles + service (e.g. replacement of worn-out tiles). (Performance: factor 30 reduction material use.)	Organizations interested in high quality floorcovering service	**Partnership** with SITA (waste hauler) **Separation** and **recycling** of backing and yarns **Energy recovery** if not suitable for recycling.	**Lease** **Pay per month**
Better Place *(repair)* (Frank Boons & Lüdeke-Freund, 2012)	Charged battery	Owners of electric vehicles	Dense network of automatic change stations + tracking system	**Rent** **Pay per kilometre**
Patagonia *(repair, redistribute, recycle)* (EMF, 2013; Preston 2012)	Rugged outdoor clothing that lasts long (less pieces of clothing needed) + **free repair service** + **free take back service** for sell or donation, else recycling.	People buying high end outdoor clothing. Environmentally conscious customers. Sale through clothing stores & website.	Multiple programmes to reduce environmental footprint and increase social conditions: Reduce/reuse/recycle campaign ("Common Threads Partnership") Supply chain visibility ("Footprint Chronicles") 11 corporate partnerships CSR and worker conditions	**Sale (pay per unit)**
Caterpillar *(repair, remanufacture)* (EMF Case studies, online; Preston 2012)	Heavy machinery. New and remanufactured. (Performance 2010: 59,000 tons of steel saved)	Construction companies which are served mostly through dealers	Make products with aim to reuse/remanufacture (65% is material cost) Periodical maintenance → replace products before breaking. **Testing** remanufactured products.	Pay per unit or rental. **Discount** if remanufactured.
Ricoh *(all CE activities, see their 'Comet Circle tool')* (EMF Case studies, online;Ricoh ())	Copiers and printers. Remanufactured units have 'GreenLine label 'with **same warranty**. Full assistance in optimization of workflow and ways of work ("Total Green Office Solution")	Organizations with larger office environments	Inspection, dismantling, replacement of key components. Collection of ink cartridges. "Total Green Office Solution" includes: Service & Support, Collection & Recycling, EoL management, R&D, Product Design, Production and Consulting	Lease and sale GreenLine labels for same price (same warranty)

***Table 6** – Examples of CBMs from practice, described through the lens of the four basic BM questions (what, who, how and why?). Also their 'circular activities' in the CE hierarchy are given (maintenance, repair, redistribution, (refurbish,) remanufacture and recycle). Note that the content of the BM components is massively simplified, concentrating on key aspects which illustrate the typical difference of CBMs described in the main text. More case studies can be found e.g. at www.ellenmacarthurfoundation.org/case_studies or in the Circular Economy Toolkit (Evans, 2013)*

3. A process framework for Circular Business Model Innovation

In this chapter the CBMI framework is developed. The CBMI framework is a process framework which outlines a process of five phases and organizes eighteen key challenges which companies normally encounter. This framework can be used by companies to plan their CBMI process and will be used in this research to analyse the extent to which existing methods and tools for BMI or CBMI can be used by practitioners to cope with the key challenges.

An introduction to business model innovation

Business model innovation (BMI) is defined as a novel way of how to create, deliver and capture value, which is achieved through a change of one or multiple components in the business model (Frankenberger et al., 2013; Osterwalder & Pigneur, 2010). It has been widely acknowledged as a key source of competitive advantage (ibid), either by changing the terms of competition or by supporting the strategic marketing of innovative processes, products and services (Frank Boons & Lüdeke-Freund, 2012). Also, studies in the practical field show that business model innovators are on average 6% more profitable over five years than pure product or process innovators (BCG, 2008; IBM, 2008). Managers consider business model innovation to be more important for achieving competitive advantage than product or service innovation (Economist Intelligence Unit, 2005). Furthermore, more than 50% of the surveyed companies plan to innovate their business model in the next years (BCG, 2008; IBM, 2008).

Novel ways of value creation is more than introducing new products or processes. Innovations can aim at all four pillars of the BM. For example, Apple Computers shook up the market of music devices with the introduction of the iPod in 2001. Although this music device with massively extended storage capacity was a 'mere' introduction of a new product, Apple soon engaged in further innovation of their BM by offering music online via their iTunes platform. Music files were no new product, but the way the product was delivered entailed a new service, creating much added value for their customers with this 'seamless music experience'. Delivering iTunes required changes in many components of Apple's BM, but resulted in superior performance over competitors.

More specific key strengths of BMI are:

- Structuring and **understanding a firm's system** or network of activities, stakeholders and interrelations (the "activity system"), instead of "being a mere participant in a dizzying array of networks" (Amit & Zott, 2012).
- Achieving higher degrees of innovation by **looking beyond traditional sets** of partners, competitors, and customers (Amit & Zott, 2012).
- A **holistic perspective** on a business allows for optimization of the whole instead of individual activities (Amit & Zott, 2012; Baden-Fuller & Morgan, 2010).
- BMI is recognized as **an operational way to implement CE** in practice (Sempels, 2014).

Adapting the 4I-framework

To perform BMI a company has to go through a specific process with distinct phases. Based on a literature study on innovation process models and experiments with 14 German and Swiss companies, Frankenberger et al. (2013) have developed the *4I-framework*, which consists of four generic phases. Each phase has key challenges which companies usually encounter (**Figure 17**).

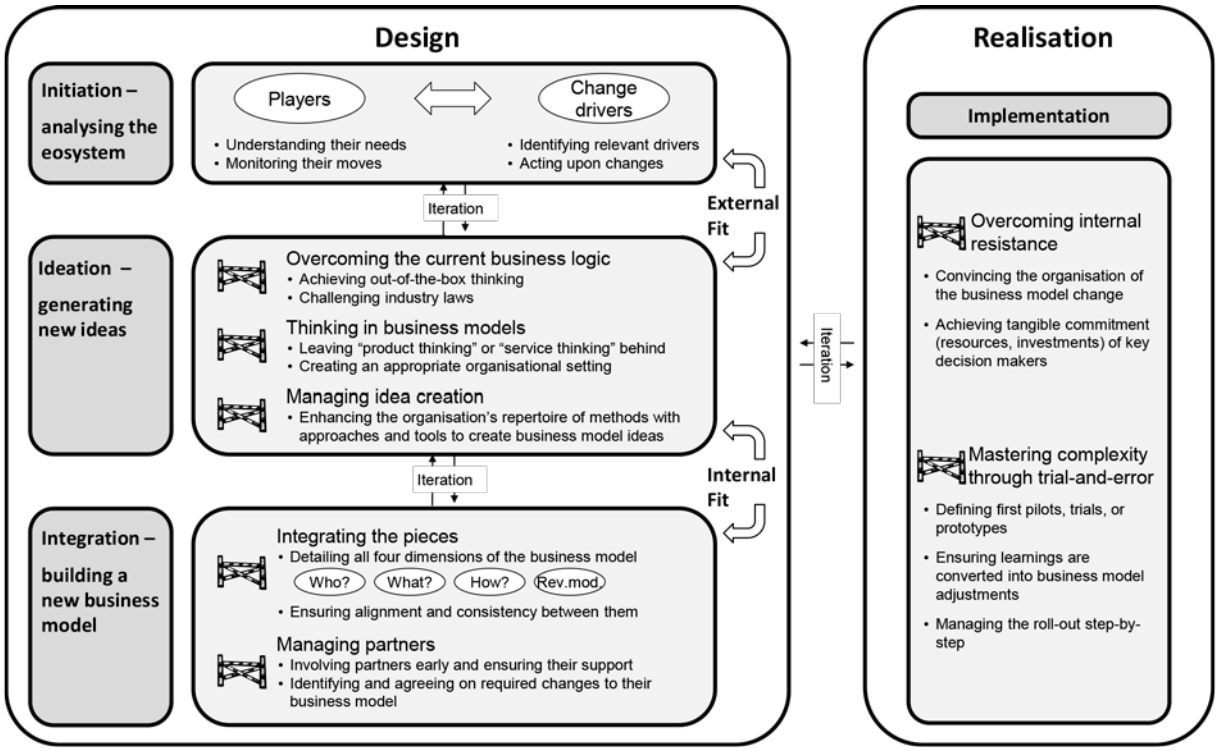


Figure 17 – *The phases and key challenges of the 4I-framework*

The four main phases in the BM innovation process are:

- The *initiation* or analysis phase, where the current business environment is analysed for changes in stakeholder (and customer) needs and in other drivers[16].
- The *ideation* or idea generation phase, where creative thinking must enable the generation of new ideas. This phase is least covered in literature.
- The *integration* phase, where ideas of the previous phase are elaborated further into complete BMs.
- The *implementation* phase, which entails all necessary processes of alignment and acquisition of resources to pilot the new BM in practice.

It is important to note the BMI process is an iterative process and passes through the phases several times, cyclical or back and forth (see reciprocal arrows). Each time more information is added (more detail, more relations, more solved issues, etc.).

Articulating the process helps to identify particular obstacles and facilitators in particular phases, which may be of practical help to managers (Hartley, 2006). Distinguishing different phases supports managers to outline and organize their BMI process. Furthermore, knowing and understanding certain obstacles (or challenges) helps to gather and prepare the right people, knowledge and tools and improve the success, speed and/or quality of the BMI process. This "process framework for BMI" is the first framework to give systemic guidance of the *process* companies go through when innovating their BM (Frankenberger et al., 2013)[17].

[16] Classic MBA often used the PESTEL framework for business environment drivers. PESTEL stands for political, environmental, social, technological, economic and legal.

[17] The 4I-framework is the first general process framework for BMI published in academic literature, but earlier process frameworks do exist, most notably Business Model Generation (BMG) and the STOF method (Heikkilä & Heikkilä, 2013). The analysis of Appendix B shows that the 4I-framework is more comprehensive compared to these other two frameworks, although it misses an important preparatory phase (project motivation, problem definition, gathering of team, etc). The STOF method is not so comprehensive and focuses on the ideation and integration phase, but does so much more extensively by taking into account 32 Critical Design Issues (CDI) and evaluating with 8 Critical Success Factors (CSF).

However, to be useful for *circular* BMI, the 4I-framework must be adapted and/or extended to a *CBMI framework*. This is because key challenges specific to CBMI have probably been absent or insignificant for the companies in the research of Frankenberger et al. (2013). The adaptation and extension of the 4I-framework is based upon several sources. First, from the description of CE in Section 2.1 several general important aspects can be derived which should be part of the BMI process. For example, the emphasis on collaboration with supply chain partners, co-creation and systems thinking should be integrated in the CBMI framework. Second, Kok et al. (2013) have identified 22 obstacles and 14 next steps "to accomplish a breakthrough to a circular economy" in the Netherlands. Many obstacles and next steps can be regarded as challenges for CBMI. In Appendix D this list has been compared to other studies on obstacles towards a CE. Third, the most important literature on BMI (most cited in Scopus) has been reviewed to find aspects of BMI which relate to general important aspects of CE or the list of obstacles. This selection of literature has been expanded with suggestions of Weiblen (2013) and Quist (2013). Tobias Weiblen is co-author of the 4I-framework and has suggested articles on BMI in networks (Berglund & Sandström, 2013; Lindgren, Taran, & Boer, 2010). Jaco Quist is co-editor of the special issue "Sustainable Innovation and Business Models" of the *Journal of Cleaner Production* and has suggested articles of this issue. Fourth and last, some of the CBMI methods which will be examined in the next chapter also contain general process outlines, challenges or required knowledge and skills for CBMI (most notably (Joustra et al., 2013; Joustra & Schuurman, 2014)). This content should be integrated in the CBMI framework.

In the following sections the key challenges will be explained per phase. The key challenges are printed in **bold**. Other sub challenges which are related to one of the key challenges are underlined.

Preparation phase

The CBMI framework introduces a *preparation phase* to the four phases of the 4I-framework, since an innovation team has to be gathered before the BMI process can began at all. First, decisions must be made on the composition of the innovation team. In practical terms, the size, knowledge, skills and attitude of the team is of utmost importance for a successful project (Dewulf, 2010; Osterwalder & Pigneur, 2010). Also, to prevent inclusion of old-rules mind sets it is recommended to select risk-takers over conservatives (Johnson et al., 2008).

Furthermore, the inclusion of external parties must be considered, since increased collaboration with value chain partners is a core aspect of CE (see Figure 2, p.15). Partners may also possess essential knowledge or skills. However, the necessary inclusion of external parties could be troublesome, since their commitment in terms of time and other resources for the BMI process is required. The leading party often needs to level awareness and urgency of opportunities or threats. The leader needs to steer towards "the right network stability", which is neither too stable and inert, nor too unstable and too inefficient or ineffective (Berglund & Sandström, 2013). However, the amount of partners has to be balanced, since the risks of opposition and consequently failure of the BMI tends to increase with more partners (Berglund & Sandström, 2013). Altogether, a company has to **balance the innovation team** in several dimensions.

Second, once it is clear how and with whom the BMI process will be started, it is important to **level and align understanding of the CE concept.** The first reason is that due to the ampleness of the CE concept, rooted in so many schools of thought, (see Section 2.1), partners often do not have the same level of understanding of the concept and its consequences for BMs. For example, the growing trend of sharing products and online platforms (e.g. Peerby, FLOOW2 and AirBnB) are regarded by some as the advent of the CE (Pakhuis de Zwijger, 2013), but sharing does not necessarily lead to closed loops (e.g. sharing of non-recyclable cars). The second reason is different parties often have different goals and interest, and consequentially different (broad vs narrow) interpretations of CE (see Section 2.1). Levelled understanding and aligned goals, interests and interpretations of CE are needed to prevent miscommunication, frustrated processes and deficient collaboration.

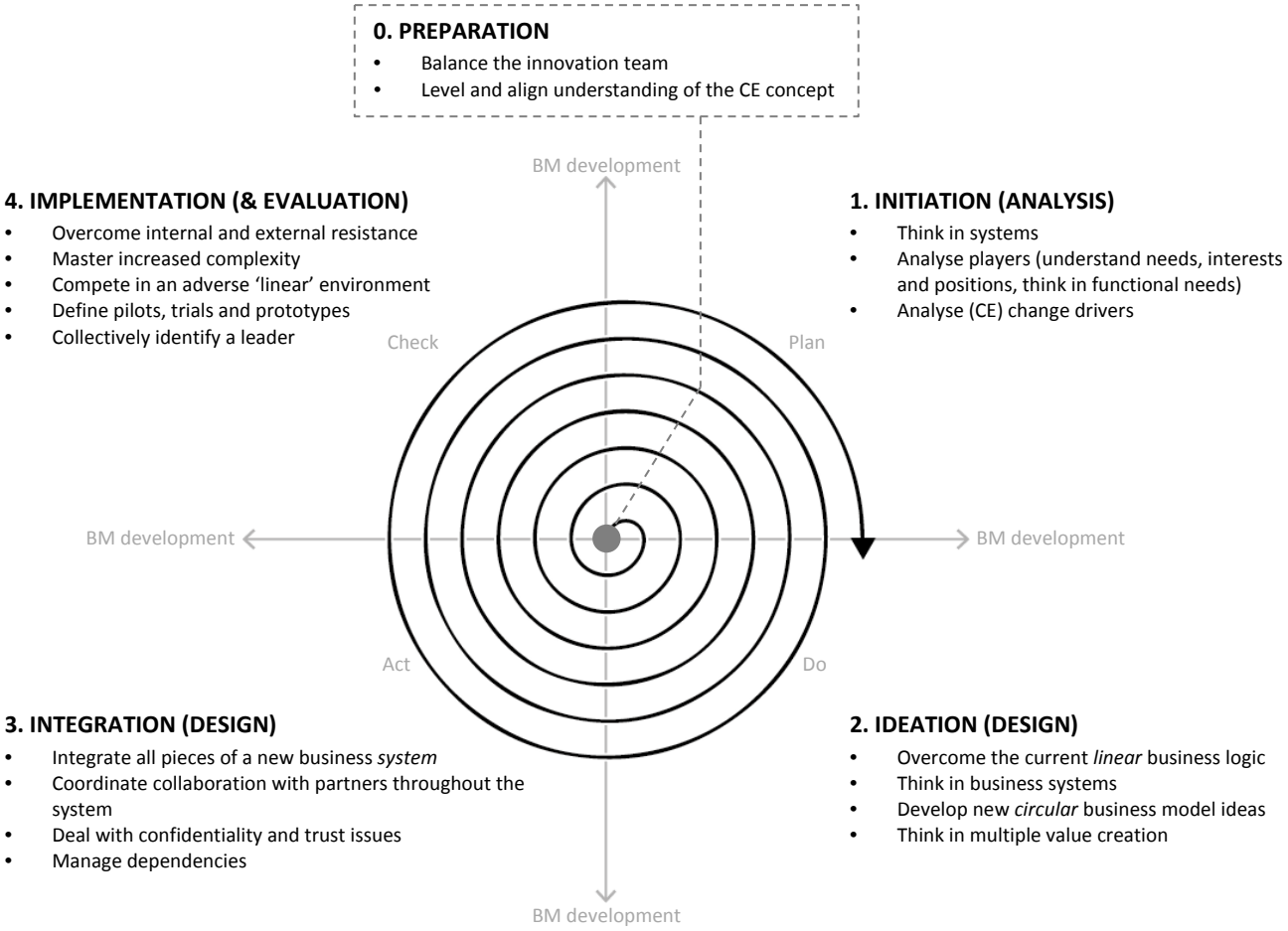


Figure 18 – *The CBMI framework*

Initiation phase

The central theme of the initiation phase is the analysis of the 'ecosystem' or business system the company or companies are part of. Therefore, **thinking in systems** is the first important challenge for companies. Thinking in systems is part of a 'traditional' BMI process as well, since BM are 'activity systems' themselves as well (see Section 2.2). However, for CBMI the whole supply chain needs to be regarded, which requires to think in systems on a higher level.

Next, a stakeholder analysis must be conducted to **understand influences, interests and positions**. Especially finding customers with **needs related to CE or CBMs** must be identified (the 'who' question). This sounds logical, but not finding a market for a new circular product or services is one of the key pitfalls of new ventures (Gassmann et al., 2013). Next to customer needs, companies need to **identify other relevant drivers and barriers for CE**. General drivers and barriers, opportunities and threats, have been identified in Section 2.3. However, these need to be expanded and detailed for a company's specific case. Also, about some drivers debate is still going on, for example about the scarcity of resources (Section 2.3). Companies need to make strategic choices despite such uncertainties. Furthermore, by mapping the interrelations between different drivers and barriers (how one driver strengthens or inhibits another) companies can locate reinforcing feedback mechanisms (or causal loops) can be used as powerful support for new circular initiatives (Joustra et al., 2013). See Appendix F for further explanation.

When business aims to servicize its products (see Section 2.4), they have to **think in functional needs** of customers. Functional needs are no products, but the performance a product can deliver[18]. However, working with functional needs comes with typical difficulties for business (see Section 2.4).

An aspect which is important for BMI in general as well, is to understand the evolution stage of the industry (Teece, 2010; Tukker & Tischner, 2006b). Competition between companies changes crucially when a market is in a growth phase, or already in a mature phase. More specifically for CBMs the evolution stage, or "product lifecycle" or "maturity", of products and components is also important, to determine how much opportunity there is for reuse (Joustra et al., 2013; Poppelaars, 2014).

Finally, the analysis of this phase must be concluded with a clear idea on how to act upon change. When several partners have been involved in the BMI process, it is also important to frame a collective strategic vision in order to align goals and activities (Loorbach & Wijsman, 2013).

Ideation phase

In this phase companies are challenged to **develop new CBM ideas**. For BMI in general it has been observed that tools or methods to support ideations for BMs are missing (Frankenberger et al., 2013). For CBMI specifically the availability of methods and tools is even lower and mostly in an early development phase (see Chapter 4). Furthermore, since the whole supply chain must be regarded, developing new CBMs is even more complex. The large quantities of information can become impossible to handle and can hamper creativity (Dewulf, 2010).

Apart from missing methods and tools, companies need to break through fixed organizational routines and myopia in order to achieve out-of-the-box thinking and challenge industry laws (H. Chesbrough, 2010; Frankenberger et al., 2013), Next to that, many business need to **overcome the current *linear* business logic**, since they are stuck in a linear paradigm (EMF, 2013). The shift in focus from internal processes to the whole system is counterintuitive to many. Most companies do not have the knowledge and skills to increase cross-sectoral and cross-cycle collaboration in order to capture new value (e.g. by optimizing the supply chain with more coordination) and develop different competitive advantages.

Furthermore, companies should think beyond their own BM and **think in business systems**. Instead of only for themselves, they should generate ideas for the entire supply chain. This is a large challenge, since there is a large lack of information and many organizations miss the appropriate skills, attitude and budgeting. In fact, thinking in business models for one's own company (Frankenberger et al., 2013) or thinking in services and functional needs (Sempels, 2014) is already a challenge to many.

Companies with a broader interpretations of CE do not focus on closing material flows, but are looking for new ways to create value in general. Often these are other types of value than financial profits, such as time, attention or sense of community (Jonker, 2013). Many new BMs – not necessarily circular – have already been observed to explicitly aim for this, such as Timebank.cc, Thuisafgehaald.nl en hundreds of small energy cooperations (Jonker, Tap, & Straaten, 2012). In contrast to the similar concept of *shared value* (Porter & Kramer, 2011), the focus of value creation (for whom is value created) is not the individual company, but the system or community (Jonker, 2013). However, many companies are not used to think in 'tripple bottom line' (Elkington, 1997) or to **create multiple values** (Jonker, 2013).

[18] For determining functional needs interesting inspiration can be drawn from methods to define 'functional units' for Life Cycle Assessments (see e.g. (Guinée, 2002))

Integration phase

The integration phase is all about putting ideas from the previous phase together into a consistent CBM concept. Remember that often individual BMs are not able to close loops (Section 2.2). Regarding other BMs is then required. This makes the challenge of integration even larger than for regular BMI, sometimes with an exponential factor, since the focus on the system level requires to **integrate all pieces of the business *system*** into a consistent CBM concept, instead of integrating a concept for 'only' an individual BM.

When no external people have joined the innovation team in the Preparation phase, at least now it becomes a key challenge to involving partners and ensuring their support (Frankenberger et al., 2013) and **coordinate the collaboration with partners throughout the system**. This intensive cooperation (especially of R&D departments) entails information exchange and agreements about responsibilities, liabilities, sharing profits, goals, knowledge and ownership (Kok et al., 2013). Strategies for **co-creation** (José de Vries et al., 2011) and **open innovation** (Chesbrough & Vanhaverbeke, 2006) suit this type of challenge well. It is important to note that the coordination of collaboration is much more difficult than the challenge of 'managing partners' in the original 4I-framework. This is because the success of BMI is likely to decrease when the number of stakeholder increases, or their (inter)dependence or required change of their BMs increases (Berglund & Sandström, 2013). For CBMI this expected to be even more difficult. Moreover, securing collaboration with legal contracts is less effective than establishing social norms and institutions. This encourages trust, reciprocity and rich information sharing (Berglund & Sandström, 2013) .

The sharing of information is a delicate point, since optimizing the supply chain requires access to information of all partners. However, this quickly becomes problematic if the information is crucial for a company's individual competitive advantage. In fact, installing 'isolation mechanisms' against quick imitation of BMIs (copying) has been coined as a core challenge for (traditional) BMI (Teece, 2010). Therefore, convincing all stakeholders that a cooperative approach will yield more benefits (if this indeed is the case) requires a mind shift to move away from protectionist thoughts. Thus **dealing with confidentiality and trust issues** becomes a major challenge. Trust is also an issue related to thinking in functional needs. Functional needs or performances are best defined in abstract terms, so that the provider has more flexibility (and creativity) to fulfil the need (Tukker & Tischner, 2006b). However, customers have to trust their service providers to correctly understand the performance they want.

Also, increased collaboration and exchange often entails increased mutual dependencies (Van Houten, 2013). This is usually a risk rather than an opportunity as collaboration comes with "the problem of coordinating the activities" (F. Boons & Baas, 1997). **Managing dependencies** therefore becomes a greater challenge. Dependencies can be treated in several ways, including formal or informal contracts (Van Houten, 2013) or collectively developed coordination systems of self-governance (FAA Boons, 2008). However, this often increases transaction costs (Tukker & Tischner, 2006b, pp. 51-53; Van Houten, 2013). High transaction costs can be decisive when competing with the cost effectiveness other BMs. Transaction costs can be kept relatively low when the elements of the CBM are well standardised and the need for mutual adjustments of product parts, service elements and production processes across company borders is low. Most adjustments are needed in an early stage of an industry.

Implementation phase

In the implementation phase the new BM transfers from paper to practice. In short, the design of a new CBM concept is tested in reality, which generates a lot of feedback. There are almost always aspects to improve and sometimes the new concept doesn't work at all. The feedback has to be taken back to the drawing table and so the initiation phase starts again (see **Figure 18**). More specific challenges are observed though during the implementation phase. First, innovators need to **overcome internal *and* external resistance** on a level which is often higher than for 'regular BMs'. This is not only because many CBMs require the collaboration and alignment of much more stakeholders (possibly the whole supply chain) than 'regular' new BMs. But also resistance of the 'linear' system needs to be overcome as well (a system

transition is needed, Section 2.4). Both sides are examples of external resistance, which cannot be dealt with by imposing formal power such as in the case of internal resistance, e.g. by a heavyweight manager with formal authority over all involved actors (Wheelwright & Clark, 1992). Instead, companies need to apply soft-power tactics to influence actors and align them to the BMI process (Berglund & Sandström, 2013) in order to achieve (tangible) commitment (Frankenberger et al., 2013). Companies have to deal with conflicts with rules and vested interests, or prevent conflicts if possible (Johnson et al., 2008). Frameworks for *business transition management* can be used to proactively engage with a system transition. Companies have to undertake four types of governance activities (Loorbach & Wijsman, 2013):

- Strategic envisioning: frame a societal challenge with partners to contribute to;
- Tactical networking: invest in developing and facilitating coalitions and networks around societal challenge;
- Operational innovation: investigate possibility and profitability of transition;
- Reflexive monitoring and evaluation: cross-business debate.

However, the amount of influence on the system should not be overestimated. Many obstacles in the context, or the current business system ((Kok et al., 2013), see also Appendix D) are under the sphere of influence of other parties than business, e.g. government or society, and can only be influenced limitedly by business actors, e.g. by lobby activities. Furthermore, for incumbent businesses the resistance is usually larger due to a larger and stronger set of existing routines and mind-sets. New entrants more often succeed in (disruptive) innovation (Christensen, 1997).

Successful implementation of a CBM also depends on competition. New CBMs have to **compete in the adverse 'linear' environment** (see Section 2.3 *Linear opportunities are circular threats*). Not surprisingly, the original 4I-framework does not regard the competition between linear and circular BMs. For new CBM wrestling with opposing forces, the general recommendation is to start with easy opportunities ('low hanging fruit'), small scale investments (with potential large learning experiences) and innovation on the system level (Van Raak & Loorbach, 2014).

Also, many of the challenges above demands great skills of companies to **master increased complexity**. The development of supporting systems, such as chain information management systems which organize materials flows, including data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling (matching of material in- and outputs), can be crucial to allow for organization on the value network level (Kok et al., 2013). However, such management systems are usually absent until the implementation phase, whilst managing complexity can be an important issue in the preceding three phases as well.

Finally, as the BMI process move from designing on paper to implementing in reality, various implementation strategies must be employed as well on a practical or managerial level. Numerous books have been written about effective new business development, project management, change management and other organizational processes. Some of the most important challenges will be shortly be mentioned below.

Defining pilots, trials and prototypes is important to create a safe environment (niche) for quick experimentation and trial-and-error. This generates a lot of information and grants lessons about the BMI, which should be used too its full benefit for improvement. The importance of ensuring these types of learning processes is substantiated by the observation that many successful businesses stopped spending too much time preparing and thinking over BMI and started to quickly test their ideas to receive feedback as quickly as possible. This idea of quick feedback generation is substantiated from different directions, including 'effectuation' (H. Chesbrough, 2010), the lean start-up (Blank, 2006, 2013; Ries, 2011), strategic niche management (Schot & Geels, 2008) and the mantra "fail often, fail cheap, fail fast". Of course is has to be noted that for software development this is easier done than for setting up a disassembly line.

Furthermore, the implementation needs a problem owner to ensure progress and priority for the innovation process. The organization or partnership needs to **collectively identify a leader** to become the main problem owner and guide the implementation process (H. Chesbrough, 2010). As manager of the pilot he can take responsibility for the success of the innovation trajectory.

The CBMI framework

Table 7 presents an overview of the CBMI framework as described in the previous section. The table lists all key challenges and below sub challenges in a bullet list. The comparison with the original 4I-framework shows the new challenges which have been introduced. To emphasize this, some sub challenges are put in a separate row. Many challenges are specific to *circular* BMI, such as 'Level and align understanding of the CE concept'. Others are also a challenge for 'regular' BMI, but have become more important in a CE context, such as 'Manage dependencies'. Note that the table outline gives an impression of a linear process, but that in reality the phases and challenges are passed through iteratively (see again Figure 18, p.44).

Equal to the 4I-framework, the CBMI framework helps companies to distinguish particular phases and understanding certain challenges beforehand. However, the CBMI framework can also be used as an analytical framework for the research of this thesis. In the next chapter the extent to which existing methods and tools provide answers or guidance to the challenges (or obstacles) described in the CBMI framework below.

Table 7 – *The CBMI framework compared to the original 4I-framework.*

4I-framework (Frankenberger et al., 2013))	**CBMI framework**
Phase: -	PREPARATION
-	Balance the innovation team - Team composition - Select risk-takers - Level awareness and urgency - Inclusion of external partners (with knowledge & skills) or not - Steer towards right network stability
-	Level and align understanding of the CE concept - Share knowledge
Phase: INITIATION	Phase: INITIATION (ANALYSIS)
	Think in systems - Understand feedback mechanisms
Players - Understand the needs of the players - Monitor their moves	Analyse players - Understand influences, interests and positions (stakeholder analysis) - Understand needs for CE and CBMs - Monitor their moves
-	- Think in functional needs
Change drivers - Identification of relevant drivers	Analyse change drivers - Identification of relevant drivers and barriers CE
-	- Understand evolution stage of industry
- Acting upon change	- Acting upon change - Frame a (collective) strategic vision
Phase: IDEATION	Phase: IDEATION
Overcome the current business logic - Achieving out-of-the-box thinking - Challenging industry laws	Overcome the current *linear* business logic - Achieving out-of-the-box thinking - Challenging industry laws and the dominant logic
Think in business models - Leave product and service thinking behind - Create appropriate organizational setting (skills, attitude, budgeting, etc.)	Think in business systems - Leave thinking product and service thinking behind - Leave thinking in individual BMs behind - Create appropriate organizational setting (skills, attitude, budgeting, etc.)

Develop new business model ideas - Enhance organization's repertoire of methods and approaches to develop new BMs	Develop new *circular* business model ideas - Enhance organization's repertoire of methods and approaches to develop new CBMs
-	Create multiple values (TBL)
Phase: INTEGRATION	Phase: INTEGRATION
Integrate all pieces of a new business model - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between	Integrate all pieces of a new business *system* - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between
Manage partners - Involve partners and ensure support	Coordinate the collaboration with partners throughout the system - Involve partners and ensure support - Co-create & open innovation - Establish social norms and institutions rather than contracts
- Identify and agree on required changes	- Identify and agree on required changes
-	Deal with confidentiality and trust issues (and 'isolation mechanisms')
-	Manage dependencies
Phase: IMPLEMENTATION	Phase: IMPLEMENTATION
Overcome internal resistance - Convince for change - Achieve tangible commitment (incl. resources) of key decision makers	Overcome internal and external resistance - Convince for change - Apply soft-power tactics - Prevent conflicts with rules and vested interests - Achieve tangible commitment (incl. resources) of key decision makers
Master complexity through trial-and-error	Master increased complexity - Use or develop supporting frameworks and systems
	Compete in an adverse 'linear' environment - Undertake four types of governance activities
- Define pilots, trials and prototypes - Manage roll-out step-by-step - Ensure learning processes (feedback implementation)	Define pilots, trials and prototypes - Ensure learning processes (feedback implementation)
-	Collectively identify a leader
-	

Limitations of the CBMI framework

The CBMI framework has been constructed on a theoretical basis. Due to time constraints the framework has not been verified in practice. Interviews with practitioners (companies, managers) or observations of practice would be needed for this. However, the CBMI framework shows much similarity with the 4I-framework (**Table 7**), which has been tested in practice. Moreover, professional experience with CE or CBMI is still very low and immature. Therefore, despite this lack of verification, the CBMI framework is still used as analytical framework to analyse the usefulness of existing methods for BMI and CBMI.

4. Validation of existing methods for Circular Business Model Innovation

The challenges in the CBMI framework, described in the previous chapter, are the problems or obstacles companies encounter during a CBMI process. Several methods and tools for BMI in general, or for circular BMI specifically, offer companies answers or guidance how to cope with these problems. In this section these existing methods for BMI or CBMI are analysed with the CBMI framework. The full analysis in Appendix G shows to what each method deals with each challenge and for what challenges they leave gaps. This has been done with an adapted methodology of content analysis (Kumar, 2005). Here content is not only counted, but also evaluated against theory on CE and BMI from preceding chapters and against other BMI/CBMI methods (comparative evaluation). The results are summarized in Section 4.1 for each method. The results on the gaps of existing methods and tools are presented in Section 4.2. The main lines have been discussed with several experts in practice (Braam & Fraser, 2013; Kimmel, 2013).

4.1. Analysis of existing methods for BMI or CBMI

Overviews of the most important methods and tools for general BMI can be found in (academic) literature (see e.g. (Heikkilä & Heikkilä, 2013)). However, academic literature focused on *circular* BMI is practically non-existent. Systematic search on the internet delivered unsatisfactory results, e.g. on a search string like 'business model innovation + circular economy'. Even for the more generic field of BMI for sustainable innovation, "only Tukker and Tischner (2006b) offer a general framework for sustainability-oriented business model innovation" (Lüdeke-Freund, 2010).

Therefore, for specific methods for *circular* BMI, several CE experts in practice have been consulted. They have been asked for methods concerning 'BMI and sustainability' or methods for CBMI developed only in practice and without (scientific) publication (Braam & Fraser, 2013; Kimmel, 2013; Peck, 2013; Veldema, 2013). All together, the following methods for BMI or CBMI have been found which could address one or more of the challenges not yet addressed by general methods for BMI like BMG and STOF:

- The method *Business Model Generation* (Osterwalder & Pigneur, 2010) with the *Business Model Canvas*
- The *STOF method* (Bouwman et al., 2008)
- The method *New Framework on Circular Design* (EMF, 2013b, p. 100)
- The method and toolbox *Practical Guide for PSS development* (Tukker & Tischner, 2006b)
- The method *Circular Economy Toolkit* (Evans, 2013)
- The method *Guided Choices Towards a Circular Business Model* (Joustra et al., 2013)
- The tool *Sustainable Business Model Canvas* (Sempels, 2014)
- The game and tool *Play if Forward* (Dewulf, 2010)

Business Model Generation and the Business Model Canvas

The most widely adopted method, academically and non-academically[19], is the handbook *Business Model Generation* (Osterwalder & Pigneur, 2010). The method is developed around the *Business Model Canvas* (BMC, **Figure 19**), a powerful tool which is applicable throughout sectors and useful for experienced and inexperienced people with diverse backgrounds. The simplicity of the BMC moreover establishes a quickly learned common 'BM language' which greatly supports multidisciplinary collaboration and strong communication to other (external) involved parties. Furthermore, the book provides a general process

[19] The usefulness of the handbook *Business Model Generation* is observed well when searching for images of 'Business model canvas' with Google. This search item results in a rich variety of uses and adaptations.

framework comparable to the 4I-framework and offers practical additional methods and tools, including patterns for BMs (using patterns is elaborated in Section 5.2), creative design techniques and strategic evaluation methods.

The book is a general BMI method and offers very little guidance specific CE challenges. For example, both the book and the BMC do not give any support for a systemic thinking on the level of the supply chain. Guidance or strategies for management of or collaboration with partners is almost entirely absent, except the inclusion of the Open Innovation concept and open business models. The usefulness of the BMC for CBMI is analysed in Appendix G and will be further investigated and discussed in chapter 6 and 7. A more detailed discussion can be found in Appendix Y (conversation with RHDHV professionals).

The STOF method

Another comprehensive BMI method is the STOF method (Bouwman et al., 2008), which is a four step design method around the STOF model (Service, Technology, Organization and Finance as main BM components, see **Figure 20**). The steps include a quick scan, an evaluation with critical success factors (CSF), specification of the BM with critical design issues (CDI) and evaluation. The STOF model is much more elaborate and precise than the BMC, but for that reason also more difficult to apply widely by different people and organizations. The precision also comes at the cost of a too narrow scope, since the STOF method focuses almost exclusively on the integration phase of the BMI process.

Like Business Model Generation, the STOF method should be regarded as a general BMI method and hardly offers guidance to specific CE challenge. As an exception the model on service design can be useful to think in functional needs (although STOF focuses mobile applications). Also the use of CSFs and CDIs helps to focus on the most important information during a BMI process.

New framework on circular design

The method focuses on valorising waste streams and others leakages of materials along and across supply chains. There are only five, rather concise steps. The five steps do cover most phases, except the Preparation phase, but leave large gaps. However, the framework is part of the report (EMF, 2013b), which contains information for some of the remaining CBMI challenges. This information nevertheless is scattered through the rather thick report, which doesn't add to the usability of the framework. Furthermore, the information remains to be abstract and does not give clear practical guidance. Despite the extra high level information, this method leaves large gaps at the more organizational challenges of BMI, in particular in the implementation phase. Also, the opportunity of multiple value creation is grasped scarcely, which hints at the focus on business values.

Critique on EMF's method:

- The method focuses on valorising waste streams and therefore resembles a bit an end-of-pipe strategy. Waste production is a symptom of an ineffective production system, has negative value by definition and should not be confused with secondary products with positive value. Furthermore, many of the building blocks and enabling conditions cannot be grasped
- EMF doesn't have ideation in 5 step framework and therefore only serves for end-of-pipe strategy. EMF's case study website complements the framework with CBM building blocks and enabling conditions, but fundamental pillars of the BM (e.g. the 'who' question) and steps for BMI are absent.
- The steps are considerably incomplete from a BM perspective. Especially the 'who' question is missing, but many other aspects of a BM are absent as well
- Although thinking in systems is mentioned as an important principle, the practical method does not assist you to think in systems instead of businesses.
- The building blocks and enabling conditions have very general descriptions and probably need specification (e.g. different categories or options) to trigger ideation by users.

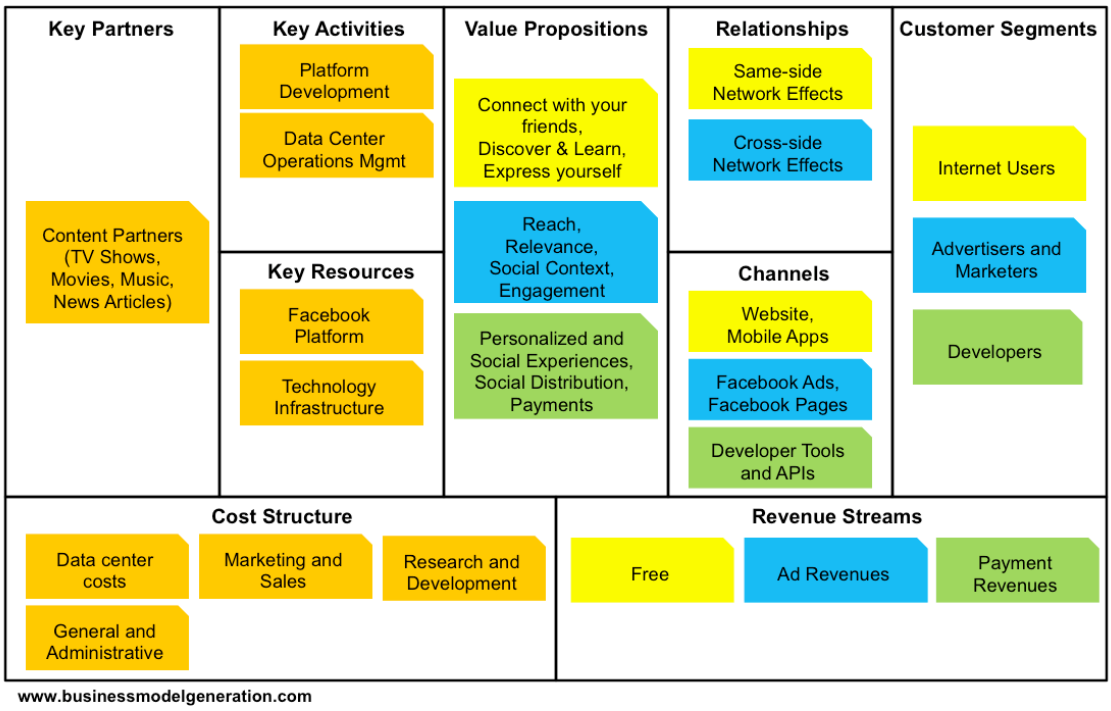


Figure 19 *– The Business Model Canvas (Osterwalder & Pigneur, 2010) has nine building blocks (see also* ***Table 3****, p.23). The building blocks are interrelated. If one changes, many or all others have to change too. The building blocks have been filled in for the BM of Facebook.*

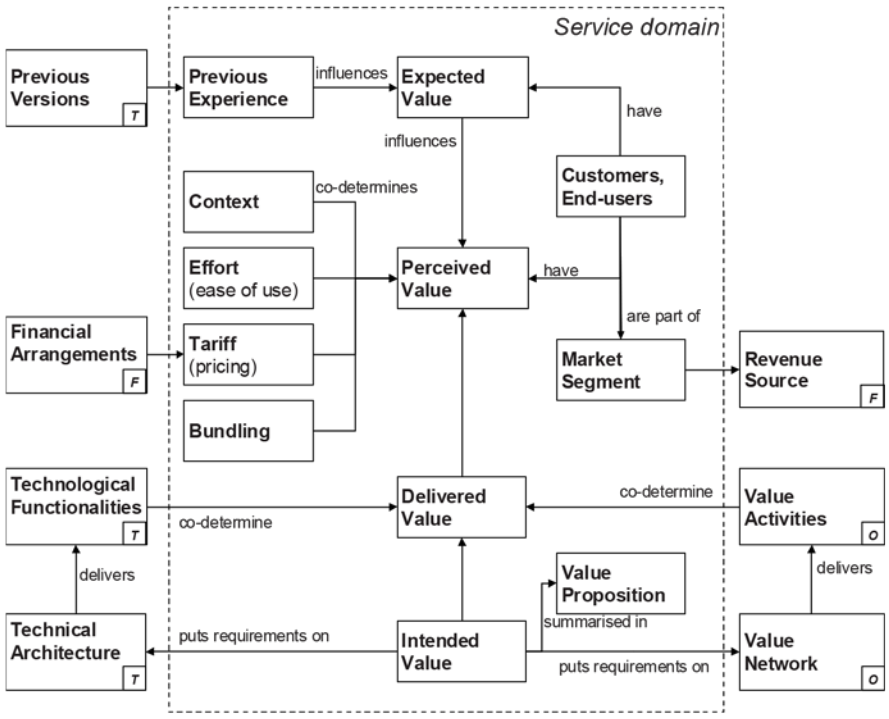


Figure 20 *– The STOF model (Bouwman et al., 2008) is a more elaborate BM model, which originally has been developed for mobile service design (IT). Each 'domain' (Service, Technology, Organization and Finance) consists of several interrelated 'design variables'. Here the design variables of the Service domain are shown. Together the design variables form a large network of 32 CDIs.*

Practical guide for PSS development

The only general framework for sustainability-oriented business model innovation (Lüdeke-Freund, 2010) focuses, as the name says, on PSS. The guide is based upon an extensive review of existing methods and tools. Although PSSs do not always imply closed material loops (see Section 2.4, *CBMs and opportunities for sustainability*), many elements of the guide will be applicable for developing CBMs as well.

The guide itself is rather concise, but very practical. The guide offers step-by-step frameworks and methods to go through five phases of an innovation process, all concluded with an explicit go/no-go moment with criteria. The concise guide is nevertheless substantiated by a massive catalogue of references to methods and tools for the initiation, ideation and integration phase. Annex 2 of the book contains an alphabetical categorization of dozens of creativity techniques and BMI tools. Furthermore, the preparation phase is supported with extensive descriptions of 8 types of PSSs and their competitive and sustainability characteristics, i.e. a full introduction to PSSs and their business and sustainability characteristics.

With regard to the focus on PSS, it is important to note that developing PSS does not automatically entail closing material loops (see section 2.4). Indeed, closed material loops have not been mentioned explicitly anywhere in the guide and the exemplary system maps do not depict any material cycles (see **Figure 21**). Furthermore, despite the ample setup of the research, some gaps have been found again in the implementation phase. This is probably due to the fact that this phase is rather distinct from the other two and can be supported one of the many titles on project management, change management and other organizational processes.

Also, whilst most CBMI challenges are mentioned on a high or abstract level, some more gaps are found on the practical level, most notably for the challenge of coordinating collaboration. Interestingly, this coincides with Tukker & Tischner's own conclusion that "tools and methods for finding the right partners and organizing the new co-operative arrangements efficiently are still largely missing" (p. 371).

Also drafting system maps has been presented as a rather simple exercise which can be done using the System Organization Map of **Figure 21** (Manzini, Evans, & Collina, 2004). It is however questionable whether this tool is able to organize the complexity of integrating many pieces of multiple BMs, as given examples of rather reduced and simplified systems are already not easy to grasp at once. Further increases of complexity however may cause the system map to explode and become unusable.

Finally the large catalogue of methods and tools supporting the concise guide is both a wealth and an overload at the same time. For inexperienced users understanding and selecting methods and tools can be too difficult.

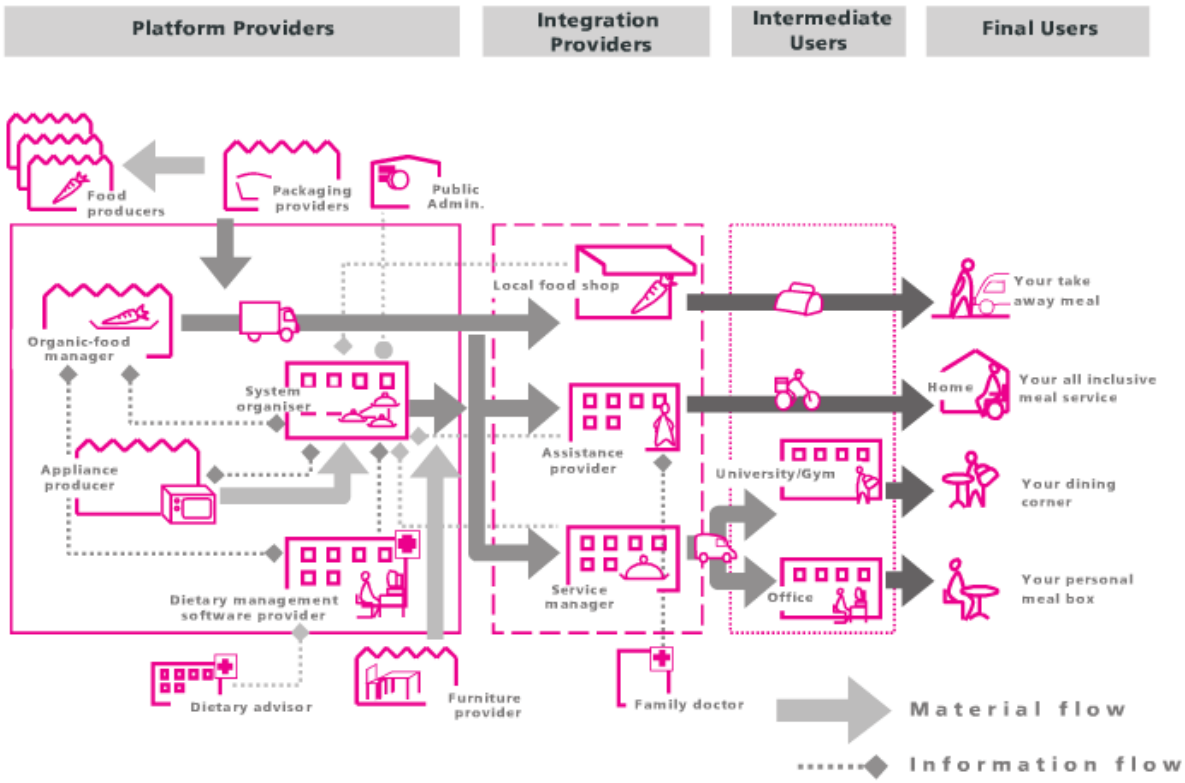


Figure 21 – *The System Organization Map is a tool to visualise business systems. The system map shows both a visualisation of the value proposition (right side) and a map of the general system organization (Manzini et al., 2004). The icons are constructed systematically from a "structure, characterisation and slogan" and three types of flows are distinguished: material, information and financial (not shown in picture) flows. This example explains a PSS for meals.*

Circular Economy Toolkit

The method has consolidated many CE opportunities and systematically provides information on benefits, considerations and implications for product design of various CE activities. It is built up around seven specific CE activities for the technocycle (**Figure 22**), which relate to the four cycles in the CE butterfly diagram, extended lifetime, circular design and production and PSSs. Essentially, the method comes down to using case studies for each CE activity to inspire companies in seeing opportunities for themselves. Prior to the workshop an analysis of products, competitors "and other analyses" are executed. The analytical methods come from the field of Industrial Ecology (LCA, MFA). The web-based Assessment Tool also assists analysis with basic questions per CE activity. The workshop is meant for a brainstorm session which must generate quick ideas on post-its which are collected in the seven circles. In a matrix the highest impact/feasibility ideas are assigned to a problem owner further investigation and implementation.

CE Toolkit has strong basis in literature about the different CE activities and provides an extensive overview of benefits, considerations and implications for product design of seven CE activities (including reduction). The fixed structure of information at each strategies greatly increases usability. However, this property of CE Toolkit is the only strong point of the method, as large gaps are found compared to the CBMI framework. Especially the integration and the implementation phase are almost absent and also the preparation phase is rather underdeveloped. CE Toolkit can therefore be regarded as CBM ideation method, but not as a CBMI method.

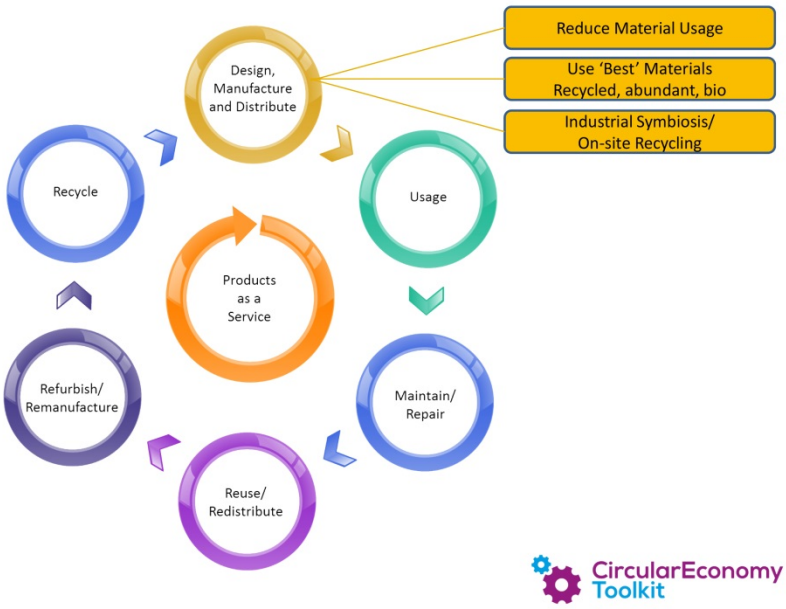


Figure 22 *– The seven opportunity areas of the Circular Economy Toolkit (Evans, 2013)*

Guided Choices Towards a Circular Business Model

This method is a comprehensive guide "meant to be a source of inspiration and support for SME's to enter the CE" (Joustra et al., 2013). It is set up as a workbook with many practical questions and tasks to assess whether someone's business would benefit from circular models. Concrete tasks include assessing the potential of a product's refurbishment and answering the first practical questions on operations and finance of a service model (step 4 'Try' and 5 'Test'). The 21 main issues which are covered are very practical and probably suit the target group of SMEs well. The focus on SME's questions (and the author's background) is also reflected by extensive information and tips on the financial side of BMI.

However, many key challenges from the CBMI framework as still covered only by some high level remarks[20], or by so-called "elementary skills" (an abstract explanation of a couple of sentences). No further guidance is offered on how to develop those skills or how to set up workshops in the organization. Indeed, the method is more a workbook than a framework for BMI processes. Other methods do manage to give further practical tips, e.g. Tukker's catalogue with descriptions of creative techniques. The method therefore does not properly address many CBMI key challenges, especially in the ideation phase.

Figure 23 *– Five main steps of Guided Choices Towards a Circular Business Model (Joustra et al., 2013)*

[20] For example, the key challenge of "Compete in an adverse 'linear' environment' is addressed only with some high level remarks about hybrid solutions which suit a transitional period. There is no further guidance in what business can do in such transitional periods, such as Loorbach and Wijsman (2013) suggest.

Sustainable Business Model Canvas

This tool has adapted and extended the BMC to 10 building blocks (see **Figure 24**). The most important changes to the original are the introduction of 'Work Organization' (organizational effectiveness and efficiency), 'Positive & Negative Externalities' and 'Drivers of Productivity', among the adaptation of several other building blocks.

Sempels (2014) gives an explanation of each building block of the canvas and a high level overview of the changes in each building block when changing from selling products to providing services (or performances). For companies considering a service or performance model, this contribution offers a great overview – although high level – of essential implications. However, as a consequence of being only a tool, no CBMI challenge is addressed on a concrete level and many are not addressed at all. Only the integration phase is covered well by the thorough explanation and possible changes of each building block, and the canvas offering a way to integrate all pieces in a CBM.

Some CBMI challenges are yet partly filled in by several paragraphs on the importance and opportunities of collaboration and partnerships, and on the change of customer relationships, both in terms of 'customers becoming partners' as important issues in perceived value of services. However, everything remains to be high level with no concrete guidance.

With respect to thinking in systems it is remarkable that an example of a network of value creation is shown as the new direction for CBMs ('Autolib', a French car sharing system), but that the Sustainable BMC itself does not facilitate the conceptualization of such networks. In contrast, the canvas is still tuned to individual businesses, only addressing the system in the building block "network of actors". It would have been consistent with the example to propose a canvas which supports the conceptualization of systems such as Autolib.

Play it Forward

This tool is also an adaptation of the BMC, which now includes building blocks for a Tripple Bottom Line (TBL). A game has been developed around the canvas (see **Figure 25**). The focus is on sustainable development, more specifically "understanding and implementing sustainability in the early stages of a [business model] innovation process". Sustainable development is a wider scope than CBMI.

The tool focuses furthermore on the "fuzzy front end" of a BMI process. During the fuzzy front end phase companies generate ideas, identify opportunities and develop concepts of ideas. Many aspects are still uncertain and feeble, but this grants more opportunity to integrate sustainability-related issues (principles, guidelines, rules of thumb, etc.).

Due to its other focus, many CBMI challenges are not addressed. Formally, only the integration phase is addressed properly with an extensive description of the extended canvas and how to use it. However, the game has to be guided by a facilitator. Although this is a practical weakness (costs and ease of use), he/she might provide additional guidance in the phases before (analysis and creative ideation) and after (conclusions, actions and implementation) using the canvas. Due to great resemblance to the original BMC, many tools and methods of *Business Model Generation* (2010) are applicable at once (see Appendix G).

Furthermore, because the tool is developed as a game, much attention has been given to the process side and practicalities of the BMI process, especially compared to the other more project-oriented CBMI methods or tools. The paper concludes with 12 concrete practical tips for running a workshop. Also, considerable investigation has been done on team composition. Skills, quality, capability and attitude are the most important aspects, however there is little consensus about ideal situations. An innovation team should consist of 3 to 7 players and diversity can lead to both a richer playground for creativity and inspiration and conflict and poor collaboration (Dewulf, 2010).

<table>
<tr><td rowspan="5">Externalités positives

Externalités négatives</td><td colspan="3">Gouvernance et légitimation</td><td rowspan="5">Système d'acteurs et partenariats clés</td></tr>
<tr><td>Activités stratégiques
(ce qu'il faut faire)</td><td>Organisation du travail
(comment le faire)</td><td>Proposition de valeur
du point de vue des bénéficiaires
pour bâtir l'avantage concurrentiel</td></tr>
<tr><td colspan="2" rowspan="2">Ressources clés
(dont les ressources immatérielles)</td><td>Gestion de la relation aux acteurs</td></tr>
<tr><td>Accessibilité & appropriation</td></tr>
<tr><td colspan="3">Déterminants de productivité</td></tr>
<tr><td colspan="2">Structure et flux de coûts</td><td>Structure et flux de revenus</td></tr>
</table>

Figure 24 – *Sustainable Business Model Canvas, an adaptation of the BMC for service models (Sempels, 2014)*

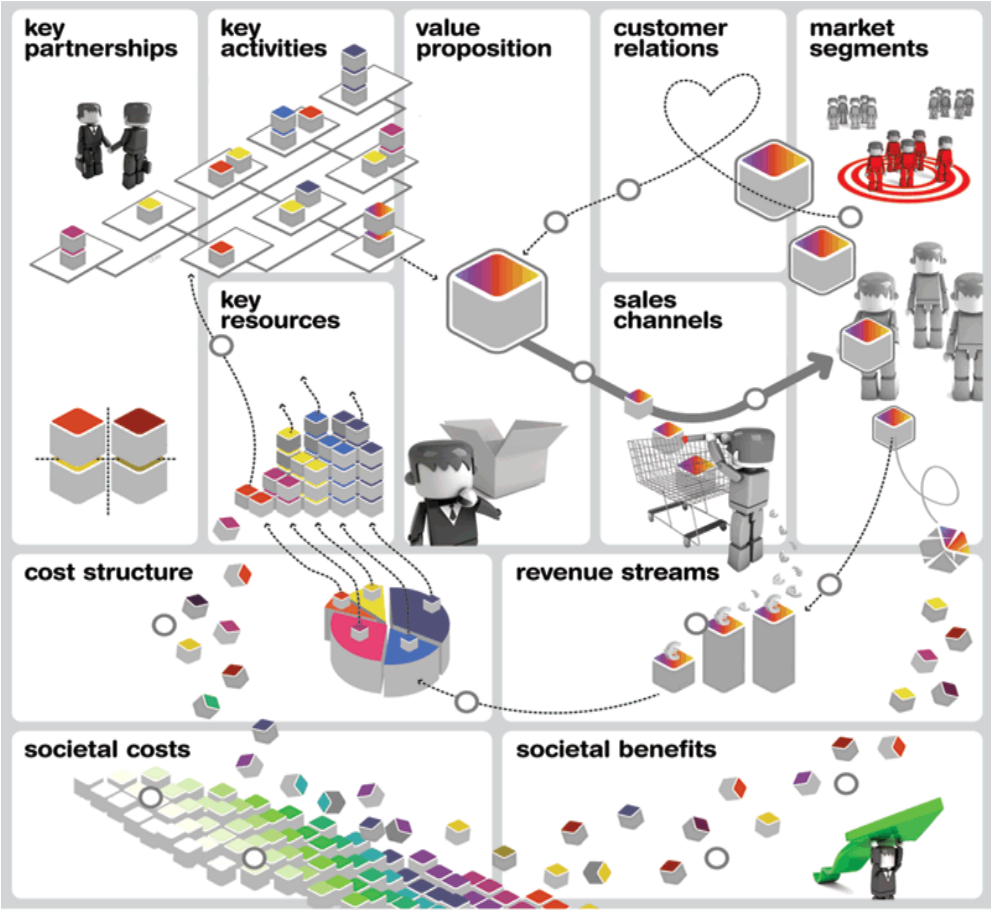


Figure 25 – *Gameboard 'Play it Forward', another adaptation of the BMC for sustainable business models (Dewulf, 2010)*

4.2. Identification of collective gaps in existing methods

By comparing the weaknesses of all methods together, collective gaps of existing CBMI methods can be found. This has been done by examining the results of Appendix G row by row, together with the comments described in Section 4.1. A visual summary per phase is given by **Table 8**. The identification of these gaps is important for further development of CBMI methods and tools.

CBMI framework phases → Method or tool ↓	Preparation	Initiation	Ideation	Integration	Implementation
Business Model Generation	No CE	Much analysis, but no CE	Well-developed, but no system-orientation	Almost nothing on collaboration issues	Only very high-level
STOF method	Nothing	Only Service Design	Too little	Elaborate and systemic, but nothing on collaboration issues	Only CSFs and CDIs
New framework on circular design	Only tips for starting innovation process	Only focus on material flows	Only 4 patterns and high-level building blocks	Nothing on collaboration issues	Not practical
Practical guide for PSS development	PSS, but no CE	No explicit system thinking	Only step by step system modelling missing	Not practical on collaboration issues	Practical, but very briefly
Circular Economy Toolkit	Too little	No method, only referrals	Only CE theory and case studies	Nothing	Nothing
Guided choices towards circular business models	Not integrated (links to EMF)	Comprehensive, but very high-level	Not practical	Not practical on collaboration issues	Only very high-level
Sustainable Business Model Canvas	Nothing	Almost nothing	Only SBMC and change descriptions per block	Not practical on collaboration issues	Nothing
Play it forward	No CE; no strategy for ext. partners	Only cards with possible drivers	Focus on individual BM	Nothing on collaboration issues	Nothing

Table 8 – *Visual summary of gap analysis in existing CBMI methods (detailed analysis in Appendix F)*
Green = challenges mostly addressed with practical guidelines (steps, concrete tips, etc.);
Orange = some challenges not addressed, or only at an abstract/high-level;
Red = most challenges not addressed, or only at an abstract/high-level.

Practical application of systems thinking

The most important gap among existing CBMI methods is the practical application of systems thinking on BMI. Almost all methods mention the importance of systems thinking, or even deal at great length with the large opportunities of innovation on the system level (EMF, 2013b; Joustra et al., 2013). However, integrating system thinking into practical methods or tools is underdeveloped, if not forgotten or ignored. Especially in the ideation and integration phase there is a lack of tools or canvases which actually support the generation, elaboration and integration of a business system – rather than an individual BM – in order to conceive a consistent CBM concept. Also remembering that an individual BM often cannot close a material loops (Section 2.2), the need to regard the business system becomes clear.

The System Organization Map (**Figure 21,** p. 54) included in Tukker (2006) is the only tool which practically facilitates to develop systems and take into account several players (and their BMs) at once. However, as stated earlier, this tool does not explicitly focus on closing material loops. Also, the basic BM questions 'how' and 'why' are not entirely present (see Table 3). Furthermore, it is questionable whether users will be able to conceive CBM concepts which take full benefit from opportunities on the system level by 'just starting off' with drawing actors and flows, as is suggested more or less by the concrete tool. In many cases

users will end up with a solution quite similar to what they already had or knew. Therefore, at minimum an introduction to the essence of systems thinking is deemed necessary.

In other phases the practical application of systems thinking is observed to be problematic as well. For the initiation phase several methods offer tools to help identify all drivers and barriers in the system. For example, the STEEP cards spur to think about various social, technological, environmental, economic and political aspects (Dewulf, 2010). However, no method offers guidance to relate these aspects to each other and find out how they influence each other. A map of these aspects reinforcing or balancing each other would gain insight in important feedback loops on which a new BM could lift (see Appendix F for a proposed system dynamics mapping of CE drivers and barriers). Furthermore, for the implementation phase systems thinking is crucial to realize the problem of a required system transition (Section 2.3). Frameworks of business transition management exist, but these remain to be rather abstract (Loorbach & Wijsman, 2013). Tukker & Tischner (2006) note however that getting a grasp on system transitions is "trying to develop a 'management approach' for the unmanageable". The full trajectory of a transition is deemed simply too complicated and extensive to manage via means-ends approaches (Tukker & Tischner, 2006b). Nevertheless, a research agenda was formed for theory development, governance approaches, toolboxes and building blocks for complex systems and transitions.

In the next Chapter a tool will be developed to support practitioners to think in business systems and think beyond the scope of an individual BM. It will be interesting to see whether a tool or a method will raise the level of systems thinking to a satisfactory level. Others argue that systems thinking is a skill which requires thorough education and training and cannot be applied 'just like that' and that the right place to improve this is at educational systems (EMF, 2013b; Kok et al., 2013).

Implementing CBMs

All methods are thin on the implementation phase and associated challenges, especially compared to other phases. Some CBMI methods explicitly focus on the prior three phases and stop as soon as a concept has been delivered on paper. Other methods do cover challenges in the implementation phase. Tukker includes one page of guidelines for a management report, which contains several much-used frameworks such as the four Ps Marketing mix[21]. Joustra is particularly elaborate on the financial side of the business case, including risk management. Contributions of the other methods are negligible (see empty cells in Appendix G).

Compared to strategies or methods from other fields, especially management and organizational studies, this is very high level and incomplete. Some wide-spread methods, which are much more specific about how to execute BMI by means of pilots and trial-and-error, have been named already in the previous section (most notably effectuation, lean start-up). Also contributions have been found which are tuned to implementing CE and CBMs. Jonker (2013) for example has extensively treated CBMI from the perspective of collaboration, which indeed is highly relevant for CE. He distinguishes five pillars for successful collaboration (ambition, interests, relationships, organization and processes), which can serve as guidance when trying to overcome internal and external resistance.

This absence of implementation methods and tools probably has to do with the nature of the challenges. The first three challenges resemble much with the typical outline of design processes and design thinking (Poppelaars, 2014), whereas implementation requires foremost managerial and organizational skills and soft tactics (Berglund & Sandström, 2013). This can only be guided scarcely with frameworks or guidelines. Most "cannot be learned from books". This difference in nature of the implementation phases compared to the other phases is also reflected in the visual of the original 4I-framework (Figure 17, p. 42), where the implementation phase is drawn in a separate box.

[21] Product, Price, Promotion and Place (distribution) are four key aspects in marketing

Other gaps

- There is room for improved methods or tools to describe functional needs or performances, especially due to the required abstraction level of performance indicators. Several methods have extensively given examples of functional needs, but standardised, meaningful ways of defining specific results would make the development of service models easier (Tukker & Tischner, 2006b). The importance is substantiated by the same difficulty observed in LCA methodologies, where defining the correct *functional unit* is often troublesome due to possible large implications for the scope and final result of the assessment (Guinée, 2002; Matheys et al., 2007).
- The importance of the evolution stage (or lifecycle) of both the industry and product or component has been recognized to determine the potential reuse of components (Joustra et al., 2013; Poppelaars, 2014), but there is no practical guidance on how to determine this exactly.
- There is no rapid circular performance evaluation or index that can give a quick impression on how much material loops are actually being closed (Kok et al., 2013). Now it often remains to be unclear what it takes 'to go circular' (see chapter 3, section *Preparation phase*).
- Although its importance has been emphasized so often, there are hardly any tools for finding the right partners and organising collaboration and co-operative arrangements. Only some tools by (Manzini et al., 2004) pay some attention to this, but there seems to be room for improvement.
- Standard agreements and revenue models for (service-oriented) CBMs are important to decrease transaction costs (Tukker & Tischner, 2006b).
- As many service models come with risks, liabilities, financial uncertainties and ambiguities caused by taking responsibility for how the customer uses the service, checklists for the most common use phase risks and liabilities, patterns how to divide responsibilities between users and provider during use can be of great importance (Tukker & Tischner, 2006b)

Conclusion

The two most important gaps identified in the examined selection of CBMI methods are the practical application of systems thinking to the integrations of all pieces of multiple BMs into a CBM concept, and guidance in the managerial and organizational challenges of the subsequent implementation phase. Opportunities have been identified that gaps in the implementation phase can be filled with contributions from other fields, most notably management and organization studies. However, for 'practical systems thinking' no leads are found to readily fill the gaps of CBMI. Therefore, chapter 6 proposes a new practical tool to support systems thinking in BMI.

5. The Business Cycle Canvas

In this chapter the Business Cycle Canvas (BCC) is developed and introduced. This is a tool which must support practitioners to think in business systems and beyond the individual BM. As has been identified in the previous chapter, existing methods do not offer such support.

5.1. Structure

The Business Cycle Canvas owes its name to the Business *Model* Canvas (BMC) of Osterwalder and Pigneur (2010). The two canvasses have similar components, but the BCC has the essential difference to regard the whole 'business cycle' instead of only the individual BM. This is visible in **Figure 26**, where the components of the BMC are translated to a canvas with boxes and arrows. In the example of **Figure 26** four BMs taken into account. These four BMs together form a *business cycle*, which is a closed chain of BMs which together close a material loop.

We will now take a closer look to the components of the BCC. To manage the quantity of information, the BCC has four components (who, what, how and why) instead of the BMC's nine building blocks (see comparison in **Table 3**, p.23). However, BMC's building blocks are also more concrete and tangible and are therefore included below with underlined words:

- 'What' (the Value Proposition or output) is represented by the arrow(s) going to a company's customer, so from one particular box to another. Value propositions can be either material (red), information (purple) (see **Table 9** for examples).
- 'Who' is the customer in the green box where the value proposition is going to. But, as shown in **Figure 26**, the customer is also the supplier (or Key Partner) to the next one in the supply chain. Usually a business has several partners and serves several customers/Customer Segments.
- 'How' is described mainly inside the boxes (in yellow). This is all the company has (Key Resources and capabilities) and does (Key Activities and processes) to make a value proposition. Inputs are also regarded as key resources and be either material (red) or information (purple). Note one's value proposition is another's key resource (see **Figure 26**).
- 'Why' is the sum of all the value coming in and going out of one box (all arrows). For most companies the financial flows (blue) are most important, but social or ecological values (also blue) can also be regarded as revenues. Note that there are both positive and negative values (Revenues, health vs Costs, pollution, etc.) and that the sum of positive values should be larger than what comes out for the business to be viable, or for a person to be flourishing.

Note that Channels and Customer Relationships are more or less left out by the reduction of building blocks to four basic BM questions. However, these can still be incorporated in the BCC by regarding (indirect) channels as other partners with separate BMs (e.g. retailers) and customer relationships as reciprocating flows of 'soft information' (see **Table 9**)

Flow category	BCC component	Examples
Material (red)	What How	products (or product-services), raw materials, waste flows, water, fuels (energy carriers)
Information (purple)	What How	hard information or services: data, licenses, education, entertainment soft information or relationships: trust, reputation, credits, exposure, marketing, contact, other customer relationships
Finance and other costs and revenues (blue)	Why	Financial revenue: lump sums at once or per month, interests, loans Social: health, happiness vs unemployment, etc. Ecological revenue: nature conservation, biodiversity vs pollution, degradation, etc.

***Table 9** – Exchanges between business are generalized into four categories. The categories are based upon (Tukker & Tischner, 2006b, p. 381).*

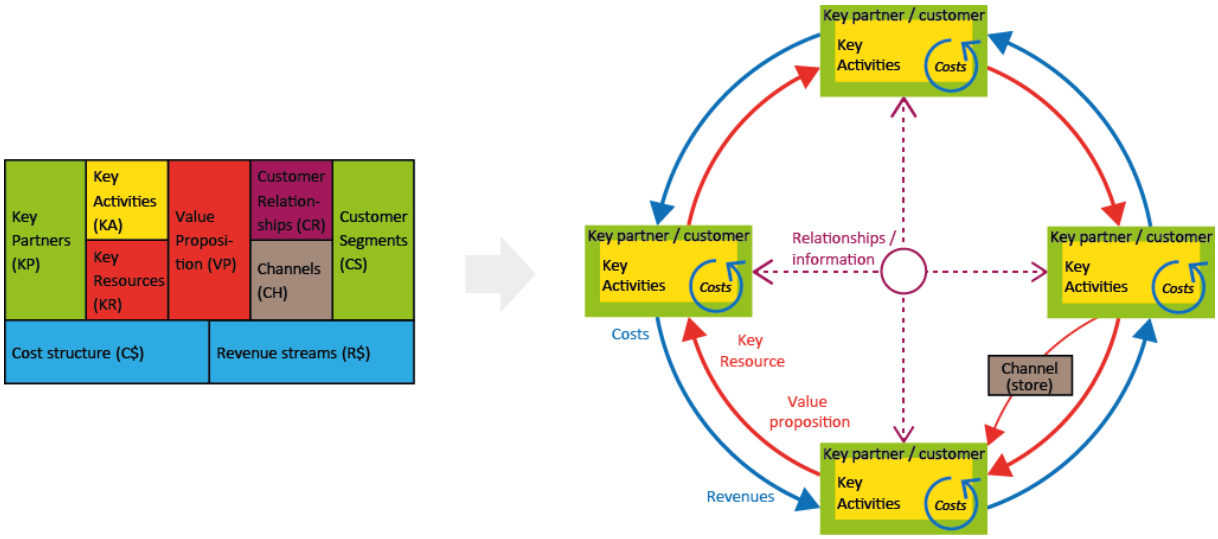


Figure 26 – *Transformation of Osterwalder's BMC to a canvas with boxes and arrows.*

Designing a business cycle may involve quite some information. The BCC offers a possibility to organize this information and create a visual overview. Connecting the BMs with various types of flows automatically generates systems. These systems can take all kinds of shapes. Virtually there are endless possibilities of systems (see **Figure 27**). This is an important contrast with the BMC, which always sticks to the same configuration of the canvas (simply because it works for all individual BMs (Osterwalder, 2004)). However, all configurations, especially if more and more CE activities like recycling, refurbishing and remanufacturing are added, will start to look more or less look like the CE butterfly diagram (**Figure 2**, p.15). However, some other actors are not mentioned in the CE butterfly diagram which can have an important role in a business cycle. For example, a systems orchestrator is an independent third party who ´orchestrates´ the whole supply chain and takes responsibility over a smooth collaboration and exchange of information between all stakeholders. The example of Dutch aWEARness below will show this.

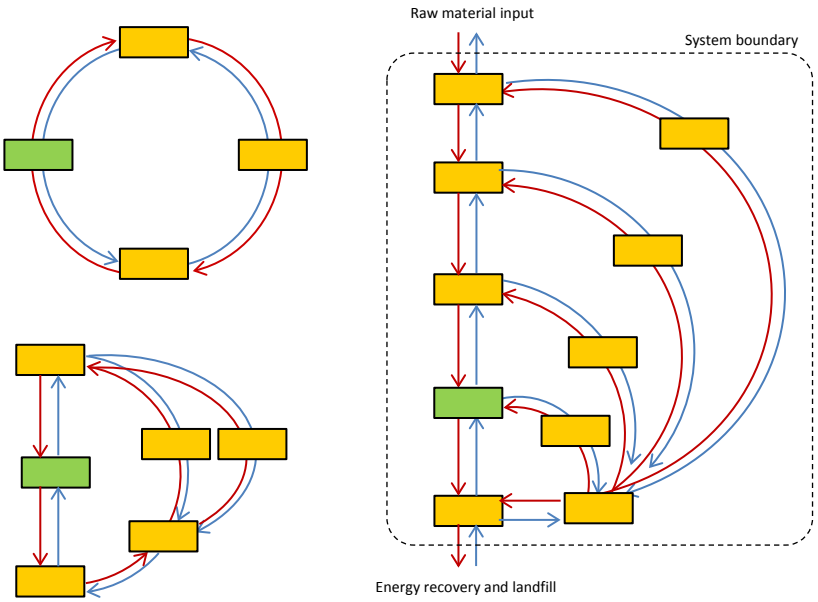


Figure 27 – *Possible configurations of business cycles. All systems will more or less look like the CE butterfly diagram (right)*

Example: Dutch aWEARness

The example of **Figure 28** shows the CBM of Dutch aWEARness, a sustainable fashion initiative operating a closed material loop with selected suppliers (www.dutchawearness.com). Their CBM focuses on the material flow of the fibre, used for football shirts of the German professional football club Vfl Wolfsburg. The figure shows that Vfl Wolfsburg is the end consumer and generates most revenue (pays most). This revenue is then distributed through the supply chain. New virgin material input (polyester) is required due to the 'leakage' of sold used football shirts and other leakages which are not represented (e.g. polyester can be reused only 7 times before the fibres get too small). Dutch aWEARness is one of the stakeholders (sorting and shredding), and also manages the chain by collecting information of all partners and giving feedback.

Note that the current information in Figure 28 is still basic. Further development of this BCC could include further inputs and outputs which could possibly be linked to each other (e.g. cutting losses from Production to Shredding), further specification of key resources and activities and calculation of exact costs and revenues for each stakeholders.

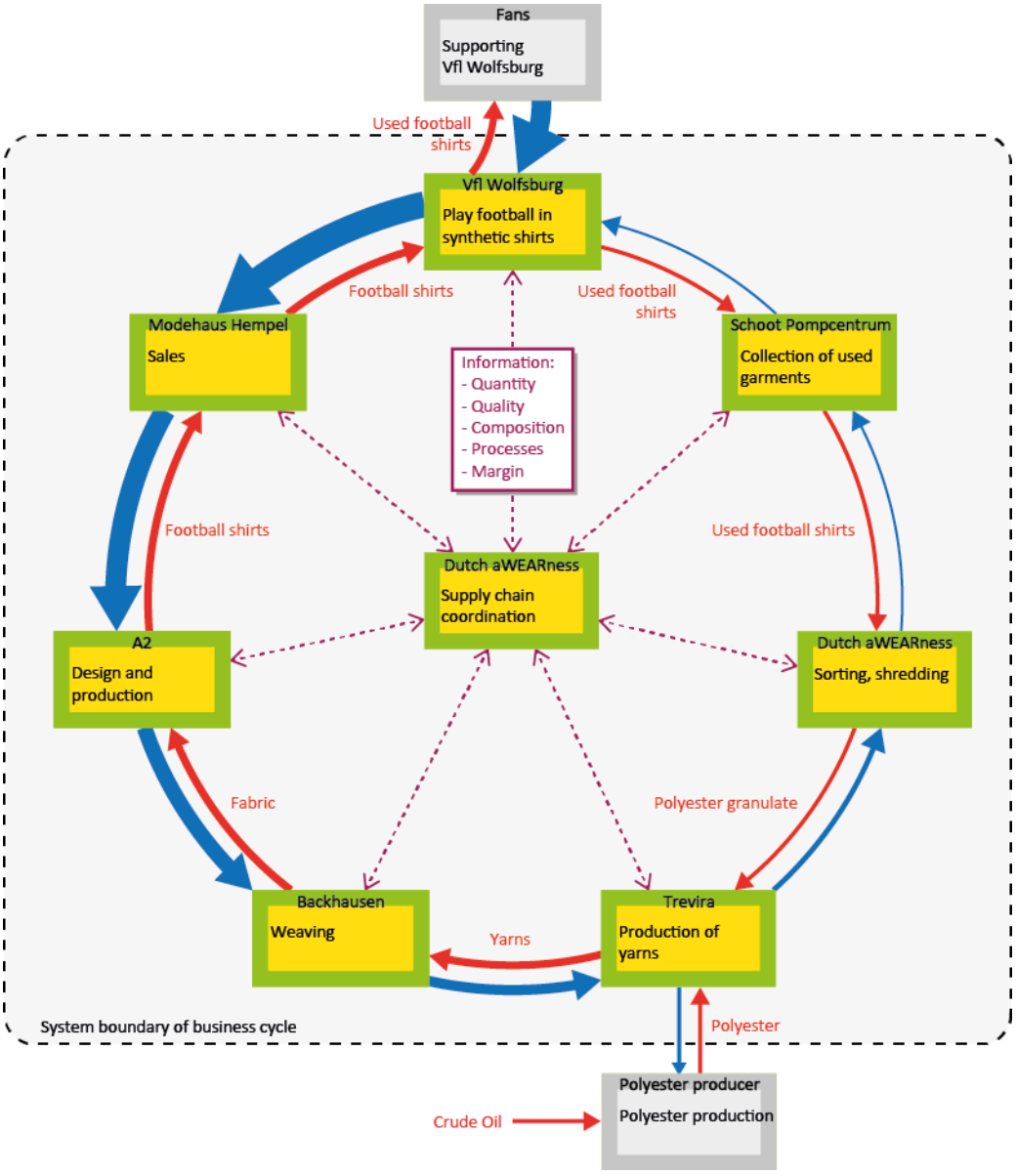


***Figure 28** – Elaborated BCC for Dutch aWEARness (see also (Dutch aWEARness, 2014))*

5.2. Method of use

The BCC can be used straight away, just like the BMC, but higher quality (more creative and innovative) ideas and concepts can be developed when performing some more steps before and after sketching out a business cycle. To define these steps and create a session plan or workshop procedure with concrete steps and tasks, the fields of creative problem solving, creative facilitation and closely related design thinking can be consulted for a wealth of methods and tools on a practical level. This helps to set up a concrete session plan for a workshop.

The compatibility of these fields with BMI is illustrated with the framework of *Creative Problem Solving* (Tassoul, 2011). The framework roughly consists out of the three phases problem finding, ideation and concept development. These phases are similar to the first three phases of the 4I-framework (initiation, ideation and integration).

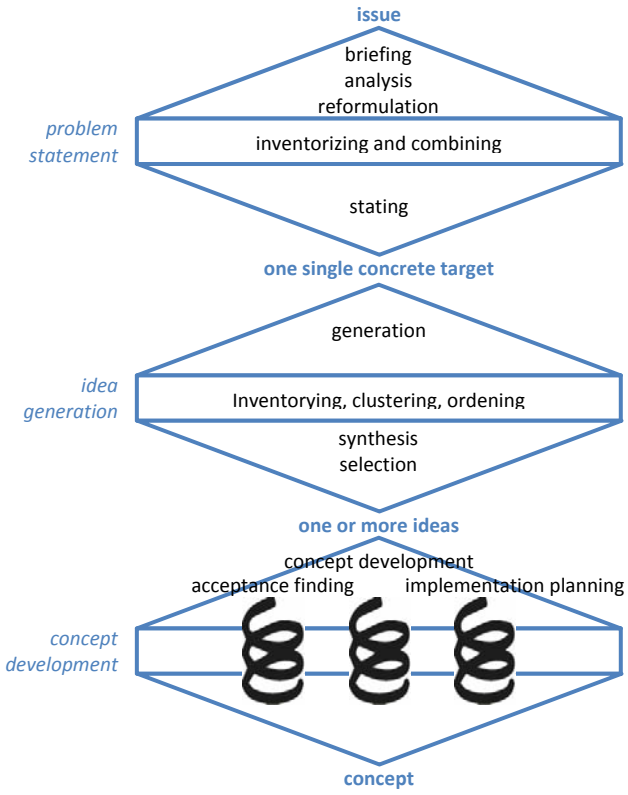


Figure 29 – *The framework of Creative Problem Solving (adapted from (Tassoul, 2011). Each phase consists out three equal sub phases, which are diverging, organizing and converging (resembled by the diamond shapes). This results in a conclusion, statement or focus at the end of each phase which forms the start or introduction of the next phase.*

Selected methods and tools have been elaborated into a manual for the BCC, included in Appendix H. This manual has been used during the workshops of Chapter 7. The content will be explained with further background information below.

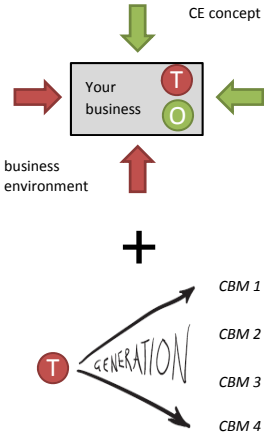
Step 0. Introduction to BMs, CBMI and the case

Before starting the workshop an introduction is given of what a BM and BMI is and how both should be applied to develop CBMs. This introduction resembles the initiation phase. First, the BM is introduced along the four basic BM questions (**Table 3**) and some examples of BM innovations are given (**Table 6**). Second, several main CE strengths, weaknesses, opportunities and threats for business are introduced (from Section 2.3) and third, several strategies and patterns are treated as a source of inspiration for generating CBMs (from Appendix J). Furthermore the case of the problem owner is introduced which contains a selection of

data deemed relevant for the workshop. This selection is made in advance by the facilitator (or workshop leader) in collaboration with the problem owner. Depending on the participant's prior knowledge this introduction ranges from a quick recapitulation to a high level explanation of BM/BMI and CE.

Step 1. Generate creative ideas for a CBM for your case

During the introduction some leads or starting points in the case for a CBM have been given (diverge). Participants have to elaborate and/or organise these leads and close this analysis (converge) formally or informally in an opportunity (or problem statement). The organization can be done using a SWOT diagram, as the CE drivers and barriers often correspond to a real opportunity or threat for the company. The best opportunity can be selected (by explicit or implicit criteria) from the SWOT.



Ideas for CBMs can then be generated by evaluating the implications and possible benefits of implementation of CE, asking questions like "How could company X benefit from a circular over a linear model?" However, higher quality ideas (more creative, innovative) may be generated with techniques for creativity idea generation or *ideation*. The potential of ideation has yet been demonstrated for BMI (Osterwalder & Pigneur, 2010) and for PSS (Tukker & Tischner, 2006b). In brief ideation comes down to generating a large number of (BM) ideas and successfully isolate the best ones (Osterwalder & Pigneur, 2010). This means that during the diverging phase "quantity is quality", where unorthodox and also crazy ideas are perfectly allowed. Nonsense may trigger you or others to come up with crazy ideas which *are* achievable and thus very innovative[22]. Several creativity techniques, such as brainstorming, metaphors and association, assist in generating a great quantity of ideas (Tassoul, 2011; Tukker & Tischner, 2006b). Descriptions of creativity techniques using analogies, assumptions and SCAMPER (by (Eberle, 1996)) were handed out – if requested – in the workshop of Chapter 6.

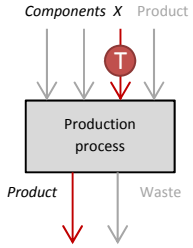
A special notion must be made on the use of **BM patterns** to create more and better ideas. "Patterns are recurring solutions for recurring problems" (Alexander, 1977) and the potential of design methodologies based on patterns has yet been introduced in the '70 (ibid). While the original field of architecture has long rejected the use of patterns (Salingaros, 2000), it has been widely adopted in software programming (Meszaros & Doble, 1996), and has recently been introduced for BMI as well (Osterwalder & Pigneur, 2010) (see also Appendix G).

Using patterns basically comes down to fitting standardized solutions to one's own case. Patterns recast well-known business concepts and best practices in a standardized format, so that these can be easily imitated. This already may lead to new ideas, but combining several patterns with each other further opens up the range of possible solutions (or the 'solution space' (Tassoul, 2011)). Especially patterns which seem unrelated at first glance can generate surprising new solutions. For example, the task of fitting a pattern called 'subscription' to the business model of a machine manufacturer led to the idea of training sought-after plant operators and leasing them to customers (Gassmann et al., 2013).

The usefulness of recurring solutions is high, since 90% of BMIs are found to be recombinations of existing patterns (Gassmann et al., 2013). The same study found 55 recurring patterns among 250 companies over the last century (ibid). Although these general patterns can already support ideation, specific CBM patterns have been found by various sources including (Bakker & Hollander, 2013; Damen, 2012; Evans, 2013; WRAP, 2013). These patterns have been collected in a **pattern library** in Appendix J as they have been used to support ideation in the workshops of chapter 5.3.

[22] As is supported by Oscar Levant: "There is a fine line between genius and insanity. I have erased this line."

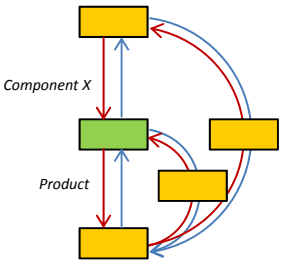
Step 2. Select a critical material flow



This step involves two selection activities (converge). First, the ideation phase started at the previous step must be closed down by selecting the best idea. The selection can be made with various selection methods, such as the opportunity-feasibility matrix (Evans, 2013). Chapter 6 introduces a set of criteria for general CBMI.

Second, the most critical material flow must be identified. The material flow is both an in- and an output. A metal for example enters a company as bulk material, and leaves as a product. The CE drivers and barriers from Step 0 can be used to ask the right questions, such as "what material runs the greatest risk of supply?" As information will often be insufficient, assumptions must be made at both selection activities.

Step 3. Close the loop with different types of value flows



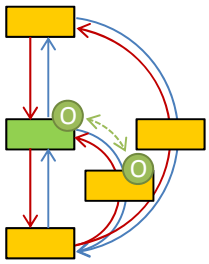
In this step the integration phase starts (diverge). The goal is to sketch out a system of all processes which are required to close the loop from the output back to the input (e.g. from product back to material). The sketching starts with the material flow as "the wire of a chain" which strings all kinds of typical processes together in a business cycle. Various business cycles are possible to close the loop, as Figure 27 (p.62) has demonstrated.

However, the system has to be supplemented with other types of flows to 'feed' the BM behind every process. The manufacturing of products often requires different key resources. Moreover, each business will only perform its process if (enough) revenues can be generated, and a customer will only buy certain product if it comes with a minimum level of service. Several flows from Table 9, p.61 should be used.

It is difficult to add these additional flows out of the blue. Whilst some could be added out of experience or resemblance with previous systems, for most processes the underlying BMs must be elaborated using the four basic BM questions (who, what, how, why). Based on these elaborations the different types of flows can be determined.

To manage the complexity of the business cycle, it is recommended to stick to the first set of boxes (processes) sketched out when closing the business cycle for one material flow. Inputs or outputs (arrows) which come from or go to other business cycles can be drawn as incoming our outgoing arrows (see grey boxes in **Figure 28**).

Step 4. Design and optimize the business models (on a systems level)



In this step the integration phase started at the previous step has to result in a final CBM concept (converge). The goal is to conceptualize a feasible business model for every process involved in the business cycle. The elaboration of all BMs has already been started up at the previous phase, but now it comes to connect them and possibly adapt them to each other in order to 'make it work for everybody' and thus innovate on a system level. It is here where thinking in business models transcends to thinking in business systems.

Elaborating the business cycle or system like this requires many iterations of generating and selecting BM ideas for each involved company. Therefore the ideation methods explained at Step 1 and 2 can be used again. However, getting to a good CBM concept may also involve making decisions about the interaction between BMs. Descriptions and visualisations of agreements, exchanges of information, partnerships, win-win situations and plans with other stakeholders outside the business cycle (for example, public-private

partnerships which generate government subsidies, or research projects with knowledge institutions) can be an important part of the CBM concept.

Interestingly, characteristics of CBMs in practice already come forward when thinking of examples of interaction between BMs, such as the need of agreeing upon a maximum profit margin throughout the business cycle or to adapt product design to ease the process of another (Kimmel, 2013).

5.3. Alternatives and elaborations on use

Starting points

In the current description of the BCC method material flows ('what') and processes to close the loop ('how') are taken as an explicit starting point. Whilst this makes perfect sense if a closed loop is the main goal of a workshop, different goals or interests can be more important (see e.g. again Figure 4, p.21). In practice the creation of more value (often profit, 'why') with available or desired (trusted) partners ('who') is often a more appropriate starting point.

The main consequence for the BCC method is then to start with mapping all stakeholders and seek for opportunities to close loops with existing instead of potential activities and resources.

Towards an integrated BM for the business cycle

Beyond the optimization of the business cycle in Step 4 one BM for the business cycle can be formulated. Practically this involves ´drawing a box´ around the whole system which provides a service (or product) to the end-consumer (**Figure 30**). A clear description of the BM of the business cycle summarizes what value (both positive and negative) the entire supply chain creates for the customer. **The BM of the business cycle thus is the sum and summary of value creation on a systems level**. This facilitates the determination of a service's True Value (WBCSD, 2011) and enables all partners of the business cycle to align the optimization of their activities to the final value proposition for the end-consumer, instead of to their own intermediary value proposition which often causes sub optimizations.

The exact configuration of the integrated BM is variable and can be quite different from the representation in Figure 30. In this representation, the end-consumer does not play an equal role to the other stakeholders in the business cycle. The relationship with the business cycle is rather traditional with tight connection only with players who supply and take back the product. This can be different for active consumers (or 'prosumers'), which have a much stronger tie with the business cycle and influence much more the production process ('how') and value proposition ('what').

Relations and needs can be different again for businesses as end-consumers (B2B vs B2C). With business much more advanced relations can be formed, opening up more possibilities for active participation in the business cycle. Also, for the more customized nature of B2B relations, more time can be spent to define customer needs, possibly creating more opportunities to agree upon abstract performance indicators for result-oriented services. Furthermore, government as a customer should be distinguished explicitly for their larger interest in circular products and services in general (see Section 2.4).

Coordination of the business cycle

Considering different configurations of business cycles, drawing relations and information flows raises questions about the coordination and the governance structure of the business cycle. The information flows in **Figure 30** imply a central element of organization (the purple circle), however there are many possibilities (**Figure 31**). Still, in Industrial Ecology literature for example there is a tendency towards decentralized organization of industrial networks like the business cycle (Frank Boons, 2008; Lifset & Graedel, 2002).

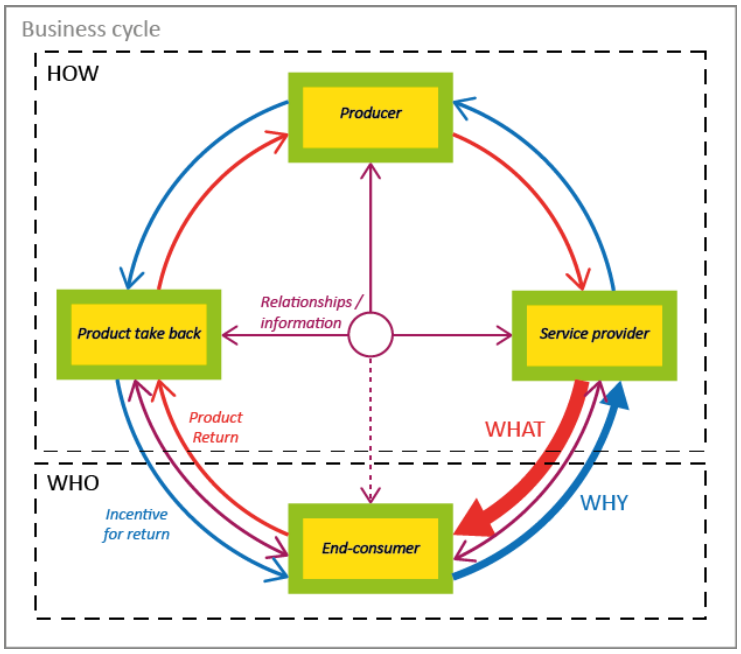


Figure 30 *– The integrated BM of the business cycle with the four basic BM questions*

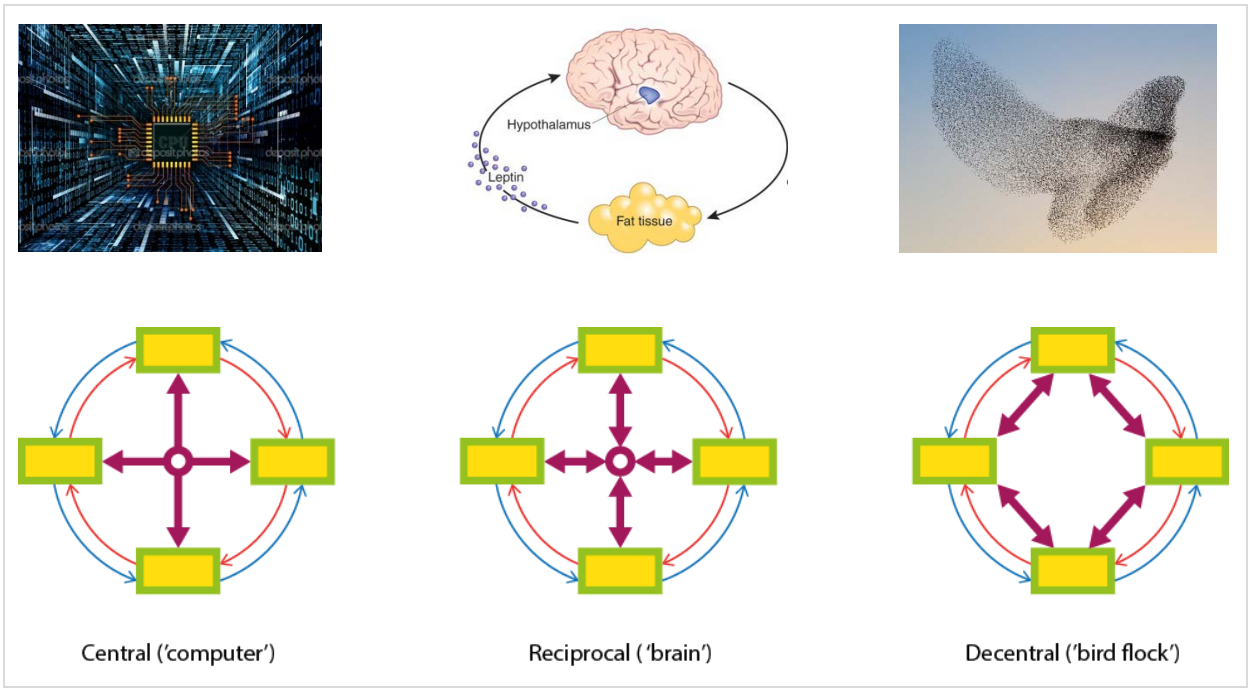


Figure 31 *– Governance structures and accompanying configurations of information flows (purple). Analogies with real-life organizational structures are illustrative to the difference between and can also be used to fill in further details of governance structures.*

6. Research experiments

To verify whether the use of the BCC improves CBM concepts, two workshops of 3.5 hours have been held. First, in Section 6.1 the design of the research will be explained. Then in the following sections the results will be presented. The results will be interpreted and limitations of the research will be treated in Chapter 7. The conclusion to the verification will be drawn Chapter 8.

6.1. Research design

For the structure of this section the framework for research design of Kumar (2005) has been used.

Goals

The goal of the research is to verify whether the use of the BCC improves CBM concepts compared to the use of the BMC. The BCC is compared to the BMC, because the BMC is assumed to be most used by companies who want to innovate their BM. Because the BMC does not say anything about CE, it is assumed that companies use the principles of CE in the documentation by EMF (2013) as well. Both sources are most wide-spread in their fields. For Osterwalder (2010) it was possible to confirm this with a citation analysis (Appendix K). For EMF (2013) this has been explained in Section 2.1. The assumptions have also been discussed with several experts (Kimmel, 2013; Peck, 2013; Tukker, 2014)

Based on these two sources a 'Manual for the Business Model Canvas in a Circular Economy' has been formed (Appendix I), similar to the manual for the BCC (Appendix H).

Session plans

The experiments of the research consists out of workshops with selected participants which use one of both manuals. A general procedure for the workshop has been drawn up which should be followed as close as possible across different workshops. However, changes will be inevitable due to different group sizes, background knowledge, available time, etc. In brief, the workshop consists out of:

1. Preparation of case and practicalities with case owner/main participant (participants, equipment, room, time, etc.)
2. Introduction / recapitulation of CE, BM & BMI (see section 6.2) and of the workshop itself.
3. CBM design (actual workshop), using the canvas manuals
4. Closure: pitches & evaluation.

Table 10 presents a more detailed blue print of the general procedure which can be used to elaborate a customized session plan for each workshop. The customized session plans can be found in Appendix L.

#	Round	Time	Exercise	Execution
1	Preparation	*done*	Examination of case and selection of relevant information Arrangement of required practical issues (people, equipment, etc.)	Phone / mail conversation with case owner/main participant
	Assign groups	-	50% uses BCC, 50% uses BMC	
2	Questionnaire	5´	Fill in pre-questionnaire about prior knowledge	Hand out pre-questionnaire
2	Background (group size <8)	10’	Who are you and what relevant background do you have?	Semi-structured interview Voice record interview
2	BM, BMI and CE strategies and patterns	20’	Introduction (or overview) of BM concept, BMI processes and most important CE strategies and patterns Q&A	Powerpoint presentation. Main sources: (EMF, 2013b; Frankenberger et al., 2013)
2	Case intro	10’	**Technical** analysis of the case’s products: components and materials **Business** perspective of case owner (drivers & barriers)	Prepared beforehand with case owner
2	Criteria	5’	Introduce CBM criteria and workshop goal (poster & pitch) Q&A	Show and explain 4 main categories of criteria (discuss all 14 criteria is too much)
	Start workshop		Hand out canvas manuals	
3	Design CBM	1h30	Design a credible CBM around the case	
3	Observations		Help groups and make observations	Write down observations Fill in facilitator questionnaire
4	Pitches	5’ x # groups	Pitch your CBM in 3 min	3 min pitch 2 min feedback Voice record pitches
4	Evaluation	20’	What was useful of the method & what not? Would you use (parts of) this method again & what would you do differently? Continue with implementation? Circular & innovative?	Semi-structured group interview Voice record interview
	Total:	3h30	(30 min possible extension)	

Table 10 – *Blueprint of general workshop procedure. The blueprint must be followed as close as possible for each workshop’s customized session plan. The customized session plans can be found in Appendix L.*

Variables

In order to measure an improvement in CBM concepts, a set of 14 test criteria has been developed (**Table 11**). These criteria have been derived from the definitions of a CBM and BMI, which led to the identification of four main **assessment categories**. First, a CBM (obviously) should close material loops and/or maintain or increase the value its material flows to make the closure of loops more likely. Second, a CBM is a BM and thus should properly contain the four BM pillars (see Table 3). Social and ecological values are mentioned separately as thinking in multiple value creation can often be important for CBMs. A risk criterion has been added after comparison with a criteria list for new business ideas of (Bragg & Bragg, 2005). Third, as BMI and CBMI are about innovations, criteria have been added for each BM pillar which can be innovated (Zott & Amit, 2010). It is interesting to see whether one of both canvasses stimulates innovation much more than the other, however it is not required for successful BMI to generate completely novel ways to do business (90% of BMI is imitation, see the use of patterns in Section 5.2). Therefore the weight is much lower. Fourth, many of the (sub) goals of using the BMC or BCC involve communication issues (see Section 5.2). Therefore, the communication of a CBM concept can be regarded an important aspect. However participants should not spend too much time on improving presentation and communication during the workshop (e.g. ‘making it look good’) and therefore the weight is kept relatively low.

Category	Description	Operationalization The CBM concept…	Weight
Circularity (12) (EMF, 2013)	Closed or open material loops are made, or material flows are restorative	closes the material loops of key resources	6
		maintains the value of material flows by keeping them pure, non-toxic and/or easy to separate	6
Business rationale (or feasibility) (14) (Bragg & Bragg, 2005; Frankenberger et al., 2013; Osterwalder & Pigneur, 2010)	How different types of value are created, delivered and captured by and for the involved stakeholders	has clearly described a value proposition (what)	2
		has identified a promising market opportunity (or customer segment) for this value proposition (who)	2
		has a credible plan with required processes, activities, resources and capabilities to create the value proposition (how)	2
		is financially viable (why)	2
		creates social and/or ecological value (why)	2
		has an acceptable level of risk (why)	4
Innovation (3) (Zott & Amit, 2010)	The CBM concept is a novel and plausible way to create value and/or to increase circularity	has a new value proposition (what)	1
		has a new way to create the value proposition (how)	1
		has new partnerships to create the value proposition (who)	1
Presentation & Communication (3)	Clarity of the concept	is understandable solely from the poster	1
		is clearly communicated with the pitch	1
		requires few clarifying questions after the pitch	1
		Total:	32

Table 11 – *14 weighted criteria for the assessment of CBM concept*

Data collection and analysis

The development of instruments for data collection is based upon previous research designs which included workshops as research experiments (De Pauw et al., 2012; Eppler & Hoffmann, 2012; Goemans, 2013; Whalen, 2013).

The participants have been asked to make a poster and pitch of the CBM concept they have developed. The **poster** is the primary source of data, which is clarified further by the **pitch** and – if and where needed – by **questions of the facilitator(s)**. The CBM concepts have been assessed using a result assessment form in Microsoft Excel (Appendix R and V). The result assessment form consists of a 5 point Likert scale for each criterion. The scores are multiplied with their weight and add up to determine the best CBM concept (totally disagree = -2 / disagree = -1 / neutral = 0 / agree = +1 / totally agree = +2). Guidelines for assessing the results are attached to the form (**Table 12**).

To totally agree with…	The CBM concept must have…
closing the material loops of key resources	no sinks. All material flows keep flowing on a technically possible way
maintaining the value of material flows by keeping them pure, non-toxic and/or easy to separate	the value of waste streams is *increased* to be able to capture more value
describing a value proposition (what)	no questions about what is sold/rented/… to me
identifying a promising market opportunity (or customer segment) for this value proposition (who)	identified an unmet need of reasonable size (# people)
having a credible plan with required processes, activities, resources and capabilities to create the value proposition (how)	all key ingredients for all key business's involved
being financially viable (why)	very high probability that revenues are larger than costs
creating social and/or ecological value (why)	created many social and ecological values other than the obvious from circularity

having an acceptable level of risk (why)	taken into account all main CE barriers which have been discussed (collaboration, information exchange and customer acceptance) and no obvious pitfalls from general business drivers (e.g. risks of radical innovation, vested interests, PESTEL forces)
having a new value proposition (what)	a completely new activity for type of business
having a new way to create the value proposition (how)	a completely new way of performing the activity for the type of business
having new partnerships to create the value proposition (who)	completely new types of partner for the type of business
being understandable solely from the poster	clearly shown closed loops or restorative material flows and four BM pillars on the post
being clearly communicated with the pitch	convinced Dragon's Den
requiring few clarifying questions after the pitch	had 0 additional questions

Table 12 – *Guidelines for assessing the CBM concepts. This helps the researcher to estimate when a CBM concepts receives the highest possible score on the Likert scale ('totally agree'). Based upon these descriptions the descriptions for lower scores can be derived quickly by changing underlined prefixes along a 5 point scale, e.g. [all / much / some / few / none] or [increased / maintained / not mentioned / decreased / decreased much].*

To check for biases in participants' background or help during the workshop by the facilitator, two questionnaires have been filled in. First, all participants have filled in a **pre-questionnaire** with five questions regarding their prior knowledge on CE and BMI (De Pauw et al., 2012; Whalen, 2013). Particularly their familiarity with the BMC has been asked (**Table 13**). Second, the facilitators have estimated the amount of help they gave the different groups along a 3 point Likert scale and added descriptions of their help on the **facilitator questionnaire** (**Table 13**).

Third, a **post-questionnaire** has been held after the workshop to gather feedback on the canvasses and methods and to assess their own results (**Table 13**). The feedback has been used to improve the method and the canvas itself and their self-assessment has been used to verify the result assessment by the researcher (Eppler & Hoffmann, 2012)(also known as triangulation, see Baxter, Elder, and Glaser (1996)). In case the self-assessment differs largely with the researcher's assessment, the researcher's argument has been reviewed and – after re-evaluation – the assessment has been adjusted or not. During the workshops with a smaller amount of participants (<8) an **evaluation** with open questions has been held next to the post-questionnaire. This evaluation has been recorded and yielded interesting comments on top of the open questions asked. The discussion has been summarized with illustrative quotes in Appendix Y (Goemans, 2013).

Finally, during and immediately after the workshops **unstructured observations** have been made by the facilitator. These observations have been made 'ad libitum', noting whatever interesting happens or happened at the time, as opposed to focusing on one person or behaviour sampling (Whalen, 2013). While there aspects which are looked out for (e.g. use of manuals), there was very little known in advance about the exact happenings of the workshop (e.g. unexpected interpretation of manuals). A structured observation would have imposed "a potentially inappropriate or irrelevant framework on the setting being observed" (Bryman, 2012). To get around this, an unstructured observation has been performed (see Appendix T and X).

Questionnaire	Content
Pre-questionnaire	Five statements with a 5 point Likert scale (totally disagree / disagree / neutral / agree / totally agree) 1. I am familiar with the Circular Economy concept. 2. I am familiar with thinking about and innovating business models. 3. I am familiar with using the Business Model Canvas. 4. I am familiar with thinking about and innovating business models for a circular economy. 5. I am familiar with the case (prior experience with the sector and/or product).
Facilitator questionnaire	Assessment of the amount of help along a 3 point Likert scale (none / a bit / a lot) and a column to describe the help for each group and ample space for comments
Post-questionnaire	Eight open questions in text boxes, in sum 2 pages. 1. Do you think your concept of a CBM will help the transition to the circular economy? Describe some reasons why and why not (pro & con). ***[verify Circularity criteria]*** 2. Do you think your concept of a CBM is an innovation? Why? ***[verify check Innovation criteria]*** 3. If you were head of the company (imagine…), would you go ahead with developing and implementing this business model? Why? ***[verify Business rationale criteria]*** 4. What went well in the process of designing a CBM? 5. What did not go well? 6. What did you find most useful of the method, tools, info, etc. for designing a CBM? 7. And what didn't work or was difficult? 8. What would you do differently next time you design a CBM?

***Table 13** – Overview of performed questionnaires and contents. See for Appendix M, N and O for the original questionnaires*

Selection of participants

The following criteria have been formed to select participants for different workshops. These criteria are based upon the intended interest groups of this thesis (see Section 1.5).

1. The **sector** background of participants must differ, since the BCC must be able to support cross-sectoral collaboration.
2. Sectors in the **technocycle** are preferred, as this thesis focus on the technocycle and both cycles might have considerably implications
3. **Experience** level of participants with CE and/or BMI must vary, since the BCC must facilitate the innovation process for various background levels, and in various phases (initiation – ideation – integration – implementation)
4. Minimum number of experiments is 2, to be able to average extreme or context-specific results or observations (see matrix on the right).
5. Preferred – but not required – number of samples is 4 or higher, to cover all types of participants (see matrix frame to the right)

		Experience	
		Low	High
Sector	A	Exp. 1	
	B		Exp. 2

For reasons of the limited availability of time for this master thesis and of considerable time investments required of the participants (minimum half a day), only the minimum level of 2 workshops has been held (introduced in the next section). However, the total number of almost 50 participants still is significant.

Intermediary improvements

Practical have been (iteratively) improved during the course of this research Intermediary improvements to the practical workshop procedure and canvas manuals have been made in between the two workshops to be able to test suggested points of improvements and further increase the quality of the workshop, method and tools (see also (Whalen, 2013, p. 54)). The points of improvements are distilled from the post-questionnaire, evaluation and observations and listed under a separate headers in the following section. Although the essence of the workshop, methods and tools has remained the same, the changes to workshop, method and tool have to be taken into account when comparing the results of different workshops.

6.2. Results TU Delft BSc Industrial Design

Description of participants

The workshop was held at TU Delft as part of the course 'Strategy & Sustainability', part of the minor 'Applied Sustainable Science, Engineering and Technology' (half year BSc education programme of TU Delft). 44 students participated in the workshop. Most had a 2-year experience in the TU Delft bachelor programme of Industrial Design (25/44) and Aerospace Engineering (7/44). Others background include MSc Industrial Design (2), BSc Architecture (2), BSc Technology Policy and Management (1), BSc Civil Engineering (1), and BSc Environmental studies (University of Utrecht)(1).

Since all students had an engineering or natural science background, the students' educational background was assumed to be insignificant for performance differences in the workshop and was not taken into account during the formation of groups. However, the pre-questionnaire revealed that three groups had significant experience with business modelling (group 1, 5 and 9) and one group had much experience with the case (group 5), as they ran a project on the same case in another course (see bias analysis in Appendix P).

Case description

As none of the participants owned a case which could supply context and readily available information, grateful use has been made of the case of a mobile phone design for a circular economy by Poppelaars (2014). The case supplied basic level information on the main components and main critical raw materials of the mobile phone, and some information on the business model of a telecom company. For the rest participants were (assumed and proven to be) familiar enough with the case to make any assumption required for their CBM concept. The telecom company was taken as main stakeholder and client/future owner of the new CBMs.

Assessment of results

A description of each CBM concept and a photo of the poster can be found in Appendix Q. The assessment of the results can be found in Appendix R. The final scores are calculated using the weighted criteria of **Table 11** and verified with the participants' self-assessment in the post-questionnaire. Group 1 till 4 used the BMC and group 5 till 9 used the BCC.

On average the groups which used the BCC scored better (**Figure 32**). The considerable difference (15 points) is mainly due to the high score of group 7 (Dongle), since only three BCC groups scored higher than average of all groups (group 5, 7 and 8). Moreover, it should be taken into account group 5 had a major bias towards both the case and business modelling (bias analysis, Appendix P). Group 1 and 9 were biased as well, but this is not reflected in their scores (both below average).

The BCC groups clearly scored higher in the assessment category of 'circularity' (**Figure 33**). Moreover, the BCC groups got most points in this category, in large contrast to the BMC groups which got least points. However this does not count for all groups. Group 6 scored neutral (0 points, see **Figure 34**), which is equal to the average of BMC groups. Also, one BMC group (group 3) scored positive on circularity. Interestingly, in their poster and pitch they abandoned the BMC (Appendix Q). The scores of the other three assessment categories are close to equal. The category 'presentation' yielded fewer points on average than 'business rationale' and 'innovation'.

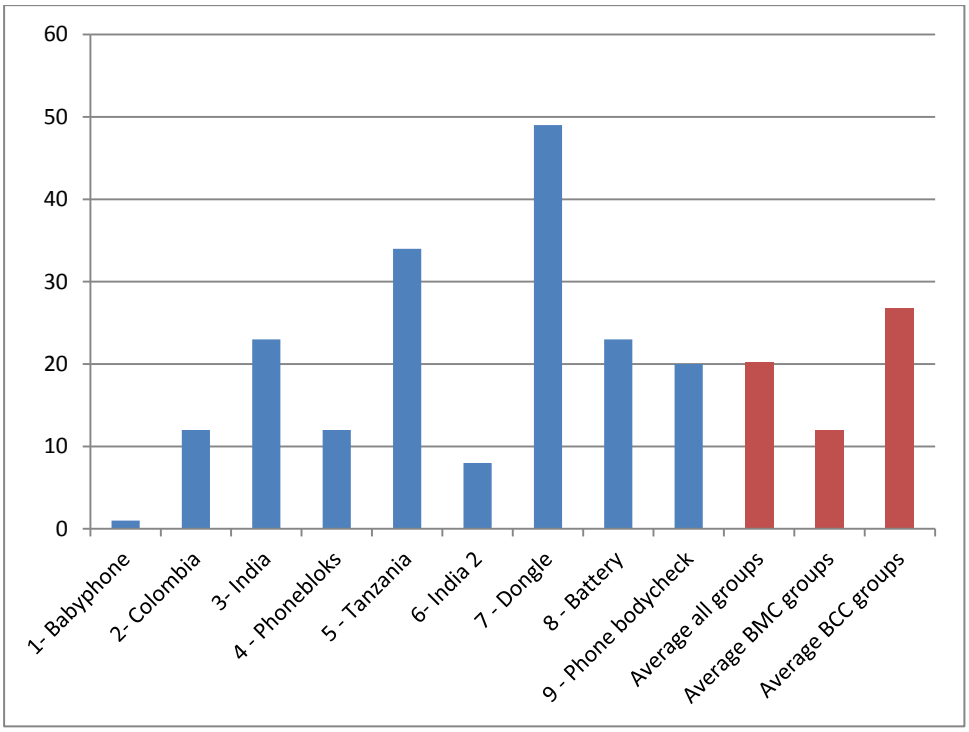


Figure 32 *– The sum of weighted scores of CBM concepts in the TU Delft workshop. It shows what CBM concepts scored best. Group 1 till 4 used the BMC and group 5 till 9 used the BCC.*

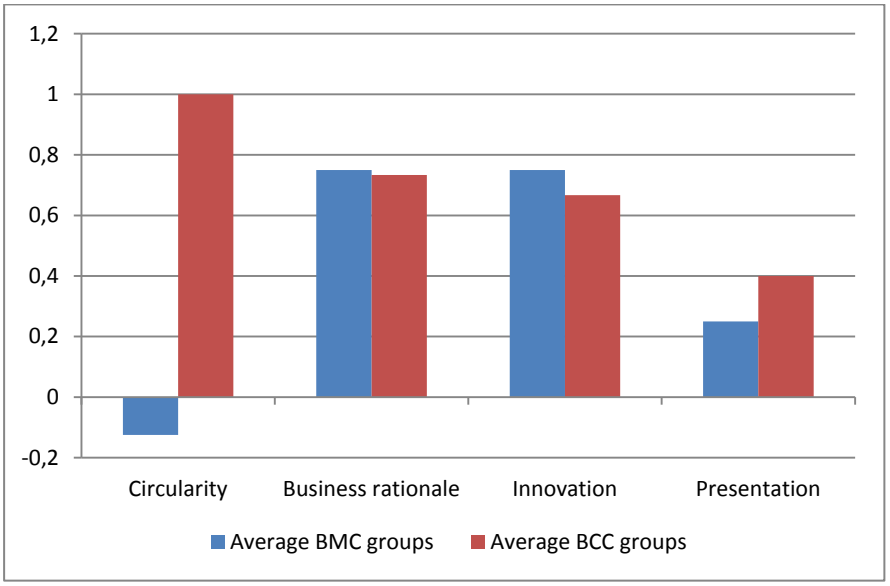


Figure 33 *– Unweighted average score of four main assessment categories of BMC and BCC groups. A score of 1 equals to 'agree' and 0 to 'neutral' (see previous section).*

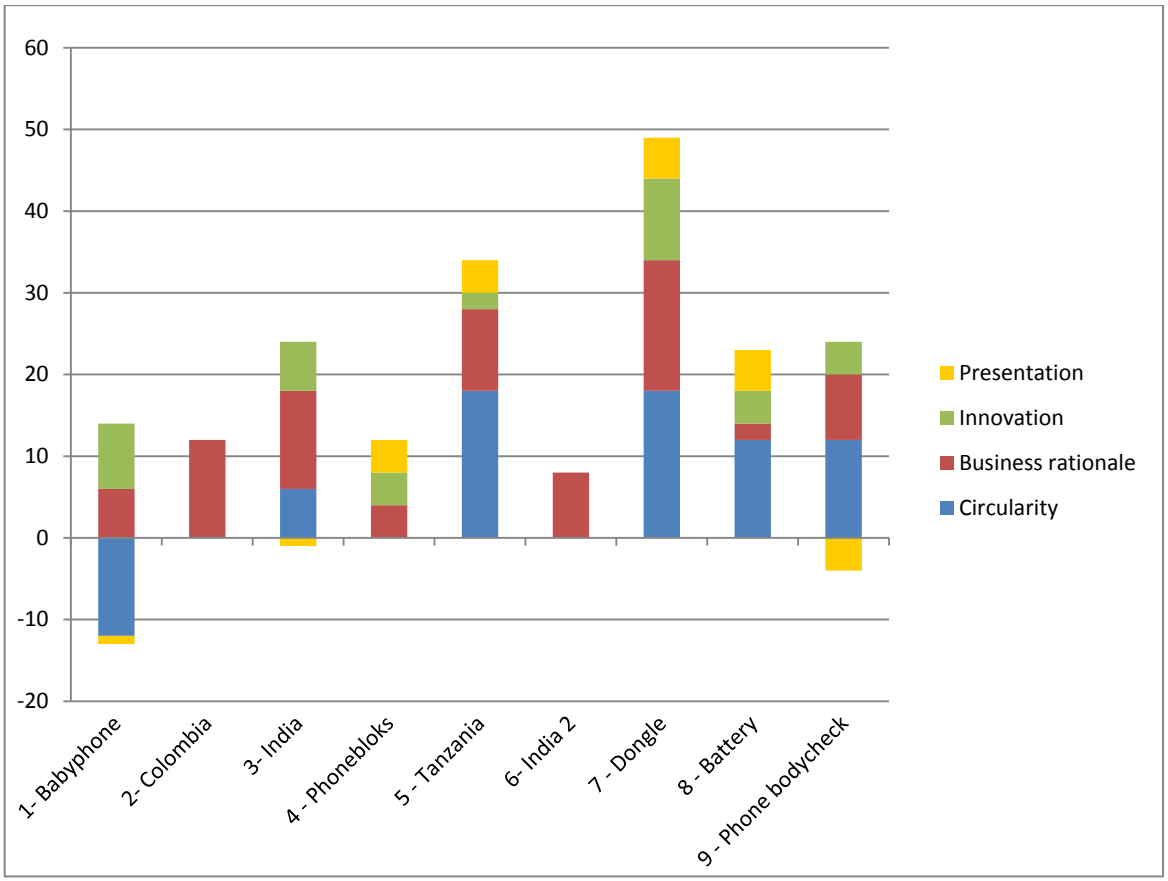


Figure 34 *– Weighted scores per assessment category of CBM concepts in the TU Delft BSc Industrial Design workshop. No score is due to assessment of 'neutral' (0 points) and negative scores are due to 'totally disagree' (-2 points) or 'disagree (-1 point). Group 1 till 4 used the BMC and group 5 till 9 used the BCC.*

Feedback on workshop, method and tools

The feedback on the CBM design process and its methods and tools (post-questionnaire questions 4-8) has been analysed using the methodology of *content analysis* as described by Kumar (2005, p. 240). A full elaboration of this analysis can be found in Appendix S. The most important positive feedback on the design process (printed **bold** in Appendix S) concerned thinking in systems of both business (stakeholders, creating mutual benefits) and material flows (connecting different processes with material flows), however this feedback was much stronger for the BCC than for the BMC. The BMC received stronger positive feedback on conceptualizing the BM itself: "the BMC has more tangible and concrete building blocks" was a firm comment of one of the participants.

The strongest negative feedback on the design process of the BCC concerned making a start. The BCC group took considerably longer to start up. This has been noted by nearly one third of the BCC users (10/32) and corresponds to the facilitator's observations (Appendix S). Only one BMC user noted this as well. The largest problem participants had with the BMC is creative thinking and ideation. Also 'circular thinking', as opposed to traditional BMs, has been noted as problematic a couple of times. A similar remark has not been made by BCC users.

With respect to the methods and tools, the CBM patterns and strategies given on the hand out of Powerpoint slides were mostly mentioned to be useful, however mainly by the BMC groups and hardly by the BCC groups. Concerning the BCC, the manual and the flexibility of the tool were mostly commended, however only by certain groups. It was observed many other groups had trouble with using the BCC and with using the manual. Many groups skipped certain steps out of time constraints (group 6 and 8) or took

too long at the first few steps (group 8, 9). For some groups using the boxes and arrows to gather information about BMs was difficult as well (most notably group 8). However, other groups did manage to take full advantage of the flexibility of the BCC to construct virtually endless configurations of systems (see again Figure 27, p. 62). Most notably winning group 7 described all processes and flows on post-its. This allowed them to construct all kinds of alternatives which supported their ideation process (Figure 35).

The most important suggestion for improved of the BCC method and tool was the acquisition of more information. This is probably related to the more explicit focus on multiple BMs which revealed large information gaps to the participants. This supports the observation that all BCC groups got lost, more or less, in the complexity of possible focus areas for a CBM. Repeatedly they needed help at making choices where to focus on or with what aspects to proceed. This also relates to the feedback that an enhanced focus on stakeholders (by which is probably meant: their information) is suggested for next time. Both groups noted they would use more time to develop a CBM concept next time. BMC users gave several other suggestions for improvement as well, but none of the suggestions was widely shared. Surprisingly, some of the negative feedback mentioned above about the design process, methods and tools didn't come back in the form of suggestions for next time.

***Figure 35** – Group 7 makes use of the BCC in a flexible way by describing all processes and flows on post-its. "The table was our canvas" and could adapt to all ideas and alternatives thought of during the design process. Group 7 scored highest, with distance, in the assessment (see Figure 32).*

Intermediary improvements

From the feedback a list of points of improvement has been concluded and processed for the next workshop (RHDHV Buildings, Section 6.3). Table 14 provides an overview of processed improvements.

Point of improvement (problem)	**Processed improvement (solution)**
Help participants to get started and not feel lost already at the start ('blank page syndrome')	• Simplify the manual • Less steps (merge steps, delete non-essential steps) • Make the steps more concise and concrete • Make the steps more concise and concrete • More freedom in the steps to use other methods. Delete steps or parts of steps which can and may be filled in by participant's own knowledge and skills. • Emphasize the use of the manual to the participants • Emphasize to "just start with the steps, also if you don't understand everything" • Simplify use of patterns

	• More concrete and concise description of EMF's 'four sources of value creation' and PtL's BM archetypes and design strategies. • More explicit attention to the CE drivers in order to assist with goal finding for the CBM ("what are we going to do/achieve?"). E.g. most notably supply risk (see again Section 2.3) is an immediate concrete goal for most cases ("we are going to decrease supply risk").
Help participants to manage the complexity when thinking and designing on the systems level and the (subsequent) need for information	• Focus on closing one material loop (business cycle) instead of elaborating the whole system • Tell participants not to be bothered by all issues of every business. Stick to the most important issues influencing the closed material loop. • Make more explicit that making rough assumptions is allowed, especially since this is the first iteration of a possibly much longer trajectory of circular business modelling
Increase the creativity of ideation	• Emphasize the importance of creativity for innovative ideas • Prepare concrete creativity techniques for the participants (from (Tassoul, 2011) and/or (Tukker & Tischner, 2006b)). • 'Direct analogy' • 'Change assumption' • 'SCAMPER'

Table 14 – *List of points of improvements after the workshop at TU Delft BSc Industrial Design*

6.3. Results RHDHV Buildings

Description of participants

Two groups of two were assigned out of the participating employees of RHDHV's business line Buildings. The two persons with most case experience were divided over the two groups. The educational and professional backgrounds are explained in **Table 15**.

Person	Education	Professional experience
Person 1, group BMC	Structural Engineering (Eindhoven University of Technology) Cradle to cradle training with EPEA	• Development of mind-set circular design in our business for 5 years • Set up of new business model for Park4All parking garage
Person 2, group BMC	MSc Real Estate & Housing (Delft University of Technology)	• 2 year work experience at RHDHV • Involved in current real estate case were circular strategies are considered
Person 3, group BCC	MSc Structural Design (Eindhoven University of Technology) Cradle tot Cradle training (EPEA Hamburg)	• Set up of new business model for Park4All parking garage • Set up of new business model for Cranenborgh facade • Publication of various articles about C2C, circular economy and sustainability
Person 4, group BCC	MSc Architecture, Urbanism and Building Technology (Delft University of Technology) Graduation supplement: Technology in Sustainable Development (TiSD) Student Assistant (3 years) in department of Climate Design and Sustainability (part of Building Technology, faculty of architecture Delft)	• Sustainability in (international) tenders and projects • Indirectly involved in Cranenborgh case (circular project) • Member of Knowlegde Group Sustainability of the business line Buildings, where Circular economy is one of the focus areas

Table 15 – *Education and professional experience of RHDHV Buildings workshop participants*

Case description

The city of Utrecht's building named "Cranenborgh" has a major block which will be demolished, creating to new outer façades at the adjacent, formally directly connected buildings. The adjacent buildings are planned to be demolished in several years to a decade, so the new outer facades will be rather temporary compared to a regular façade's lifetime (20-40 years). Previous plans and designs for these façades have already resulted in an energy producing façade with much glass and solar cells, supported by a steel frame. The plans included an imaginary company "Façade BV" which could supply the façade in a circular model. Several numbers for potential revenues out of different CE activities (reuse, remanufacture and recycling) are given.

The participants are asked to design a CBM for Façade BV. Cranenborgh may be chosen as a helpful context, but other buildings or other façade design (not glass and solar cells) is allowed.

Figure 36 *– The demolishment of a large building block of the "Cranenborgh" building. This will create a new outer façade which needs a skin for the time the remainders of the buildings are still used. Plans and designs have yet been made for a demountable façade made predominantly out of glass and solar cells (seen in the picture).*

Assessment of results

A description of each CBM concept and a photo of the poster can be found in Appendix U. The assessment of the results can be found in Appendix V. The final scores are calculated using the weighted criteria of **Table 11** and verified with the participants' self-assessment in the post-questionnaire. Group 1 used the BMC and group 2 used the BCC.

The BCC group scored considerably better (**Figure 37**). The difference (22 points) is entirely due to the category 'circularity' (**Figure 38**). The BMC group performed better on the criteria for 'business rationale'. The presentation by the BMC group required more clarifying questions, which lowered their score on presentation. The scores on the category 'innovation' were exactly equal.

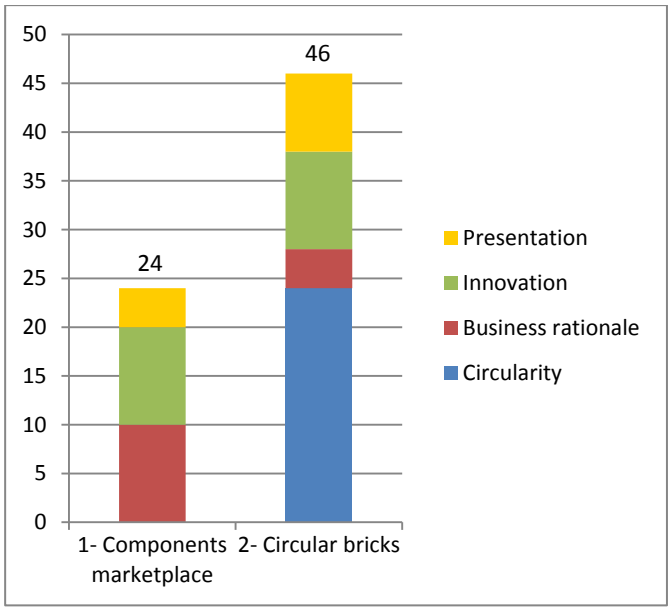


Figure 37 *– Weighted and total scores per assessment category of CBM concepts in the RHDHV Buildings workshop. No negative scores have been achieved, so the total scores are visible at once.*

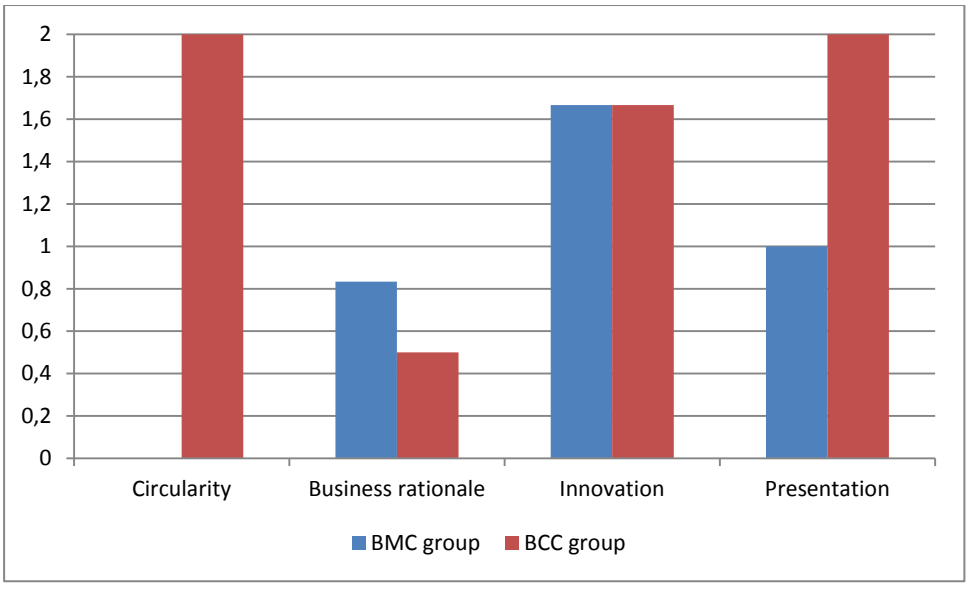


Figure 38 – *Unweighted average score of four main assessment categories of BMC and BCC groups. A score of 2 equals to 'totally agree', 1 equals to 'agree' and 0 to 'neutral' (see previous section).*

Feedback on workshop, method and tools

In general the workshop and the design process were experienced positively with sufficient structure, but also **enough space for other ideas and methods** to achieve the set goal (design of CBM for Facade BV). Another general positive experience was that the workshop and the canvasses allowed different perspectives and backgrounds well to work together.

Most important feedback on the BMC was that it does not support the development of a circular strategy so well. In principle it is possible, as key aspects of a circular model can be written out in the building blocks. For example, new collaborations can be included in the Key Partners building block, and recycled material or remanufactured components at Key Resources. However, **BMC does not explicitly ask the right questions or drawings for a CBM** and rather hints at a linear over a circular model. For instance, "in the BMC you name partners, but you don't state what is *expected* from them and what contribution they need to make to the whole" Also, incorporating several CE strategies makes the information on the BMC much too complex, as each strategy might involve specific value propositions, activities, channels and more. "You need several Business Model Canvasses to describe what happens in the different circles from the CE diagram." In contrast, **the BCC better supports the development of a comprehensive CBM** and more clearly shows important CBM aspects, such as required exchanges (knowledge, material, etc.), collaborations, changes of processes, responsibilities and dependencies. In this way the BCC is able to clearly visualise the difference between a CBM and a 'linear' BM. "If you don't have that you fall back to the traditional or linear models way sooner."

The lack of explicit CBM details leads to the **less visible risks in the BMC**. This is regarded by the participants as a principal reason why the business rationale of the BMC group scores better. However, this should not be regarded as a strength, as risks should be rather emphasized than hidden to prevent future losses. Participants find that the BCC clearly shows interrelations between different stakeholders and thus shows dependencies.

Participants think the **BCC is more adequate to convince the market of CBMs**. This mainly is because the BCC clearly shows the bigger picture of the whole chain and how possible improvements in production processes can be made as a consequence of using returning material flows. The development of Herman Miller's chair is taken as a main example, which caused unexpected additional benefits in production costs (reducing the number of parts reduced costs more than expected). However, the bigger picture could be well complemented with **BMC's more tangible, specific and concrete building blocks**, which makes the business rationale stronger (i.e. to convince an investor like Donald Trump). The suggestion is made to use both methods parallel (so not integrated) for their complementary focus: BCC for the system overview and BMC for company level details. Due to the complementary focus participants find also both CBM concepts hard to compare: "They just focused on another dimension".[23]

Another major critique was the **lack of numbers and calculations of revenues** in the workshop. However, most participants did not expect to arrive there already. Some see how future iterations could start to include more numbers. The BMC is expected to facilitate numbers and calculations easier. Also, **starting up creative ideation was difficult** (BCC group) or totally absent (BMC group). Participants were unable to get into a creative, out-of-the-box thinking mode from the manual step. The BCC group managed to do so only after explicit explanation and motivation by the facilitator. The prepared manuals for creativity techniques weren't used.

Intermediary improvements

Since no subsequent workshop was undertaken, no intermediary improvements are described. Suggestions for improvement are included in the recommendations for further research (chapter 9).

[23] An interesting remark has been made after the workshop. Developing the BCC could be seen more as a *public task*, as on the system level many benefits concern society and not profit-oriented (traditional) companies.

7. Discussion

Interpretation of the results of the experiments

The results of both workshops indicate an improvement in the quality of CBM concepts. In both workshops the total average score of BCC groups was around two times higher than of BMC groups. The higher average score is predominantly due to the category 'circularity'. There the largest differences in scores between BCC and BMC groups were observed. One exception is TU Delft group 6 (India 2) which developed a concept which was very similar to one of the BMC groups (group 2 - Colombia) and thus scored equally few points in this category. Despite the exception, the feedback of many participants supported the observation that the BCC serves better to think in business systems and take into account important aspects and details of a CBM, such as all required process to actually close a material loop. Some aspects where easily overlooked in the BMC (risks) or simply did not fit well in the canvas (roles of key partners). Use of the BCC therefore is likely to be of important influence to the circularity of CBM concepts.

Furthermore, the professionals of RHDHV mentioned that due to its systems perspective (a tool like) the BCC better shows how a CBM should function, what the activities are of different stakeholders and what they need to change or exchange. The visual characteristic of the BCC is an important element in communication. To the professionals' knowledge, such a tool is currently lacking. This feedback supports the gaps identified among current CBMI methods (Chapter 4).

However, from the point of view of other categories the improvement in quality of CBM concepts is questionable. Most notably in the category 'business rationale' BCC groups in general scored lower. This is clearly visible in the RHDHV workshop, where the BMC group's score was more than two times higher. The difference was noted as well by the RHDHV participants, who said that the more concrete, specific and tangible building blocks of the BMC supported them better to include important details for a business perspective (i.e. an investor like Donald Trump). A similar comment was made by TU Delft participants. However, it cannot be said that the BMC itself supports the business rationale better, as this could also be credited to the setup of the BMC *manual*. The BMC manual focused more on the individual company level and thus included more concrete and tangible details, whereas the system level of the BCC manual didn't contain much detailed information (in order to prevent a too lengthy manual). What is interesting furthermore is TU Delft's higher average score on the business rationale, whereas it would have been expected to be the professionals of RHDHV. A clear explanation has not been found, but the concept of RHDHV's BCC group scored highest by far on circularity (24 points, against 18 of TU Delft's best group 7). The high score on criteria of circularity perhaps has caused a trade-off with the business rationale.

The category 'innovation' does not reveal a clear message on improved CBM concepts, as scores are almost equal and with too much spread among BMC and BCC groups to make any generalization. Both RHDHV groups scored much higher than the TU Delft groups, which is probably because they had worked on CE concepts for their practice for quite some time already. In the category 'presentation' the BCC groups did score higher on average. However, this cannot be credited directly to the BCC, since the criteria of this category are not independent of criteria of other categories. For example, if a concept scores high on circularity or business rationale and thus is convincing, automatically there is a low need for clarifying questions and a high score on presentation and communication. Moreover, RHDHV participants found the BMC to more useful to communicate company level details, which further impedes conclusions.

Limitations of the research

Next to a possible discussion on the interpretation of the results there are more factors which should be noted before drawing conclusions on the improvements the use of the BCC brings. First and foremost, the scores on which improved quality of CBM concepts is measured, is heavily dependent on the weight factors

of all criteria. Current weight factors make the categories circularity and business rationale most and equally important. Where this can be justified for educational programmes about CE and force a focus on circularity in students' BM design processes, this is highly questionable in a professional context. Indeed, in Section 2.3 a range of business opportunities for CE is described, but these opportunities are usually *subordinate* to business rationale criteria (such as risk and revenue). This subordination is not reflected in the weight factors of this research. Further limitations of the research design include the assumed existing general approach of companies for CBMI. Arguments for this assumption have been given previously, but conclusions on improvements by using BCC in practice remain to be largely dependent on the actual existing approach of a company or person.

Another category of important factors regards practical limitations of this research. First, only two workshops have been held. Although the total number of participants is significant (close to 50), the canvasses have only been tested in two specific environments. Second, these environments furthermore focused on the technocycle. Although this is perfectly in line with the scope of this research, most business systems in practice mix biological and technical nutrients. This makes it crucial for the actual improvement of CBM concepts that methods and tools are able to support both the techno- and the biocycle. Third, the RHDHV professionals have been regarded as 'experienced' and the TU Delft students as 'unexperienced', but the students were half way their educational programme on sustainability and had previously discussed CE in class. Therefore it remains to be questionable to what extent the BCC method instead of participants' backgrounds are responsible for current high scores, especially in the category circularity. And fourth, the assessment remains to be qualitative (no exact measuring possible) and requires (subjective) interpretation of the researcher, despite the fact that the assessment of the CBM concepts has been done carefully, including assessment guidelines to assist interpretation of the research, checks for internal consistency (no large differences in scores for very similar concepts) and verification with participants' feedback (post-questionnaire).

Theoretical implications of the research

So far no scientific experimental studies have been found on measuring improvements of BM concepts by using different BMI methods. Previous experimental studies on improvement of BM concepts did not include a scientific methodology, e.g. the contribution of (Gassmann et al., 2013) on the use of BM patterns. A study by (Eppler & Hoffmann, 2012) did measure various variables during the BMI process, but none of these concerned the actual quality of the CBM concepts. This research has developed a research methodology to assess (circular) business model concepts and shown a possibility to carry out experimental research on improving business model concepts. However, conclusions are difficult to draw due to many incontrollable influences. This is an important reason why research in this exact area is absent, if not insignificant (Weiblen, 2013).

Furthermore, this research adds the start of a CBMI framework to the body of literature on both BMI and CE. The CBMI framework has only been derived theoretically, needs considerably elaboration and especially verification from (a still absent or nascent) practice. However, the framework seems to serve as a sufficient basis to analyse existing CBMI methods and identify gaps. Moreover, the BCC, identified as a new method and tool to fill one of these gaps, has been confirmed in practice to be a missing method. This is a modest verification of that the CBMI framework has been developed to an interesting level.

Practical implications of the research

Despite many points of discussion, participants recognize the added value of using the BCC when developing a CBM, and in many cases say to use it again. Although this research includes no verification whether participants have actually used the BCC again, clear arguments are given, especially by RHDHV professionals, for various important benefits of (using) the BCC. Interestingly, these arguments show that the BCC also supports users to cope with other CBMI challenges than thinking in business systems. From the feedback of the participants it can be concluded:

- The BCC visually organizes information of the business cycle. This explicitly drives users to **think in business systems**, by taking into account and integrating the BMs of multiple stakeholders. This is accompanied by an increased **understanding of the needs of other stakeholders**.
- Visualizing the business cycle improves analysis and **understanding of the structure and dynamics of a business system**, and relations between different stakeholders (compared to the BMC).
- A visualized business cycle supports users to communicate the CBM better to other stakeholders (most notably key decision makers) in order to **achieve tangible commitment** and/or to **coordinate collaboration**.
- Improved insight in stakeholders, activities and relations supports the **identification of risks (or barriers)** in the business system.
- The method around the BCC explicitly confronts with the implications of a closed material loop for all BMs in the business cycle. This increases **understanding of the CE concept** and what is needed to actually 'go circular'.

Next to this list, interesting potential is seen in some elaborated uses of the BCC explained in Section 5.4. These elaborations have not been noted by the experiment participants, but by one of the experts (Kimmel, 2013):

- Beyond integrating multiple BMs the BCC allows to **determine the BM of the business cycle** or system. This enables all stakeholders to start innovating or optimizing the system and (together) yield additional economic, social or ecological values which were previously – on the level of individual BMs – out of reach. Note: this has not been
- Focusing on information flows in visualizing the business cycle may support design and development processes of **governance structures** for the business system.

However, the list of positive aspects does not mean companies should focus on the BCC. Results show some weaknesses of the BCC on the one hand and strengths of the BMC on the other hand:

- The BMC *and/or* its manual are more concrete and tangible and as such are complementary to the BCC. Interestingly though, the BMC and BCC practically contain the same building blocks, as has been shown by the transformation from one to the other in Section 5.1. Comments of participants however differ and suggest both to integrate the concrete BMC building blocks in the BCC and to use the two canvasses separately
- The BCC and the method does not show a decent way yet to **manage complexity**:
  - Designing on a system level requires more information and participants find it hard to deal with this, either by gathering the information or making assumption. The BCC method does not properly support this obstacle yet.
  - The BCC does not properly manage large quantities of information (yet). This becomes especially problematic when more than one business cycle (e.g. different routes, or for different material flows) must be considered. Rather quickly it will be impossible to manage such information on paper, but possibilities of digital systems could be explored.
  - Professional participants expressed the need to condensate and simplify information into critical success factors or design principles for communication and formulation of agendas and actions.
- No indication that the BCC method **deals with confidentiality and trust issues** among stakeholders who need to share information to model the full business cycle
- Although the scores on innovation were not so low, the quality of **creative ideation** has much to gain when compared to description and the author's experiences of creative problem solving sessions (Tassoul, 2011). Insights of study on creativity in the context of BMI highlight the use of artefacts point (Eppler & Hoffmann, 2012) and the quantity of complexity (Dewulf, 2010) as major issues.
- Participants have used **patterns for CBMs** only (very) limitedly. Due to the large potential of using patterns described above (Section 5.2), quality of CBM concepts and CBMI processes could increase considerably when existing CBM patterns are used better (Appendix J).

8. Conclusions

When implementing CE often multiple, if not all four components (or pillars) of a company's BM are affected ('what, who, how and why' or product, customer, process and revenue model). How much the current BM must change depends on the how 'circular' it already is and on the strategic decision how much more circular it needs to become. Usually a new BM can be copied from others, since 90% of BM innovations are recombinations of existing BMs. For example, many companies already use recycled materials and service models (renting, leasing, hiring) are yet widespread among capital intensive or otherwise inaccessible goods, such as cars and houses. Nevertheless, both small and large innovations companies need to engage in a process of CBMI.

The CBMI process starts with the design of CBM concepts, based on an analysis of the present and future business environment. This thesis has investigated the extent to which new methods or tools for BMI can be used to improve CBM concepts. CBM concepts are the result of an iterative process of CBMI. The first version of a design almost always needs improvement after feedback from reality, and then the CBMI process starts at the first phase again.

To engage in or improve this CBMI process this master thesis has developed the *CBMI framework.* This is a process framework, which outlines a process of five phases. Companies can use this framework to plan a process and specific activities. After a preparation phase, the innovation team goes through an initiation (analysis of the system), ideation (generation of ideas), integration (conceptualization) and implementation phase several times over in iterative cycles. Also, eighteen key challenges are identified which companies normally encounter. Knowing and understanding these challenges helps companies to gather and prepare the right people, knowledge and tools and improve the speed and/or quality of the CBMI process. The framework is an adaptation and extension of the 4I-framework for BMI by Frankenberger et al. (2013) to the specific context of a CE.

Several existing methods and tools from the young field of BMI can be used to cope with many of the challenges in the CBMI framework. Examples are patterns for BMs, creative design techniques and strategic evaluation methods (Frankenberger et al., 2013; Gassmann et al., 2013; Osterwalder & Pigneur, 2010). However, these methods and tools are not fit for some challenges which are different or specific to CE, such as 'think in systems'. Other contributions do take these characteristics into account, most notably by Tukker and Tischner (2006b), Jonker (2013), Joustra et al. (2013) and the latest report of the EMF (2014). However, none cover all challenges and also not all phases of circular business model innovation (CBMI).

The CBMI framework has served as an analytical framework to identify gaps among both general BMI and specific CBMI methods and tools. The most important gaps are methods and tools to support thinking in business systems and to manage and organize the implementation of a new CBM. These gaps have been identified with the CBMI framework. For these managerial and organizational challenges it is recommended to investigate the fields of business, organization, change management and transition management for applicable and comprehensive methods and tools.

For thinking in business systems the *Business Cycle Canvas* (BCC) has been developed in this master thesis. The tool is a translation of the widely used Business Model Canvas into a canvas oriented to a *business cycle*, a supply chain with one or more closed material loops. Using the BCC drives and supports practitioners to "broaden their horizon" and take into account all BMs of relevant stakeholders. This enables to design solutions optimized for the whole supply chain instead of for an individual BM and yield additional profits or create other values which were previously out of reach. The results of the research experiments confirm that using a BCC improves the quality of CBM concepts considerably, based on a newly

developed list of selection criteria. However, the results are i.a. heavily dependent on weight factors of criteria. Feedback during the workshops nevertheless indicated that the BCC supports users in addressing several CBMI challenges next to thinking in business systems, summed up in the previous chapter.

Next to the validation of existing and the development of new methods and tools, the research on the concept – rather than the implementation – of CE resulted in several aspects which should be taken into account for any strategy involving CE.

First, our current economy is not completely linear. Many of today's companies run on resources which are considered wastes by others, such as repair shops, recyclers or waste collectors. Moreover, a completely circular economy is practically impossible, due to inevitable leakages, continued absolute growth of consumption and required quantities of energy. One or more system innovations may push the boundaries of what is possible, but the next best implementations of CBM remain to be transitional. The final solution cannot be found yet and this should be kept in mind when defining (SMART) goals for CBMI.

Second, business, government and other societal (citizen) actors usually have different interest in CE, e.g. securing profits, protecting the environment or changing lifestyle. Because CE is a wide concept and includes ideas on many aspects of a system transition (technological, regulatory, economic, etc.), all have been able to reflect their specific interests in the concept and emphasize or focus on different aspects. Most business for example continues to be Profit-minded and focuses on mitigating risks and increasing revenues. Therefore the goals of companies with implementing CE are to secure the supply of (critical) resources, anticipate governmental intervention (such as legislation or subsidies) or attract new customers. Reducing virgin resource consumption can also be a goal, but probably more to increase operational effectiveness and increase profits than to decrease environmental impact.

Third, different interpretations of what CE is and what it is not. The narrow interpretation of EMF (2013) and this thesis focuses on closing material loops and does not fundamentally aim for sustainability. Norms to balance social, ecological and economic values are missing. The link with decreasing environmental impact by reducing wastes and use of virgin material is evident, but aspects such as social equality or fairness or the need for absolute decoupling of welfare and environmental impact is absent. Broader interpretations do relate CE to sustainable development by including goals or principles (Tukker et al., 2014; UNEP, 2010; Yuan et al., 2006), or relate CE to societal trends which seek to create other values than financial profit and organize things differently, for example on a community basis or in cooperations (Jonker, 2013). All interpretations want to implement CE, so for all a CBMI process is relevant. However, since implementing CE will often depend on collaboration between different parties, it is important to understand different interests and interpretations and align goals of a CBMI process.

Fourth, the risks or barriers to implement a CBM should not be underestimated. The complexity of organization and management often increases, including issues of confidentiality and trust or the difficulty to seek a benefit for every stakeholder involved. Also, new information is needed, such as the availability of material (when can I start recycling?), or expected lifetime and reparability of components and products. But above all the current system of legislation, consumer behaviour, financing, etc. is still to the advantage of the current dominant linear models. More than 20 obstacles of the current system have been identified by previous studies. Strategies have been developed for business to proactively engage with a required system transition (Loorbach & Wijsman, 2013), but a strategic decision has to be made whether to be an innovative early adopter or a safe late follower (Van Raak & Loorbach, 2014). Well, those who initiate change will have a better opportunity to manage the change that is inevitable…

9. Recommendations for further research

9.1. CBMI in general

In Section 4.2 several gaps among existing CBMI methods to support professionals and non-professionals in addressing all challenges of the CBMI framework have been identified. The gap of thinking in business systems has been treated in this thesis, but the following research (questions) is also recommended:

- The extent to which existing strategies, methods and practical experiences for **implementing new BMs** can be used for CBMI. Challenges such as overcome internal resistance, setting up pilots and organizing learning processes is not new, see e.g. (Blank, 2006; Bragg & Bragg, 2005; H. Chesbrough, 2010; Ries, 2011). To what extent do these contributions need adjustment to the specific context of CE?
- More specifically, existing strategies, methods and practical experiences of **transition management** (see e.g. (Loorbach & Wijsman, 2013; Schot & Geels, 2008)) are essential for successful CBMI (Tukker & Tischner, 2006a; Van Raak & Loorbach, 2014), especially for the more radical innovations which will probably encounter many opposing forces from the existing socio-technical regime. How should a system transition to a CE look like? And how can frameworks of transition management be applied for a transition to a CE?
- Improved methods or tools to **describe functional needs or performances**. Especially due to the required abstraction level of performance indicators further support may be required. Several methods have extensively given examples of functional needs, but standardised, meaningful ways of defining specific results would make the development of service models easier (Tukker & Tischner, 2006b). Methods in the field of LCA to define functional units could be of interest.
- Practical guidance on how to **determine the evolution stage of both the industry and product or component** has been recognized. Van Raak and Loorbach (2014) have described patterns in system transitions and describe some general recommendations for companies in a transition to a circular economy. Poppelaars (2014) bases the maturity of components on “the past pace of innovations, trends and foreseen upcoming technical improvements” and Joustra et al. (2013) presents three criteria to determine the potential for refurbishment (number of reusable parts, “technical effort and complexity of the remanufacturing process”, “product use time per lifecycle”) to determine the potential reuse of components. However, none of these contributions support companies on a practical (e.g. step by step) level.
- A rapid **circular performance index or evaluation tool** that can give a quick impression on the extent to which material loops are actually being closed (Kok et al., 2013). In a stable state system with a static equilibrium an equation of material inputs over outputs could indicate how circular the system is. However, supply chains are dynamic (grow and decline) and boundaries are hard to determine (what is part of the supply chain, and what not). This makes it difficult for companies to estimate current circularity and room for improvement. Moreover, it will be difficult to make the index meaningful, as improving circularity is never a goal. What is important is for example decreasing environmental impact, which can still increase despite more due to the use of fossil fuels and CO2 emissions.
- Tools for **finding the right partners and organizing collaboration** and co-operative arrangements. Although the importance of collaboration has been emphasized so often, only some tools by (Manzini et al., 2004) pay some attention to collaboration, but there seems to be room for improvement (Tukker & Tischner, 2006b). It should be noted that tools for organizing collaboration differs from matchmaking programmes such as the British National Industrial Symbiosis Programme. Further research and usefulness of these programmes to the CBMI process however are recommended too (see e.g. Boeters et al. (2013)).
- **Standard agreements and revenue models for CBMs** are important to decrease transaction costs (Tukker & Tischner, 2006b).

- As many service models come with risks, liabilities, financial uncertainties and ambiguities caused by taking responsibility for how the customer uses the service, **checklists for the most common use phase risks an liabilities**, patterns how to divide responsibilities between users and provider during use can be of great importance (Tukker & Tischner, 2006b)

Beyond the identified gaps in CBMI, other potentially interesting links have been laid for which further research is recommended:

- The extent to which the fields of **open innovation and co-creation** can offer more comprehensive support to shared innovation for CBMs. The fields have been highlighted as important strategies to approach the challenge of coordinating collaboration throughout the supply chain (Chapter 3). José de Vries et al. (2011) for example have identified four types of needs in a co-creation process (strategy, sense, structure and win-wins) and studied the importance of these needs during different stages of a co-creation process. Such insights are useful in CBMI processes.
- The usefulness of (developing a method to make) **system dynamics maps** based on the list of general drivers and barriers for a CE (Appendix F). System dynamics maps enable to find reinforcing loops which could maybe be used to support the implementing CBMs or to identify whether too many balancing (negative) loops in the current (adverse, linear) system will inhibit successful. Current literature on transition management however does not mention this opportunity (Loorbach & Wijsman, 2013).
- The significance to CE of the development of new BMs in different areas of society. Jonker (2013) described how CE is related to new initiatives, often bottom-up by proactive citizens, who want to create and focus on other values than financial profit and who want to organize things differently, for example on a community basis or in cooperations (the 'Weconomy'). Because Jonker sees CE as "an economic model where value chain partners find each other on the basis of mutually strengthening relations and services", it is interesting to investigate to what extent and how CE can be a vehicle to support these new initiatives and shape this new economic model.

9.2. BCC and CBM workshops specifically

Based on the discussion on the results of the CBM workshops (Chapter 7) it is recommended to further research:

- Use of BCC in more advanced projects. Does the BCC support many iterations well (adding information, flexible in use, etc.)?
- The required level of prior knowledge to use the BCC. Students were regarded as 'unexperienced' in circular business modelling, however they were half way their educational programme on sustainability and had previously discussed CE in class. Experiments with totally unexperienced people may reveal important prior knowledge.
- How to manage increasing quantities of information for more complex CBM concepts or after several iterations when more and more information is available and needs to be organized. During this research several potential leads have yet been identified: modelling according to the method of **value networks** (Allee & Schwabe, 2011), the development of **computer-aided design tools** (Osterwalder, 2004; Osterwalder & Pigneur, 2010). and the development of **critical success factors** or CBM design principles (see e.g. (Bouwman et al., 2008) and/or Appendix B).
- Improved integration of **creative ideation** processes and techniques. Methods and techniques for creativity problem solving have already been found and integrated in the CBM workshop, however have not supported participants yet to start up creative ideation on a level experienced in specialized creative problem solving sessions or as described by experts (Tassoul, 2011). Lessons from research on creative ideation in the context of BMI (Eppler & Hoffmann, 2012) and the complexity of sustainability in BMI (Dewulf, 2010) are an important starting point. Also practical experience with the ideation part of the BMG method (Osterwalder & Pigneur, 2010) can be very helpful for better integration.

- Improved use of **CBM patterns**. The potential for using BM patterns has been discussed in section 5.2, substantiated by feedback in section 6.3 and demonstrated in practice – for general BMI – by the BMG method (Osterwalder & Pigneur, 2010). Specific *circular* BM patterns have already been collected in a pattern library in Appendix J (including the work of (Bakker & Hollander, 2013) and integrated to a certain extent in the CBM workshops. Further research is required to find out how these patterns can be applied more effectively in CBM workshops and/or complement the BCC.For example, in the BMI method *Business Model Generation* patterns of BMs have been presented using the BMC itself, which has made the way patterns could be used more explicit (Osterwalder & Pigneur, 2010).
- Best **use of BCC versus BMC**. The BMC is found to be more concrete and tangible, although the BCC is directly derived from it. Comments of participants differ and suggest both to integrate the concrete BMC building blocks in the BCC and to use the two canvasses separately. Further research is required to see how the strengths of both canvasses could be used best.
- How to **support the optimization or innovation of supply chains** in the CE. The possibility of system optimization or innovation by means of applying CE has been mentioned frequently (most notable EMF, 2012, 2013), but it is still not clear how to support this exactly. The use of the BCC can play an important role, as has been suggested in Section 5.4 and supported by one expert in this research. Stakeholders in the business cycle could be supported in finding shared goals (usually fulfilling needs of the end-consumer) on the system level with the BCC, which could be the start of system optimization instead of suboptimal optimization of individual BMs.
- How to **support the design of governance structures**. Also for this the potential of using the BCC has been explained in section 6.4. Governance structures can be visualised, but the participants have not come to elaborations of governance structures. It would be of interest to further research the possibilities of using the BCC to support this. To this regard, meshworking has been identified as potential strategy to facilitate the implementation of a CE (Jonker, 2013; Voorhoeve, Merry, & Hordijk, 2012). Meshworking aims at finding shared purposes beyond shared practices and interests. As the use of the BCC can help all stakeholders, also far up in the supply chain, with a BM for the business cycle to focus on the need of the end-consumer, there might be interesting possibilities to support meshworking processes with the BCC.

9.3. Sustainability

CE as described in this thesis, based predominantly on the work by EMF (2013), could be characterized as a 'narrow interpretation' and misses essential fundaments for sustainable development. When aiming for sustainability, new normative requirements (Frank Boons & Lüdeke-Freund, 2012) should be integrated with the CE concept. However, it is questionable whether a broader interpretation of CE, including these new normative requirements, generates more positive impact.

It is perhaps because of the current dominant and narrow interpretation of CE, focused on business risks and opportunities, which has generated such a wide attention of business, government and other actors. The positive framing and tangible and quantitative (several USD billions of) economic opportunities have activated important stakeholders. And although environmental constraints are only increasing, aiming for practical and realistic actions might do more good than raising the bar with (sometimes) ambiguous, intangible or impossible goals from a business perspective (e.g. the C2C goal to fully eliminate negative impacts).

What way will generate **the most significant progress on sustainability**? Without being able to quantitatively argue, the sustainability movements since the report Limits to Growth (1972) have not been able to mainstream sustainability development. Should EMF's 'narrow' interpretation and propagation of CE therefore be praised for finding the way to accelerate developments or criticized for missing core aspects towards a sustainable future?

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Appendices

A. Parallel studies to CE

Parallel studies to CE, next to the core reports by EMF (2012, 2013), are helpful to discern a broader consensus on the definition and demarcation of the concept. It was not possible to do the selection of studies with usual methods, such as number of citations or relevant authors (see e.g. the literature review by Tukker (2013)), since the field with the explicit name of "circular economy" (used search item in Scopus) is not established yet. Although there is a lot of content in the literature and documentation about the many schools of thought in which CE is rooted, it cannot be derived what parts of this literature should be considered as part of the CE concept, and what not. For example, many schools of thought explicitly treat sustainable development, but CE does not necessarily (see Section 2.1). Moreover, most European (and American) contributions specifically on "circular economy" (including Google search hits) are no parallel but continued studies, since they largely base their explanation of the concept on the work of EMF.

Finally, many articles on "circular economy" originate from China, where the development of CE literature takes a quite specific and predetermined path towards resource productivity, eco-efficiency and the application of the "3R principles" and where CE is "pursued by China's environmental policy makers as a potential strategy to solve existing environmental problems" (Yuan et al., 2006). This focus is much more specific than the Northern European debate, illustrated for example by EMF's statement (2013) of the general aims of CE, which is "to enable effective flows of materials, energy, labour and information so that natural and social capital can be rebuilt."

Therefore, to be able to discern a broader consensus of the definition of the concept within the time constraints of this thesis, the most cited Chinese article in Scopus with search item "circular economy" in the title, and two European parallel studies found in overview studies including Kok et al. (2013) and Bechtel et al. (2013) have been selected to analyse the characteristics of CE.

The characteristics of CE as described by Yuan et al. (2006) are listed below:

- No commonly accepted definition of CE so far, but the core is circular flow of materials;
- The concept originates from the industrial ecology paradigm, building on the notion of loop-closing emphasized in German and Swedish environmental policy;
- Potential strategy to solve existing environmental problems, and to achieve an efficient economy while discharging fewer pollutants;
- CE could help improve resource productivity and eco-efficiency, reform the management of the environment, and achieve sustainable development;
- The "3R" principles, reduction, reuse and recycling, are often cited to describe the three possible approaches in practice;
- Complete reform of the whole system of human activity, both production and consumption, needed;
- CE is emerging as an economic strategy rather than a purely environmental strategy;
- Attempts to develop a CE paradigm by integrating theories and methods of industrial economics, systems engineering, bionics, and physics, but completely original theories and methodologies for analysing industrial and social systems was very difficult.

Preston (2012) departs from the central idea "that open production systems – in which resources are extracted, used to make products and become waste after the product is consumed – should be replaced by systems that reuse resources and conserve energy." Although no definition for CE has been articulated either, the following characteristics are coined:

- Roots in industrial ecology;
- Closing resource loops as main aim, requiring deep changes in the basic structures of industrial systems;
- Redesign at a system level;
- Inconsistent application of the term by governments and companies, e.g. in China CE is a generic term for reducing, reusing and recycling activities.

Damen (2012) had adapted the work of (Andersen, 2007). The essence of her CE diagram is the feedback of waste from industrial processes into the original source (e.g. resource extraction). Next to that, for the identification of four main principles of CE, the principles of Industrial Ecology (Vermeulen, 2006), Design for Environment (Van Hemel & Cramer, 2002) and Cradle to Cradle (McDonough, Braungart, Anastas, & Zimmerman, 2003) are taken as a starting point, since they are "the most extensively researched and widespread schools of thought" (Damen, 2012, p. 13). The four principles are (pp. 15-16):

1. The redesign of products and production processes so they can operate in closed loops with a minimal- or zero impact on the environment and human health.
2. The improvement and creation of end-of-life systems for flows of resources and products.
3. The creation of, preferably regional, networks of material exchange.
4. The collection, management and exchange of resource-related information.

Most notable differences with EMF's description of CE

Probably due to a broader systems perspective, more economic or business aspects and implications of the CE are described. Most notable examples are the inclusion of Walter Stahel's performance models for new business models, and the statement to rebuild not only natural, but also social capital (Ellen MacArthur Foundation, 2013, p. 26).

However, the a balanced sustainability perspective is absent, such as the need for absolute reductions in material consumption by dematerialization and decoupling strategies, as suggested by e.g. (Jackson, 2009) and (Kok et al., 2013). See further Section 2.1, *CE and sustainability.*

B. Comparison of 4I-framework with BMG and STOF method

The 4I-framework is derived from a qualitative case study of 14 cases, including 6 multinationals and more than 7 different industries (Frankenberger et al., 2013). The key BMI challenges identified in each phase are based upon case study results. **Table 1** shows that the 4I-framework has rather comprehensively grasped the BMI framework compared to the BMI process frameworks of other sources. Compared to *Business Model Generation* (BMG) (Osterwalder & Pigneur, 2010) the 4I-framework misses a preparatory phase in which the stage of the project set, defining the problem and gathering the BMI team.

BMG on the other hand misses strategies to manage partners. Within the organization BMG takes stakeholders well into account from the start till the end (mobilization of team, participatory design, communication campaign, storytelling, etc.), but strategies for involving extra-organizational, Key Partners (which is even more important for CBMs) lack. The most important strengths of BMG are the integrated use of BM patterns, creativity techniques and strategic evaluation methods.

It is clearly visible that the STOF method (Bouwman et al., 2008) has a focus on the ideation and integration phase of the BMI process. Although for a comprehensive BMI process the STOF method thus falls short, the covered phases are elaborated extensively with 32 Critical Design Issues (CDI) and 8 Critical Success Factors (CSF). These CDIs are explicitly interrelated in a network structure (see **Error! Reference source not found.**, p.**Error! Bookmark not defined.**) and cover more areas than BMC's nine building blocks (**Table 3**). Bouwman et al. (2012) comments that "the BMC provides little detail with regard to the design variables and leaves much room for interpretation". His STOF method indeed "provides a more detailed and elaborated way of dealing with design issues and success factors for BMs" (ibid).

	4I-framework phases (Frankenberger et al., 2013)	**Business Model Generation phases (Osterwalder & Pigneur, 2010)**	**STOF method phases (Bouwman et al., 2008)**
↓	X (preparation)	Mobilize	X
	Initiation	Understand	X (analysis)
	Ideation	Design	Quick scan
	Integration	X (management of partners)	Evaluation Specification Robustness check
	Implementation	Implement	X
		Manage	

Table 1 – Similarity between BMI process descriptions of three different sources. This table is a summary of **Table 2**.

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Table 2 – Comparison of main phases and key challenges of three BMI frameworks. Special elements are highlighted.

4I-framework phases and key challenges (Frankenberger et al., 2013)	**Business Model Generation phases and key challenges (Osterwalder & Pigneur, 2010)**	**STOF method phases and key challenges (Bouwman et al., 2008)**
Phase: -	1. MOBILIZE	-
-	- Build project legitimacy - Manage vested interests - Gather cross-functional team - Orienting decision makers - Describe motivation and create awareness - Establish common language (= canvas) → Storytelling (p.170)	-
Phase: 1. INITIATION	2. UNDERSTAND	-
Players - Understand the needs of the players	- Looking beyond status-quo - Searching beyond existing client base - Immerse into the customer: gather knowledge and identify needs - Mapping/assessing existing BMs → Customer insights (p.126) → BM Patterns (p.57)	-
- Monitor their moves	*Idem, but specifically:* - Mapping/assessing existing BMs → Scenarios (p.180) → BM Environment (p.200) → Evaluating BMs (p.212)	-
Change drivers - Identification of relevant drivers	-	-
- Acting upon change	-	-
Phase: 2. IDEATION	3. DESIGN	1. QUICK SCAN
Overcome the current business logic - Achieving out-of-the-box thinking - Challenging industry laws	- Prevent taming of bold ideas - Use techniques for creative ideation, such as what-if questions - Avoid short-term focus → Blue Ocean Strategy (p.226) → Scenarios (p.180)	-
Difficulties to think in BMs - Leave product and service thinking behind	→ The BMC (is a suitable artefact to help think in BMs) → BM Patterns (p.57) → Visual Thinking (understand essence, enhance dialogue, explore ideas & improve communication) → Prototyping (p.160) (iterations)	-
- Create appropriate organizational setting	- Design attitude (p.246) - Create the setting: warming-up, brainstorming rules - Warming-up - Participatory design - Old versus new → Visual Thinking (understand essence, enhance dialogue, explore ideas & improve communication) → Prototyping (p.160) (iterations) Again Scenarios, Evaluation of BMs	-
Develop new BM ideas - Enhance organization's repertoire of	Use the BMC	Make broad outline of BM - Examinating specific design variables

methods and approaches → new BMs		- Formulating initial design choices
Phase: 3. INTEGRATION	-	2. EVALUATION
Integrate all pieces of a new BM - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between	Elaborate the BMC → BM Patterns (p.57)	Assess expected viability of BM - Evaluation with Criticial Success Factors - Modification of weak parts *ITERATION WITH STEP 3*
-		3. SPECIFICATION
Management of partners - Involve partners and ensure support	- Participatory design - Team selection (during Mobilize phase) *BMG misses strategies to involvie Key Partners*	Balancing of requirements and interests of various involved parties - Mind interrelations of Critical Design Issues
-		4. ROBUSTNESS CHECK
= integrate all pieces of a new BMs	-	Internal evaluation - Check relationships between domains (STOF) External evaluation - Check robustness of design (sensitivity to changes)
- Identify and agree on required changes	-	Completion: viable and feasible BM with respect to context and expected conditions - Prevent overlooking important issues - Prevent market failure
Phase: 4. IMPLEMENTATION	4. IMPLEMENT	-
Overcome internal resistance - Convince for change	- Old versus new BM (also looks like 'Create appropriate organizational setting') Communication campaign Again Storytelling	
- Achieve tangible commitment (incl. resources) of key decision makers	- Project sponsorship	-
Pilots, trial and error, and experimentation - Defining pilots (or pivots (Blank, 2006)) - Manage roll-out step-by-step	-	
- Ensure learning processes (feedback implementation)	-	-
Phase: -	5. MANAGE	
= Pilots, trial and error, and experimentation	- BM governance - Manage synergies and conflicts - BM portfolio (finance innovation) - A beginner's mindset	-

Table 3 – Comparison of BM components of BMG and STOF method

BMC Building Blocks	Critical Design Issues (CDIs)	Critical Success Factors (CSFs)
Value Proposition	**Service domain:** • Intended Value • Delivered Value • Expected Value • Perceived Value • Tariff (pricing) • Effort (ease of use) • Bundling of services*	**Creating Customer Value:** • Compelling Value Proposition • Acceptable Quality of Service
Customer Segments	• Customers • Market segment • Context (situation, location, etc.)	• Clearly Defined Target Group
Customer Relationships	*No corresponding CDIs*	• Unobtrusive Customer Retention
Channels	*No corresponding CDIs*	
Key Resources	**Technological domain*:** • Technical Architecture • Backbone Infrastructure • Access Networks • Service Platforms • Devices • Applications • Data • Technical Functionality	
Key Partners	**Organization domain:** • Actors • Value Network • Interactions and Relations • Organizational Arrangements	**Creating Network Value:** • Sustainable Network Strategy • Acceptable Devision of roles
Key Activities	• Value Activities	
Key Resources (2)	• Resources and Capabilities	
No corresponding building block	• Strategies and Goals	
Revenue Streams	**Financial domain:** • Investment sources • Revenue sources • Pricing • Financial arrangements (sharing costs and benefits among actors)	• Acceptable Profitability
Cost Structure	• Cost sources	
No corresponding building block	• Performance indicators • Risk sources	• Acceptable Risk

C. The sustainable business model

Only recently the gap in literature between the BM and sustainable innovation has been bridged (Frank Boons & Lüdeke-Freund, 2012; Lüdeke-Freund, 2010; Tukker & Tischner, 2006). As CE is rooted in many preceding sustainability concepts (C2C, Biomimicry, Industrial Ecology), this bridge could be relevant to broader interpretations of CE (narrow interpretations do not fundamentally aim for sustainability, see Section 2.1).

The connection between BM and sustainable innovation manifests itself primarily by the application of *normative requirements*, i.e. ecological, economic and social values balanced according to (new) sustainable norms and values, on the four pillars of the BM (Frank Boons & Lüdeke-Freund, 2012):

1. "The value proposition provides **measurable ecological and/or social value** in concert with economic value[1]. The value proposition reflects a business-society dialog concerning the **balance of economic, ecological and social needs**[2] as such values are temporally and spatially determined. For existing products, a particular balance is embedded in existing practices of actors in the production and consumption system; for new products or services, such a balance is actively being struck among participants in the evolving alternative network of producers, consumers, and other associated actors."
2. "The supply chain involves suppliers who take **responsibility** towards their own as well as the *focal company*'s stakeholders[3]. The focal company does not shift its own socio-ecological burdens to its suppliers. This condition requires that a firm actively engages suppliers into sustainable supply chain management, which includes, for example, forms of social issue management and materials cycles that avoid/reuse wastes (see further Seuring and Müller (2008))"
3. "The customer interface motivates customers to take **responsibility** for their consumption as well as for the focal company's stakeholders. The focal company does not shift its own socio-ecological burdens to its customers. Customer relationships are set up with recognition of the respective sustainability challenges of differently developed markets[4] (Hart & Milstein, 1999) as well as company-specific challenges resulting from its individual supply chain configuration."
4. "The financial model reflects an **appropriate distribution of economic costs and benefits**[5] among actors involved in the business model and accounts for the company's ecological and social impacts (Maas & Boons, 2010)."

Important to note is that a balance of economic, ecological and social needs based on new normative requirements entails "taking care for ecological carrying capacities and drawing conclusions for consumer behaviour and consumption patterns" (Lüdeke-Freund, 2010) and requires the principle of Sufficiency, which means having enough, beyond Efficiency (ibid). Especially readers critical to this will affirm that "transferring [this] principle to the growth-driven business world seems hardly possible" and requires at least overcoming further psychological barriers (Huber, 1995; Lüdeke-Freund, 2010).

The gap between the BM or BMI and sustainable innovation is bridged on a much more practical level by the game *Play if Forward* (Dewulf, 2010). This game is built up around an adapted version of the BMC which includes building blocks for a Tripple Bottom Line (TBL) and meant for "understanding and implementing sustainability in the early stages of a [business model] innovation process". Ideas for innovative BMs are scored with People, Planet and Profit scorecards. *Play it Forwards* provides an interesting structure and lessons learnt for CBMI.

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[1] See also the proposal of the WBCSD to develop the concept of True Value (WBCSD, 2011, p. 24). The principle of *multiple value creation* is deemed *the* leading principle for sustainable production (Jonker, 2013, p. 270) and also an important next step towards a CE (Kok et al., 2013, p. 25).

[2] Commonly referred to as 3P-values, or People, Planet, Profit/Prosperity (Elkington, 1997).

[3] Focal companies are those companies that usually (1) rule or govern the supply chain, (2) provide the direct contact to the customer, and (3) design the product or service offered (Seuring & Müller, 2008)

[4] "There are multiple levels to what is currently regarded as a single global economy. Focused attention at the three levels—consumer, emerging, and survival economies—will enable managers to see business opportunities where now they see none" (Hart & Milstein, 1999)

[5] A new balance is needed to take externalities into account and recover costs to society or the environment to the causing business. The lack of this is one of the obstacles towards a CE (Kok et al., 2013).

D. List of obstacles and next steps for a CE

Kok, L. et al. (2013). Unleashing the Power of the Circular Economy

		Obstacles	Challenge for CBMI
Financial	1	Major up-front investment costs	Calculate returns on investment (revenue model and cost savings)
	2	Environmental costs (externalities) are not taken into account	Seek for business opportunities to include Triple Bottom Line (TBL) in revenue model (see (Braam, Koper, & Moratis, 2012)
	3	Shareholders with short-term (financial) agenda dominate corporate governance	Convince with powerful long-term benefits or include short wins (e.g. Unilever, see (The Guardian, 2013))
	4	Recycled materials are often still more expensive than virgin	Seek for opportunities to create more value with recyclates or additional revenue streams (e.g. governmental subsidies, or see Method soap bottle)
	5	Higher costs for management and planning	Use CBM as communicative and organizational tool to facilitate management of change
Institutional	6	Unlevel playing field created by current institutions	- (governmental affair)
	7	Financial governmental incentives support the linear economy	- (governmental affair)
	8	Circularity is not effectively integrated in innovation policies	- (governmental affair)
	9	Competition legislation inhibits collaboration between companies	Primarily a governmental affair. However, creatively seek for CBMs which get round inhibitions
	10	Recycling policies are ineffective to obtain high quality recycling	Primarily a governmental affair. However, seek for opportunities to create more value with HQ recycled material and thus create a market incentive (see also above)
	11	Governance issues concerning responsibilities, liabilities and ownership	Map stakeholder activities ('who does what') by creating clear overview of CBMs involved in material cycle. Use inspiration from possibilities in data visualization.
Infrastructural	12	Limited application of new business models	**Improve concepts of CBMs by CBMI framework**
	13	Lack of an information exchange system	Provide insight in information requirements (part of Infrastructure management, or BM 'how' question) by mapping various CBMs involved in material cycle
	14	Confidentiality and trust issues hamper exchange of information	Provide insight in information requirements (see above) and judge business sensitivity. Seek for cooperative opportunities to share information. Build trust through joined CBMI processes (cooperative meetings, workshops).
	15	Exchange of materials is limited by capacity of reverse logistics	Calculate returns on investments on reverse logistics systems
Societal	16	Lack of awareness and sense of urgency, also in businesses	Determine key drivers and barriers, for business and society (government and customers), for circular models
	17	GDP does not show the real progress or decline of our society	Establish additional performance indicators (norms and standards) and seek opportunities through CBMI to use this to create additional value for customers (e.g. (PUMA, 2011))
	18	Resistance from powerful stakeholders with large interests in status quo	Provide insight in full scale (quantitative) benefits for stakeholders' interests, or disrupt with competing start ups
Technological	19	Limited attention for end-of-life phase in current product designs	Meet both end-of-life and first consumer needs
	20	Limited availability and quality of recycling material	Seek for business opportunities to increase availability and quality and for CBMs which can use both virgin and recycled

	21	New challenges to separate the bio- from the technocycle	Include separation of bio- and technocycle in CBMs
	22	Linear technologies are deeply rooted	Seek for possibilities for radical innovation

	Next steps (niche and mainstreaming)	**Challenge for CBMI**
1	Set up a simple index for circular performance.	See Obstacle 17 to create value with additional indicators
2	Encourage experimentation, innovation and redesign	Enable people to quickly and creatively generate alternative CBMs and understand possible gains and losses
3	Gather and spread successful business examples	Provide patterns and best practice strategies for CBMs (see use of patterns in (Osterwalder & Pigneur, 2010))
4	Integrate circular economy principles in education and training programmes	Make CBMI framework suitable for (higher) education
5	Develop a long-term company vision identifying linear risks and circular economy opportunities	Provide insight in both linear and circular opportunities and threats
6	Search for material pooling opportunities	Gather data and map material in- and outputs of CBMs and seek mutual benefits for the involved businesses (e.g. using chain information management systems or specialized intermediaries such as the NISP programme)
7	Promote circular products using modern marketing techniques and social media	Seek for added value and appropriate distribution channels of circular products for customers
8	Prepare roadmaps for established economic sectors	Use CBMs as market device (Frank Boons & Lüdeke-Freund, 2012) and starting point for (shared) visions
9	Initiate and stimulate stakeholder fora about the circular economy	Identify relevant stakeholders by mapping required CBMs for a material cycle
10	Mandatory and accountable integrated reporting and develop the concept of True Value	Primarily a governmental affair. However, see Obstacle 2 and 17 to create value with TBL and additional indicators
11	Create a tax shift from labour towards natural resources	- (governmental affair)
12	Implement a new economic indicator beyond GDP that steers towards circularity	Primarily a governmental affair. However, see Obstacle 2 and 17 to create value with TBL and additional indicators
13	Establish international independent systems to organise materials flows, including data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling	Provide insight in Infrastructure management (or CBM 'how' question) of various CBMs involved in material cycle and show requirements or added value of information systems, certifications, standardizations, etc.
14	Adjust national and international government policies for corporate governance, accounting, competition, recycling, and health, safety and environment	- (governmental affair)

Preston, F. (2012). A Global Redesign? Shaping the Circular Economy

Obstacles and Steps in tables refer to the obstacles and steps as defined by (Kok et al., 2013)

Obstacles	**Challenges for CBMI**
Lock-in to resource-intensive infrastructure and development models	See Obstacle 22
'Perverse' legislation for appropriate price on resource use	See Obstacle 7, 18, (2)
High up-front costs	See Obstacle 1
Complex international supply chains	Map CBMs involved in material cycle and create overview of individual information and material requirements. Also, determine shared goals for the entire cycle (or system) See also Obstacle 11
Lack of consumer enthusiasm	See Obstacle 16 and Step 7

Challenges for B2B cooperation	See Obstacle 13, 14 and 17
Data gathering (e.g. RFID) and information sharing	See Obstacle 13

Next steps	**Challenges for CBMI**
Best practice and knowledge-sharing	See Step 3, 9 (and 8)
Smart governmental regulation (support, setting conditions)	See Step 14
Standardization	See Step 13
Education to ensure a next generation of ideas	See Step 4
Raising public awareness	See Step 7
Setting credible benchmarks	See Step 1
Support for developing countries	Generate CBMs which are suitable for the context of developing countries

EMF (2013) (p.74-77)

Obstacles and Steps in tables refer to the obstacles and steps as defined by (Kok et al., 2013)

	Key challenges for CE	**Challenges CBMI**
Info.	Information and visibility. Extended information and transparency is needed to manage circular models. Intermediaries or brokers can help, e.g. NISP. Data is especially needed on consumer behaviour.	See Obstacle 13 and 14
Organization	Process design and management. Especially interdepartmental competition and other mismatched goals and incentives.	Use BM as communicative and organizational tool to align goals and incentives
	Incorporation of new players within the value chain, in order to capture the value of circular initiatives.	Map current BMs involved in material cycle and identify gaps. Seek for new partners with 'job descriptions' to close material cycle
	Cross-cycle and cross-value chain collaboration	Show added value of closed material cycle. Map CBMs involved and what they need of each other.
T.	Circular product design: performance-based, standardized and easy to separate or pure	Map closed material cycle with involved BMs and identify requirements for products
Social	Acceptance and adoption by end consumers of **performance-based use** instead of ownership. Customer value is leading, so an individual benefit is necessary[6]. Awareness[7] for change among consumers is needed. Focal companies with brands are in the best position to win (and lose).	Generate CBMs with customer target groups as starting point (BM 'who' question). Seek opportunities to create additional customer value. See also Obstacle 16 and Step 7
Financial	Development of private investors and public-private organizations.	See Step 2 (Green deals to support access to finance)
	Access to financing and risk management tools facilitated for circular initiatives	See Step 2 (Green deals to support access to finance) See also Obstacle 7
Institutions	Levelled playing field and aligned economic incentives ('rules of the game')	See Obstacle 6
	Provide a suitable international set of environmental rules, including adapted certification programmes and more *extended producer responsibility* regulation	See Step 13

[6] EMF suggests models with "economic benefits first and foremost". This does not take into account social and environmental ethics, (= norms and values).
[7] Awareness, Agency and Accommodation (Ballard)

	Leading by example and driving scale up fast (government as larger customer)	Focus on governments as customers of CBMs

Jonker, J. (Ed.). (2013). *Werken aan de Weconomy*.

Obstacles and Steps in tables refer to the obstacles and steps as defined by (Kok et al., 2013)

Principles	**Challenges for CBMI**
Multiple value creation	Map the material cycle (or system) and identify how individual CBMs can create (additional) value for the cycle. See also Obstacle 2 and 17 to create value with TBL and additional indicators, however this is narrower than the idea of Jonker
Polluter pays (to the frontrunner)	See Obstacle 2, but additionally with the money paid by the polluter front runners are supported.
New balance between local and global	Seek for local possibilities for BMs to close material loops
Access over ownership, including service economy	Generate CBMs with customer target groups as starting point (BM 'who' question). Seek opportunities to create additional customer value. See also Obstacle 16 and Step 7
CE, closed material loops	Generate CBMs which fit in a closed material loop
Shared innovation	Generate ideas for CBMs, map all CBMs involved in the material cycle and cooperatively define actions and (innovation) strategies for shared goals.
Freedom to act responsibly → Private interest governance or self-governance	Design CBMs which imply as little costs as possible, but preferably benefits, for society

Bastein et al. (2013) *Opportunities for the Circular Economy in the Netherlands*

(Bastein et al., 2013) have identified an action plan especially for the Dutch government. Many of these actions correspond to the contribution of (Kok et al., 2013). Not surprisingly, all proposed actions are mainly governmental issues. The following actions have been proposed (see for further explanation (Bastein et al., 2013, pp. 84-90)):

- create a clear, cross-departmental, consistent strategy for building a circular economy;
- develop a coherent education and research plan for the circular economy;
- make a comprehensive assessment of the pros and cons of existing rules and regulations regarding waste;
- increase knowledge and awareness of raw materials in each value chain;
- ensure that frontrunners and others who stick their necks out receive a permanent and true advantage, for example through value chain management;
- review the effectiveness of a broad set of fiscal and financial incentives to promote circular behaviour;
- determine the impact of incineration plants on the viability of circular business cases and take appropriate action;
- develop the role of the government as an active and expert 'launching customer';
- and use the international playing field to help the circular economy move forward.

E. Origin of companies allied to CE100 or Circle Economy

Sector	Members CE100 (EMF)	Members Circle Economy	Total
Consultancy and support services	• Turntoo (business intermediary) • Recoup • Innoverne (end-to-end retail) • Antea group (engineering) • Wermuth Asset Management	• Royal HaskoningDHV • Partners for Innovation • IMSA • Deloitte • Enviu • Dutch • TNO • Kirkman Company • De Transformatiegroep • AAFM • Metabolic • Allen & Overy • Squarewise • TheTerrace	19
ICT	• Ricoh • Cisco • SGW Global • Vodafone • BT		5
Electronics	• Chevron Group (power tools and machinery) • National Physical Laboratory • Philips	• Xindao • LED Lease	5
Food & Beverages	• Nespresso • Coca-Cola Company • Unilever	• FrieslandCampina • GRO	5
Finance	• Rabobank	• Rabobank • PGGM • ABN Amro • Convent Capital	5
Retail	• M&S Retail • IKEA • WM Morrison Supermarkets • Kingfisher	• PON	4
Government	• Danish Business Group • Scottish Government • Wallonia	• MVO Nederland	4
Construction and materials	• Royal BAM Group • Ecovative • Midal cables	• OVG	4
Waste management	• WRAP • EnvironCom	• Van Gansewinkel Group • KICI	4
Flooring	• Tarkett • Desso	• InterfaceFlor • Desso	4
Platform	• iFixit (repair community & service provider) • FLoow2	• Floow2	3
Apparel/fashion	• H&M • Aquafil (nylon manufacturing)	• Mudjeans	3
Chemicals	• Royal DSM	• Royal DSM • AkzoNobel	3
Transport	• Renault • Veolia Environnement		2
Renewable Energy	• Vestas Technology • ADBA (biogas)		2
Energy distribution	• National grid (energy distribution)		2

	• Selfrag		
Agriculture	• Aerofarms		1
Design	• The Agency of Design		1
Other	•	• Roggebotstaete	1

F. General CE drivers and barriers and system dynamics maps

The identification of general drivers and barriers for CE in the Netherlands is an important step in CBMI. This step corresponds to the *Initiation* phase in the adapted CBMI framework of Chapter 3.

Table 4 below comprises a long but probably still incomplete list of forces (drivers and barriers) which appear or could appear when conceptualizing or implementing a CBM. Some emanate from the (mostly adverse) 'linear' business environment with which CBMs will be confronted today, but which might diminish when a transition to a system favouring CBMs is realized. Others are intrinsically related to the increased complexity of a circular over a linear business model and rather become more stringent in a circular system.
Apart from driving or hampering a CE, the forces drive or hamper each other as well. Forces are thus interrelated and together form a system. The list of forces and interrelations can be used to draw system dynamics maps as in **Figure 1** in which reinforcing and balancing loops can be found. As has been noted in Chapter 3, it is recommended in a CBMI process to make use of these reinforcing loops. However, further research and elaboration is required to make practical use of this method.

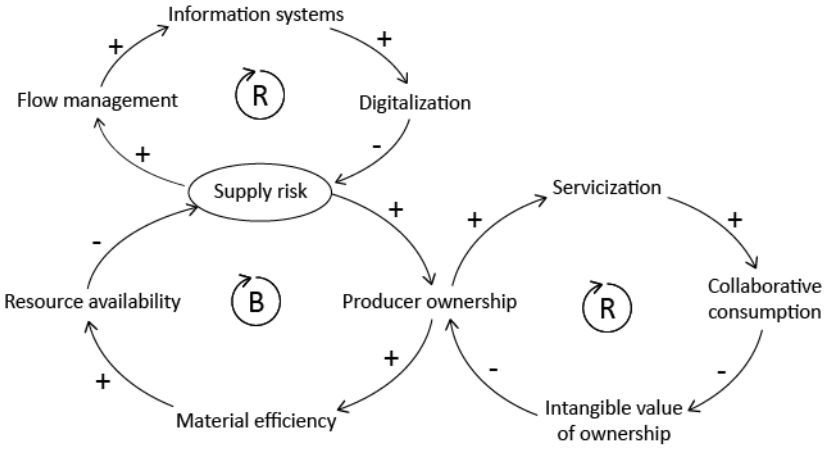


Figure 1 *– Exemplary system dynamics map of forces from Table 17. The interrelations of forces causes reinforcing and balancing loops which should be taken into account. An interesting example is the required increase of flow management and information systems to manage material flows. This requires more IT (digitalization), which are built with critical raw materials and further increase supply risk…*

Legenda

Forces:	**Categories[8]:**	**Levels[9]:**
+ = reinforcing - = balancing 0 = neutral	P = institutional (politics, policies) F = financial O = organizational S = societal T = technological E = environmental L = legal	F = firm or BM level (microeconomic / under direct influence of an individual firm) N = network or system level (mesoeconomic / influence must be organized on a network level, by collaborating, organizing, branch or lobby organizations, etc.) L = landscape level (macroeconomic / trends, to which all actors of a system contribute but all at most have indirect influence)

[8] Based on categories of (Kok et al., 2013) and PESTEL framework: Political (institutional), Economic (financial), Social, Technological, Environmental, Legal
[9] Adapted from the multi level perspective of (Schot & Geels, 2008)

Table 4 – List of drivers and barriers for a CE.

	Cat	Lvl	Description of forces	Explanation	Related forces	Sources
+	F	F	**Supply risk** of scarce resources	Physical, economic or political scarcity of CRMs	Producer ownership; Flow management; Export restrictions	EMF, 2013
-	O	F	**Complex organization** of value networks	Cross-sector collaboration of entire (international) value networks or supply chains is an organizational challenge	Producer ownership; Competition legislation; Value network governance; Limited RL capacity	(Preston, 2012)
+	All	F	**Value conservation**	CE strategies aim at conserving added value	Ecological footprint	(Bastein et al., 2013)
+	All	F	**Circular performance index**	Set up a simple index for circular performance.	Value network governance; Complex organization; Accounting externalities	(Kok et al., 2013)
+	All	F	Appropriate **product lifetime**	Range: 6 months – 25 years. Too short: CE strategies not feasible. Too long: too much uncertainty about reuse possibilities.	Flow management	(Bastein et al., 2013)
+	All	FN	Design for Environment (**DfE**)	Design paradigm which has equal attention for first as second use or EoL strategies.	Old design paradigm; Education; Material costs	(Damen, 2012)
+	E	F	Reduced **ecological footprint**	CE strategies diminish material throughput	Value conservation; Ecosystem degradation; Pollution	EMF, 2013
+	F	F	Retaining **producer ownership**		Supply risk; Value network governance	EMF
+	F	F	**Material costs**	Less dependency on virgin materials (and actors)[10]	Tax; Producer ownership; Price recyclates	Ex'tax
-	F	F	**Labour costs**	CE strategies – especially the inner circles – require more labour	Tax	Ex'tax
+	F	F	Lower **waste handling costs**	Material flows in a CE are restorative and therefore produce less waste	Ecological footprint; Industrial symbiosis;	EMF, 2013
+	All	F	**Innovation**	Circular thinking → new products, processes or business models	System optimization	EMF, 2013
+	F	N	**Tax**	A tax shift from labour to Tax will boost CE strategies	Material costs; Labour costs; Tax	Ex'tax
-	F	F	Major up-front **investment costs**	CE strategies are more expensive in the *current* economic system	Producer ownership; Price recyclates	(Kok et al., 2013)
-	F	F	**Capital intensity**	Certain PSS models require more capital	Investment costs; Servicization	(Kok et al., 2013)
-	F	F	**Short-term thinking**	Shareholders with short-term (financial) agenda dominate corporate governance	Long-term thinking; Awareness; Vested interests	(Kok et al., 2013)
-	F	N	**Price recyclates**	Recycled materials are often still more expensive than virgin	Investment costs; Recyclates availability	(Kok et al., 2013)
-	F	F	Higher costs for	-	Complex organization	(Kok et al.,

[10] However, today recyclates are still more expensive than virgin materials. So **material costs** are only a strength if the sociotechnical system (most notably legislation has changed)

			management and planning			2013)
-	F	L	**Path dependency**	Linear technologies are deeply rooted	Vested interests; Investment costs	(Kok et al., 2013)
+	F	F	**Long-term thinking**	Develop a long-term company vision identifying linear risks and circular economy opportunities	Short-term thinking; Vested interests	(Kok et al., 2013)
-	F	F	**Cannibalization**	Switching to CBMs may mean cannibalizing current production BMs	Collaborative consumption	(Bastein et al., 2013)
-	F	F	**Transaction costs**	Switching to CBMs may increase transactions costs (risks, liability, …)	Value network governance	(Tukker & Butter, 2007)
-	FO	F	**Uncertainty** and higher introduction costs of CBMs	New business models have a smaller case and test base	Investment costs	(Kok et al., 2013)
+	FSE	F	**Multiple value creation**	Societal or business-ethical recognition of multiple types of value favours CBMs over linear	New economic indicator; Integrated Reporting	(Jonker, 2013)
+	FSE	F	**Extended customer value**	Sustainable value propositions must create societal next to individual value	Multiple value creation;	(Lüdeke-Freund, 2010)
+	O	N	**System optimization** of entire value network	Instead of sub optimization of individual firms	Complex organization; Innovation	EMF, 2013 (Tukker & Tischner, 2006)
-	O	F	**Trust** among partners	Confidentiality and trust issues must be resolved to exchange of information	Dependency; Complex organization	(Kok et al., 2013)
+	O	N	Urbanization increases **centralized consumption**	Living in high densities increases scalability of RL.	Limited RL capacity	EMF, 2013
-	O	N	**Limited RL capacity**	Exchange of materials is limited by capacity of reverse logistics	Price recyclates; Centralized consumption	(Kok et al., 2013)
+	O	F	**Experimentation**	Experimentation, innovation and redesign. In NL, use Green Deals to remove legislative obstacles and support access to finance and a resource passport	Investment costs;	(Kok et al., 2013)
+	O	F	**Best BM practices**	Gather and spread successful business examples	Education	(Kok et al., 2013)
+	O	F	**Sector roadmaps**	Prepare roadmaps for established economic sectors	Long-term thinking; Investment costs	(Kok et al., 2013)
+	O	F	**Stakeholder fora**	Initiate and stimulate stakeholder fora about the circular economy	Awareness; Education; Best BM practices; Experimentation; Trust; Industrial symbiosis; Innovation	(Kok et al., 2013)
+	O	F	**Flow management**	Establish international independent systems to organise materials flows, including data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling	Circular performance index; Industrial symbiosis; Cascading; Supply risk; Product lifetime; Standardization; Certification; Circular performance index; Multifunctionality	(Kok et al., 2013)

-	OF	F	Increased **dependency**	Dependency is often regarded as a risk	Trust; Complex organization	
-	OT	F	**Information exchange**	Value network optimization requires cross-organizational information exchange	System optimization; Complex organization; Flow management	Kok
+	OT	F	**Separation** of waste streams	Separation creates waste streams with higher quality	HQ recycling	
+	P	N	**Environmental legislation**	CE strategies diminish waste discharges	Ecological footprint	EMF, 2013
-	P	N	**Negative subsidies**	Financial governmental incentives support the linear economy	Pro-circular policy; Tax	(Kok et al., 2013)
-	P	N	**Ineffective policies**	Circularity is not effectively integrated in innovation policies	Pro-circular policy; Investment costs	(Kok et al., 2013)
-	P	N	**Competition legislation**	Competition legislation inhibits collaboration between companies	Pro-circular policy	(Kok et al., 2013)
-	P	N	Limited **recycling times**	Some materials can only by recycled a number of times (paper, aluminium?)	Material costs; Value conservation; HQ recycling	(Valstar, 2013)
-	P	N	**HQ recycling**	HQ recyclate is needed to achieve equal product performance as with virgin material use	Ineffective policies; Pro-circular policy	(Kok et al., 2013)
-	P	F	**Value network governance**	Governance issues concerning responsibilities, liabilities and ownership	Complex organization; Product ownership	(Kok et al., 2013)
+	P	F	**Accounting externalities**	Mandatory and accountable integrated reporting and develop the concept of True Value	Accounting externalities; Multiple value creation	(Kok et al., 2013)
+	P	N	**Pro-circular policy**	Adjust national and international government policies for corporate governance, accounting, competition, recycling, and health, safety and environment	Unlevel playing field; Negative subsidies; Inhibiting policies; Competition legislation; No HQ recycling;	(Kok et al., 2013)
+	P	N	**Export restrictions**	Raw material producing countries (e.g. China) increasingly restrict exports for their own economy	Supply risk; Resource depletion	(The Hague Centre for Strategic Studies (HCSS), 2011)
+	P	N	**Standardization**	Enables 'legolization' of PCSs	Flow management	(Kok et al., 2013), EMF 2013
+	P	N	**Labelling** and certification	Assists interorganizational need for information for a circular model	Flow management	(Kok et al., 2013)
0	T	F	**Dematerialization**	Reduce material use at same performance level. This strategy may counteract restorativeness of material flows (too low	DfE; Ecological footprint	(Kok et al., 2013)

				quantities endanger recover viability)		
+	S	N	**Collaborative consumption**	Increased choice and access to higher-quality experiences by shared use	Intangible value of ownership; Producer ownership	EMF 2013
+	S	N	**Servicization**	Focus on functional instead of product needs; access over ownership	Producer ownership; Collaborative consumption	EMF 2013
+	S	N	**Asset-light lifestyle**	Trend: the desire to own products decreases	Collaborative consumption	(Hulshof & Van der Veen, 2013)
-	S	N	**Intangible value of ownership**	Ownership is related to status → socio-psychological nature of man	Collaborative consumption	(Tukker & Tischner, 2006)
+	S	F	**Customer loyalty**	Customers get bonded to a service and become more loyal		EMF 2013
+	S	F	**Employment**	CE strategies require more labour	Labour costs; Material costs	EMF 2013
-	S	F	**Awareness** and sense of urgency	Awareness and sense of urgency needed to change	Short-term thinking	(Kok et al., 2013)
-	S	F	**Vested interests**	Resistance from powerful stakeholders with large interests in status quo	Short-term thinking	(Kok et al., 2013)
+	S	F	**Education**	Integrate circular economy principles in education and training programmes	Old design paradigm; Awareness	(Kok et al., 2013)
+	S	F	**Circular marketing**	Promote circular products using modern marketing techniques and social media	Awareness; Experimentation;	(Kok et al., 2013)
+	S	N	A proper and common **prosperity indicator**	A new (economic) indicator beyond GDP that steers towards circularity	New economic indicator	(Jackson, 2009; Kok et al., 2013)
+	S	F	**Sheltered workshop**	Non-specialist work of labour intensive CE strategies can generate social value by employing underprivileged people	Labour costs;	Recover-E
+	S	N	**Consumer participation** in refuse schemes	Many consumers are on ethical grounds willing to contribute to separation of waste streams	Circular marketing; Education; Separation	EMF, 2013 p. 48
+	T	F	**Cascading**	Generating multiple, sequential revenues from one physical flow	Industrial symbiosis	EMF 2013, (Pauli, 2010)
+	T	F	Treatment of byproducts to increase **versatility**	Treatment of waste may open up more possibilities for reuse	Industrial symbiosis	EMF 2013
-	T	F	**Co-location** required for profitable symbiosis	For some physical flows co-location is required for a sound BM	Industrial symbiosis	EMF 2013
-	T	F	**Old design paradigm**	Limited attention for and knowledge of end-of-life phase in current product designs	Education; Awareness	(Kok et al., 2013)
-	T	N	**Recyclates availability**	Limited availability and quality of	Price recyclates	(Bastein et

				recycling material, at least in a growing global economy		al., 2013; Kok et al., 2013)
+	T	F	**Multifunctionality** or flexibility	Design (of components) for multiple uses increases restorative possibilities of the material flow	Flow management; DfE	EMF, 2013
+	T	F	Preservation of **material purity**	Design (of components) which prevents energy requirements for separation	DfE	EMF, 2013
+	TO	F	Additional profits from **industrial symbiosis**	Generating income out of byproducts and waste	Cascading; Complex organization; Co-location; System optimization	EMF, Kok
+	E	L	**Resource depletion**	Running out of technical and biological materials	Pro-circular policy	EMF 2013
+	E		**Ecosystem degradation**	Degradation of natural capital due to intensive agriculture, urbanization or bad care	Resource depletion; Pro-circular policy	
+	E	L	Environmental **pollution**	Closed loops requires elimination of toxics, to prevent harmful accumulations	Pro-circular policy	EMF 2013
+	E	L	**Global warming**	Reusing/recycling products lowers CO2 emissions	Pro-circular policy	EMF 2013
+	S	L	**Population growth**	Increases pressure on resource availability	Resource depletion; Ecosystem degradation; Pollution	EMF 2013
+	S	L	**Digitalization**	A strong increase of devices is expected	Supply risk; Material costs	(El Sawy & Pereira, 2013)
-	T	F	**Substitution** of critical materials	Alternative strategy to reduce supply risk	Supply risk	(VNO-NCW, 2012)
-	T	N	**Information systems**	Support management of material flows	Flow management; Digitalization	EMF 2013
			...	…	…	…

G. Analysis of existing CBMI frameworks

Table 5 – Part 1 of analysis of existing BMI/CBMI methods

CBMI framework	**Business Model Generation phases and key challenges (Osterwalder & Pigneur, 2010)** → = specific tool	**STOF method phases and key challenges (Bouwman et al., 2008)**
PREPARATION	1. MOBILIZE	-
Balance the innovation team - Team composition - Select risk-takers - Level awareness and urgency - Inclusion of external partners (with knowledge & skills) or not - Steer towards right network stability	- Build project legitimacy - Manage vested interests - Gather cross-functional team - Orienting decision makers - Describe motivation and create awareness - Establish common language (= canvas) → Storytelling (p.170)	-
Level and align understanding of the CE concept - Share knowledge	-	-
Phase: INITIATION (ANALYSIS)	2. UNDERSTAND	-
Think in systems - Understand feedback mechanisms	-	-
Analyse players		-
- Understand influences, interests and positions (stakeholder analysis) - Understand needs for CE and CBMs - Monitor their moves	- Looking beyond status-quo - Searching beyond existing client base - Immerse into the customer: gather knowledge and identify needs - Mapping/assessing existing BMs → Customer insights (p.126) → BM Patterns (p.57) → Scenarios (p.180) → Evaluating BMs (p.212)	-
- Think in functional needs	- *(only one little example of Rolly-Royce on p.141)*	Model on service design *(focus on mobile application)*
Analyse change drivers		-
- Identification of relevant drivers and barriers CE	- Map key external forces from the BM environment → Framework of BM Environment (p.200)	Drivers and Trends for Service Innovation
- Understand evolution stage of industry	-	-
- Acting upon change - Frame a collective strategic vision	-	-

Phase: IDEATION	3. DESIGN	1. QUICK SCAN
Overcome the current *linear* business logic - Achieving out-of-the-box thinking - Challenging industry laws and the dominant logic	- Prevent taming of bold ideas - Use techniques for creative ideation, such as what-if questions - Avoid short-term focus → Blue Ocean Strategy (p.226) → Scenarios (p.180)	-
Think in business systems - Leave thinking product and service thinking behind - Leave thinking in individual BMs behind - Create appropriate organizational setting (skills, attitude, budgeting, etc.)	- Design attitude (p.246) - Create the setting: warming-up, brainstorming rules - Warming-up → The BMC (is a suitable artefact to help think in BMs) → BM Patterns (p.57) → Visual Thinking (understand essence, enhance dialogue, explore ideas & improve communication) → Prototyping (p.160) (iterations) *No guidance at thinking in business systems*	*No guidance at thinking in business systems* *STOF too complicated to stimulate creative thinking in BMs*
Develop new *circular* business model ideas - Enhance organization's repertoire of methods and approaches to develop new CBMs	Use the BMC	-
Create multiple values (TBL)	Use Triple Bottom Line BMs (p.265)	Make broad outline of BM - Examinating specific design variables - Formulating initial design choices *(no guidance to close material loops)*
-	-	
Phase: INTEGRATION	-	2. EVALUATION
Integrate all pieces of *multiple* business models - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between	Elaborate the BMC → BM Patterns (p.57) *(no guidance to close material loops)*	Assess expected viability of BM - Evaluation with Criticial Success Factors - Modification of weak parts *ITERATION WITH STEP 3* 3. SPECIFICATION - Balancing of requirements and interests of various involved parties - Mind interrelations of Critical Design Issues 4. ROBUSTNESS CHECK - Internal evaluation: check relationships between domains (STOF) - External evaluation: check robustness of design (sensitivity to changes) - Completion: viable and feasible BM with respect to context

		and expected conditions - Prevent overlooking important issues - Prevent market failure
Coordinate the collaboration with partners throughout the system - Involve partners and ensure support - Co-create & open innovation - Establish social norms and institutions rather than contracts	- Team selection (mostly done during Mobilize phase) - Participatory design *BMG misses strategies for collaborating with Key Partners*	-
- Identify and agree on required changes		-
Deal with confidentiality and trust issues (and 'isolation mechanisms')	-	-
Manage dependencies	-	-
Phase: IMPLEMENTATION	4. IMPLEMENT	-
Overcome internal and external resistance - Convince for change - Apply soft-power tactics - Prevent conflicts with rules and vested interests - Achieve tangible commitment (incl. resources) of key decision makers	- Old versus new BM (also looks like 'Create appropriate organizational setting') Communication campaign - Again Storytelling - Project sponsorship	-
Master increased complexity - Use or develop supporting frameworks and systems	-	Use Critical Success Factors and Critical Design Issues to focus on the most important information
Compete in an adverse 'linear' environment - Undertake four types of governance activities	-	-
Define pilots, trials and prototypes - Ensure learning processes (feedback implementation)	5. MANAGE - BM governance - Manage synergies and conflicts - BM portfolio (finance innovation) - A beginner's mindset	-
Collectively identify a leader	-	-
-	-	-

Table 6 – Part 2 of analysis of existing BMI/CBMI methods

CBMI framework	**New framework on circular design** (Ellen MacArthur Foundation, 2013)	**Practical guide for PSS development** (Tukker & Tischner, 2006)	**Circular Economy Toolkit** (Evans, 2013)
PREPARATION		Preparation and introduction	People, Venue and Equipment
Balance the innovation team - Team composition - Select risk-takers - Level awareness and urgency - Inclusion of external partners (with knowledge & skills) or not - Steer towards right network stability	"What's needed to win" (p. 73): - Develop visibility of material flow - Match-maker mechanisms - Development of private investors	Plan project and set up team	- Cross-company attendees (product, process & marketing) - Balance management and business knowledge - The right setting
Level and align understanding of the CE concept - Share knowledge	"CE's natural principles" (p. 26) - Design out waste - Build resilience through diversity (flexilibity/adaptivity and eco-effectiveness over –efficiency) - Use renewable energy - Think in systems - Think in cascades	Familiarise team members with *PSS concept* , treated extensively in other book chapters: - Description of 8 types of PSSs (Ch.2) - Competitive (business) characteristics of each type (Ch.3) - Sustainable characteristics of each type (Ch.4)	Watch YouTube movie of 2 minutes
Phase: INITIATION (ANALYSIS)		Analysis of PSS opportunities	
Think in systems - Understand feedback mechanisms	Think in and analyze systems - Understand feedback mechanisms **Step 1-2 of 5** (analysis) - What flows to go after? (Mapping exercise which must give an overview about size, quality and dynamics of flows) - What is the potential payoff? (Ideally include social and environmental revenues)	Sketch system maps with primary and secondary actors, their roles and tasks, and material, information and financial flows (p.381). Referred to System Organization Map *Systems thinking is present through treated system-oriented methods and tools (see p. 141) but is not described explicitly*	Analysis - Product Analysis (→ Assessment Tool on website) - Competitor Analysis (→ case studies) - Scarcity and prices - LCA - MIPS - MFA Or make "any analysis"
Analyse players			
- Understand influences, interests and positions (stakeholder analysis) - Understand needs for CE and CBMs - Monitor their moves	"What's needed to win" (p. 73): - Seek for acceptance and adoption by end-consumer by showing benefits *No practical guidance*	Select priority need area Several tools for stakeholder analysis and need identification in Annex 2 (e.g. Stakeholder's Motivation Matrix and ViP approach) New needs: Societal megatrends and shifts in mode of value creation (p. 51)	Introductory video - Needs: Middle class grows immensely and wants sustainable solutions
- Think in functional needs	*Mentioned, but no further guidance*	Choose between 8 types of PSs	Examples of 4 types of PSSs (referral to Tukker)
Analyse change drivers	-		-
- Identification of relevant drivers and barriers CE	**Step 3 of 5**: What has so far prevented or could prevent the value from being realised? - Main types of barriers: technical,	Analyse existing system - SWOT - Main problems and opportunities	Urgency (introductory video) - Affected productivity (resources and environment)

	infrastructural, commercial and regulatory Enabling conditions: - Enabling technology - Access over ownership - Tighter regulation - Investment opportunities	- Market segments and underlying client needs (develop sense of customers) - Draft system map of existing system Find windows of opportunity	- Mitigation of environmental impact Opportunities - Government intervention less likely - Business is placed best to create CE
- Understand evolution stage of industry	-	Implications of industry life-cycles on PSS development (p. 50) *No practical guidance*	-
- Acting upon change - Frame a collective strategic vision	*See above Step 2*	Decide roughly if PSS can be interesting for you Decision: do PSS project or not	-
Phase: IDEATION	-	PSS idea generation	Circular Economy Opportunities
Overcome the current *linear* business logic - Achieving out-of-the-box thinking - Challenging industry laws and the dominant logic	Think in the new paradigm (p. 78) *Only high level recommendations for education*	Generate PSS ideas - Use creativity techniques (brainstorm, brainwrite, etc.) - Use 'archetypical' models for new value creation (see Annex 2, e.g. Strategy Canvas (Kim & Mauborgne, 2004)) - Use Sustainability Guidelines	- *No creative techniques*
Think in business systems - Leave thinking product and service thinking behind - Leave thinking in individual BMs behind - Create appropriate organizational setting (skills, attitude, budgeting, etc.)	Circular product design and production Building blocks: - New BMs - Cross-sector collaboration - Reverse logistics - Radical design	Think in PSS - Think on high abstraction level (especially for Functional result/need, p. 68) - Define performance indicator - Seven keys to develop sustainable PSS that make good business sense (p. 365)	Use case study examples
Develop new *circular* business model ideas - Enhance organization's repertoire of methods and approaches to develop new CBMs	Apply four sources of value creation - Inner circle - Circling longer - Cascaded use - Pure, no toxics or at least easy separable	Describe ideas (PSS Description Format) Do completeness check (PSS Innovation Matrix) Select best ideas (Portfolio Diagram)	Apply 7 CE strategies (including reduction of material use)
Create multiple values (TBL)	Add information to mapping exercise (step 1) on environmental and social footprint *Poorly substantiated*	Check sustainability of ideas (PSS Sustainability Screen)	-
-		Define criteria for go/no-go decision Decision: go to design or not	-
Phase: INTEGRATION	-	PSS design	-
Integrate all pieces of *multiple* business models - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between	**Step 4 of 5**: How should the value be extracted? - Consider whether the flow is interesting for the core business "What's needed to win" (p. 73): - Reverse logistics - Technology	Design new PSS (use Sust. Guidelines) - Draft system map of existing system - Create interaction storyboard - Solution element brief - Decide make or buy issues	Opportunity Prioritisation (using matrix frame with 'opportunity' and 'feasibility´)

	"What's needed to win" (p. 73): - Development of cross-value chain business models -		
Coordinate the collaboration with partners throughout the system - Involve partners and ensure support - Co-create & open innovation - Establish social norms and institutions rather than contracts	"What's needed to win" (p. 73): - Incorporate new players within and across the value chains to perform (new) activities (reverse logistics, processing and marketing) or for support (authorities, universities, research institutions and industry associations)	- Select partners where needed *No practical guidance*	-
- Identify and agree on required changes	- Industry standards		-
Deal with confidentiality and trust issues (and 'isolation mechanisms')	*Mentioned, but no further guidance*	Refine go/no-go criteria Decision: go to implementation phase or not	-
Manage dependencies	-	Keep transaction costs low by standardization and low need for mutual adjustments (p. 53)	-
Phase: IMPLEMENTATION	-	Implementation plan	Next Steps
Overcome internal and external resistance - Convince for change - Apply soft-power tactics - Prevent conflicts with rules and vested interests - Achieve tangible commitment (incl. resources) of key decision makers	-	Identify implementation issues (analysis of 9 business indicators, p. 392) Prepare management presentation	Assign problem owner with required completion date
Master increased complexity - Use or develop supporting frameworks and systems	"What's needed to win" (p.73): - Develop visibility of material flow - Match-maker mechanisms	*Misses supportive systems or frameworks for increased complexity of PSS development → "just sketch out system map"*	-
Compete in an adverse 'linear' environment - Undertake four types of governance activities	*Mentioned, but no further guidance for business (only suggestions for governments)*	Innovate the system, not just the business model. Use the approach of transition management (p. 369)	-
Define pilots, trials and prototypes - Ensure learning processes (feedback implementation)	**Step 5 of 5:** What could a continuous improvement process look like for a new circular flow?	-	-
Collectively identify a leader	-		Implement a quick-win identified
-	-	Decision: implement PSS or not	Complete further analysis

Table 7 - Part 3 of analysis of existing BMI/CBMI methods

CBMI framework	**Guided choices towards circular business models** (Joustra et al., 2013)	**Sustainable Business Model Canvas** (Sempels, 2014)	**Play it forward** (Dewulf, 2010)
PREPARATION	Read – CE awareness	-	FUZZY FRONT END
Balance the innovation team - Team composition - Select risk-takers - Level awareness and urgency - Inclusion of external partners (with knowledge & skills) or not - Steer towards right network stability	Be creative, innovative and connected (skill 8)	Additional partnerships for additional expertise (see Manage partners below) *No practical guidance*	Market-driven teams challenge technology-driven teams. Careful team composition (size, skills, attitude) Prevent group think and social loafing *No general solution for external partners (probably considered case dependent)*
Level and align understanding of the CE concept - Share knowledge	Read EMF reports and watch several YouTube movies	-	*No focus on CE; treats sustainability in general (with triple P)*
Phase: INITIATION (ANALYSIS)	Learn – Company and partners review	-	FUZZY FRONT END
Think in systems - Understand feedback mechanisms	Think in systems and identify causal loops (skill 3) Analyse (redesign for) refurbishment possibilities (p. 27)	*Not mentioned. The canvas moreover is still tuned to the individual business level.*	*Only the importance of systems (over individual products) is mentioned*
Analyse players		-	
- Understand influences, interests and positions (stakeholder analysis) - Understand needs for CE and CBMs - Monitor their moves	Aim craftsmanship at desired products/services (skill 2) Analyse internal and external stakeholders on function, impacts and CE awareness Benchmark your industry (p. 16) Organize a customer panel discussion (p. 16)	Marketing: - Increase perceived benefits and reduce perceived risks - Educate existing markets or create new	*Maybe done by market driven teams, who take customers as a starting point*
- Think in functional needs	Service design (p. 31-38)	*Mentioned, but no further guidance*	-
Analyse change drivers		-	
- Identification of relevant drivers and barriers CE	Address insecurities (skill 6) Identify influences on functional, technical or economical lifetime of products or components (e.g. fashion, politics, design). (p. 24) Product redesign: when and why? (p. 27-28)	"Indeed many BMs are environmentally and socially untenable" (Further refers to EMF, 2013)	Use STEEP Innovation Cards to evaluate various external factors
- Understand evolution stage of industry	Understand lifecycle of product (p. 24) and market (p. 34) -	-	*No. Would be to deep ("keep it simple")*
- Acting upon change - Frame a collective strategic vision		"How to become sustainable without destructing revenue streams?"	Answer who, what, how and why[11] beyond compliance when it comes to sustainability

[11] Who = organization; what = goal finding; how = realization; why = organizational commitment (Dewulf, 2010)

Phase: IDEATION	Talk – Product (re)design	-	FUZZY FRONT END
Overcome the current *linear* business logic - Achieving out-of-the-box thinking - Challenging industry laws and the dominant logic	Think future oriented and out-of-the-box (skill 4) Creative, innovative and connected (skill 8) *No concrete guidance on creativity and innovation*	-	*Maybe done by game facilitators who inspire participants*
Think in business systems - Leave thinking product and service thinking behind - Leave thinking in individual BMs behind - Create appropriate organizational setting (skills, attitude, budgeting, etc.)	Be entrepreneurial and developing (skill 1) Rethink your business and organizational ambitions (p. 14) Collect or develop 8 elementary CE skills (p. 11) *No explanation of the BM*	'Servicize' products, deliver performances - Create confidence and trust in performance agreements	Workshop is built up around adapted BMC (for the rest, probably referral to Osterwalder (2010))
Develop new *circular* business model ideas - Enhance organization's repertoire of methods and approaches to develop new CBMs	Design circular systems, products and services (skill 7) (referral to CE Toolkit, p. 21)	Use the new Sustainable Business Model Canvas.	Facilitator = tool Two starting points: market and technology
Create multiple values (TBL)	*Focus on business*	-	Extension of BMC with societal costs and benefits Use People, Planet and Profit scoring cards *No concrete examples*
-		-	
Phase: INTEGRATION	Try – Service (re)design	-	FUZZY FRONT END
Integrate all pieces of *multiple* business models - Integrate who, what how and why (rev. model) - Ensure alignment and consistency between	Celebrate diversity (skill 5) → don't integrate for one optimum Service design (p. 31-38): - Extended customer insights (service design thinking) - Integrate suitable channels with service model (direct/indirect) - Differentiate customers, seek for pilot customers - Calculate service rate - Setup reverse logistics system Revenue model (p. 41-46): - Marketing: revolution or evolution - Manage depreciation - Ask pre-funding - Construct cash flow and include unexpected and opportunity costs	Integrate 10 building blocks (adapted BMC) - Take into account new resources and activities (disassembly machines, reverse logistics, etc.	Integrate 11 building blocks (BMC + societal costs and benefits)
Coordinate the collaboration with partners throughout the system - Involve partners and ensure support	Search for partnerships (benefit from scale, knowledge, impact or risk sharing) (p. 44)	*Only high level remarks* - Co-create with customers - Customers become partners	*Only 'Key Partner' building block*

- Co-create & open innovation - Establish social norms and institutions rather than contracts	*No further guidance in how to collaborate with partners*	- Customer relation must take precedence over transaction - Providing services requires more expertise, more activities and may generate win-win situations. All lead to more partners.	
- Identify and agree on required changes		-	-
Deal with confidentiality and trust issues (and 'isolation mechanisms')	Define go/no-go criteria or fail cheap	-	-
Manage dependencies	Avoid unprofitable customers (p. 36) Manage return of products with revenue models (retain ownership) (p. 37)	-	-
Phase: IMPLEMENTATION	Test – BM calculation (finance)	-	-
Overcome internal and external resistance - Convince for change - Apply soft-power tactics - Prevent conflicts with rules and vested interests - Achieve tangible commitment (incl. resources) of key decision makers	Only separate business lines when affordable (p. 10) Don't get distracted from sunk costs (p. 42) Transform high risk into low risk business case with customer pre sign ups, down payments, subsides or loans of partners (p. 45) *No guidance in organizational issues*	-	Playing the game improves interdepartmental communication
Master increased complexity - Use or develop supporting frameworks and systems	-	-	*Complexity seen as a problem ("kills creativity"), but no solutions offered*
Compete in an adverse 'linear' environment - Undertake four types of governance activities	Temporarily develop hybrid solutions which utilize advantages of both 'linear' and circular environments (p. 10)	-	*No. Would be to deep ("keep it simple")*
Define pilots, trials and prototypes - Ensure learning processes (feedback implementation)	*No guidance in conducting pilots and learning processes*	-	*Only mentioned that playing this game could be a good kick off for a new innovation project*
Collectively identify a leader	Use guidelines for CE strategies (p. 22)	-	-
-	Cross check on ambitions (p. 48)	-	

H. Manual for the Business Cycle Canvas (Hand out)

These steps will guide you through the process of sketching out a **business cycle**. A business cycle is a circular system of businesses. Together the businesses in a cycle close a material loop. Eventually, your business cycle canvas might start to look like the CE butterfly diagram (see Figure 2 and 3 on p.3).

An individual business model is represented in boxes and arrows (see Figure 2). The essence of a business model is captured by four questions (remember the Powerpoint slides):

- **Who** is my target customer? What kind of persons is it? What does he really need?
- **What** do you offer your customer? What products, services, or bundles of products and service do you offer him?
- **How** is the value proposition created? What key activities, processes (production, organization), resources (physical, human, intellectual, financial) and capabilities (skills) are required?
- **Why** do you run this business? How are revenues or benefits generated? (People, planet, profit)

In the diagram of Figure 2 these questions are present as following:

- 'What' is represented by the arrow between the boxes, so this can be either material (e.g. a product), money, information or something else (e.g. a service).
- 'How' is described inside the boxes.
- 'Who': the target customer is the box where the arrow is going to. So in this network, the customer of someone is the supplier of the next one in the supply chain. A business can have more than one customer.
- 'Why' is the sum of all the arrows going away and coming back to one business, so to one particular box. The value of the flows coming in should be larger than what comes out! For most businesses the financial flows will be most important.

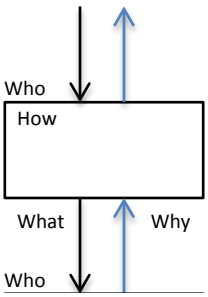


Figure 2 – A business model in boxes and arrows

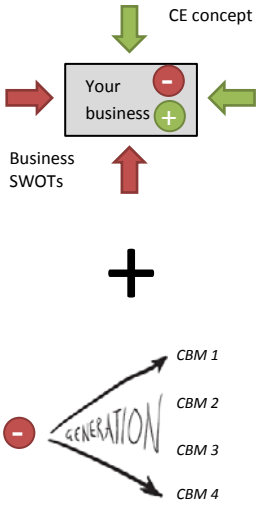
Step 1. Generate creative ideas for a CBM for your case

Generate ideas and explore opportunities for a CBM. You can do this by evaluating how the concept of CE could be beneficial to the SWOTs of your case. A systematic approach can be fine, analysing how the business model of your case would change in a circular model.

But, **methods for creative idea generation** might help you to come up with more innovative ideas and opportunities. More innovative ideas of course are a stronger basis for a good business model. Below are several tips!

Tips for creative idea generation:

- **QUANTITY** = QUALITY. Generating many ideas may be a stepping stone to new ones. Be **unorthodox** or unrealistic; crazy ideas may trigger you to think of innovative ideas.
- Use **post-its** and **draw**: try to visualize the core of your new idea one post-it.
- Try to apply patterns from the **Pattern Library**. Do these help to come up with new ideas and opportunities?
- Use other creativity techniques (brainstorming, "what if" questions, or creative copy-pasting of known best practices or metaphors)
  Need a tip for a creative technique? Ask Bas.



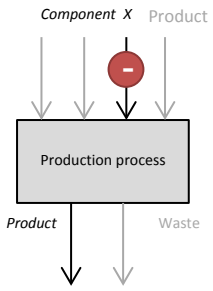
Step 2. Select a critical material flow

A) Select your favourite opportunity from the collection of step 1, based on the criteria of the workshop (circularity, business rationale and innovativeness, see Powerpoint slides)
B) Identify what material flow (= in- + output) is most critical for this opportunity.

Example: a key CBM opportunity for Philips is decreasing the supply risk of critical raw materials by staying owner of their products. The Rare Earth Elements of the circuit boards bear the most critical supply risk. Critical input: printed circuit boards. Critical output: televisions.

Tips:

- Selection of most promising opportunity: quickly position all opportunities in a graph with one criterion on y-axis and another on x-axis.



Step 3. Close the loop with different types of value flows

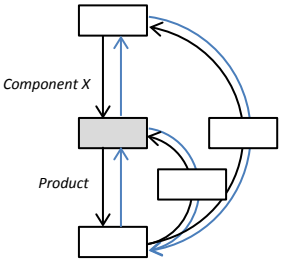
Map all processes which are required to close the loop. Obviously, material flows link all processes together in a cycle. But also map other key value flows which are exchanged (e.g. often financial flows run in opposite direction of material flows).

Types of value flows:

- Material: products (or product-services), raw materials, waste flows, water
- Financial: lump sums, rates per month, interests, loans
- Information: data, license, credits, exposure
- Other: services, social values like community building, trust, reputation

Tips:

- Use a large flip over sheet, or use post-its as boxes and arrows.
- There are several **parallel routes** possible for a closed loop (remember the CE butterfly diagram, Figure p.3). Usually different routes are required for different qualities of material flows (e.g. broken products can't be reused).
- There are probably also **alternative routes**. Be creative, generate multiple alternatives and select the best one, just like at **Step 1**!

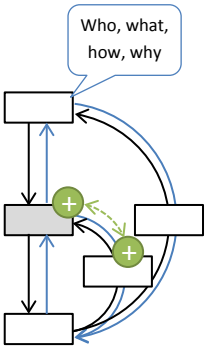


Step 4. Design and optimize the business models (on a systems level)

To let the processes run, every process needs a feasible business model. Use the four basic questions to design (or evaluate) the business models of each process. Stick to the most important characteristics (e.g. one post-it per question).

Tips:

- Design & improve BMs (1) → creative techniques again
- Design & improve BMs (2) → design and optimize the BMs on a systems level: seek for win-win situations between BMs and 'design' collaborations or plans with other stakeholders to make use of larger opportunities (or SWOTs) elsewhere in the business cycle!
- Evaluation of BMs → SWOT analysis & PESTEL developments again
- Draw additional value flows to make a BM generate enough value, e.g. financial flows from governments (= subsidies).



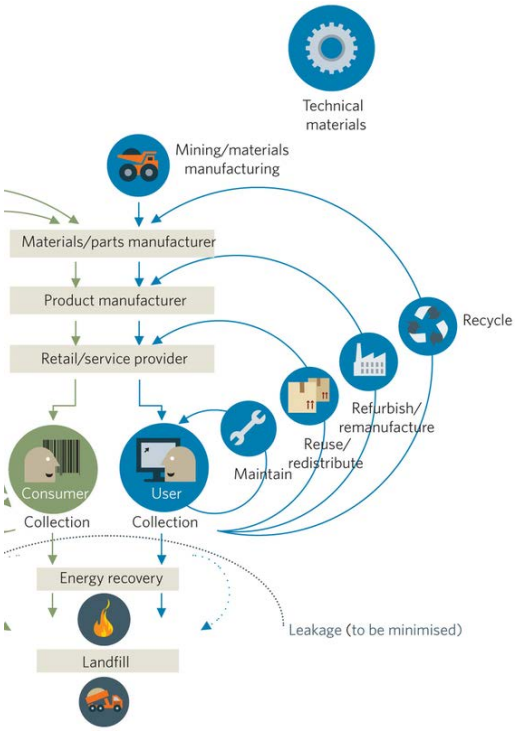


Figure 3 – The 'butterfly' diagram for the cycle of technical materials is a good inspiration for the business cycle canvas.

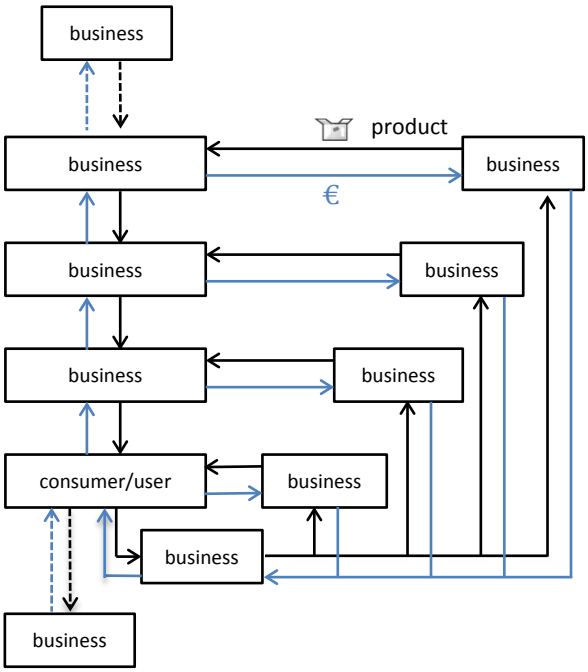


Figure 4 – The business cycle: a network of businesses. Businesses create and capture value by exchanging all kinds of flows (material, money, information, etc.). Eventually, your business cycle might look like the CE butterfly diagram.

I. Manual for the Business Model Canvas in a CE (Hand out)

This manual introduces the Business Model Canvas (or short: Canvas), a powerful and much used tool (even in board rooms!) to both analyse and design business models. A few examples and tips are given as well, to give you a feeling of how to use the Canvas best.

You will use the canvas during this session.

Contents:

- Introduction to the Canvas
- More in-depth description of each building block
- An example which shows how to fill in the Canvas and how the building blocks relate to each other
- A stepwise guide for using the Canvas

Introduction to the Canvas building blocks

The Business Model Canvas (Figure 1) consists out of **9** building blocks. The red arrows show how the 9 building blocks are related to each other. So changing the content of one building block may influence others too! All together they describe how an organization creates, delivers and captures value. This is the essence of business, a blueprint for a strategy to be implemented.

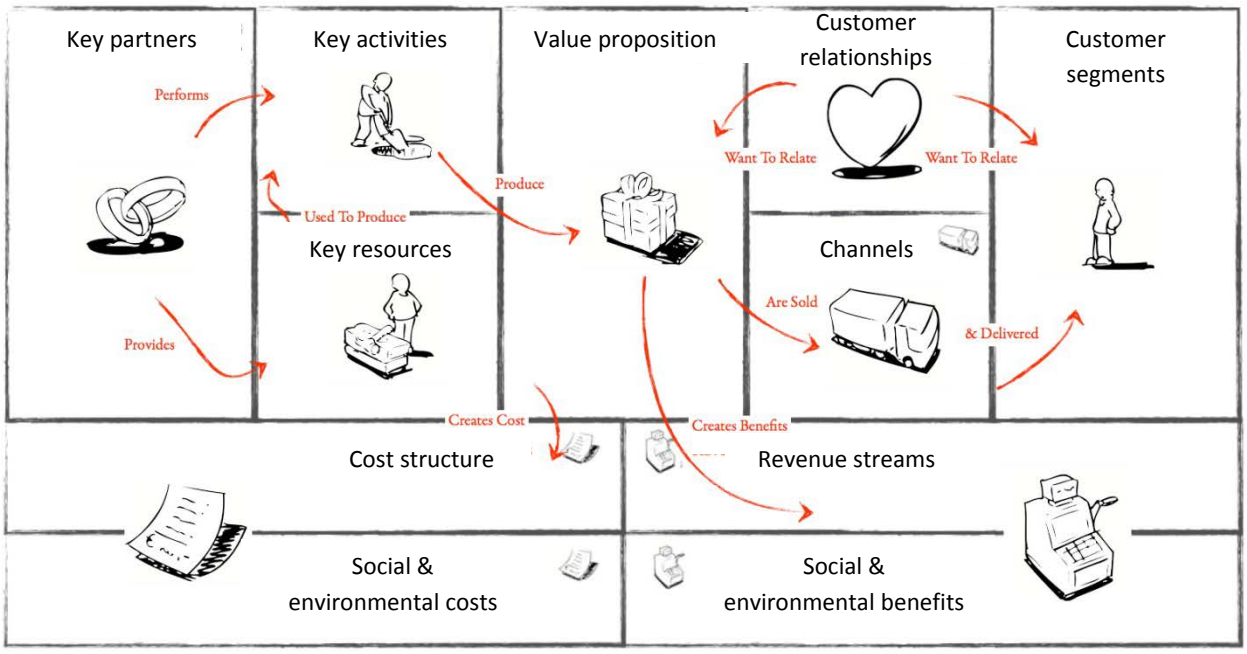


Figure 1 – The Business Model Canvas (adapted from the original of Osterwalder & Pigneur, 2010).

In-depth description of each building block

WHO:

1. **Customer segments** (CS) defines the different groups of people or organizations a business aims to reach or serve (*who* is your target customer?). **Examples**:
    a. Niche or mass market
    b. Upper / middle / lower segment (in terms of purchasing power, quality standards, or something else)
    c. Diversified (= totally different customer types)
    d. Multi-sided markets (like a credit card company connects to types of customers: credit card holders and shops or other merchants who accept the card).

WHAT:

2. **Value proposition** (VP) is the product, service, or *bundle* of products and services that create value for one or more Customer Segments (*what* do you offer your customer?). **Examples** of elements of a VP: Newness, Performance, Customization (like tailoring, but also co-creation), Design / aesthetics, Results (like the Rolls Royce example where airlines pay for every hour an engine runs!), Brand/status, Price, Accessibility, Convenience/usability (ease of use)

HOW:

3. **Key resources** (KR) describe the most important assets requires to make a business model work. **Categories**:
    a. Physical: machines, buildings, material, energy, systems
    b. Intellectual: brands, intellectual property (patents, copyrights), data
    c. Human: employees
    d. Financial: capital
4. **Key activities** (KA) describe the most important things a company must do to make its business model work. **Categories**:
    a. Production: designing, making, delivering (production organizations)
    b. Problem solving: coming up with new solutions (service organizations)
    c. Platform/Network: connecting people with products or with other people (like eBay, Mastercard, Facebook, …)
5. **Key partnerships** (KP) describe the network of suppliers and partners that make a business model work. **Motivations for partnerships**:
    a. Optimization and economy of scale: outsourcing, sharing infrastructures
    b. Reduction of risk and uncertainty: strategic alliances, bilateral agreements, etc.
    c. Acquisition of particular resources and activities
6. **Channels** (CH) describe how a company communicates with and reaches its Customer Segments to deliver a Value Proposition. **Examples**: Marketing, Sales force, Web sales, Own stores, Partner stores, Wholesaler (like Bijenkorf or Wal-mart).
7. **Customer relationships** (CR) describe the types of relationships a company establishes with specific Customer Segments. **Examples**: self-service, automated service, personal assistance, dedicated personal assistance (like “your personal banker”), communities, co-creation.

WHY:

8. **Revenue streams** (RS) describe the cash a company generates from each Customer Segments. **Examples**: unit sales/pay per piece, usage fee/pay per use, subscription fee/pay per month, lending/renting/leasing, licensing, advertising, commissions (e.g. brokers).
9. **Cost structure** (CS) describes the costs incurred to operate a business model. **Characteristics**:
    a. Fixed costs (remain the same despite the volume of products or services, e.g. the rent for the factory building)
    b. Variable costs (proportional to volume, e.g. costs of materials and other procurement)
    c. Economies of scale: cost advantages at larger volumes (e.g. bulk discounts)

d. Economies of scope: cost advantage by using activities or resources for multiple goals (e.g. same marketing activities for a company with multiple products).

10. **Social & environmental benefits** describe values such as health, happiness, jobs, status, sense of belong to a community, a clean environment, biodiversity, etc.
11. **Social & environmental costs** describe are the opposite of social & environmental benefits, e.g. the opposite of jobs is unemployment, the opposite of biodiversity is loss of biodiversity.

Example: BM of telecom company

This is the BM which a telecom company uses to attract customers. They initially lose money by offering a *free* phone (red line), but they make up for the loss by the revenue they generate by the monthly subscriptions people pay (green line).

This example is very simple and basic, and obviously has a lot of room for detailing.

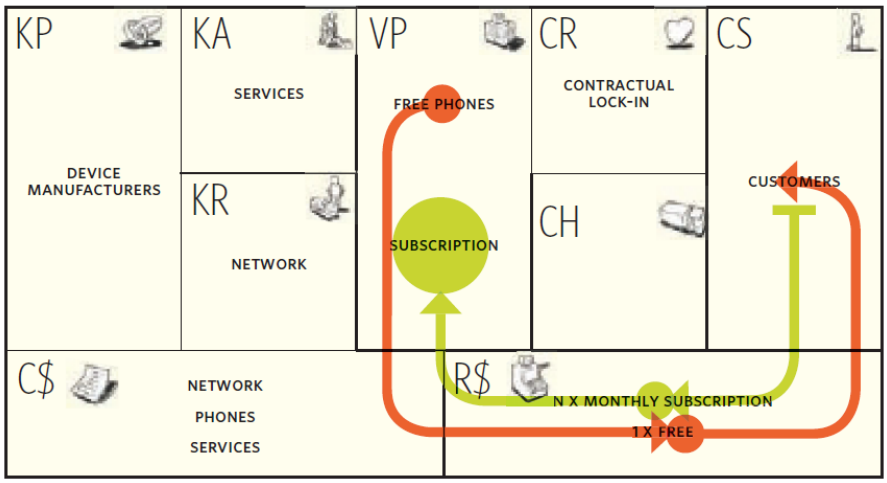
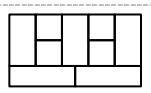
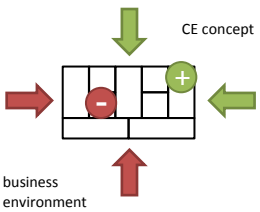
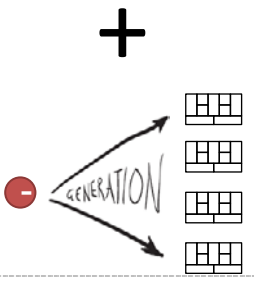
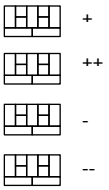
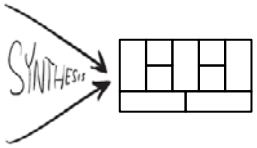
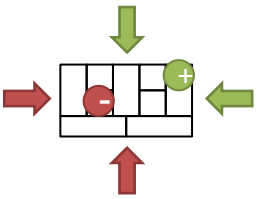


Figure 2 - Exemplary business model canvas for a telecom company

Proposition 1 = free phone → Attract customers, but revenue = 0 → Customers want to use phone and need network → Your businessoffers network (Value Proposition 2) → Customers pay a high subscription per month (revenue stream 2).

A stepwise guide for using the Canvas

Step 0. Sketch a blank Business Model Canvas. Use post-its to fill in the model: that way you can change them later on!	
Step 5. Map the opportunities of a CBM for your business Map the key opportunities of a CE for your business. Do this by evaluating how a CE could benefit the processes of your business, both internally (improve existing processes) and externally (deal with developments in the business environment). Think creatively to generate new ideas! **Tips for analysis:** • Create overview of opportunities → SWOT analysis	

• Types of developments in the business environment → PESTEL: political, economic, social, technological, environmental, legal developments (see also Figure). **Tips for idea generation:** • Try to fit the **CE strategies** or **CBM archetypes**. Would one of these bring new opportunities? • Use creativity techniques (brainstorming, "what if" questions, creative imitation of other examples or metaphors)	
Step 6. Select the best option Select the best idea by assessing them against criteria. The two main criteria of the challenge are circularity, business rationale and innovativeness. The handed-out lecture slides contains a list of the more detailed criteria. **Tips**: • Selection of most promising opportunity: quickly position all opportunities in a graph with one criterion on y-axis and another on x-axis.	
Step 7. Elaborate the BM and update the others building blocks Elaborate your selected idea to a basic BM by filling in or adjust the content of the 9 building blocks of the Canvas. Make sure the building blocks are integrated well with each other. If that's not so easily done, make a note of it by writing down the problem you encounter. We'll use those notes for the next step. Often you have to change one or more to make the fit together, e.g. another product sometimes better fits with another customer.	
Step 8. Further improve Do another iteration to improve the BM (step 2-5). There are several areas for improvement: • The changes evoked by your new BMs might come with new SWOTs. Especially the weaknesses and threats are now important to deal with. • There are maybe some opportunities left on your list which can be grasped as well with your BM (→ synergies, add-ons, win-wins, etc.) • There are maybe possibilities for your CBM to also close other material loops. This would be excellent news for your business rationale: more possibilities to create and capture value!	

More general business drivers

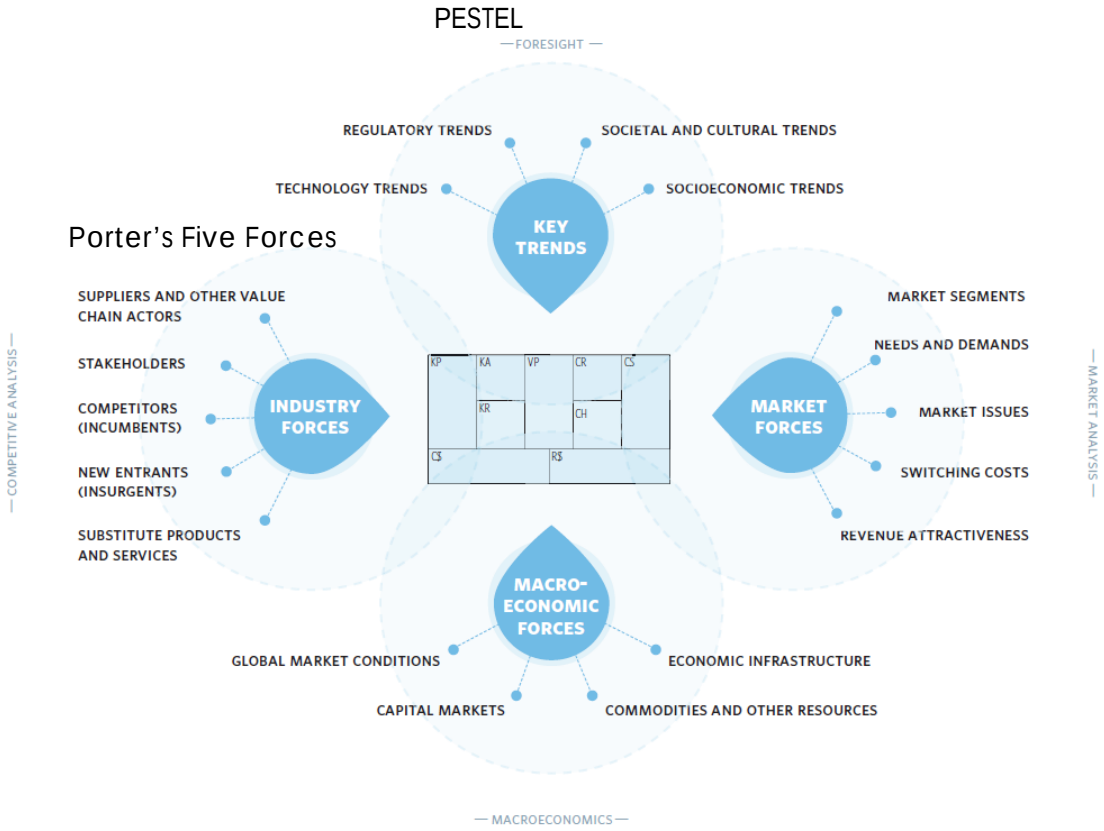


Figure 3 - General business drivers (from Osterwalder & Pigneur 2010)

J. Pattern library for circular business models (Hand out)

Use this hand-out to generate more ideas for a circular business model (CBM). Let the patterns inspire you or help you to come up with new, innovative ideas. Do you see new opportunities for a CBM for your case?

Collect your ideas on **post-its**.

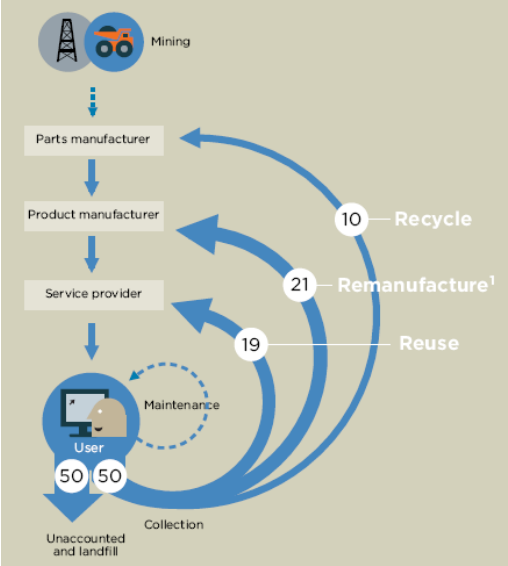
PATTERN LIBRARY

1. Main CE patterns (technocycle)

For technical or abiotic materials, there are four main CE patterns:

1. Repair/maintenance
2. Reuse
3. Remanufacture
4. Recycle

If you're dealing with biological materials, see the *CE patterns (biocycle)*



2. Dematerialised services

Providing a service that offers product benefits where the 'physical' product does not exist at all at the point of use. The model changes consumption patterns and delivers potential material saving through not producing a physical product for consumers. However, this must be balanced against the materials used in the service infrastructure.

Note: Not producing a product does not correspond to the principle aim of CBMs to close material loops (since there are not loops anymore). However, wider interpretations of CE include dematerialization strategies.

Examples: Spotify (online music), Netflix (online films), Dropbox (online data storage / 'cloud computing')

3. Long-life products

A final product contains much embedded costs in terms of material, labour, energy, capital and wastes. The business model is built around high-quality products which are designed for a long and useful life, possibly (re)used by many consecutive users.

Example: Miele washing machine, Patek Philippe watches (illustrative commercial: "you never actually own a Patek

Philippe, you merely look after it for the next generation")

4. Hybrid products

Combination of a durable product and short-lived consumables. Main revenue stream from repeat sales of the fast-cycling consumables.

Examples: printer with cartridge, Nespresso machine with cups

5. Exploiting left over value or "Trash-to-cash"

The business model is built around creating value in discarded products, which the original owner or producer does not see.

Examples: Repair Service NL (offering a repair service), Van Gansewinkel Group (from trash to resources), De Steigeraar (design and build of furniture from scrap-wood)

6. Access over ownership

(sometimes referred to as Product Service System)

Provides product access rather than ownership. Main revenue stream from payments for product access.

Exampe: GreenWheels (shared car use)

7. Performance-based

(sometimes referred to as Product Service System)

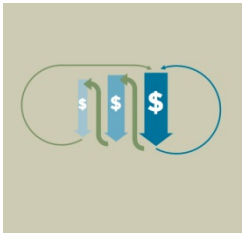
Provides a performance, not a product. Provider determines the best product fitting the customer's need. Revenue stream from payments for performance delivered.

Example: hours of thrust in a **Rolls- Royce**, 'Power-by-the-Hour' jet engines, paying for transport (not necessarily a car).

8. Cascaded use

Use products, components or material in other product categories, before putting effort in recovering them to their original state and ready for their original use.

Examples: GRO Mushrooms (grow mushrooms on coffee grounds), Upcycle (make range of products from bicycles, e.g. lamps, belts and wallets).



9. Pure, non-toxic and separable

Making material flows pure, non-toxic and easy to separate, makes them more valuable for businesses in the reverse cycle.

Examples: Van Gansewinkel Group pays more money for separated plastics.

10. Collaborative consumption

Rental of products between members of the public or between businesses. Generates an income for the product owner and provides cheaper access to a product for the renter. Can also be non-income based peer-to-peer online and/or offline exchange and re-use .

Examples: Floow2 (platform for professional equipment hiring), Peerby (platform for borrowing household tool and products), AirBnB (platform for bedroom space rental)

11. Incentivised return & re-use

Encourages customers to return used items for an agreed value. Customers gain value for unwanted items and return products via a convenient system. Collected products are refurbished and sold for re-use on appropriate markets.

Examples:

- Discounts (H&M 15% discount for old cloths)
- Deposits (‘statiegeld’ on PET bottles)
- Legislation (fines on illegal dumping of paint)

12. Collection of used products

Collection by a service provider to ensure products/ materials are passed on to an appropriate re-use system.

Examples: Wiltshire Wood Recycling (resale of scrap wood and prunings)

13. Product Attachment & Trust

Create products that will be loved, liked or trusted longer

Examples: Patek Philippe watches, Apple products

14. Product Durability

Develop products that can take wear and tear without breaking down

Example: Miele washing machines

15. Product Standardization & Compatibility

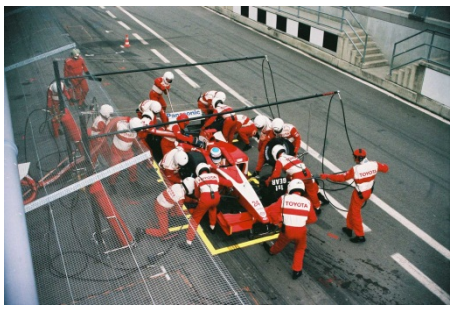
Create products with parts or interfaces that fit other products as well

Example: Lego

16. Ease of maintenance and Repair

Enable products to be maintained in tip-top condition

Example: Rolls Royce jet engines or quick possibility of repair during Formula 1 pit stops.



17. Product Upgradability & Adaptability

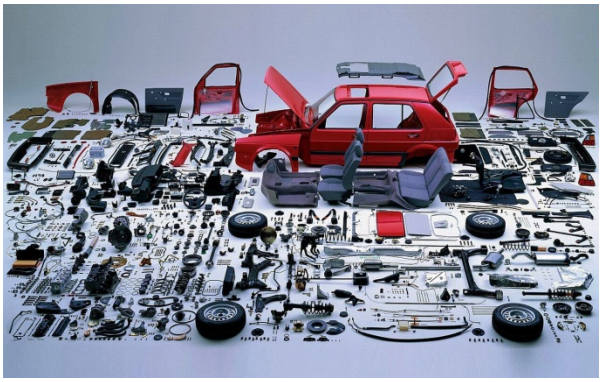
Allowing for future expansion and modification

Example: Phonebloks

18. Dis- and Reassembly

Ensure products and parts can be separated and reassembled easily

Example: Herman Miller chair or disassembly of cars (EU demands 85% of reuse and recycling)



19. * Your pattern ! *

The list of patterns is never finished. Do you see other solutions from your knowledge or experience of a circular economy? Could that solution work for you CBM as well?

Sources

Bakker, C. and M. Den Hollander (2013). "Products that Last." from http://www.productsthatlast.nl.

Ellen MacArthur Foundation (2013). Towards the Circular Economy. Opportunities for the Consumer Goods Sector. 2.

WRAP (2013). "Innovative business model map." Retrieved 14-08-2013, from http://www.wrap.org.uk/content/innovative-business-model-map.

K. Citation analysis BMI literature

Article or book	Google Scholar cited by	Relative
(Osterwalder & Pigneur, 2010)	855	1
(Osterwalder, Pigneur, & Tucci, 2005)	867	1,01
(Osterwalder, 2004)	764	0,89
(Teece, 2010)	592	0,69
(H. Chesbrough, 2010)	356	0,43
(Johnson et al., 2008)	522	0,61
(Zott & Amit, 2010)	278	0,33
(Tukker & Tischner, 2006)*	129	0,15

L. Session plans

Session plan workshop TU Delft BSc Industrial Design

Date	Time	Activity	Sources
28/11	??	**Presentation of the case: a mobile phone for a CE** • Introduction (or overview) of CE principles and sources of value creation • **Technical** analysis of the mobile phone: components and materials • Introduction of case owner Vodafone and their **business** perspective on a mobile phone for a CE (focus on drivers & barriers, not on concrete BMs, because these are spoilers!) • Application of a design strategy for a CE (referring back to CE principles and sources of value creation)	Thesis Flora
	10’	**Make groups** and write down groups and group members	
	5’	**Fill in pre-questionnaire** (adapt question on familiarity with CE)	Ingrid Pauw research in ASSET
05/12		Organize: • Sit in your groups • **David en Joeri** and some others have to still fill in the pre-questionnaire	
13:45	20’	**Presentation on the BM, BMI and CBMI:** • BM ontology (4 pillars) • Thinking in BMs (as opposed to thinking in products or even services) • What is BMI? And usefulness • Connecting CE to BMI: **1.** CE drivers for BMI **2.** CE barriers for BMI (remember for challenge!)	(Ellen MacArthur Foundation, 2013; Frankenberger et al., 2013)
	5’	**Presentation: introduction of challenge** • Goal: Design a credible circular business model around **mobile phones** • Extra info • Criteria (see Result Assessment form)	(Bragg & Bragg, 2005; Ellen MacArthur Foundation, 2013; Gassmann et al., 2013) Thesis Flora (Dewulf, 2010)
	5’	**Questions** (total 30’)	
	2’	Break	
14:20	20’	**Read manuals for BMI** • Manual 1: Business Model Canvas (hand-out to groups with people who are familiar with the Canvas) • Manual 2: Business Cycle Canvas	(Osterwalder & Pigneur, 2010) + My own work!
	2h00	**Design!!!**	
		Conduct observations (help from Thomas and/or Maarten) + make photos	
	2’	Break	
16:30	45’	**Pitches** • 3’ pitch • 2’ assessment and feedback	
		Voice record pitches + make photos of results	

17:15	10’	**Fill in post-questionnaire** • What went well? • What did not went well or was difficult? • What things do you take home? Things you’ve learned and you think you would use again. • What would you do differently next time?	Ingrid Pauw research in ASSET
		Thomas during post-questionnaire: Calculate winner with excel sheet	
Total:	3h45	Max.: 4h00. Use additional time for breaks or a longer design process.	

Session plan workshop RHDHV Buildings

Date	**Time**	**Activity**
11/12	10:00-11:00	• Selection of case with participants (Thijs & Martine) • Walk through BM, BMI and CE D&B slides → are they enough familiar with this?
17/12 08:45		Groups: 1. Michiel & Teun use BMC 2. Thijs & Martine use BCC
	2’	**Fill in pre-questionnaire**
	30’	**Revision of PPT slides on BMs, CE D&B and strategies, and case Cranenborgh** Q&A Make SWOT CE for Cranenborgh
	2’	Break
09:20	10’	**Read manuals for BMI** • Manual 1: Business Model Canvas • Manual 2: Business Cycle Canvas
	1h30	**Design!!!**
		Conduct observations *Track help and feedback given* *Hand out manuals for creative techniques if asked*
11:00	10’	**Pitches** • 3’ pitch • 2’ assessment and feedback by other participants and me • Answer to questions regarding the results: • Does the concept contribute to a CE? • Would you implement it yourself?
		Voice record pitches + make photos of results
	50’	**Evaluation** (regarding process) • What was useful of the method & what not? • Would you use (parts of) this method again & what would you do differently?
12:00		**End**
Total:	3h15	

M. Pre-questionnaire

Name:

Group number:

1. Up till now in this course, I have learned many new things about the Circular Economy.

☐ Totally disagree ☐ Disagree ☐ Agree ☐ Totally agree ☐ Neutral

2. I am familiar with thinking about and innovating business models.

☐ Totally disagree ☐ Disagree ☐ Agree ☐ Totally agree ☐ Neutral

3. I am familiar with using the Business Model Canvas.

☐ Totally disagree ☐ Disagree ☐ Agree ☐ Totally agree ☐ Neutral

4. I am familiar with thinking about and innovating business models for a circular economy.

☐ Totally disagree ☐ Disagree ☐ Agree ☐ Totally agree ☐ Neutral

5. I am familiar with the things which have been presented about the mobile phone case for a Circular Economy

☐ Totally disagree ☐ Disagree ☐ Agree ☐ Totally agree ☐ Neutral

N. Facilitator questionnaire

Group	Help (encircle)	Description of help
1	a lot – a bit – none	
2	a lot – a bit – none	
3	a lot – a bit – none	
4	a lot – a bit – none	
5	a lot – a bit – none	
6	a lot – a bit – none	
7	a lot – a bit – none	
8	a lot – a bit – none	
9	a lot – a bit – none	

O. Post-questionnaire

Name:	Group number:
Do you think your concept of a circular business model will help the transition to the circular economy? Describe some reasons why and why not (pro & con).	
Do you think your concept of a circular business model is an innovation? Why?	
If you were head of Vodafone (imagine… ☺), would you go ahead with developing and implementing this business model? Why?	
What went well in the process of designing a CBM?	
What did not go well?	
What did you find most useful of the method, tools, information, etc. for designing a CBM?	
And what didn't work or was difficult?	
What would you do differently next time you design a CBM?	

P. Bias analysis of workshop TU Delft BSc Industrial Design

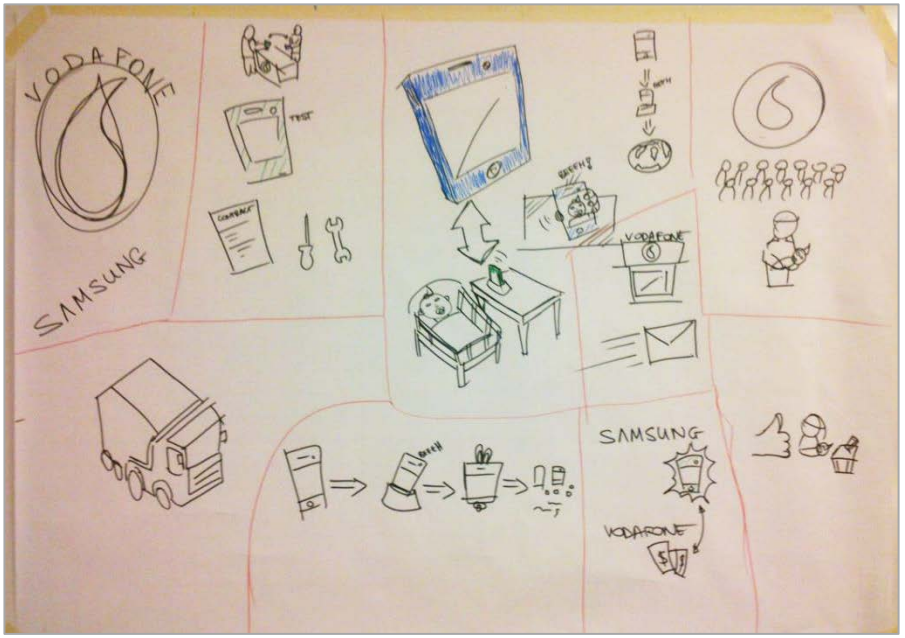
Group	*Bias by prior knowledge and skills for CBMs and/or mobile phones*	*Value (0-5)*	*Bias by help received from workshop facilitators (David Peck, Thomas Latcham & Bas Mentink)*	*Value (0-5)*	*Bias seen in results*	*Bias seen in post-questionnaire*
All	• No groups have practical experience with the mobile phone or telecom sector. • Q5 of pre-questionnaire is deled due to wrong interpretation by many people. They thought their understanding of the previous presentation was asked instead of CBMs around mobile phones in general		• Facilitators have been instructed to give help to groups which are stuck and can't continue. Because it is important to get to a result (CBM concept + pitch) to compare the influence of the two methods (BMC vs BCC).		•	•
1	• 3/5 persons familiar with BMI	2	• Tip to focus back on BMC: what Key Activities does your VP need? (BM) • Tips for pitch, focus on strengths (BM)	1	•	•
2	• 1/6 persons familiar with BMI	1	• ***Given*** the CBM idea for BoP market opportunity Colombia! (DP)	***5***	•	•
3	• No biases	0	• Help to structure BM/story by asking to tell their idea (TL)	1	•	•
4	• No biases	0	• Proposed to consider revenue through blocks and not contract (DP)	3	•	•
5	• 3/5 persons familiar with CBMI • 1/5 persons familiar with BMC • Runs a 12 ECTS CE project around Vodafone • Conceptualized a CBM the day before!	***5***	-	0	• CBM idea originates from their private session the day before	•
6	• No biases	0	• ***Given*** the CBM idea for BoP market opportunity in India! (DP)	***5***	•	•
7	• No biases	0	• Tip to use a figure-8 model for reusing a component in another product before sending it off to recycling. (BM)	3	•	•
8	• No biases	0	• Explanation of differences in manual steps: first sketch out technical processes and flows, then add business model aspects. (BM) • Endorsed the battery idea for confidence to work it out in a pitch. (BM) • General tips for a pitch. (BM)	4	• Leads given have become core of the CBM concept	•
9	• 3/4 persons familiar with BMI (2/4 very familiar) • 1/4 persons very familiar with BMC • 1/4 persons familiar with CBMI	4	• Help to structure information (group had very elaborated analysis of mobile phone). (BM) • Tip to focus on problem of supply risk upstream and seek for opportunities to transfer value creation downstream upstream to also change processes there. (BM)	3	•	•

Q. Results of workshop TU Delft BSc Industrial Design

Group 1 – "Babyphone"

End-of-use phones are remanufactured to simpler models which meet the needs of children at various stages of their lives. The phones can subsequently be used as baby monitor (NL: babyfoon), children's phone or educational models (for practicing repairing and disassembly). The CBM generates revenue by remanufacturing the phone in between each stage.

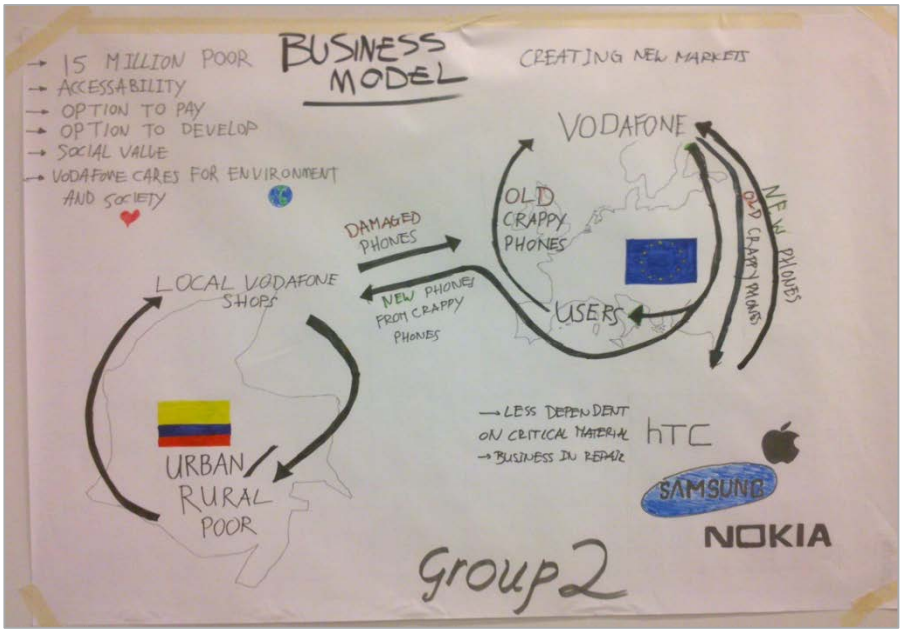
Some strengths: creating emotional attachment to the phone which adapts to different stages of your life
Some weaknesses: remanufacturing is done in China (transport costs); change in design by Samsung is required (dependency)



Group 2 – "Colombia"

Phones are leased both in the Netherlands and in Columbia. Broken phones are returned to producers to recover critical materials. Old but functional phones are refurbished and leased in Colombia via local telecom shops.

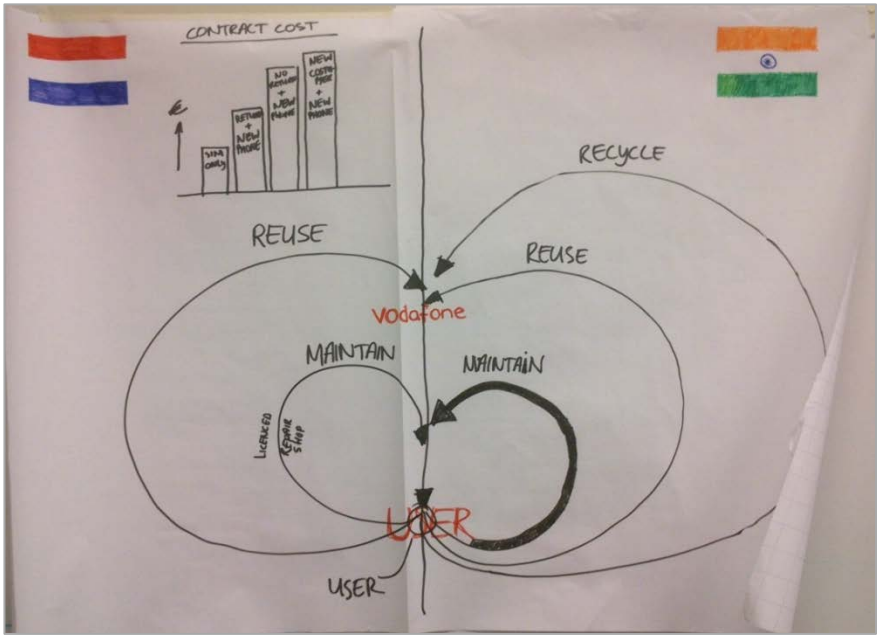
Some strengths: clearly identified and quantified market opportunity ("15 million poor")
Some weaknesses: transport costs to Colombia; dependence on stable situation in Colombia (e.g. do people return their phones)



Group 3 – “India”

The telecom company includes an option for a discount for returned phones. Returned and still functional phones are refurbished and sold to poor families in the Netherlands. After their return the (even older) phones are put on the Indian market. Additional revenues can be created by setting up repair shops and offering free repairs with new contracts.

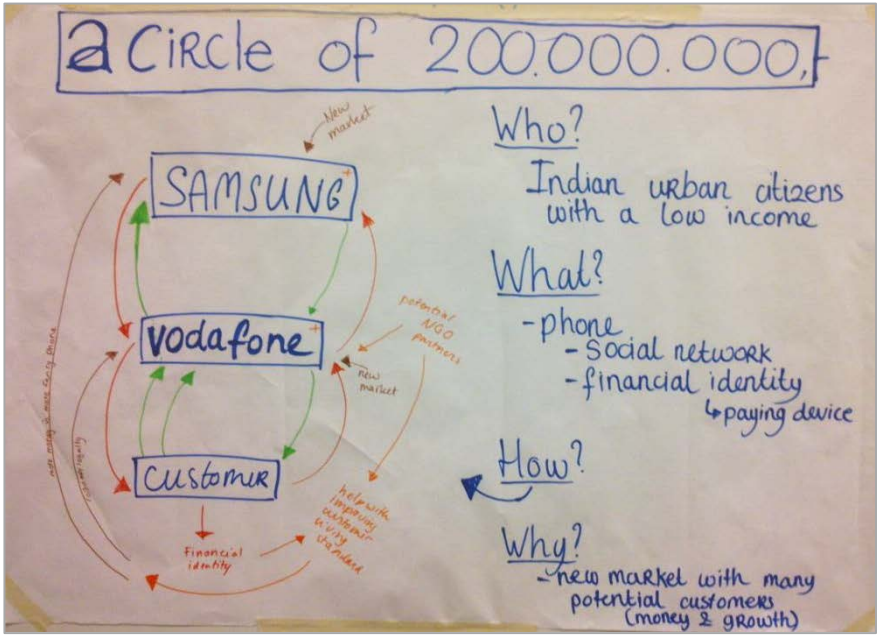
Some strengths: telecom company partners up with small Dutch repair services to perform the refurbishing; clear pricing strategy to increase returns (but why no lease contract with fines?)
Some weaknesses: recycling shown as important activity, but no recycling partners identified



Group 6 – “India 2”

Telecom company buys used and simple phones (only texting and calling) from producer and sells them to Indian customers together with a telecom contract. Phones can be returned for money and are sold back to producer. Look-a-like of Grameen phone (www.grameenphone.com) which also focuses on base of the pyramid opportunities in India.

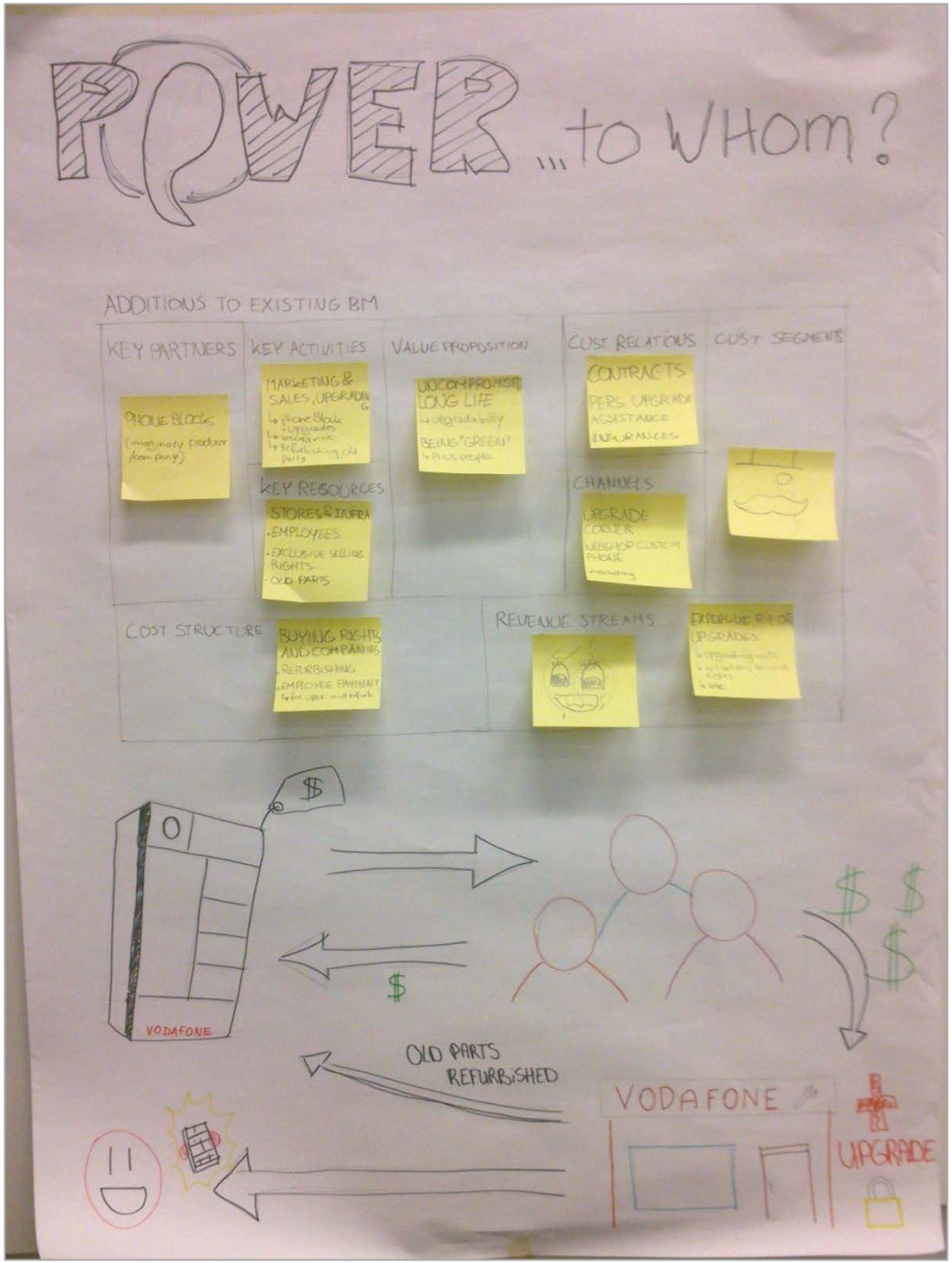
Some strengths: clearly identified and quantified market opportunity (“200 million”); identified secondary partners (NGOs); creates much social value
Some weaknesses: no incentives named for (cooperation with) producer (why would producer cooperate with western telecom provider in India?)



Group 4 – “Phonebloks”

The telecom company collaborates with a yet to be found producer of modular phones (after the viral example of ‘Phonebloks’). Customized phones can be sold at a web shop and phone in use can be upgraded to prolong functional and technical lifetime.

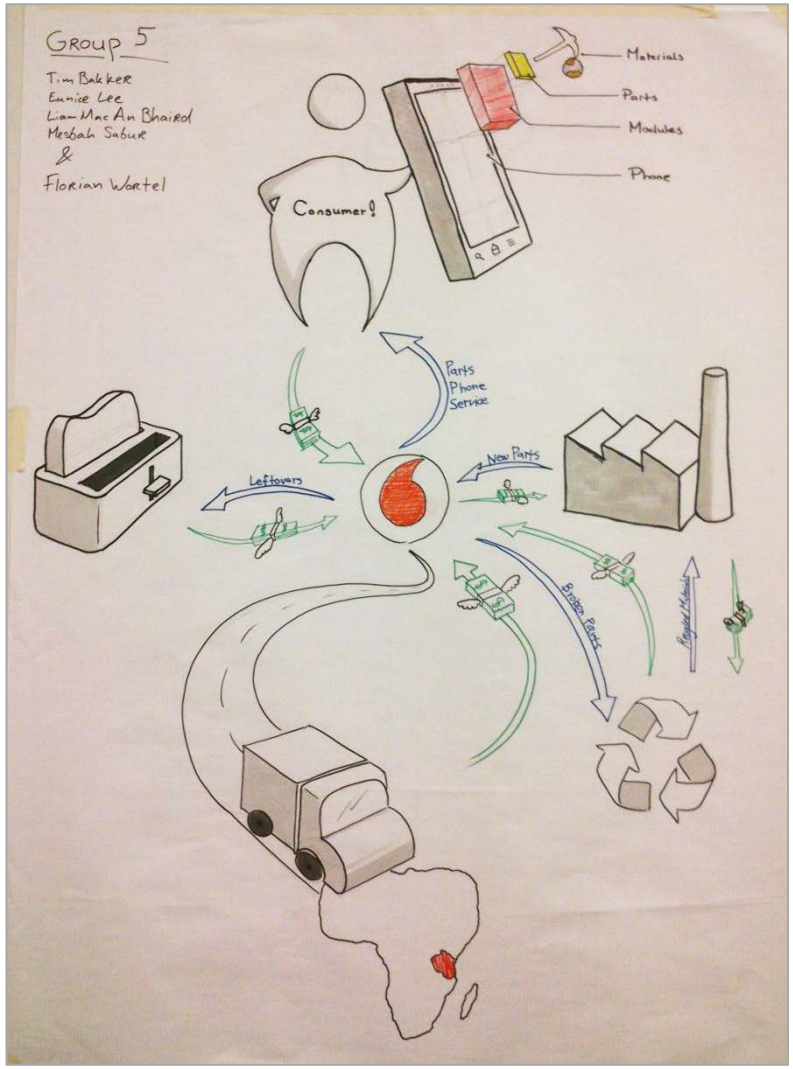
Some strengths: exclusive licensing to sell first modular phones; “uncompromised long life” insurance offer
Some weaknesses: ill-defined target customers (‘who’); full dependence on future producer; no strategy for unused old parts (parts nobody wants)



Group 5 – “Tanzania”

Phones are both directly reused in the Netherlands if still popular, sold in Tanzania if still working, remanufactured into other products if *components* still function and recycled if components are broken. The telecom company becomes a hub company for all these activities.

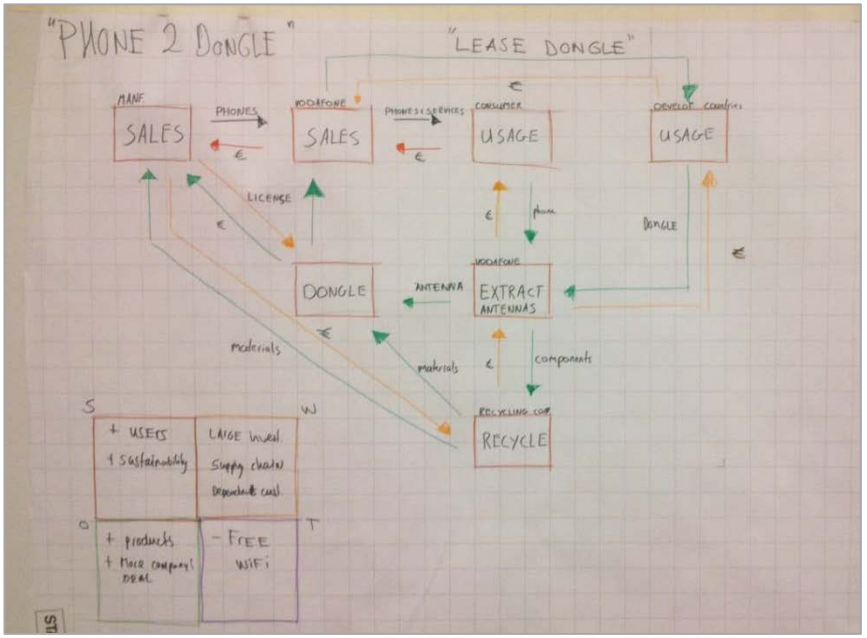
Some strengths: full range application of CE strategies (capturing value from all strategies)
Some weaknesses: material sink in Tanzania



Group 7 – “Dongle”

Wifi components of used phones are sold as a dongle (internet connection device) in developing countries. Dongles can be returned for money and are sold again (redistribution).

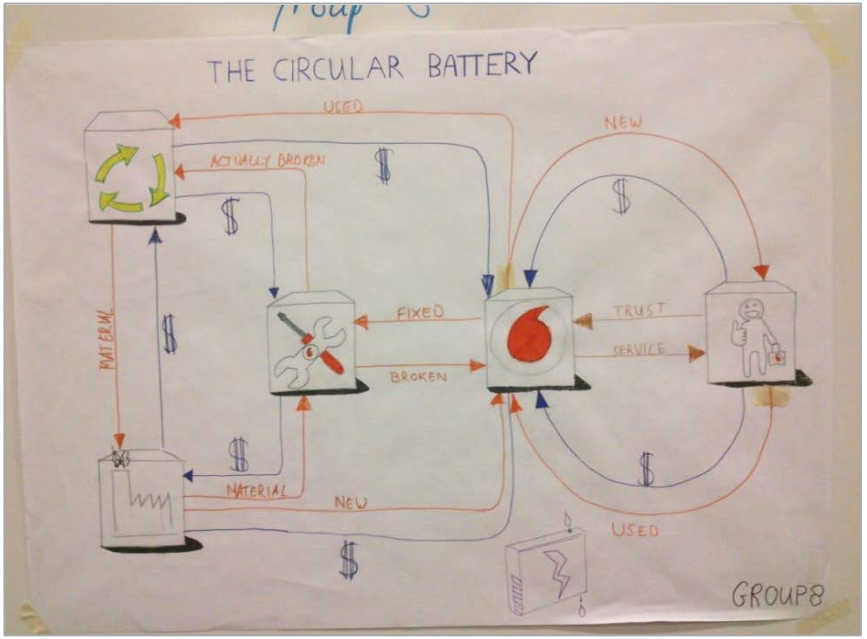
Some strengths: clear SWOT analysis with identification of additional opportunities for dongles in the future (‘Internet of Things’); license of producers to reuse their (wifi) technology
Some weaknesses: much value lost with direct recycling of other components



Group 8 – “Battery”

Telecom company offers a battery repair service.

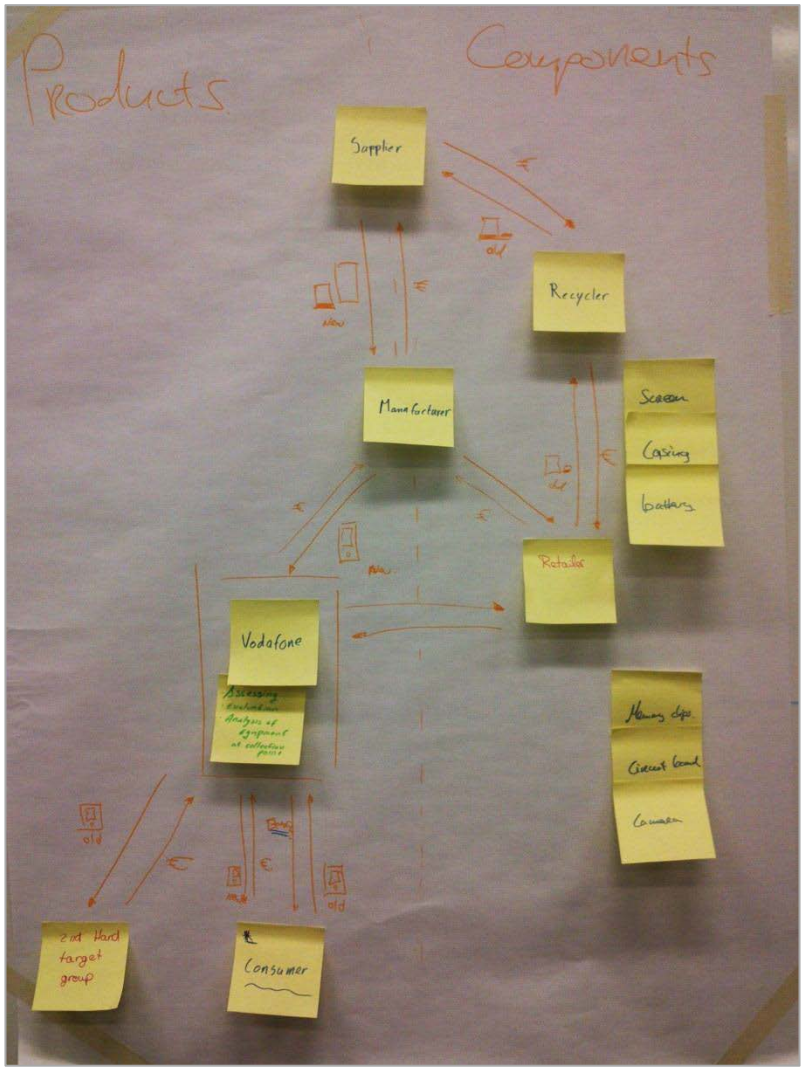
Some strengths: batteries identified as critical phone components for extended functional and technical lifetime;
Some weaknesses: does not work if batteries are self-replaceable (e.g. due to iFixit repair manuals); dependency on OEM to sell new batteries



Group 9 – “Phone bodycheck”

Telecom company offers a full bodycheck (quick scan) and additional services for the phone. Customers can gather information on phone residual value, upgrade possibilities, use advice and recommendations (how to use your phone better), maintenance and repair

Some strengths: new type of information need identified
Some weaknesses: old phones are difficult to upgrade



R. Assessment of results workshop TU Delft

The CBM concept…	**1- Babyphone**	**2- Colombia**	**3- India**	**4 - Phonebloks**	**5 - Tanzania**	**6- India 2**	**7 - Dongle**	**8 - Battery**	**9 - Phone bodycheck**
Circularity									
closes material loops	-2	0	1	-1	1	0	2	1	1
maintains the value of material flows by keeping them pure, non-toxic and/or easy to separate	0	0	0	1	2	0	1	1	1
Business rationale									
has clearly described a value proposition (what)	2	2	2	2	2	2	2	2	2
has identified a promising market opportunity (or customer segment) for this value proposition (who)	1	2	2	0	0	2	1	1	1
has a credible plan with required processes, activities, resources and capabilities to produce the value proposition (how)	0	0	-1	2	1	0	2	-1	0
is financially viable (why)	1	1	2	0	1	1	1	0	0
creates social and/or environmental value (why)	1	1	1	-2	1	1	0	1	-1
has an acceptable level of risk (why not)	-1	0	0	0	0	-1	1	-1	1
Innovation									
has a new value proposition (what)	1	-2	2	0	0	-2	2	1	2
has a new way to create the value proposition (how)	2	1	2	1	1	1	2	0	1
has new partnerships to create the value proposition (who)	1	1	-1	1	0	1	1	1	-1
Presentation & communication									
is understandable solely from the poster	-1	0	-1	1	2	0	1	2	-1
is clearly communicated with the pitch	2	1	1	1	2	1	2	2	0
requires few clarifying questions after the pitch	-1	-1	0	1	-2	-1	1	-1	-2

Table 8 – Assessment of CBM concepts. Totally disagree = -2 / disagree = -1 / neutral = 0 / agree = +1 / totally agree = +2. Total weighted scores can be found in section 7.2

S. Analysis of post-questionnaires TU Delft

Note: **question 1-3** are not displayed here. In question 1-3 participants have assessed their own CBM concept on circularity, business rationale and innovation (see Appendix O). Answers were used to verify the assessment done by the researcher. In case of large differences with the researcher's assessment, the researcher's argument has been reviewed and – after re-evaluation – the assessment has been adjusted or not. This verification has not been elaborated in this appendix.

4. What went well in the process of designing a CBM?

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Get overview of all involved stakeholders **Mapping of required processes and stakeholders**	2		3	
Think in win-win situations **Think of mutual benefits**	1		3	Group 9
Making links between different involved stakeholders (after we had the idea)			3	
Making the actual connections and flows (after we knew what the components were – Group 8)			3	
Everything went well			3	Group 5 (apparently no further improved brought by method…?)
Thinking in systems			2	Group 9 (Maarten). Is loops the same as systems…?
Thinking in loops	2			
Integration of cycle Integrating different aspects "The middle/end part when we knew which product we wanted to do."	1		2	
Elaborating the idea for a CBM			2	
Get an overview (general remark)			1	
Come up with more ideas for a CBM (after the first)			1	
Awareness of in- and outputs of Vodafone and how these can be changed			1	
Detailing			1	Group 8
Creative thinking and idea generation	2			
Using EMF's four sources of value creation	1			
Define value proposition	1			
Get overview of all involved resources	1			
Analyse current situation/BM	2			
Adapting the existing BM	1			
jConceptualize a revenue model	2			
We had enough time	1	Group 3		

Quotes:

- Group 7: "Making the links between the various stakeholders involved was relatively easy. However, in reality this would be a far more complex process to execute due to various conflicts of interest and arguments about profit division."
- Group 8: "We became aware of all the input/output and how these can be changed to be more beneficial to Vodafone."
- Group 8: "connecting all the pieces of information in the system. "

5. What didn't go well

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Start somewhere **Decide where to start** **Choose a beginning**	**1**		**10**	
Slow **start** Didn't know what to do			2	
Sketch out the canvas	1		2	
Creative thinking and idea generation **Think of new things** **Innovate**	**6**	Also due to explicit demand for innovation (criteria)	**2**	
Apply SWOT			1	
Going in too much detail			1	
Manage complexity Too much possibilities	1		1	
Taking into account all stakeholders			1	
Analyse negative aspects			1	
Detailing			1	Group 5
Completeness			1	Group 5
Elaboration of business model	1			
Making the BM circular	1			
Circular thinking (instead traditional or linear thinking)	3			
Shortage of time	2			
Integration of all ideas into a coherent concept	1			

Conclusions:

- Students needed help with making decisions. The only aim for decisions they were given were very general CE drivers (e.g. supply risk of critical raw materials). This appears to be insufficient for students to come up with selection criteria and make decisions.

6. What was most useful of the method, tools, information, etc. for designing a CBM?

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Clearly defined steps **Well organised steps, good sequence**			**5**	**Group 6**
BCC only used for checking, verification of design process **"Most steps were taken on an earlier day"** **"Took steps unconsciously" (!)**			**4**	**Group 5**
The BCC building block (four basic BM questions in box and arrows)			2	Group 7
Visual framework			2	
Easy expandable framework			2	
Patterns in general (CE butterfly + concept + PtL archetypes)	**4**		**1**	
Canvas provides overview of all things to take into account, **And how everything is linked**	**4**		**1**	
SWOT analysis			1	Group 7 (presented it as well)
CE butterfly diagram (→ patterns)			1	Group 8
Analysing SWOTs in the final schematic overview			1	Group 8
Start at the consumer			1	Group 9 (Ivo likes to do this)
Analysing the physical process (BCC step 2)			1	Group 9 (did this thoroughly)
EMF's four sources of value creation (→ patterns)	**3**			
The canvas in general	**3**			
Interrelations of BMC building blocks The BMC pattern	2			

"The way how blocks are joined by arrows"				
Design guidelines "The criteria by which we could test our model"	1			
PtL's CBM archetypes (→ patterns)	1			
Focusing on the BM	1			
BMC for idea generation ("once we had the idea, we stopped looking at the tool")	1	Group 3		
The four basic BM questions (who, what, how, why)	1			
Overview of stakeholders (general remark)	1			
"Isolating and identifying business activities, values & consequences"	1			
How a BM works	1			

Conclusions:

- Applying patterns enables participants to hop over the initial barrier of getting started ('blank page syndrome'). Furthermore they quickly give insight in the dynamics of a system. → Working with patterns for a BCC is very recommendable. IDEA: patterns of current best practice business cycles.
- I guess a **step plan** helps participants equally to get started.

7. What didn't work or was difficult?

Aspects	***# times (BMC)***	***Comments***	***# times (BCC)***	***Comments***
Start			**4**	
Estimate the largest opportunities **Choose direction**			**3**	"It now was random" (Gr.8)
SWOT	1		2	
Breaking out of the linear model / canvas / thinking	2		1	
Idea generation New CBMs	1		1	
Too much information required			1	
Look at components or materials			1	
Follow all steps precisely			1	
Looking at all components			1	
Estimate viability of the BM			1	
Criteria about material value is too narrow	1			
Make a good poster Show the loops	3	Group 1		
Keep it realistic	1			
New product	2			
Create a *circular* model	1			
Abstraction level			1	Group 9

Quotes:

- Group 4: "It was kind of hard to develop really 'out of the box' ideas, because you needed to 'follow' the model."
- Group 6: "The manual didn't inspire to make new ideas."

Remarks:

- Not being able to estimate the largest opportunities is related to not being able to use / apply SWOT.

8. What would you do differently next time you design a CBM? (suggestions for next time)

Suggestion	***# times (BMC)***	***Comments***	***# times (BCC)***	***Comments***
Accepting transitional CBMs which are not totally circular yet	1			
Focus on strengths	1			
Focus on stakeholder	1		4	
Focus on product	3	All group 4		
Focus on most important things			1	
More time needed	3		3	
More circular approach need	1			
Start with ideal situation instead of existing Start on a blank page	2			
No suggestions	1			
Don't know	2			
More info required			**10**	
Go through the process faster Make quicker decisions Choose low hanging fruit			2	
Consider different options			1	
More creative idea generation More brainstorming			1	

T. Unstructured observations TU Delft

Observations and interpretations

- BCC groups experienced a slow start. Many students got drawn back by the complexity of a business system. This made many groups stuck at the first two steps.
- All BCC groups got lost, more or less, in the complexity of possible focus areas for a CBM for Vodafone. Repeatedly they needed help at making choices where to focus on or with what aspects to proceed.
- Ivo (BCC group 9) finds the BMC more tangible and concrete. Interestingly, he comes up with an idea to put the BMC in a sequence, because a one customer is the other's supplier in a supply chain, which is closely related to the starting point of the BCC
- Ivo wants to graduate on a topic with SPD and sustainable business models (!)
- Marcel den Hollander commented the current systems approach of the BCC rather took an existing product as a starting point, around which a circular system is designed by the students. The approach lacks attention to product innovations (e.g. by using the ViP approach).
- I have a tendency to make things too complicated. Especially the manual. Many groups by far didn't make it to the last step and more room should be left open for participants to use their own knowledge and skills to execute tasks. Several routes to a CBM concept should be allowed. Only mention essential tasks or tools in the manual.
- Especially group 6 already came up with good ideas at early steps. How could creative ideation be facilitated whilst building up the system? I shouldn't restrict users to start ideation only after they have mapped the existing system and done a SWOT analysis (steps 1-5).
- Maarten would have liked to more easily go on with the low hanging fruit. This related to the remark about early ideation. I guess though that in a company setting you would like to see whether there are even bigger opportunities to grasp, behind the early and obvious opportunities you encounter when applying CE on BMI.
- BCC groups that drew value flows at all, almost always drew 2 flows, one to each side. All the examples provided by the Board of Innovation also only have max two flows between two boxes (Powerpoint with examples on their website). Does this mean something?
- The amount of questions in the post-questionnaire was estimated to be too much by the teacher of the students. However, the content analysis revealed that the entries resulted in more than enough valuable information.
- The exchanges of values (neither economic, nor social or environmental) were not really part of the pitches.
- Group 7 totally got into systems/value network thinking and presented a very clear and convincing CBM (they won and the teacher agreed)
    - Vodafone has been split over several process boxes!
- (!) Recycling seems to be some kind of plan B which must always be included to deal with other material flow drains, e.g. developing countries and low-level products (from smart phone to baby phone) as a dead end for material fllows.

On difficulties of using the BMC for CBMs:

- Group 3 questions whether the BMC is the right framework for a CBM. They filled it in and abandoned it for their final presentation.
- Participant feedback:
    - "Coming up with circular business models is made easier by having explicit circular routes which you can follow and adapt to your situation"
    - Stefan (group 3) "BMC didn't say anything about the return of products"
    - Ivo (group 9): "BMC is concentrated around one organization. It's difficult to use the BMC for the whole system"

Conclusions

Changes to method or manual:

- All BCC groups need more information at the start of the design process. First, simplification of the BCC manual is needed to not both with tools which are not essential (participants can use their own familiar tools). Second, recommend to focus on the low hanging fruit, 'obvious' opportunities for a CE model.
    - This means lessons/hand-outs/presentations about CE drivers and barriers related to the specific case should always be included. In a stand alone version, the manual should include generating creative ideas for CBMs (creative route) or making a **heat map** (analytic route), e.g. a SWOT analysis of an existing BM in a CE context to get to the low hanging fruit.
- Reduce the amount of steps, more room for people to find out the rather obvious steps themselves. Clear expectations of the result needed. Essential elements:
    1. 'Heat map': Identify main CE opportunities. What's your starting point?
    2. Map a closed loop/chain of business activities. What's your loop?
    3. Optimize on a system level. How does the loop (not only the business!) work?
- Elaborate the four basic BM questions. They need to be elaborated more to the concrete level of the BMC. What makes the BMC building blocks concrete enough to work with right away, where the four basic questions remain to abstract?
- Explore ways to merge creative ideation techniques with system mapping. How to use systems thinking – by boxes and arrows, or system dynamics mapping in general – to support creative ideation? This new way should not replace the old, more linear and more extensive analytic way, but complement or offer an alternative.

Practical

- Ask more to help with practical stuff, so I can observe and listen better.

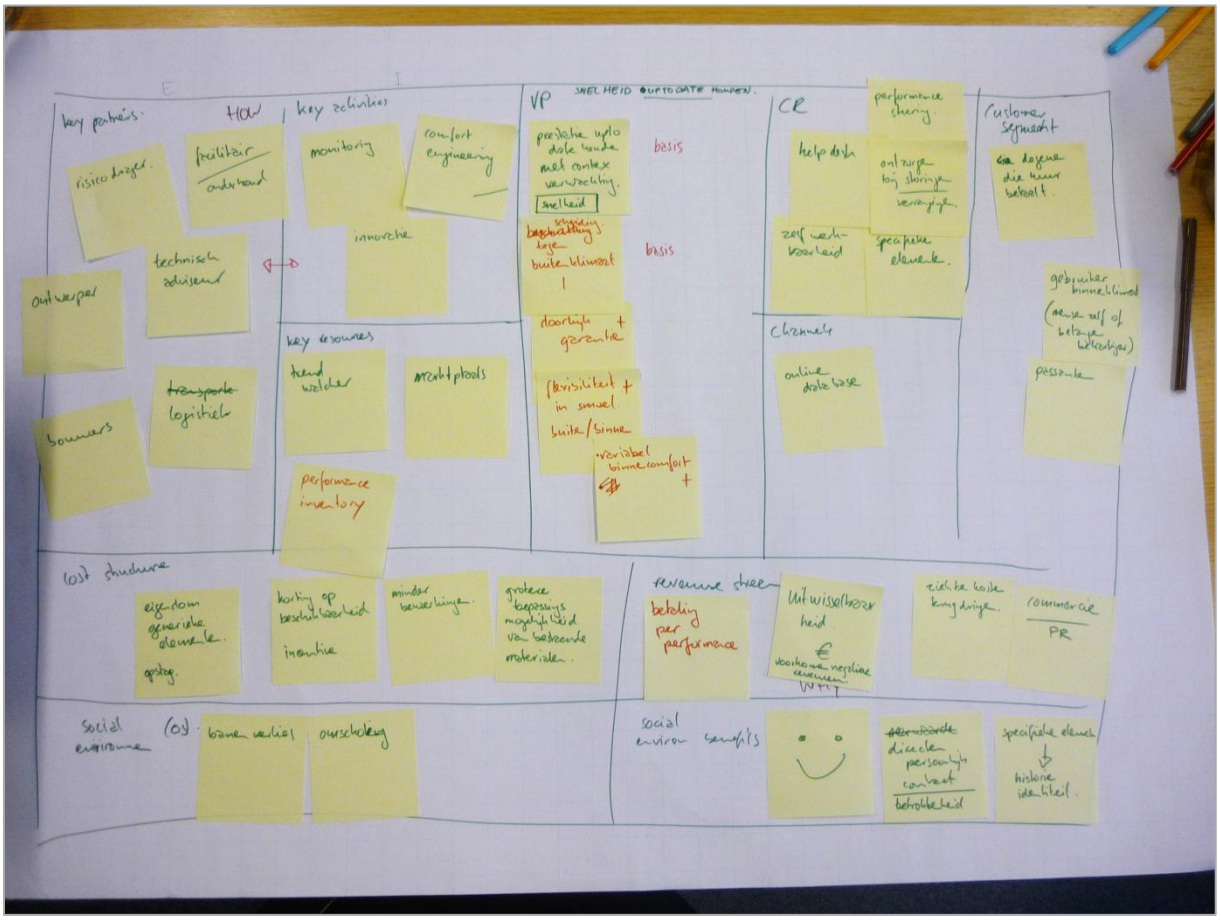
U. Results of workshop RHDHV Buildings

Group 1 / BMC group – Building components marketplace

This CBM is built upon the customer need to increase flexibility of his building's façade, as façade performances today often don't meet with changing needs of (changing) users. Façade BV manages a large inventory of building components with which customer's performance wishes can be fulfilled. I.e. the customers do not select components, but they define desired performance for which Façade BV selects the optimal components.

Some strengths: includes trend watching activities to anticipate better on future needs; ample identification of partners

Some weaknesses: very abstract; no strategy for unused old components (components nobody wants); (payment per performance forgotten on the canvas)

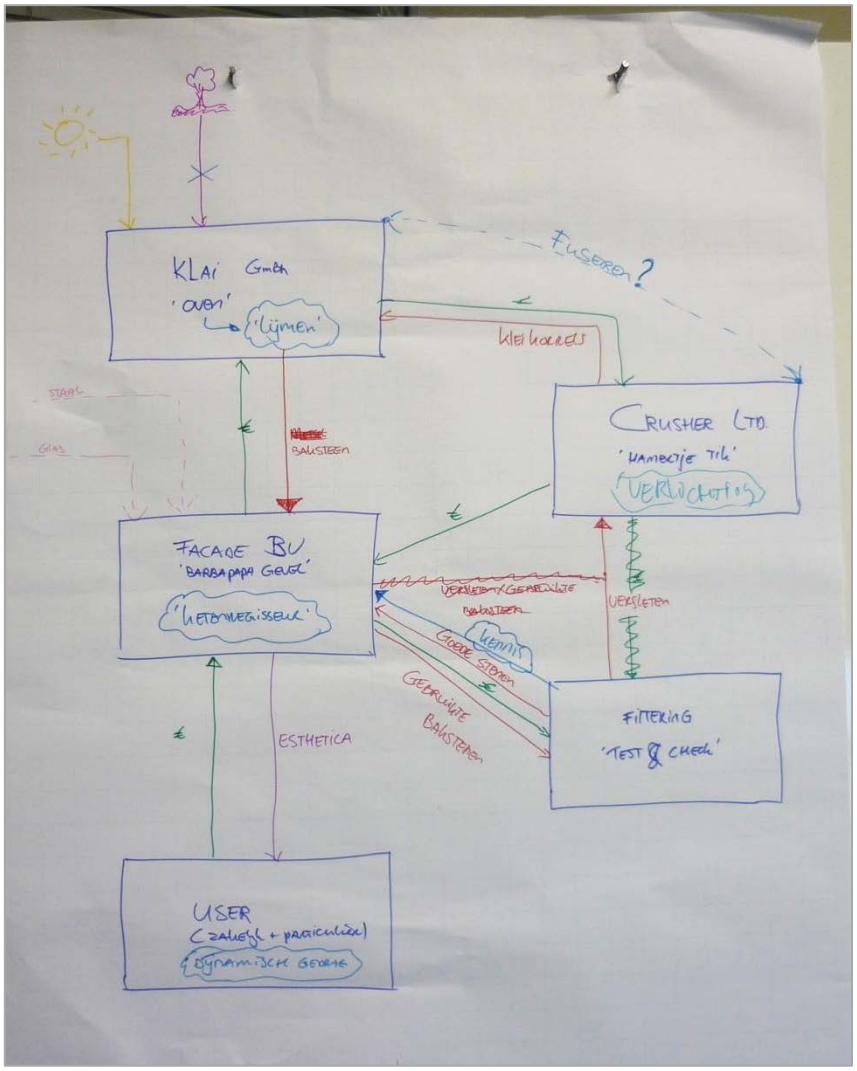


Group 2 / BCC group – Circular bricks

A new type façade system hold bricks together with a steel frame. Bricks can be stacked without use of mortar and are thus easy to separate. Various designs of brick façade can be made to meet aesthetic needs of customers or designers (architects). Collaboration with other partners is required to make this new type of 'circular bricks' and to win back new stones.

Some strengths: fully closed loop of brick and clay; identified requirements on system level (knowledge and material exchanges and collaboration or mergers)

Some weaknesses: no identified need (market/customers) of fast changing aesthetic needs; dependencies on other partners; are recycled bricks cheaper than new clay (especially in river deltas like the Netherlands) and will Klai GmbH support this system then?



V. Assessment of results workshop RHDHV Buildings

The CBM concept…	**1- Components marketplace**	**2- Circular bricks- Colombia**
Circularity		
closes material loops	-1	2
maintains the value of material flows by keeping them pure, non-toxic and/or easy to separate	1	2
Business rationale		
has clearly described a value proposition (what)	1	2
has identified a promising market opportunity (or customer segment) for this value proposition (who)	2	1
has a credible plan with required processes, activities, resources and capabilities to produce the value proposition (how)	2	2
is financially viable (why)	1	0
creates social and/or environmental value (why)	-1	-1
has an acceptable level of risk (why not)	0	-1
Innovation		
has a new value proposition (what)	1	1
has a new way to create the value proposition (how)	2	2
has new partnerships to create the value proposition (who)	2	2
Presentation & communication		
is understandable solely from the poster	1	2
is clearly communicated with the pitch	1	2
requires few clarifying questions after the pitch	1	2

Table 9 – Assessment of CBM concepts. Totally disagree = -2 / disagree = -1 / neutral = 0 / agree = +1 / totally agree = +2. Total weighted scores can be found in section 7.3

W. Analysis of evaluation RHDHV Buildings

Note: **question 1-3** are not displayed here. In question 1-3 participants have assessed their own CBM concept on circularity, business rationale and innovation (see Appendix O). Answers were used to verify the assessment done by the researcher. In case of large differences with the researcher's assessment, the researcher's argument has been reviewed and – after re-evaluation – the assessment has been adjusted or not. This verification has not been elaborated in this appendix.

Note on the interpretation of results: the same protocol for content analysis is used as in the pilot experiment, although the data source includes an evaluation interview next to a questionnaire, and the number of respondents is 4 instead of 44. Still, the number of times a specific aspect is mentioned by one of the interview respondents is counted, but the numbers should be interpreted differently. A high score is less guiding in ranking the aspects in importance, as has been done for the pilot experiment, since high scores can also be the result of one person repeatedly mentioning an aspect.

4. What went well in the process of designing a CBM?

Aspects	***# times (BMC)***	***Comments***	***# times (BCC)***	***Comments***
Optimize the BMs on a systems level			1	
Think of ideas for BM aspects	1			
Visualise the difference of a CBM over a linear BM			1	
Work together with different perspectives	1			
Enough space for other ideas Not too much structure	1			

Quotes:

- Michiel: "The BCC shows how the reverse material flow is used to improve things on the production sides."
- Michiel: "You really need to visualize a CBM. The BCC helps in doing so. If you don't have that, you fall back to the traditional or linear models way sooner."

5. What didn't go well

Aspects	***# times (BMC)***	***Comments***	***# times (BCC)***	***Comments***
Make a different product based on closing material flows	1			
Quantify Add numbers		BMC found easier to do this (see quote)	1	
Add concrete aspects of the BM			1	
Understand differences between canvas building blocks	1			

Quotes:

- Michiel: "The BMC has more concrete, specific and familiar aspects of the BM, to which you can assign economic value."

6. What was most useful of the method, tools, information, etc. for designing a CBM?

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Show the bigger picture of a CBM Think holistically	1	BMC is already bigger picture than regular practice (Teun)	1	BCC is even a bigger picture
Show important aspects for a strong business rationale	1			
Show responsibilities of different businesses			1	
Show dependencies on different businesses			1	
The four BM questions as guiding questions	1		1	
The components of the BMC were familiar	1			
Better tell our CE story to customers. Immerse better in customers.	1		1	

Quotes:

- Teun: "Normally I am used to focus on several aspects of the CBM. The BMC is a good tool to check the bigger picture."
- Michiel: "The BCC is a larger framework, which is necessary to close a cycle in the first place."
- Michiel: "The BMC has more aspects which are influential and necessary to convince Donald Trump."
- Michiel: "In the BMC you name partners, but you don't state what you expect from them and what contribution they must make to the whole. That's an important difference."
- Michiel: "The methods have a different focus, which leads to the collection of different information. It can be useful to use them both and add up and complement information."

7. What didn't work or was difficult?

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Focus on reverse material flows	2			
Elaborate more than one CE strategy on the canvas	1			
Show dependency and expectations of partnerships	1			
Show responsibilities of different businesses	1			
Show risks	2	Main reason why BMC concept was perceived to have better business rationale		

Quotes:

- Michiel: "You need several Business Model Canvasses to describe what happens in the different circles from the CE diagram."
    - "Every circle has a different customer, so that's why you need several BMCs"
    - "Describing all circles on one Canvas makes it too complicated and probably will be a mess."
- Teun: "The focus on elements in a holistic approach is difficult."

8. What would you do differently next time you design a CBM? (suggestions for next time)

Aspects	*# times (BMC)*	*Comments*	*# times (BCC)*	*Comments*
Use both the BMC in the BCC parallel			1	So from both perspectives they agree

				on this aspect
Integrate the BMC and the BCC			1	So there is no agreement among partners
Work towards numbers Add more concrete details		Next time interpreted as next step	1	
Focus on one VP	1	Next time interpreted as next step		
Focus more on value creation (the 'why' question)	1			
Balance long term and short term strategies (how it *should* versus how it *could* work)	1			
Seek collaboration with market parties	1	Next time interpreted as next step		
Add critical success factors Develop design principles	1		1	See (Bouwman et al., 2008)
More time to design the entire system (chain/network)			1	

Quotes:

- Thijs: "The BCC is another level of scale, so I find it hard to compare the two canvasses. I'd rather use them both and integrate."
    - Martine: "I wouldn't integrate them, that's too complex, but you can do the same exercise with both methods."
- Thijs: "You really need pilots to show concrete results and opportunities of CE and therefore we need numbers and other concrete details in the BM to really on convince parties."
- Thijs: "Changing one link can already be enough to be successful with CE. And that can already be done with just one extra arrow between two businesses."

Other quotes:

- Martine: "It looks like you have more choices in the BMC, but in the BCC you see dependencies better."

Conclusions

- The BCC shows risks related to a circular model (mainly dependencies, on other parties and on the system as a whole). The BMC doesn't.
- The BMC is more convincing because of more detailed content. This is a matter of time for the BCC, however I have questions around the representation of so much detailed information.

X. Unstructured observations RHDHV Buildings

Observations

1. One or more participants hadn't done the requested preparation of scanning the sent Powerpoint slides.
2. The experts around the table repeatedly wanted to discuss deeper on the matter presented in the introduction slides, whereas the facilitator wanted to only introduce information for the participants to use in their teams.
3. Too much information presented in the introduction. Although all information is highly relevant for a CBM, participants are not able to work with it all.
4. The difference between two CBM archetypes, the access and the performance model, was not clear.
5. The four basic BM questions mix up with another set of questions (what, how and why) by Simon Sinek (2009).
6. It took a while before the participants came up with content for the plenary SWOT analysis, but it did activate and engage them. The result of the analysis was usable for both groups. However, the printed slide was not used anymore during the process. Many of the content didn't return on the poster or in the pitches.
7. Participants read very little of the manual text. The facilitator repeatedly had to give them tips which were present in the manual as well.
8. Starting up creative ideation was difficult (BCC group) or totally absent (BMC group). Participants were unable to get into a creative, out-of-the-box thinking mode from the manual step. The BCC group managed to do so only after explicit explanation and motivation by the facilitator.
9. Interesting to see how the BMC group departed from the Key Partners building block.
10. Selecting a customer and defining a VP took a considerable amount of time.
11. The BMC gives the impression of more level of detail. Participants didn't have clear answers when they were shown how similar the two canvasses actually were in terms of information content (both performance model around façade elements; BMC had a bit more detail, but totally missed substantiation of activities of other stakeholders in the chain).
12. The setup of the evaluation interview wasn't ideal to retrieve all the information wanted/needed. The questions often weren't clear enough, time pressure was felt and – compared to the data of the pilot – answers of participants were much longer, whilst not adding much more relevant information than participants of the pilot study could give with short sentences or even key words on their questionnaire.

Interpretations

Numbers correspond with numbers of Observations (see above)

1. This probably will always be the case, so the workshop shouldn't rely too much on participants' preparation.
2. In order to run through slides quickly with experts, the presenter must ask the participants to only ask questions for clarification and not to start discussions about how to use it in the upcoming design workshop. That should be considered within the teams and during the workshop.
3. A stronger selection of information must be made (e.g. 8 slides maximum).
4. Adding two examples will clarify. In a performance model a company formulates rather abstract performance indicators with or without the customer. In the access model, this abstraction is not made. It is still possible to think in products. Example: "I want to have access to a car" (GreenWheels) versus "I want to have access to mobility" (fictive company 'Mobility Inc.').
5. In general, it should be noted that asking general term questions ('what' instead of 'value proposition') more often will cause participants to mix up with totally different frameworks using the same general terms. Specifically in this case, Sinek (2009) argues that the most best performing (innovative, profitable) companies "start with why" (inspiration) in communication to their customers. The set of questions (why, how, what, in this order) thus applies to marketing or the Customer Relationships building block. This should can be made clearly by showing the hierarchy between BM as a whole and marketing/customer relationships as a part.

6. The participants haven't given any specific feedback about the SWOT analysis, so only some observer's thoughts are given about the extent to which the SWOT analysis was a useful element in the workshop. It could be the participants had the information clear in their minds and did not need to view the slide, since all were familiar with the case, or have even worked on it. It is still remarkable though much of the content did not return on the posters and in the pitches. Especially on the BMC this is remarkable, due to its higher level of detail. The following content of the SWOT could have easily been integrated: no waste streams (→ KA/C$), innovativeness (→ KA/KR), multiple customers (→ CS), evade waste taxes (→ C$), dependence on users (→ CR). The absence of many Threats is understandable, for the BMC indeed doesn't provide much space for risk identification (Oskam, personal communication). However, since the BMC group also forgot an obvious revenue stream (payment per performance), it is likely the absence of content is **mainly a time issue**. Since both CBM concepts have clear starting points to defend a circular model and time is very limited, the use and the conducting of the SWOT analysis is judged as OK.
7. The facilitator can give further explanation, examples and motivation when working with 3 groups or less per facilitator. Else the manual needs elaborations.
8. One hour actually in general is too little time to create a creative mode successfully, especially for beginners (Cleese, 1991; Tassoul, 2011).[12] Still, participants have managed to conceptualize a CBM within an hour. → Adjust goals, don't ask too much. Important goal for first workshop is: learn something about the complexity of a CBM. Use CBM criteria to show this (complying to these automatically will show participants what it really takes to design a CBM…)
9. There is an understanding that the game changing aspect of CE lies somewhere at partnerships and collaboration. However, this hasn't led to a special improvement of the VP.
10. Consider giving a predefined VP and predefined potential customers. However, this contradicts with Marcel den Hollander's feedback on the pilot session (personal communication) that focussing too much on an existing (predefined) case distracts from thinking of completely new ways to fulfil needs, ways which may be extra advantageous for circular models. In other words, to escape from the current business logic (Frankenberger et al., 2013), and introduction should fill the minds of participants too much with information on the existing. Breaking with existing logic requires, among other things, not minding, or even not knowing, about existing rules, routines and such.
    A solution might be to focus on a specific stakeholder and **prepare a background slide** with information, to give the participants if they are stuck in the process because of a lack of information (they have too many questions they cannot answer, even with assumptions).
11. As participants noted in the interview as well, the two canvasses mainly have a different starting point (business vs system level). This should be kept intact and definitely has its consequence for the level of detail of individual businesses. This shouldn't be regarded too much as a weakness of the BCC, but more as a matter of time. With more time, more concrete details can be added to the BCC too. However, with more time, users of the BMC not necessarily arrive at a business system level.
12. The facilitator needs to give more structure and clarity to the participants, so they know what kind of answer is expected.

[12] That's is also way the use of patterns is so appreciated, since the imitation or adaptation facilitates quick generation of new solutions.

Conclusions

Notably strong points (with respect to improvement points of workshop TU Delft):

- Case preparation (focus on Façade BV and plenary SWOT analysis of the fictive company in a CE context)
- Size of the manuals (probably further explanation by facilitator needed, but this is manageable with 3 groups or less).

Improvement points

- Reduce information of introduction to a quantity which participants can apply right away in a workshop. Other information is overload and will only frustrate the design process. Put the rest in background slides to hand out later in the process, if participants ask about more information or inspiration.
- Stress importance of a quick session of creative ideation, before filling in the entire canvas. E.g.: innovative ideas are sometimes crazy!
- Add step to BCC for more details for those participants who have time left (the system is more important than the parts, but if there is time left, detailing will improve the CBM concept).
- Prepare a background slide with information on and around a stakeholder, which can be used as information input for a CBM concept.
- Structure the interview better for the participants (create more of a scientific interview atmosphere instead of an informal conversation): introduce the seven questions, mention you want an answer to all of them, mention the available time per question, ask for short answers and ask all participants for a (quick) response and their *own* opinion (contradictions and disagreements are allowed). Suggest to the participants to write down additional thoughts they want to share in a continued conversation after the interview questions.
- Don’t forget to make photos!
- Ask participants to what extent they find the SWOT analysis useful for designing a CBM

Y. Summarized transcription of evaluation of RHDHV Buildings

Related to section 7.3.
The evaluation was held in Dutch, so the transcription is kept in Dutch as well. The most important conclusions are collected in English section 7.3 and illustrative quotes can be found in Appendix W.

Afkortingen
BMC = Business Model Canvas (gebruikt door groep 1: Michiel en Teun)
BCC = Business Cycle Canvas (gebruikt door groep 2: Thijs en Martine)
CBM = Circulair Business Model

In hoeverre is het daadwerkelijk gelukt om een materiaalkringloop te sluiten?

Thijs: Als wij Klay GmbH kunnen overtuigen om grondstoffen uit de keten te halen, in plaats van uit de natuur, dan heb je al een mooie stap te pakken.
Michiel: Ik zie BMC daar niet geschikt voor [het sluiten van materiaalkringlopen]. De BMC is voor bedrijven, hun klanten en partners om een dienst te leveren. Dit gaat niet over de retourstroom. BMC gaat alleen over de heenstroom.

Waar zie je de obstakels om daadwerkelijk materiaalkringlopen te sluiten?

Michiel: Wij hebben het BMC ingevuld met een gebrek aan focus op de retourstromen. Partners zijn 'gewoon' partners en bepaalde belangrijke key activities mis je. Je VP en klanten kunnen bovendien grof wijzigen als je die wel meeneemt.
Thijs: Ik ben het niet helemaal met je eens, want het sluiten van kringlopen middels hergebruik zit er wel degelijk bij jou in. Je gaat immers uit van uitwisselbare gevelelementen. Dat stimuleert wel de circulaire gedachtengang. Het klopt daarentegen wel dat ontbreekt wat er met elementen gebeurt die je niet meer kan uitwisselen.
Michiel: Het maken van een ander product door het sluiten van de kringloop en het focussen op de retourstroom, zit niet zo in het BMC.
Thijs: je hebt in CE toch verschillende strategieën[13] om een kringloop te sluiten?
Michiel: je kunt wel van één CE strategie een kringloop maken, maar dan heb je wel meerdere canvassen nodig om in de verschillende cirkels te beschrijven wat er gebeurt. En daar kan je dan wel weer een samenvatting van maken, maar al je het in één canvas gaat vatten, dan wordt het te complex.

Hoe bepaalde partners in het business model zitten, komt niet goed naar voren, omdat we begonnen zijn met deze waardepropositie.

Je kunt wel bepaalde key activities benoemen die bij een CE horen, zoals het terugnemen van producten, maar dan veranderen ook de klanten. Dat is wat ik bedoel met de behoefte aan meerdere canvassen. Dat je voor verschillende CE strategieën verschillende klanten hebt, en dus ook allemaal verschillende bijbehorende building blocks. Dat wordt te ingewikkeld op één plaat.
Maar goed, op zich kun je het er uiteindelijk wel allemaal instoppen...

Thijs: ik zou Michiels BMC in ons BCC plakken en alles wat jij net noemde zijn de pijlen die in ons canvas aanwezig zijn. Maar eigenlijk zou je een BMC moeten maken voor de vier andere bedrijven. Want ik zie het BCC ook niet als één business model, meer als ketenmodel. Dat is een andere dimensie, dus ik vind dat lastig te vergelijken.

Hoe zou Dragon's Den deze CBMs beoordelen?

(= question about business feasibility)
Thijs: Ik mis getallen dan. Martine: maar dat waarschijnlijk een tweede stap.

[13] Repair/maintenance, reuse, refurbish/remanufacture & recycling (see CH.1)

Michiel: In de BMC zitten concretere, specifiekere en bekendere business model aspecten in, en waar je een duidelijke economische waarde aan kan toekennen.

Martine: waar Michiel het gevoel heeft dat hij [met het BMC] het circulaire proces minder heeft, zie ik juist dat ik kleinere concrete aspecten mis die een aanvulling zijn op ons concept. Ik denk dat je niet de twee modellen moet samenvoegen, want dan wordt het echt complex. Maar je kan wel dezelfde oefening met beide methoden doen misschien.

Thijs: De vraag is eigenlijk, kunnen we laten zien dat CE succesvol kan zijn en kunnen we de markt hiermee overtuigen?
Martine: ja, ik denk dat dat kan.
Michiel: Dat kan ik met de BCC wel. Los van de getallen, daar staat in dat je de retourstroom gebruikt om aan de maak-kant dingen te verbeteren. Een verbetering kan een besparing, meer kwaliteit of meer performance zijn. En innovatie.
Martine: Grappig, want ik zou het verhaal precies andersom vertellen. Je verkoopt het namelijk uiteindelijk aan een gebruiker. Je maakt [*met het CBM concept*] het oplossingenspectrum aantrekkelijker, zowel in kosten als in esthetica. Bijkomend voordeel is dat je de retourstroom oplost. Ik ben blij dat we niet alleen maar vanwege stijgende grondstoffenprijzen naar een CE gaan, maar dat we het verhaal ook op een andere [*meer klantgerichte*] manier kunnen insteken.
Michiel: ik denk dat het en-en is. Ik denk aan de Herman Miller bureaustoel. Dat bedrijf heeft zich gecommiteerd aan een ideële visie (gesloten kringlopen, vanuit C2C gedachte) en moest dus iets doen met de retourstroom. Om de retourstroom beter te kunnen handelen, hebben ze het aantal onderdelen teruggebracht. Daarna kwamen ze erachter dat het maken van de stoelen ook goedkoper was, want er zaten minder onderdelen in. Die link, die mogelijkheid tot kostenreductie door te focussen op retourstromen, had nooit iemand gemaakt. Daarom is die focus een belangrijke waarde.

Denk je dat één van de twee methoden meer geschikt is om te innoveren met CBMs?

Michiel: Het BCC geeft een groter plaatje, en geeft meer inzicht in wat er waar gebeurt. Dan heb je nog wel een verhaal erbij nodig, want een plaatje op zich laat het (wat?) niet zien. In de stroom van Facade BV naar de klant gebeurt een heleboel en in de stroom daarachter ook, en dat heeft met elkaar te maken.
Michiel: Als je het puur hebt over retourstromen, wat krijgen we terug in onze fabriek en wat doen we ermee, dan denk ik dat het BMC sterker is. Daar staan meer factoren in die van invloed zijn, en die nodig zijn om Donald Trump te overtuigen.
Maar zodra je afhankelijk bent van andere partijen... *[geïnterrumpeerd door ander persoon]*

Michiel: ik vind jouw [Thijs'] idee welk aardig om de BMC te stoppen in elk van de partijen die je in je BCC hebt weergegeven. Als je de VP van de verschillende onderdelen weet, kom je ook de VP van de hele keten terecht. Als je het hebt over Facade BV als ketenregisseur, ben je afhankelijk van andere partijen voor het succes. Als er één schakel uitvalt, valt het model stil. Dat zie je niet in de BMC terug, die kan er ook nog uitzien als een 'gewone' business.

Waar zit het 'm in dat het BCC te weinig aanleiding gaf om op concrete invulling voor (circulaire) BMs te komen?

Thijs: je vraag is eigenlijk, waarom kunnen we Donald Trump beter overtuigen met het BMC?
CE vraagt iets waarop veel bedrijven niet zijn ingericht. Je gaat veel meer samenwerken met elkaar. Dat zal Donald Trump aan zijn reet roesten, als dat bedrijf van hem maar succesvol is.

Wat zit in het BMC wat Donald Trump aantrekkelijker vindt?

Michiel: BMC is herkenbaardere (bestaande) structuur. Elke verandering is lastig en moeilijk. CE is veel complexer, dus de risico's voor succes zijn veel groter. Aan de andere kant, als het lukt zijn de kansen ook veel groter. Maar voordat je daar bent... je hebt veel meer afhankelijkheden voor succes.

Thijs: Je ziet de risico's van een CBM niet zo in het BMC
Martine: Het oogt alsof je in het BMC meer keuzes hebt, terwijl je op het BCC de afhankelijkheden beter ziet.

Is het daarom geen kwestie van visualisatie?

Thijs: Ik had de indruk dat je als je als bedrijf in de CE wil opereren, je eerst het BCC gaat invullen, en aan de hand daarvan ga je het BMC invullen.
[Antwoord op andere vraag]

Aanvulling Michiel per mail: is het BCC misschien een meer publieke taak, hier zitten lange termijn winsten in voor de maatschappij; dat botst misschien met korte termijn bedrijvigheid; ook risico's voor lange termijn functionering van de cycle is wellicht te groot; de keten is zo sterk als de zwakste schakel<
Een praktijk voorbeeld is een stichting die vlakglas inzamelt voor de glasindustrie, opgezet door de glasindustrie zelf. Deze draait met positieve resultaten, maar te weinig om er als een bedrijf in te investeren… daar zit precies de spanning… het kan, en het lukt, maar het past niet in het bedrijfseconomische denken van de westerse maatschappij. Wellicht zou je voor deze stichting een BMC kunnen opstellen.

Wat zijn dan belangrijke dingen die je tegenkomt als je met het BMC verdergaat?

Michiel: Het BMC vult in wat er tussen twee partijen op concreter niveau gebeurd. Misschien is het BMC daarom wel een soort 'business contract'. Het BCC is een groter raamwerk, wat nodig is om überhaupt een gesloten kringloop voor elkaar te krijgen. Als daar iets mis valt, houdt het gelijk op, terwijl individuele BMs kunnen dan nog steeds wel kunnen werken.

Waar zit het 'm in dat het BCC te weinig aanleiding gaf om op concrete invulling voor (circulaire) BMs te komen? (2)

Thijs: Volgens mij is het de schaal. Als ik naar Donald Trump ga, dan gaat hij eerder voor een simpel model. Het BCC laat de afhankelijkheden en risico's heel goed zien. Het gebruik van het BMC heeft geen expliciete aandacht voor de keten, waardoor je veel minder risico's hebt, of ze in elk geval niet in één oogopslag ziet. Voor een CBM is dit een zwakte, want je wil juist aan zaken werken buiten je traditionele invloedssfeer. Kennis van producten moet gedeeld worden met de hele keten.

Martine: Het BMC is herkenbaarder, omdat het focust op de business activiteiten rondom je eigen bedrijf. Met het BCC word je gedwongen om de rest van de (circulaire) keten ook te bekijken.

Thijs: Het BCC is ook maar een samenvatting, ook maar een begin van de hele keten (of het hele netwerk) die betrokken is bij een CBM.

Michiel: Je moet het wel over de hele keten hebben. Als er een schakel weg valt, dan werkt het niet meer. Je moet je met andere dingen bemoeien en je moet er verantwoordelijkheid voor nemen dat het ook op de langere termijn blijft werken. En dat je daarvan leert en dat je je bedrijfsvoering verbetert en blijft verbeteren.
Aanvulling Michiel per mail: de gehele keten inclusief klanten staat aan dezelfde kant van 'ontwerp' opgave. Opgave omvat zowel de business als de content van producten / diensten.

Michiel: In een CBM leer je van een helpdesk of anderszins feedback van gebruikers. Daar wordt nu wel over nagedacht, maar alleen maar om nieuwe producten te maken en niet hoe oude producten daarvoor ingezet kunnen worden. Dat komt als beeld sterker naar voren met het BCC. De verantwoordelijkheid die je aangaat met een CBM zie je terug in het BCC, en niet in de BMC. Je BM wordt concreter met het BMC. Je komt daardoor misschien makkelijker op meer ideeën, omdat het kleinschaliger en overzichtelijk is, maar je moet het totaal willen overzien.

Michiel: We merken bij veel mensen die we spreken over CE dat het echt iets anders is, en dat moet je visualiseren. Het BCC doet dat. Als je dat niet hebt, is het heel makkelijk terug te vallen op wat we al kennen [bijv. lineaire modellen]. Als mensen dat plaatje zelf moeten verzinnen, wordt het veel moeilijker.

<u>Aanvulling Michiel per mail:</u> elke kringloop in het algemene CE model heeft zijn eigen BCC; anders gezegd: het BCC heeft meerdere lagen / cirkels met andere samenwerkingsvormen en uitwisselingsmomenten (dienst, euro, materiaal etc). Dit levert dus ook een diverser palet van diensten en producten op in het BMC, met een grotere schare klanten…
Tot op detail niveau fileren van hoe de cirkel in elkaar zit is noodzakelijk, om daarna eventueel weer clusteringen te maken. [vergelijk EPEA met C2C: zij maken als eerste een assessment op molecuul niveau en parts per million van wat in de materialen zit, om daarna te bekijken wat je ermee kunt of moet doen. Een dergelijk proces zou je voor het BM ook moeten doen; we zijn echter geneigd om dingen snel te clusteren]

Michiel: In de BMC zeg je wel wie de partners zijn, maar je zegt niet wat je van ze verwacht. Welke bijdrage ze in het grotere geheel leveren. Daar zit een belangrijk verschil.
Ze zijn partners en dat impliceert misschien dat ze je helpen met je value proposition. Maar omdat het een gesloten keten is, en het retourstromen betreft, moeten jij of je partners wellicht conformeren. Dat kan belangrijke gevolgen hebben voor de value proposition die je eigenlijk van plan was te gaan creëren.

Michiel: Wat wel waardevol is aan het gebruik van beide methoden, is dat er met twee verschillende focussen informatie wordt verzameld. Die informatie kan elkaar waarschijnlijk zeer goed aanvullen.

Vervolgstappen

Enerzijds stelt Thijs voor om met een focus op bepaalde materiaalstromen mogelijkheden voor CBM te zoeken. Anderzijds is Martine ontevreden met die focus, omdat een focus je gelijk in een bepaalde oplossingsrichting duwt (bijv. een bepaald constructiesysteem), waar wellicht überhaupt niet de grootste kansen zit.

Thijs: We moeten als organisatie een bepaalde dienst gaan leveren, maar het moet concreter worden dan het roepen om standaardisatie, lease modellen en hergebruiken. Pilots zijn noodzakelijk om aan klanten enige haalbaarheid te kunnen laten zien.

Michiel: Ik heb vraagtekens bij de denkkracht van bepaalde partijen. Ze zien teveel risico's en laten daardoor niet het achterste van hun tong zien [→ information exchange].

Michiel: Als het voor ons bedrijf business wordt, moeten we toch met partijen in de markt, zoals het nu is, iets proberen te doen. Dat is de enige manier om het te doen, want ik zie ons niet zelf een business line "Circular Economy for buildings" ontwikkelen.

Vonden jullie het een nuttige ochtend?

Michiel: Je doet het leuk. Je bent gedreven, je weet je wat je wil. Maar je staat ook ruimte toe voor andere ideeën. En structuur is niet het belangrijkste.
Thijs: Ik vond het een goede workshop en je hebt ons goed geleid. Zeker gezien het feit dat je 10 jaar jonger bent dan de rest.
Thijs: Why, how, what and how zijn goede eyecatchers om te gebruiken. Wij hebben al best veel dingen gedaan, maar we missen een dergelijk framework in ons dagelijks werk.
Thijs: Ik dacht alleen, bij een BM horen ook getallen. Maar dat is misschien de business case die je dan krijgt.
Bas: Je kunt het ontwikkelen van een BM zien als een iteratief proces. In een latere iteratie zou je dan getallen kunnen toevoegen.
Thijs: Op dit schaalniveau kun je geen getallen invullen, want alles wat je invult is toch fout.

Thijs: Qua concretisering was de Cranenborgh case al vrij concreet en was deze ochtend juist weer een stapje terug eigenlijk. Het was wel goed om te leren hoe een BM op te bouwen, maar zaak is wel om nu door te gaan. Hier kunnen we namelijk nog niets mee, als we hier een artikel over schrijven en het land ingaan, zo van 'we vinden het allemaal mooi.'
Michiel: Waar wij op zoek moeten gaan is een case met een mooie 'why'. Gewoon één value proposition, met wat variaties daarin, en daarom doen we het. En dan kun je een CBM er omheen verzinnen.

Thijs: En je hoeft maar één klein schakeltje te kantelen om succesvol te zijn. En dat kan al één pijltje zijn [*tussen twee businesses in het BCC*]. Dat is al het begin.

Hadden jullie de verwachting om getallen uit de Cranenborgh case te verwerken?

Thijs: Nee, maar ik had het wel wat economischer verwacht. Maar je studie vraagt er ook helemaal niet om.
Michiel: Ik had het bedrijfskundig verwacht, en daar valt dit wel onder. Ik had geen concrete verwachting, maar ik heb wel een stap gemaakt in het compleet denken van iets heel anders.

Welke zaken van vanochtend neem je mee in je werk?

Thijs: Zulke plaatjes hebben we wel eens eerder gemaakt, maar de vier BM vragen brengen wel meer structuur en helderheid aan.
Michiel: ik zie deze sessie om ons verhaal over CE dat we willen vertellen beter te vertellen of in elk geval specifieker, naar een specifieke doelgroep. Dus als je het hebt over zakenmensen die een beslissing voor een pilot moeten nemen. Die staan er anders in dan wij, en daar helpt de expliciete why-vraag bijvoorbeeld bij, om daarover na te denken vanuit hun perspectief in plaats van de onze.
Martine: Ik herken me wel in wat Michiel zegt.
Martine: ik vraag me af of een huidige business developer zijn huidige dienst moet wijzigen naar iets circulairs, of heb je een professional nodig die deze amibitie kan volgen en dit (apart) eens moet voorstellen bij de klant?
Jouw vraag moet ik nog even laten bezinken.

Companies need new business models to grasp the opportunities of a circular economy. This thesis investigates to what extent existing frameworks, methods and tools for business model innovation are useful to cope with the challenges of designing and implementing circular business models. To innovate towards a circular business model, the use of a new framework and tool is recommended. The Circular Business Model Innovation framework outlines a process of 18 typical obstacles – or challenges – which should be taken into account. The Business Cycle Canvas supports practitioners to think in systems and develop supply chains with a closed material loop, one the most important challenges when designing a circular business model.