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The internal barriers and drivers of implementing circularity in companies, after joining a circularity training

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ABSTRACT

Circular business model innovation is an important factor to drive the circular economy. For businesses to innovate to a circular business model, change needs to happen internally. However, this change can be impacted by various internal barriers and drivers. One possible intervention to support businesses in this process is circularity training, which is focused on evaluating the current business model and bringing forward a concrete circularity implementation idea. Nevertheless, the participating companies are still encountering different internal implementation factors which hinder or enhance circularity innovation. These are the resources of the company, the knowledge and organisational factors. Depending on the case company, these factors acted as a barrier or as a driver for circular business model innovation and implementing circularity. Among others, the research showed that the circularity training helped with overcoming the knowledge barrier of silo thinking. Furthermore, the resource barrier and driver showed the importance of time investment and financial value of circularity for the company. Finally, the research concludes with various recommendations for the training, based on the internal barriers and drivers that the companies encountered when working towards circularity implementation and circular business model innovation after the circularity training.

Keywords: Circular business model innovation, Circularity training, Barriers and drivers

TABLE OF CONTENT

LIST OF TABLES AND FIGURES

INTRODUCTION

The general problem is, that in the current economic system, more resources are used than the earth can regenerate, exceeding planetary boundaries (1–3). Therefore, an alternative system with a focus on sustainability is needed, such as the circular economy (CE) (4,5). It is referred to as a more sustainable industrial paradigm, focussing on environmental impact, resource scarcity and economic benefits (5–8). Compared to the current system, which is a linear economy making use of take-make-waste behaviour, CE adopts borrow-use-return behaviour for the production systems, with closed-loop resource flows (5,6,8–14). To close these resource loops co-creation is a possible strategy, as the companies rely on their stakeholders, like customers and suppliers, to return the materials (15,16). Moving from a linear consumption to a circular, closed production system, means that resources can generate more value as they are being used for a longer period of time (5,8,14,17,18). Scholars argue for different resource efficiency strategies for companies implementing circularity, such as reduce, reuse, recycle, redistribution, and remanufacturing, which are also working towards a product life extension (6,8–11,14,17,19,20). It is needed for businesses to collaborate when implementing these circularity strategies and changing the way they are operating, to work towards a CE (7,10,21). Businesses are an important part of the current economic system and are therefore also essential for the transition to CE (4,7,22). Hence, this research is focused on exploring what factors affect companies working towards a CE however, adding the intervention of joining a circularity training.

It is known that one of the requirements for businesses to implement circularity strategies is the adaption of their current business model (BM), moving from a linear approach to a circular one (5,8,14,17,23). This means that the business must either change elements of the current BM or design an entirely new one, making use of business model innovation (BMI) (14). BMI can

play an important role in enabling circularity strategies and their implementation (17). In the context of the CE and circularity strategies, BMI is extended to circular BMI (CBMI) (4,5,10,24). CBMI belongs to the category of sustainability BMI (SBMI), which focuses on organisational and social changes in business practices (25,26). CBMI is linked to several internal and external barriers, thus incentives have to be created to motivate businesses to engage in the change towards circularity (27,28). Especially internal factors are important, since BMI results in organizational change (5,27,28). One driver for implementing circularity is training the employees (28,29). However, there is a research gap regarding the internal barriers and drivers which are encountered by businesses implementing circularity and CBMI, specifically after participating in a circularity training.

This research aims to capture and understand the internal barriers and drivers which companies encounter when working towards CBMI and circularity implementation after joining a circularity training. Therefore, the rationale for the study is the contextual and theoretical contribution, focussing on theory testing and enriching, adding to the knowledge base on circularity training as an intervention for CBMI and the related internal barriers and drivers. This is also addressing the gap between the established concepts of barriers and drivers and the experience in practice (30). Additionally, there is a lack of taking businesses as the unit of analysis when looking at CBMI (8). Therefore, the objective of this research is to explore the internal barriers and drivers, which companies encounter when implementing circularity and working towards CBMI. Hence, the following research question is investigated: "*What are the internal barriers and drivers for companies to implement circularity and work towards CBMI after completing a circularity training?".* This research question is being answered, making use of a cross-sectional study, conducting semi-structured interviews with participants from different companies that have joined in the following circularity training.

In the case of the circularity training provided by the case organisation, the training is focused on assisting companies to operate in a more circular way, by redesigning their services, products and business models. The companies that participate in the training are considered established local companies which are operating in the sectors of plastic, construction, consumer goods or manufacturing. All of these are product-based businesses, therefore aiming for circularity is applicable (7,8). Part of the training is to develop a circular business model and implementation idea and then set up short- and long-term plannings for its implementation, which relates to initiating the CBMI. The final step of the training is to pitch the circularity idea to the company and call for action internally. The training consists of three workshops, where four to eight companies work together on circularity ideas and operational opportunities. The companies that participate in the training bring an external partner with whom they would like to work together towards implementing a circularity innovation. The participants focus on one specific idea together with their partner and work it out into an actionable plan in the course of the training while being supported by the present circularity trainers. The training is being provided by an association that is focused on regional circularity enhancement.

Moving on, the structure of the research is as followed, next the literature review will be introduced, which is followed by the results section, then the discussion chapter and finally the conclusion.

LITERATURE REVIEW

The theory chapter discusses the topic of circular business model innovation further, which is aimed to be the result of the circularity training. Furthermore, the internal barriers and drivers for implementing circularity are introduced based on existing literature. Finally, the circularity training as an intervention is illustrated, as all three concepts are addressed by the research question.

Circular Business Model Innovation

A CBMI enables the move from a linear business model to a circular one (5,8,23,31,32). Generally, BMs are about how a business creates value, delivers and captures it (33,34). This means that the value is the central aspect of the BM (5). Additionally, the BM shapes the strategy of the business related to internal activities and stakeholder relationships (8,17,35). CBM, also known as Circular Economy BM, is a different type of BM (10). Since circularity is a step towards sustainable development, CBMs belong to the category of SBMs, which aims to create shared value (5,34,36). This goes beyond the economic value and includes social and environmental values as well (5,29). That means innovating the current product which is central to the BM, by revising the current way value is created, delivered and captured by the company (4,17,29,31). This revision and innovation process is generally called BMI, however since the focus is on moving from a linear BM to a circular one, it is called CBMI (24,37). Scholars argue in different directions when it comes to the classification methods of CBMs, including the direction of the Ellen Mac Arthur Foundation, from Osterwalder or a hybrid option of both (10). The Ellen MacArthur Foundation is building on the ReSOLVE framework for CE strategies, while Osterwalder makes use of the business model canvas method (10). Focussing on the value aspect, the circularity idea brings in the extension from value proposition, creation and delivery, and capture to an extended value proposition with value creation and delivery to value

recreation and redelivery and finally, the value capture adds the recapture (see Appendix A for Figure 1) (38–40).

BMI is a process which includes different levels of organisation design perspectives on institutional, operational, and strategic levels (29). The process starts with the ideation, followed by the implementation, and finally the evaluation of the innovation (5,41). Furthermore, this process can happen at different levels of detail, ranging from conceptual changes to operational practices (5). Focussing on the application to practice, a starting point could be to emphasise product durability and product life extension, which could result in slower resource loops as well as the introduction of a recycling approach to close the loop (14,39). Moreover, businesses may adopt circularity on the different levels of the value network and customer value proposition and interface (8,17). A focus on the first is called upstream circular, meaning an emphasis on the supply chain and internally making the product design more circular, rather than communicating this to the customer (8). Being downstream circular means focusing on selling the idea of being circular, while internal product design improvements or supply chain changes have not happened (8). Another option would be that neither has been adopted to circularity, which would mean that the company continues operating in a linear way. Finally, the combination of adopting both levels would mean that the company has achieved being fully circular, which involves internal and external changes, including production processes, suppliers, and customer relationships (8). For example in the case of the supply chain, BMI looks at moving from a forward supply chain in a linear setting, to adding a reverse supply chain (6–8). This means introducing return flows by collaborating with different intermediaries, including the producers as well as the end users to recover the materials and reintegrate them into the value chain, making use of resource efficiency strategies (7,10,14,17,37).

Looking further into the possible strategies which firms can pursue for CBMI, an important concept are the archetypes from Bocken et al., as they can help a company with adopting sustainability principles (25,42). Specifically focussing on the concept of circularity, the archetypes ‘creating value from waste’ and ‘maximising material and energy efficiency’ should be mentioned (10,42). The aim of ‘creating value from waste’ is reducing the use of virgin materials, while the archetype, ‘maximising material and energy efficiency’, aims to use fewer resources and energy in products and activities (42). In both of the archetypes, there are opportunities in the material flows through resource efficiency strategies (5,17). However, there are also certain challenges associated with these archetypes, namely legislative pressure, economic incentives and, awareness and understanding among market participants (25).

Implementing circularity or working towards CBMI results in organisational change, as the innovation ignites different internal changes within the company by engaging internal and external stakeholders (5,17,28). One of the options for established businesses is to implement sustainability strategies, such as circularity, after participating in a circularity training (43). Integrating circularity into existing businesses is a process, which requires change management for sustainability (7,9,44). This means that integrating a CBM involves changing the way the company currently operates, thus resulting in internal changes (17,27). The extent to which businesses engage in circularity can be categorised into different sustainability phases, which range from defensive and inactive to transformative and proactive business approaches (27,35). Businesses can move from one stage to the next, for example by engaging in CBMI (45).

Barriers and Drivers for implementing circularity

It is already known that companies are experiencing various barriers and drivers on different levels, when aiming to implement circularity innovation strategies into their BM, including working towards CBMI (13,29,32,34,37,46). Even though these barriers and drivers can be

internal or external, because external factors are an important part of the CE, the focus of this study lies on the internal ones so related to organisational change (11,47,48). According to Blanco-Portela et al., it is important, on the one hand, to identify drivers for sustainability implementation, to serve as an example of good practices for other companies, and to motivate the integration of such practices (47). While on the other hand, identifying the barriers can help to anticipate issues and prevent them, aside from overcoming barriers also exemplary for other companies (47). The latter is important as the barriers can slow down or stop the implementation of a sustainability strategy, such as circularity (47).

There are different categories in which the internal barriers and drivers can be separated, and based on the literature, the following categories were established for the purpose of this research, namely organisational, knowledge and skills, and financial (see Appendix B for table 1) (11,12,20,23,47). The first one is the organisational category, which includes for example the compatibility of circularity with the existing linear operations and targets, as well as the business culture (20,44,49). Also, management support and commitment is an important factor since strategies and long-term planning is required, as well as achieving internal cooperation (8,20,23,24,27,37,44,47). This includes complex management and planning processes which are associated with additional administrative work (11,12,20,47). Furthermore, on the organisational level silo thinking and risk-averse management, are important factors that should be accounted for, as businesses tend to fear taking a risk and therefore continue doing business as usual (13,20,34,47,49). Moving on to the category of knowledge and skills, the important factors are, technical know-how, expertise, and information and data, to work on the circularity of product design and material flow, meaning managing the product lifecycle (11–13,20,23,34,37). Furthermore, sharing knowledge along the value chain, so the supply and demand network of the company, has been mentioned to be another vital activity to achieve circularity (11,20,48). This is because certain circularity activities depend on the return flow of

materials, which is relying on collaborations or partnerships, or co-creation, making this another important factor for implementing circularity (7,8,10,14,15,17,37). These resource recovery activities are needed to extend the life of the product, parts or materials, which then creates additional value, making use of different resource efficiency strategies, such as recycling or repairing activities for example (7,14,17). Finally, the financial area includes amongst others the financial resources of the company, the future financial business case and the investment costs (12,20,27,34,37,49). A common financial factor of circularity is the risk of cannibalization, as the resource efficiency strategies are said to lead to decreased sales, due to the extended product life (8,17,37). All these different factors together form the internal barriers and drivers for implementing circularity and working towards CBMI, to which this research adds circularity training as an intervention, as Figure 2 shows.

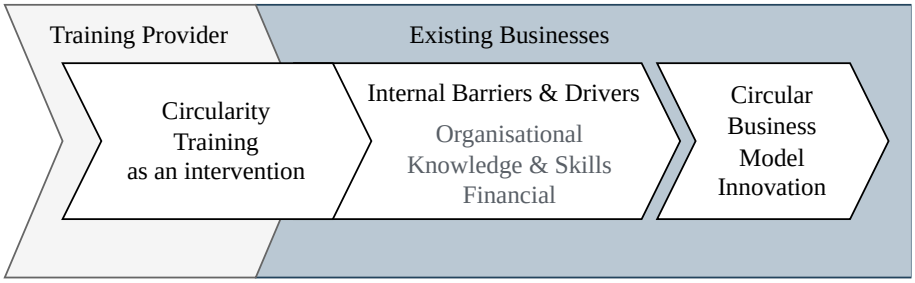

Figure 2: Conceptual Model

Circularity Training

Innovations such as CBMI can be driven by various interventions, for example by the government through regulation and legislation on circularity (50). For the purpose of this research, the focus is on training as an intervention, specifically circularity training, to drive circularity innovations (29). Training generally, is a tool companies use to educate their employees and initiate certain thought processes and actions aiming at innovating the current way of working (51,52). This includes innovation workshops, as an external force, with interactive meetings which are focused on innovating the current business by implementing

circularity for example (16,53). In the case of circularity implementation, training the employees is a vital driver for innovation, showing the importance of circularity training as a dynamic concept in the context of CBMI (28,29). However, that does not mean that circularity training addresses all barriers and drivers for implementing circularity.

METHODS

Research Design

For the purpose of this study, the qualitative research method was chosen because the research aimed to understand the process of implementing circularity after a circularity training. It made use of existing concepts and connected them, to comprehend the implementation process of companies that joined the training in circularity. The chosen design for this study was a cross-sectional study, as this approach disregards the unique context of the different cases and focuses on the sample of cases, aiming at generating more general findings (54). This also means that this study was abductive, as it researched which internal barriers and drivers the companies were facing and extended the existing literature with the findings.

Data Collection

For the data collection, semi-structured interviews were held because it allowed staying on the topic with to the interview guide (see Appendix C), but also provided flexibility and space for the interviewees to elaborate on certain questions and go more into depth (54). The interviewees were the participants of the circularity training, coming from different companies which completed the training between, November 2020 and February 2023. The case organisation was the gatekeeper to these interviewees, as they have an overview of the participants' information. The interviewees were chosen and contacted by the case organisation and invited to participate in the research. An invitation to join the research was sent via email to potential participants, with the researcher in cc to create the connection. Consequently, the sample consisted of different participants, coming from various industries who joined different training sessions (see Appendix D for table 2). In total ten interviews were conducted, until data saturation was reached, as aspects were reoccurring. The data collection procedure included that the interviews were all held between Monday and Friday, during working hours online in Google Meet. The interviews lasted up to an hour, which allowed for in-depth data collection. A pilot interview

was done with another participant of the circularity training, to minimise the possible leading question bias and question order bias, meaning the interview guide was revised accordingly.

Data Analysis

For the data analysis, the transcription tool otter.ai was utilised, and the software atlas.ti was chosen for the coding procedure. The analysis was based on the six steps of the thematic analysis approach (55). Starting with familiarising with the data, the researcher worked through all transcripts within otter.ai, also to eliminate any mistakes that were made by the transcription tool. While working through the transcripts some notes were already taken regarding possible results. Next, the researcher generated the initial codes in atlas.ti making use of an abductive approach, by combining codes from theory while being open for new codes. These codes were structured using colour coding, which was then used to create code groups and then themes in which these code groups fitted together. Afterwards, the themes were reviewed, combining themes and creating new themes with code groups. Once all themes and code groups were finalised, these had to be structured, by looking into relations between them, resulting in the coding scheme (See appendix E for table 3). Finally, the themes were used to write up the results section.

The quality of the data is ensured by transferability through a transparent research procedure. Additionally, data triangulation was exercised with some companies' websites to ensure the credibility of the data. Nevertheless, possible biases must be taken into consideration. In the case of this research, the social desirability bias was expected of the companies overstating their circularity actions. However, as the interviews were semi-structured, the opportunity was given to adjust a question or reformulate it to minimise social desirability. Furthermore, a possible literacy bias should be mentioned as the interviews were held in English which is not the interviewees, nor researchers first language. However, it was offered to the interviewees, that

questions or words could be translated into Dutch if needed. Finally, a common limitation of qualitative research is the lack of consistency, which was aimed to be overcome with the homogenous interview timing.

Ethical Considerations

For ethical considerations, the research complied with the code of conduct of the University of Groningen and was in correspondence with the university's GDPR legislation. The potential participants received a research information sheet and an informed consent form with their Google Meet invitation (see Appendix F& G). The information sheet introduces the topic of the master thesis and outlines the expectations. The consent form was signed and sent back before or shortly after the interview. Additionally, at the beginning of the interview, the participants gave their verbal consent for the research participation. Finally, the data was anonymised and handled confidentially.

RESULTS

With the focus on CBMI after joining a circularity training, the data analysis brought forward different themes, which are the circularity implementation, the internal implementation factors and the external implementation factors. The internal implementation factors, are the internal barriers and drivers.

Circularity Implementation

The circularity implementation refers to the operational approach or actions that were executed in connection to the circularity training.

Circularity Approach. The interviewees mentioned different examples of ways that circularity is part of their operational business approach or how it became part of it due to the circularity training. A key point of implementing circularity, which was stated, is that innovation is a continuous process of trying new things and gaining more knowledge. Furthermore, various examples of implementing circularity and the importance of circularity innovations for their approach were stated by the interviewees.

> "*[…] during the [circularity training], we started looking at the complete business case. And by doing that, we were able to alter the way of thinking and we saw solutions on how we could fit things together. And by doing that we not only are going to be able to offer a more circular product but also combine it with different demands." (Interviewee 1).*

Also, the challenges of innovating and implementing circularity were shared in the interview, as it requires time, manpower and money to be able to change the current way of working. Some of the operational opportunities were easy to seize in the daily operations as they were small simple changes that were implemented right after the training. One example shared by multiple interviewees is collecting certain waste streams to potentially create value from it,

which was mentioned to be a rather easy change innovation to implement. Others stated being focused on complex ideas that were challenging to implement and require more time, interviewee 6 mentioned: *"So, [the circularity training] gave me some insights, but I'm still trying to look for more things."* Moreover, the interviewees also stated that innovating includes making decisions as to which resource efficiency strategy to explore first. Besides that, some interviewees also shared that part of their circularity approach is being a pioneer with their innovation or leading in their sector.

Circularity Activities. The circularity activities outline the actions that were already taken by the companies. Some of the circularity activities were already part of the BM or services offered by the company, while others were only implemented after joining the circularity training. The interviewees bring forward various examples per activity that resulted from the training, which depend on the industry of their company (see Appendix H for Table 4). A circularity action that was shared is, for example, a combination of two activities, by finding a solution to maximize the use of a certain material, but also to create value from waste: *"So first reduce the waste, second reuse the parts, what is being waste." (Interviewee 9).* A challenge that was stated by multiple interviewees is closing resource loops, for example receiving the products back from the customer. Furthermore, most interviewees mentioned the importance of energy efficiency as a strategy, also financially. For the resource efficiency strategies such as recycling, but also product life extension, like repair, the interviewees reported on the importance of collaborating with other companies to outsource such activities, as interviewee 4 described: "*[…] so, there are two partners who are doing the recycling."* The interviewees frequently shared the circularity actions in connection with one or more of the internal implementation factors, such as the importance of finances to pursue a certain activity, wondering: "*[…] how can we use the waste materials […]? How can we use that also in sales, of course." (Interviewee 5).*

Circularity Training Intervention. There is not one uniform circularity definition as a result of the training mentioned by the interviewees. The definitions that were stated partly referred to aspects of resource efficiency strategies and product life extension. The interviewees mentioned various benefits of the training, such as making connections with other companies to execute circularity actions, as stated by interviewee 5 *"[…] the most important was the companies who also were there on the courses",* but also on the level of knowledge and skills, as it brought a different point of view with operational opportunities as interviewee 4 shared:

> *"I'd say in adapting our business model towards one, where we keep our eyes on the product through the entire lifespan of it, thus lengthening the lifespan of our product, that's definitely something that we discovered during the [circularity training]."*

The new knowledge and awareness that the training stimulated was mentioned more frequently by the interviewees. This includes a more technical thinking and changes in mindset. Furthermore, the main outcomes of the training, that the interviewees reported on are on an operational level, meaning new ideas and projects that resulted from the circularity training, as stated by interviewee 4: *"[…] since [the circularity training], we've made a lot of steps, I would say was the first serious step towards something actually changing."* Some interviewees stated how after introducing the circularity idea to the company, the actual implementation happened directly. Others shared that the implementation had not happened yet, but that it was still being discussed internally. Furthermore, future plans to introduce innovations and change or expand the current BM as a result of the training were also mentioned.

Internal implementation factors

The internal implementation factors are referring to the internal barriers and drivers the interviewees described, which impacted the circularity implementation and efforts to a CBMI.

Resources. The idea of implementing circularity at the expense of sustaining the current business finances played an important part as usual business had to be secured before investing into circularity. One owner mentioned: "*[…] we're only fairly small, so everything I do in sustainability or innovation, I would have to do it myself. So, the focus got into a different direction for a while." (Interviewee 1)*. For companies that are looking into making their existing product more circular, monetary investments are required into machinery to enable innovation on a larger scale. Furthermore, it stood out that regarding the financial factor, the pricing mechanisms continued to be mentioned, as companies considered how to price their circular innovation or product compared to the linear one. This is also related to the willingness of the customer to pay for the difference in case sustainable or circular products are more expensive. One of the opportunities in circularity that has been stated, has also financial motivation, because *"Using material and using energy, costs money. So, when we use, reduce the energy and material consumption we save money […]." (Interviewee 9)*. Besides that, it should be mentioned that multiple interviewees stated that their company has an additional income stream by collecting valuable materials such as aluminium which are being sold to a recycling company. Another part of investing in circularity that has been shared repetitively by the interviewees is the decision to assign an employee to work permanently on circularity projects internally. This also connects to the final resource, the time investment. The interviewees mentioned the high amount of time needed for implementing circularity, as interviewee 9 stated: *"I think the biggest investment is a time investment to generate plans to set up the systems, a supply chain, a storage of the reusable waste, […] creating the company statement, the vision. Yeah, it's the quite [a] big time investments I think."*

Knowledge. The interviewees report on different levels of prior knowledge about circularity, since for some the training was the first exposure while others have it at the core of their BM. Part of the knowledge and skills the interviewees state, are those, gained through the

circularity training. Some interviewees mentioned that existing knowledge and skills on different levels in the company were underestimated. But even if knowledge and skills are already present the interviewees stated the ambition of learning and implementing more, by introducing further innovations and additional circularity actions after the training. In case knowledge or skills are lacking regarding circularity, the interviewees mentioned the plan of expanding their knowledge and skills through external parties. Some make use of students for example to help with working out the circularity ideas on a conceptual level, while others shared the plan to collaborate with experts, for example for circular material options: *"We would need external expertise on the materials on what can be done, on how to do it and what matches and what won't." (Interviewee 1).* Regarding skills, some interviewees mentioned technical hurdles when it came to implementing circularity, on the level of product development. Another important part of the knowledge factor is providing training, as some interviewees shared that internal training on circularity is already in place, enhancing the knowledge of the employees on circular materials for example.

Company acceptance. The interviewees reported different reactions depending on the department to which they spoke and the hierarchy level in the company that was being addressed. Connecting to this the ways of communicating differ between the participants as some make use of written information in the form of a newsletter or the intranet, while others prefer face-to-face communication in the form of presentations or meetings. Besides this, the companies also make use of physical examples to let the employees see the ideas in the form of a prototype. Internal communication was mentioned to be necessary to achieve the change towards implementing circularity. However, the communication lines were said to be rather long in the case of bigger companies, posing a hurdle for internal communication. Some interviewees also brought forward the idea of forming a team inside their company which would focus on circularity and sustainability. This also relates to the reoccurring issue mentioned, of

departments acting individually and not communicating their circularity actions internally. This hinders introducing internal processes that require internal cooperation of the different departments to test the idea for example. Furthermore, they shared that one important step is changing the mindset of the employees, to make them more conscious towards circular solutions. This also includes raising the awareness of the employees on the work floor, as an owner stated: "*What I really would like is […] that it becomes part of their DNA, […] so that they think along with how they can change the steps in what they do." (Interviewee 1).* Some of the interviewees also mentioned facing some issues when it came to gaining trust on their circularity expertise and convincing the rest of the company of the circularity idea.

Management support. In some cases, the management themself participated in the circularity training while in other cases employees were sent to participate. In the cases where the management participated, their support was already given due to their initiative. Some interviewees, however, also shared the lack of time that the management has, to get involved in the circularity project. Furthermore, some mentioned a hurdle when it comes to getting the management on board and trying to convince them about the circularity idea, to get permission for implementation, which is crucial because "*[…] to make the step really to circularity, then it would need to have the awareness of, someone higher up in the company, […]." (Interviewee 1).* Others reported that they are experiencing enthusiasm and support from the management also regarding internal communication and willingness to potentially decrease sales due to product life extension or make investments. Furthermore, the interviewees shared examples of the top-down approach more often, where the management would be willing to make use of their power to enforce the change of implementing circularity. Regarding risk-taking, it was frequently mentioned that there was a willingness of the management to take a risk, as long as it did not endanger the vitality of the business in general, as interviewee 1 stated: "*I cannot afford it, that it would risk business on the other side.".*

Business model. The BM category addresses the stage of sustainability of the company, the compatibility of circularity with the current BM, and the change in the company, meaning how the BM impacted the CE adoption. Regarding the stage of sustainability, the interviewees had different reasoning for associating a certain stage with their company. Some differentiated between the different levels or departments in the company, showing multiple sustainability stages in one company, such as in the case of interviewee 4: "*I think at the top level, we are active. I think, going down in the levels of the organization it gets more reactive […]."* The stage was also described using the companies' activities in the past compared to after the training, as a board member shared: "*We are active. Before we were reactive." (Interviewee 2).* Others compared their current activities with other companies or their industry. Moving on to the compatibility of circularity with the current BM, interviewees shared different opinions. Some mentioned having found circularity actions already in their current BM, like interviewee 5: "*So that was already circularity only we did not call it that way."* or found it easy to implement, because: *"[…] I can use the same machines for it […], we only change the materials […]." (Interviewee 6).* Others described a conflict between the linear and the circular goals of the company, such as interviewee 1: *"Compatibility of the circularity idea within the linear production that was already there, was not really too positive"*. Furthermore, it is being mentioned that the circularity implementation caused a change in the BM in regards to the activities of the company, for example: "*We used to not be able to do that, because that wasn't part of our business model, now it is, so we repair [the product]." (Interviewee 4).* Furthermore, the interviewees stated different levels of transformation including operational changes, the mindset of employees and management, but also customers, to see circularity as an opportunity rather than a threat. They described how internal processes changed to implement circularity, for example changing materials or production procedures. However, another point that was shared is the resistance to change of internal as well as external stakeholders, meaning employees as well as suppliers and customers. An example that was mentioned refers to the

challenges of introducing resource recovery loops, for which external collaboration is needed. However, the collaboration can also have an effect the other way around, as some companies decided to change because of the demand of the customers for example. Others want to be the front runner in their sector and therefore are eager to change and innovate their BM, which is partly financially motivated as they stated that they can ask for higher prices. It was mentioned that combining the circularity idea with the economic factor convinced the management to implement it into the BM. An important part, of implementing circularity, that was shared is communicating internally about the changes and evaluating how they worked out in practice. One essential change that recurred when working towards circularity is the vision of the company, and how it might need to be adjusted. Another vital aspect that the interviewees shared in regards to change, is the slow tempo of the process, mentioning: "*You don't have to reduce, like directly 100%. 20% is also very nice. There's also 20% and make some small steps but start right now." (Interviewee 10).*

External implementation factors

Even though the external factors were not the focus of this research this aspect emerged, which is not surprising since circularity has these dynamics and, the training also required the attendance of an external collaboration partner.

The interviewees reported on the importance of collaborating along the value chain. This includes for example the suppliers that are needed to execute the circularity idea for example for alternative materials, because *"Having that working relationship with our suppliers really made it possible to make actual steps towards a more sustainable business model. It wouldn't have been possible without them." (Interviewee 4).* It is mentioned more often that the circularity idea was initiated internally but now relies on external cooperation to be able to continue with the implementation. Often the collaboration efforts that were shared by the

interviewees referred to the industry partner which they brought to join the circularity training, but also to the other companies that participated in the same training. These collaborations are often mentioned to be focused on introducing resource recovery loops and resource efficiency strategies for product life extension, meaning "*It's a collaboration, it's us working together to recover those materials." (Interviewee 4).* The interviewees stated mostly that they collaborate with other businesses to recycle materials. Besides that, the interviewees also mentioned getting inspiration for further circularity actions from visiting companies that are already further with the implementation. Another collaboration partner that the interviewees reported on is the training provider, due to the extended network with circularity-oriented companies. The interviewees also mentioned the ambition for the future to continue collaborating with more companies, because "*I think the solution is it's into the local regional partnerships." (Interviewee 10).* Regarding external communication, the interviewees focus especially on informing their customers of the circularity changes and available options in the company. Some shared for example the challenge of convincing the customers to choose the circular or more sustainable material option when purchasing a product, while others do not use their circularity as a selling point. Furthermore, the market demand is also a reoccurring factor, which drove the companies to implement circularity, as customers asked for details and the market is changing. Some interviewees mentioned the importance of rules and regulations for circularity, as it would be easier to enforce changes if it was an external requirement by the government for example. Others stated the zero waste ambitions of the government as a key driver for working towards circularity.

DISCUSSION

The results together with the previously established literature are aiming to answer the research question: "*What are the internal barriers and drivers for companies to implement circularity and work towards CBMI after completing a circularity training?"*. By exploring the internal barriers and drivers further, the ambition is to extend them based on the circularity training as an intervention factor. The data suggests that these internal barriers and drivers that the companies encounter after joining the circularity training, slightly differ from those established in the literature.

Circular Business Model Innovation: Circularity Implementation

The circularity implementation theme that resulted from the data is a key part of the CBMI, as it includes the circularity approach and activities which the companies have pursued. Furthermore, it brings forward the importance of the circularity training as an intervention to stimulate the CBMI (28,29). The intervention of the circularity training was mentioned as an important factor in the literature and the data, as this external factor is said to influence the circularity innovations in different ways (53). The interviewees shared various examples of circularity actions that resulted from the training as it helped initiate certain thought processes and drive the circularity innovation that was implemented as a result (51,52). Furthermore, the results and theory are also in line with the fact that these innovations created different internal changes in the companies (5,17,28). It stood out that there were different degrees of organisational change and innovation of the BM, relating to the existing linear BM and the stage of sustainability in the company prior to the circularity training, which was also suggested by literature (27,35). Regarding the change from one stage of sustainability to the next, the data is matching the literature, as an example was mentioned of a company moving from reactive to active due to the training, so through CBMI (45). Generally, the data showed the importance of the circularity training as a driver for CBMI for the companies (28,29). Regarding the

circularity activities, the results of this research are in line with the literature, as the data describes how the theorised strategies were put into action. For example, for the resource efficiency strategies, product life extension and the archetypes, various actions were described in line with these concepts (6,8–11,14,17,19,20,42). As for the circularity strategies, the fact that CBMI is a process involving for example conceptual changes or alterations in operational practices was described also by the results (5).

Relating these results to the CE, it stands out that the data reflects various examples of companies moving from linear consumption to implementing more circular production systems through CBMI, which was mentioned by literature as an important aspect of CE (5,8,14,17,18). Furthermore, the importance of businesses for the transition from the current economic system to the CE can be concluded from the data and is in line with the literature (4,7,22). Finally, the fact that businesses must cooperate to implement circularity strategies and therewith work towards a CE as mentioned by the literature, was also reflected in the data (7,10,21). This means that these results have confirmed the existing literature and extended it with practical illustrations.

Barriers & Drivers: Internal implementation factors

The results show different internal implementation factors, which can function both as a barrier and as a driver, depending on the company case. The participants from the companies encountered these barriers and drivers when working towards a CBM and implementing circularity, after joining the circularity training. These implementation factors which were the results of this research, can be related to the initially introduced barriers and drivers from the literature (see Appendix I for Table 5). Therefore, the main findings are, that the financial barrier and driver fall into the resources factor and the knowledge and skills barrier and driver is included in the knowledge factor. The organisational barrier and driver covers the company

acceptance, management support and business model factors from the results. This means that the barriers and drivers that were established with existing literature were either extended or integrated into the newly discovered categories. Therefore, the barriers and drivers can be narrowed down to resources, knowledge and organisational, combining existing literature with the results of this research, as Figure 3 shows with arrows indicating how the factors merged based on results.

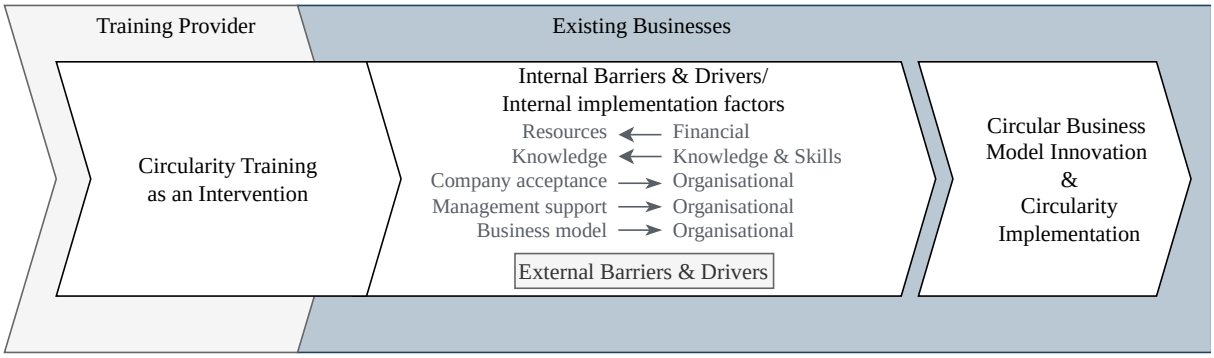

Figure 3: Conceptual model including results

Compared to the literature, the results were in line with the organisational barrier and driver, as the BM factor can be connected to the compatibility with the existing strategies, targets and business culture mentioned by theory (20,44,49). Furthermore, the company acceptance factor is in line with the internal cooperation aspect from the literature and the management support factor from the results relates to support and commitment from management (8,20,23,24,27,37,44,47). Also, risk-taking was mentioned in the results in relation to management support and the tension between current and future business vitality (13,20,34,47,49). Only the administrative work and silo thinking were not mentioned as a barrier by the interviewees (11,12,20). This could be related to the circularity training as an intervention, as the workshops bring in new ideas and therefore break the silo thinking.

Moving on to the knowledge and skills barrier and driver, the technical know-how was brought forward also in the results in regards to technical hurdles for product development for example (11–13,20,23,34,37). Furthermore, knowledge sharing in the value chain was encountered in literature and mentioned in the data as external communication (11,20,48). This also relates to the aspect of external collaboration, which was brought forward in the results section as well as the literature (7,8,10,14,17,37). This is related to an important technical implementation factor mentioned in the literature and the data, called resource recovery cycles, which also depend on external cooperation, including co-creation to realise product life extension (8,14,15,17). Therefore, the results confirmed that external collaborations are needed to drive circularity, meaning also CE (7,10,21). Finally, the data brought forward another factor, namely providing training, which relates to extending the knowledge and skills for circularity inside the company (28,29). Therefore, the knowledge and skills, together with providing training form the internal barrier and driver of knowledge.

The financial barrier and driver which was introduced by the literature was extended by the time investment and therefore summarised in the barrier and driver called resources. This still includes also the financial resources of the business, which was brought forward in theory and the results (12,20,27,34,37,49). Also, investment costs were a factor that was mentioned in the literature and confirmed by the data (12,20,27,34,37,49). Finally, the cannibalization due to product life extension was only slightly touched upon in the data and is already known in theory (8,17,37).

It stands out that the internal implementation factors are interlinked. For example, the factor management support was mentioned to be impacted by finances, as an economic benefit would convince the management to implement circularity in the BM, so achieving CBMI. Furthermore, the results showed that these internal implementation factors are slightly different,

compared to the established internal barriers and drivers. It stood out in this research how the training supported the companies to initiate a circularity implementation idea and to innovate the current BM. This means that the circularity training as an intervention indeed initiated the change towards CBMI and implementing circularity.

CONCLUSION

To conclude this research, the main internal barriers and drivers for CBMI and circularity implementation after a circularity training are organisational, knowledge and resources. These internal barriers and drivers, that the companies encountered when working towards implementing circularity, are slightly different from what the literature suggested. Therefore, the results contribute to the field of internal barriers and drivers for CBMI, after joining a circularity training. For example, the result of overcoming the barrier of silo thinking by joining the circularity training is an important outcome of this research and relates to knowledge as a barrier and driver. Furthermore, the fact that the training was able to help companies see financial value and opportunity in the CE is an important factor that resulted from the training, which is part of the resource barrier and driver. Finally, the results showed how time investment is a common barrier when implementing circularity and working towards CBMI, which is also part of the resource barrier and driver. Besides that, the extended results of circularity activities and strategies that were taken on by the companies due to the training, illustrate the importance of circularity training as an intervention to initiate working towards CBMI and to drive organisational change towards circularity. This also suggests the importance of interventions such as circularity training for the transformation to a CE.

A three-day workshop such as the one the case organisation is providing can start the thought process and initiate the implementation of circularity and working towards CBMI. However, based on the fact that the companies encountered various barriers and drivers the training should be altered accordingly, to make the best use of the drivers and to help overcome the barriers. For example, looking specifically at the factor of management support, the circularity training could introduce a module for those companies, where the management did not participate themselves, to prepare the employees specifically for pitching the idea to the management team. Furthermore, in regards to the company acceptance, the circularity training could focus more

on internal communication and addressing team members with a different mindset on different organisational levels. This way the factor of internal cooperation and company acceptance could be addressed which was mentioned as an issue to implement the circularity idea internally. Looking at the external collaboration, the fact that the participants bring an industry partner would suggest introducing more focus also on co-creation during the training. Finally, the training provider could initiate a platform for training participants to share their experiences, circularity actions as well as struggles, so that the companies can help each other, share their knowledge to overcome internal barriers and utilise the drivers to achieve a bigger circularity impact and work towards a CE. By combining such practical implications for society to work towards CE with the theoretical framework and data, the study is transdisciplinary.

Limitations & Future Research

One of the limitations is the selection bias since the case company has chosen the interviewees that were invited for this research. Furthermore, the interviewees participated in different training moments, meaning the circularity implementation has different timeframes, ranging from six month to three years between training completion and the interview.

Future research could look more into the discovered barriers and drivers and either extend these with external ones or validate the data further with quantitative research. Either way, the focus should continue to be on the circularity training as a driver for CBMI and circularity implementation.

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APPENDIX

Appendix A: Value Figure

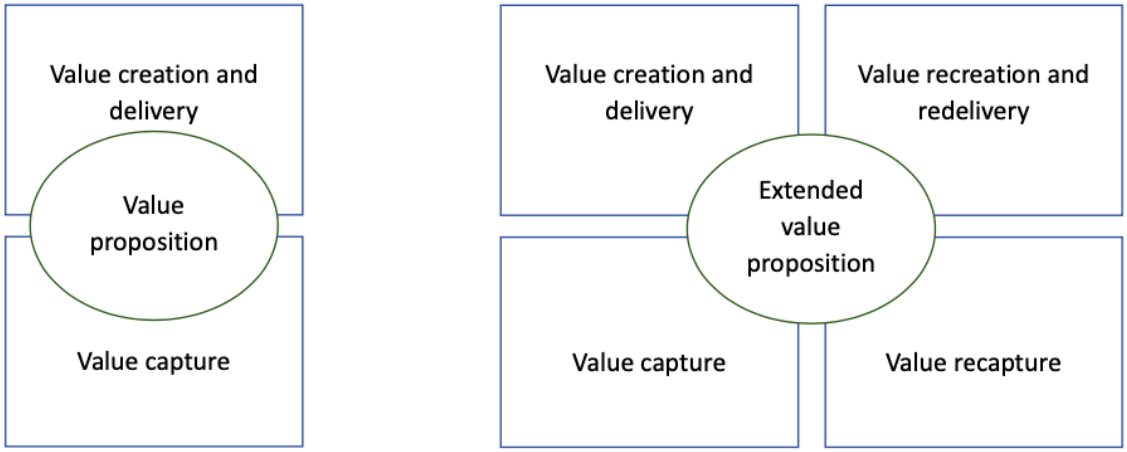

Figure 1: Key elements of a circular business model, from E. Guldman (2018) (38)

Appendix B: Internal Barriers and Drivers

Internal Barriers and Drivers	**Sub categories**
Organisational	Compatibility with the existing strategies, targets & business culture (20,44,49)
	Support & commitment from management (8,20,23,24,27,37,44,47)
	Internal cooperation (8,20,23,24,27,37,44,47)
	Administrative work (e.g. planning) (11,12,20,47)
	Risk taking & Silo thinking (13,20,34,47,49)
Knowledge & Skills	Technical know-how (11–13,20,23,34,37)
	Knowledge sharing in value chain (11,20,48)
	Collaborating with other companies (7,10,14,17,37)
Financial	Financial resources of the business (12,20,27,34,37,49)
	Investment costs (12,20,27,34,37,49)
	Cannibalization due to product life extension (8,17,37)

Table 1: Internal barriers & drivers, based on literature

Appendix C: Interview Guide

Introduction:

Thank you very much for joining me today, I will be asking you some question regarding the circularity of your company. I am most interested in what happened after you joined the circularity training, how it might have helped you with establishing or working towards a circular Business Model. I would like to understand the internal barriers and drivers that you experienced after bringing your knowledge on circularity back to the company. So: what happened when you were trying to implement circularity. This will help me answering my research question: *What are the internal barriers and drivers for companies to implement circularity after completing a circularity training?*

Please be reminded that you can drop out or refuse to answer at any point in the interview. If you should have any questions or would like me to rephrase something in Dutch, please feel free to let me know. I have already started the recording.

Verbal consent: Please confirm that you have read and understood the consent form and that you agree to participate in the research study. Please also still send it to me signed, via email.

Do you have any questions or concerns that you would like to share with me before we begin?

Topic	**Questions**	**Follow up**	**Based on (Authors)**
General information	Please shortly introduce yourself	In what field does your company work? What is your position in the company? When did you participate in the circularity training?	
	How did you get to know about the circularity training?	Why did your company decide to participate?	
	Was the circularity training your companies first step		

	towards circularity or sustainability (in their operations)?		
Degree of circularity	What does circularity mean to you?	The definition of circularity I use is (read if needed): *Moving away from take, make, disposal behaviour and focus on the principles of reduce, reuse and recycle or product life extension, redistribution/ reuse, remanufacturing and recycling. This means, moving from a linear consumption to a closed production system, where the resources can generate more value as they are being used for a longer period of time.*	Definition Circularity: Urbinati (8), Kitchherr (30) & Tura (20)
	How does your current business model look like? How did the circularity training help?	To what extent is circularity part of your Business Model? Did it change/ Is that due to the circularity training? Or regardless? Or not at all?	Urbinati: C(E)BM (8)
	How would you describe/ rate the phase/ stage of sustainability your company is currently in? How would you rate your company's sustainability/ circularity level?	Inactive: No/ limited vision for sustainability Reactive: Limited actions Active: Focus on supply chain and strategy Proactive: Full integration into BM Do you think there is a difference between before and after the circularity training?	Long: CSF (27) Schaltegger: Phases (35)
	Can you describe the ways in which the organization has changed or is proposing to change its operations as	How does this approach differ from the traditional strategies? How did the employees react?	Doppelt: org. Change (9)

	a result of becoming circular?		
	How does your company work towards maximising material and energy efficiency?	Can you give examples	Bocken: Archetypes (42)
	How does your company work towards creating value from waste?	Reuse, Recycle or remanufacture How did the mapping of the value chain at the circularity training help? What is the focus? Do you remember which lost value you identified during the circularity training and what you did about it?	
Internal Barriers & Drivers	So, there are 7 steps of the Circularity training where the last one is the pitching and calling for action internally. Can you walk me through the process: What happened after you finalised the circularity training? What impacted the implementation after the circularity training?	Why do you think this happened? So how did that look like? What was the next step after completing the Circularity training? And what are the next steps still to come? Any goals set?	
Organisational **Know. & skill** **Finance**	How would you describe the compatibility / fit, of circularity with the current/ old way the company is/ was doing business?	How do these plans fit with your current (linear) operations and targets? / Business culture?	Blanco-Portela: Organisational change (47)

	How would you describe the commitment of the management for implementing circularity?	What are the goals for implementing circularity in your organisation? How is the level of internal cooperation towards circularity? How would you describe the administrative work that is connected to becoming circular?	Tura: B&D for CB (20) Vermunt: B&D to implement CBM (12)03/06/2023 09:52:00
	Is the company open for the ideas that you are bringing in from the circularity training? – Silo thinking	To what extent do you think the management is willing to take risks for circularity?	
	How would you describe the knowledge and skills which the company already has for implementing circularity? Resource recovery Relying on Supply chain and working with others	What information or data do you have or need to be able to move further towards circularity? How were/ are you able to work towards updating the product design?	
	What role do finances play in the discussion and planning to become circular?	Are/ were there any investments needed to get started? What are the financial hopes for circularity?	
	In case you were successful with introducing circularity: What would you say was the critical success factor?	Product life extension! e.gs.. management, finances, knowledge	Long: CSF (27)

Training Provider	What would you say your organisation would need from the training provider or their network to continue working towards circularity?	What would you say went well during the track? What do you think could have gone better?	

Closing:

Thank you very much for participating. Do you have any further questions or concerns that you would like to share with me? Would you like to me send you the results of the research?

Thank you and I hope to see you at the circularity training event.

Appendix D: Interviewee overview

Interview Number	**Type of company/ Activity description**	**Industry (e.g., Plastic, construction, consumer goods and manufacturing)**	**Position of interviewee**
1	Boatbuilding & renting	Manufacturing and Consumer goods	Owner
2	Construction	Construction	Board member & Head of department purchasing
3	Boatbuilding	Manufacturing	Carpenter & Sustainability department
4	Production company	Manufacturing & Plastic	Sustainability department
5	Construction	Construction	Manager
6	Print service	Consumer goods	Owner
7	Renting service (of white goods)	Consumer goods	Owner
8	Engineering	Manufacturing	Engineer
9	Boatbuilding	Manufacturing	Quality assurance engineer
10	Waste separation	Plastic	Manager Marketing & Communication regional

Table 2: Interviewee overview

Appendix E: Coding scheme

Themes	Code Group	Code	Frequency	Illustrative Quotes
Circularity Implementation	Circualrity Approach	Business approach	76	"[…] during the [circularity training], we started looking at the complete business case. And by doing that, we were able to alter the way of thinking and we saw solutions on how we could fit things together. And by doing that we not only are going to be able to offer a more circular product, but also combine it with different demands. (Interviewee 1, p3) "we're only fairly small, so everything I do in sustainability or innovation, or, I would have to do it myself. So the focus got into a different direction for a while." (Interviewee 1, p.3) "I can't just put that aside and then start making the circular products. So I need to make sure that the other this side of the company is doing well, and then I can take it along." (Interviewee 1, p.9) "[...] learning by doing. Yeah, but I think that's the only way to, to if you want to be successful and things I think, you have to just do it. And you really have to do it, you have to learn and it's not written in a book how you can do it and every every company is unique. Every situation is unique. So you have to do it yourself." (Interviewee 5, p.8) "[...] in a practical way that we use nowadays, that our software platforms like apps, and those apps get the data from the total system for example here the factory of the ship and based on the running hours and issues. You get an advice what to repair or refurbished or downgrade or upgrade in certain maintenance moments."(Interviewee 8, p.10) "I'm still trying to see what how I can get it more circular anyway. Yeah. So it gave me some insights, but I'm still trying to look for more things." (Interviewee 6, p.12)
		Circularity execution	91	
		Operational opportunities	46	
		implementing circularity	80	
		Leading by example	6	
		Innovation	63	
	Circualrity Activities	Material maximisation	27	"At the aluminum to reduce cutting waste is to cut more efficient, the aluminum parts so reduce the aluminum waste. But if it's, it's not possible, how can we reuse the waste parts of the aluminum in other at another places at the yard." (Interviewee 9, p.9) "So we are looking with a different mindset now to it, and how can we use the waste materials, we come from ourselves? How can we use that also in sales, of course." (Interviewee 5, p.6) "Nowaday here, we, we look at reuse the caremics, so that when we renovate a house, we have a washing bowls, we have toilets, and we reuse these, we we are going to try to reuse them. That's our project at this moment." (Interviewee 2, p.5) "Now we have to work it out now. We have we have the idea now. But now we have to make make a work plan, actually. So yeah, that is what we are doing. Yeah, from this week, actually. Yeah. So that my idea is to Yeah, to see if we can reduce the waste. So. But how? Yeah, maybe more a better program to fit all the pieces into a bigger piece." (Interviewee 3, p.9) "[...] it's completely in the partners hands. We are We are definitely connected. I've been there, I've been to all of their recycling plants, but it is also a partner for them. And yeah, so there are two partners who are doing the recycling. They're specialized the UPVC as well, they're dependent on our business model now." (Interviewee 4, p.14)
		Product life extension	32	
		Resource efficiency strategies	96	
		Energy Efficiency	27	
		Resource recovery loops	33	
		Value from Waste	4	
	Training - Intervention	Circularity definition	14	"[…] the most important was the companies who also were there on the courses. […] Together with those companies, we made a plan for what we can do with wood what comes back from demolition if we can use it again." (Interviewee 5, p.2) "It really gave direction. It was not just we've got this question and we find an answer to that question. But it may really resulted in a way of thinking about the whole process. So that's what I really liked about it." (Interviewee 1, p.4) "And since [the circularity training], we've made a lot of steps, I would say was the first serious step towards something actually changing." (Interviewee 4, p.2) "I'd say in adapting our business model towards one, where we keep our eyes on the product through the entire lifespan of it, thus lengthening the lifespan of our product, that's definitely something that we discovered during the [circularity training]." (Interviewee 4, p.6)
		Benefits of the Training	24	
		Training Outcome	33	
External Implementation Factors		External Collaboration	118	"[…] Together with some other companies we also do a lot more circularity" (Interviewee 5, p.3) "I think the solution is it's into the local regional partnerships." (Interviewee 10, p. 12) "It's a collaboration, it's us working together to recover those materials." (Interviewee 4, p.5) "Having that working relationship with our suppliers really made it possible to make actual steps towards a more sustainable business model. It wouldn't have been possible without them." (Interviewee 4, p.13)
		External Communication	50	
		Market demand	6	
		Rules & Regulations	20	
Internal Implementation Factors	Resources	Investments	23	"It's not, the goal is not to get loaded with money we don't need it. We don't want it. Of course, we have our daily operation here we have to we have to pay our employees." (Interviewee 2 p.25) "Saving [material] waste, […] is saving money." (Interviewee 9 p.23) "We've got a small machine […] so we […] can do what is necessary but if you want to scale up, we have to buy that kind of machine." (Interviewee5 p.9) "I think the biggest investment is a time investment to generate plans to set up the systems, a supply chain, a storage of the reusable waste, company statements, creating the company statement, the vision. Yeah, it's the quite big time investments I think." (Interviewee 9 p.19)
		Finances	64	
		Time investment	12	
	Knowledge	Providing Trainings	5	"I'm still trying to see what how I can get it more circular anyway. Yeah. So, it gave me some insights, but I'm still trying to look for more things."(Interviewee 6, p. 12) "We would need external, external expertise on the materials on what can be done on how to do it and what matches and what won't." (Interviewee 1, p.7)
		Knowledge & Skills	48	
	Company Accpetance	Internal cooperation	78	"What I really would like is […] that it becomes part of their DNA, […] so that they think along with how they can change the steps in what they do." (Interviewee 1, p.5). "Because we talk to them at the office, in a in a group, and explain them what the ideas are and why […] we could show them. That moment, they say, okay, this is a nice idea, we're going to do it." (Interviewee 2 p. 19) "I want to get everyone involved. So that that is the my biggest challenge, actually. So it's, I don't need it anymore. It goes from the people themselves." (Interviewee 3, p.10)
		Internal process	57	
		Internal communication	67	
		Mindset	35	
		Trust	2	
	Management	Management support	42	"Well to make the step really to circularity, then it would need to have the awareness of, well, someone higher up in the company, because the company needs to be willing to make a step in that direction." (Interviewee 1, p.11). "So that was the first real obstacle which was won over quite quickly because it there was already excitement from the board so to speak." (Interviewee 4, p.12) "So, we created in our management team at this stage awareness that we need to do something about that." (Interviewee 8, p.4). "I cannot afford it, that it would risk business on the other side." (Interviewee 1, p.9). "at least, like the commitment of the management was there to like trying to start the process, but then, yeah, running into some issues." (Interviewee 1, p.7)
		Top Down Approach	7	
		Risk taking	6	
	Business Model	Stage of sustainability	29	"I think at the top level, we are active, I think, going down in the levels of the organization. It gets more reactive as we go down." (Interviewee 4 p.6). "Compatibility of the circularity idea within the linear production that was already there was not really too positive" (Interviewee 1, p.7) "We used to not be able to do that, because that wasn't part of our business model, now it is, so we repair it." (Interviewee 4, p.4). "So that was already circularity only we did not call it that way." (Interviewee 5, p.5)
		Change	88	
		Compatibility with current BM	20	

Table 3: Coding scheme with illustrative quotes

Appendix F: Participant Information Sheet for the Research

Research Topic: The barriers and drivers companies encounter when working towards implementing circularity, after joining a circularity training.

Dear reader,

Thank you for your interest in participating in this research. My name is Marie Hartmann and I am currently studying Sustainable Entrepreneurship at the University of Groningen. For this, I am now writing my master thesis, which is the reason for this research. This letter explains what the research entails and how the research will be conducted. Please take time to read the following information carefully. If any information is not clear kindly ask questions using the contact details of the researchers provided at the end of this letter.

What this study is about?

- The research explores, how the training has supported your company (or not) to implement circularity/ sustainability
- In total there will be at least 10 interviews done with different companies that have participated in the circularity training
- You have been asked to participate in the study, since you have joined the circularity training yourself
- The research is done in collaboration with the training provider

What does participation involve?

- It involves one interview that will be held online in google meet, for 45-60 minutes
- The interview will be in English, however If you have any difficulties along the way, the questions can always be rephrased in Dutch

Do you have to participate?

- The participation is completely voluntary and you can choose to withdraw at any moment
- During the interview you can choose not to answer questions without consequences or explaining yourself

Are there any risks in participating?

- There are no risks for you in participating in the interview

Are there any benefits in participating?

- There are no direct benefits for you, but the interview will help the research and may add to the research topic
- The interview can help with improving the circularity training and understand how support services from the training provider could assist further. This is helpful for participants in the future.

How will information you provide be recorded, stored and protected?

- The interviewees names will be removed and replaced with a number, so it won't be possible to connect the information to the participants and the transcripts will be fully anonymized since the beginning
- The original audio file of the recording will be deleted, once transcripts have been made
- Only the researcher has access to the recordings and the first and second assessor of the master thesis have access to the anonymised transcripts
- The data will be stored according to GDPR rules of the University of Groningen

What will happen to the results of the study?

- The results will be used for the master thesis, however there is also a chance for publishing the research at a later stage
- In both cases the respondents identity are kept anonymous and all information is provided confidentially

Ethical approval

- The research has received the ethical approval from the Campus Fryslân Ethics Committee
- The researchers will uphold themselves to relevant ethical standards

Informed consent form

- If you would like to participate in the research, please sign the consent form
- Even if you agree to participate and sign the form, you can still withdraw at any time

Who should you contact for further information?

Researcher: Marie Hartmann (Email: m.l.e.hartmann@student.rug.nl)
Member of staff: Tom Long

Appendix G: Informed Consent Form

Title study: The barriers and drivers companies encounter when working towards implementing circularity, after joining a circularity training.
Name participant:

Assessment

- I have read the information sheet and was able to ask any additional question to the researcher.
- I understand I may ask questions about the study at any time.
- I understand I have the right to withdraw from the study at any time without giving a reason.
- I understand that at any time I can refuse to answer any question without any consequences.
- I understand that I will not benefit directly from participating in this research.

Confidentiality and Data Use

- I understand that none of my individual information will be disclosed to anyone outside the study team and my name will not be published.
- I understand that the information provided will be used only for this research and publications directly related to this research project.
- I understand that data (consent forms, recordings, interview transcripts) will be retained on the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

Future involvement

- I wish to receive a copy of the scientific output of the project.
- I consent to be re-contacted for participating in future studies.

Having read and understood all the above, I agree to participate in the research study: yes / no
Date
Signature

To be filled in by the researcher

- I declare that I have thoroughly informed the research participant about the research study and answered any remaining questions to the best of my knowledge.
- I agree that this person participates in the research study.

Date
Signature

Appendix H: Examples of circularity actions

Case company	**Circularity actions**
1	Producing 3D printed circular boats
2	Refurbishing & reusing toilets in social housing
3	Giving an employee 1 day per week to work on circularity and sustainability projects, looking into reducing & upcycling wood waste
4	Assigning 2 employees to work on circularity full time
5	Collaborating with 2 other companies from the training to create a resource loop and refurbishing activities for wood from construction sides
6	Introducing more circular materials, through collaboration
7	Networking - Already had a CBM before the training
8	Planning to assign 1 employee to work on circularity full time
9	Waiting for management permission to work towards material maximisation and value from waste for aluminium
10	Networking - Already had a CBM before the training

Table 4: Examples of circularity actions resulting from the circularity training per case company

Appendix I: Internal Barriers & Drivers and implementation factors

Colour coding: Concepts from Theory = black and Results = grey

Internal Barriers and Drivers/ Internal implementation factors	**Sub categories**
Organisational	Compatibility with the existing strategies, targets & business culture (20,44,49) → Business model
	Support & commitment from management (8,20,23,24,27,37,44,47) → Management support
	Internal cooperation (8,20,23,24,27,37,44,47) → Company acceptance
	Administrative work (e.g. planning) (11,12,20,47) wasn't really mentioned → Management support and company acceptance
	Risk taking → Management support & Silo thinking wasn't mentioned (13,20,34,47,49)
Knowledge & Skills → Knowledge + providing trainings	Technical know-how (11–13,20,23,34,37) in line
	Knowledge sharing in value chain (11,20,48) in line
	Collaborating with other companies (7,10,14,17,37) → external implementation factors
Financial → Resources + Time investment	Financial resources of the business (12,20,27,34,37,49) in line
	Investment costs (12,20,27,34,37,49) in line
	Cannibalization due to product life extension (8,17,37) wasn't really mentioned

Table 5: Internal barriers and drivers and implementation factors based on literature and results