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Clothing the Loop

Exploring Design Features of Circular Performance Indicators and their Application among Textile Retailers

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There he is in free fall, experiencing the exhilaration of what he takes to be a flight. From his great height he can see for miles around, and one thing he sees puzzles him: The floor of the valley is dotted with crafts just like his – not crashed, simply abandoned. 'Why', he wonders, 'aren't these craft in the air instead of sitting on the ground? What sort of fools would abandon their aircraft when they could be enjoying the freedom of the air?' Ah well, the behavioral quirks of less talented, earthbound mortals are none of his concern. However, looking down into the valley has brought something else to his attention. He doesn't seem to be maintaining his altitude. In fact, the earth seems to be rising up toward him. Well, he's not very worried about that. After all, his flight has been a complete success up to now, and there's no reason why it shouldn't go on being a success. He just has to pedal a little harder, that's all.

Daniel Quinn, "Ishmael"

We're building towers with no foundations,
Just stacking stone on stone.
Whatever it takes - mix our mortar with bones.

But true progress means matching the world to
The vision in our heads,
But we always change the vision instead.

We set sail with no fixed star in sight.
We drive by braille and candlelight.

Thrice, "Circles"

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Abstract

This thesis addresses business performance indicators in the context of the Circular Economy (CE) and the textile industry. Its purpose is to explore possible design features of Circular Performance Indicators (CPIs) in the textile industry, to examine the application of such metrics among retailers and to define potential indicators for the Swedish fashion retailer MQ.

The research design is exploratory and follows a triangulation approach. A literature analysis on the concept of CE, best practices for designing CPIs and selection criteria for performance indicators is conducted. This is complemented by qualitative content analysis of 19 interviews with experts from textile retailers and other institutions. Qualitative content analysis of 19 sustainability reports and interviews with ten retail representatives examines the implementation of CPIs among textile retailers. Finally, a framework for selecting CPIs in the textile industry is proposed. This framework is applied in a focus group session with the Swedish fashion retailer MQ, resulting in a set of 16 applicable metrics.

Findings suggest that CPIs mainly focus on environmental aspects and material flows. Metrics can be defined for every lifecycle stage of textile products, yet experts' understanding predominantly refers to manufacturing and the end of life. Based on the analysis of sustainability reports, the current application of CPIs among retailers appears to be in an early stage. Examples found in reports mostly pertain to chemicals, energy, materials consumption, waste and water. Experts from retailers highlighted the need for further organizational development before CPIs could be applied. In this context, data collection was perceived as a barrier to implementation. The MQ focus group session defined indicators for chemicals, energy, material consumption, waste and water. Discussions suggest that the company's business model impedes the application of indicators which pertain to product reuse and leasing.

MQ may consult the findings of this study in preparation of its (prospective) sustainability reports. In the short term, it is recommended to focus on CPIs which are compatible with the company's business model and core values. For the intermediate future, MQ may use CPIs which deliver a better understanding regarding the company's environmental impacts and resource consumption. In the long term, MQ may consider assessing the economic feasibility of leasing and reselling activities, e.g. by measuring resell prices of second hand products.

Keywords: Circular Economy, performance indicators, textile industry

Executive Summary

Background and Problem Definition

Research suggests that the planet has entered a new geological epoch, the Anthropocene (Crutzen, 2002), in which human activities represent the main geophysical driving force and induce large-scale environmental changes (Wilkinson & McElroy, 2007). In humanity's conquest for a safe operating space (Rockström et al., 2009), various sustainable development models have emerged in society, one of which is the Circular Economy (CE). This model can be defined as an economic system which produces neither waste nor pollution, either by circulating materials at a high quality within the production system or by feeding them back into the biosphere at the end of life.

The textile sector is a retail-driven and highly globalized industry. Through recent years, it has been widely criticized for being unsustainable and following a wasteful "take-make-dispose" (EMF, Ellen MacArthur Foundation, 2013: 5) logic. Against this background, circular business approaches can offer attractive opportunities for reducing environmental impacts and tapping into previously uncaptured value streams. Since companies extensively rely on indicators for managing resources and evaluating success, seizing CE-related business opportunities will largely depend on the availability of meaningful performance metrics. To date, only few attempts have been made to conceptualize such metrics on the business level. Existing indicators – henceforth referred to as *Circular Performance Indicators (CPIs)* – are designed in a general, non-sector specific fashion. Hence, there is an urgent need for developing CPIs which incorporate further considerations for the textile industry and can help managers to operationalize business transformation on the ground.

Purpose Statement and Research Questions

The purpose of this thesis is to contribute to the advancement of CE in the textile sector by exploring possible design features of CPIs, examining their application among retailers and defining potential indicators for the Swedish fashion retailer MQ. In this, the paper addresses the following exploratory research questions (RQs):

- *RQ1:* What are possible design features of Circular Performance Indicators in the textile industry?
- *RQ2:* How are Circular Performance Indicators applied among major European textile retailers?
- *RQ3:* Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ?

Research Design and Methodology

In order to produce warranted findings, the paper takes a triangulation approach and examines each question through a set of complementary methods. Due to the exploratory nature of the RQs, the level of examination moves from broad to specific, starting at the industry-wide level, then focusing on retailers only and finally, discussing relevant metrics for one particular company, i.e. the Swedish fashion retailer MQ.

With regards to RQ1, literature analysis examined the design features of non-sector specific CPIs. Subsequently, qualitative content analysis of 19 expert interviews provided a deeper understanding of their features in the textile sector. To answer RQ2, qualitative content analysis of 19 sustainability reports provided insights as to how major European textile retailers currently apply CPIs. This is complemented by content analysis of interviews with ten retail representatives who shared their experience about CE and performance measurement as well as corresponding barriers to implementation. In order to answer RQ3, an explorative framework for discussing and selecting meaningful CPIs is proposed. The framework takes the previous findings and complements them with a set of selection criteria derived from literature and interviews with retailers. Lastly, the framework was applied in a focus group session with MQ. In doing so, metrics of potential interest were extracted from the framework and discussed among participants.

Findings RQ1: What are possible design features of Circular Performance Indicators in the textile industry?

In combing literature analysis and qualitative content analysis of expert interviews, a system of 16 main categories and 22 sub-categories for CPIs was developed. These categories describe potential design features of CPIs in the textile sector.

Analysis suggests that design features of CPIs pertain to environmental impacts and material flows across the entire lifecycle of textile products. Experts predominantly suggested CPIs which address energy, material consumption, material cyclability, product reuse and waste and emphasized indicators for manufacturing and the end of life. Notably, measuring recycled input material in textile production was mentioned by every single expert. Further, CPIs for chemicals and water were perceived as particular important for the textile industry as both aspects represent key inputs along the value chain.

Other types of CPIs that are notable from a CE-perspective but did not receive much attention during interviews pertain to captured value points, leasing, longevity and product reuse. Some experts highlighted their importance because, from a CE-driven business perspective, prolonging the lifespan of textile products and engaging in business activities beyond conventional retailing may offer valuable opportunities. Despite reducing environmental impacts, such activities would allow companies to maximize profit per product, e.g. by reselling or leasing one product many times. Thus, CPIs in these categories may be useful for companies engaging in reselling or leasing by evaluating the economic opportunities of underutilized value streams.

Findings RQ2: How are Circular Performance Indicators applied among major European textile retailers?

By scrutinizing disclosed indicators of 19 sustainability reports in accordance with the design features of CPIs developed for RQ1, a set of metrics applied among major European textile retailers was produced.

Analysis suggests that the application of CPIs among textile retailers is still in an early stage. Overall, six out of 19 sustainability reports mention CE as a means to reducing the corporate environmental footprint. Based on the design features of CPIs explored in RQ1, indicators for eleven out of 22 categories were identified across the analyzed sample of reports. Moreover, CPIs identified across the sample mainly pertain to chemicals, energy, material consumption, waste and water. Here, the scope of measurements taken varies considerably. Analysis suggests that retailers predominantly measure aspects under their direct control. This is reflected by, inter alia, greenhouse gas (GHG) emissions where measurements predominantly capture scope 1 and 2 emissions.

During interviews with retail representatives, none of the interviewees mentioned to explicitly measure progress towards CE. Against this background, representatives perceived various barriers to implementation. By highlighting the complexity of the textile value chain and internal resource constraints, interview participants suggested that data collection would pose a major challenge to implementing CPIs. In addition to that, retailers emphasized the need for further organizational development before such metrics could be implemented. Based on the findings, the author argues that the lifecycle character of CE could further augment these challenges because CPIs may rely on data from upstream *and* downstream processes.

Findings RQ3: Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ?

By complementing the findings from the previous analysis with a set of selection criteria, a framework for defining meaningful CPIs from the perspective of textile companies was proposed (see below).

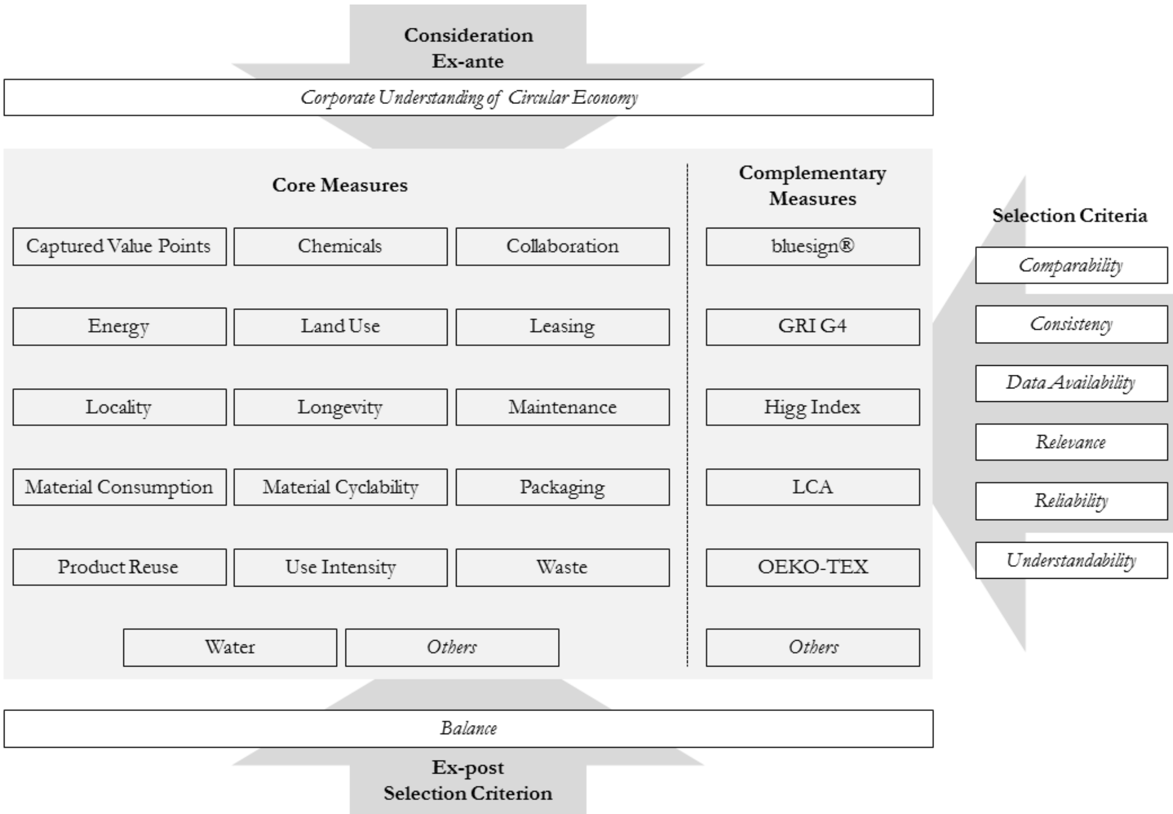

Figure: Explorative framework for selecting CPIs in the textile sector.

Based on the previous analysis, the framework differentiates between *core measures* and *complementary measures*. Core measures *explicitly assess circular business performance* and *reflect the design features of CPIs*. Complementary measures are comprised of *tools, frameworks and aggregated metrics* which partially reflect the CE-mindset but do not offer a comprehensive view on the circular performance of a business or product.

The framework was applied during a focus group session with Swedish fashion retailer MQ. In this, participants extracted and discussed CPIs which were of particular interest for the company's transformation towards sustainability. As a result, the categories chemicals, energy, longevity, maintenance, material consumption, waste and water were perceived to be of particular interest for MQ. The workshop produced a set of 16 indicators (core measures) which may be of potential interest.

Recommendations for MQ

Besides taking into account the general findings presented in this paper, the following recommendations shall be given to MQ:

- In the short term, the company may consider indicators for which *data is easily accessible* and which are *compatible with MQ's business model* and *focus on high quality* (i.e. CPIs for maintenance)
- In the intermediate term, MQ may consider the use of indicators for which *data is not immediately available* but which provide important insights regarding the company's *environmental performance* and *resource consumption* (i.e. CPIs for material inputs, energy, waste and water)
- In the long term, MQ may explore economic and *environmental opportunities arising from reselling and leasing activities*; in this case, it may be advisable to apply metrics which reflect the feasibility of such activities (i.e. CPIs for captured value points, product reuse and leasing)

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Abbreviations

CE – Circular Economy

CPI – Circular Performance Indicator

GATT – General Agreement on Tariffs and Trade

GRI – Global Reporting Initiative

LCA – Lifecycle Assessment

MCI – Material Circularity Indicator

T&C – Textile & Clothing

1 Introduction

Since the industrial revolution, economic growth has brought about unprecedented wealth for many people across the Global North. Yet, the modus operandi of the current economic model in these countries is inherently linear; it relies on the extensive extraction of raw materials which are transformed into goods, sold on the market place and, once consumed, simply burnt or landfilled. Such a "take-make-dispose system" (EMF, Ellen MacArthur Foundation, 2013: 5) has been widely criticized because it is harmful to the environment, wastes valuable resources and overexploits the world's natural capital.

In fact, research suggests that the planet has entered a new geological epoch, the Anthropocene (Crutzen, 2002; Zalasiewicz et al., 2010), in which human activities are the predominant geophysical driving force (Wilkinson & McElroy, 2007). The 1950s marked the advent of the Great Acceleration (Steffen et al., 2007), characterized by a two-fold increase of human population and a 15-fold increase in economic activity by the end of the century. Similar growth patterns can be observed for various aspects of human development, including global carbon emissions, use of water and fertilizers as well as urban population and international tourism (ibid.: 617). Following this argument implies that unrestricted economic growth which is rested upon a take-make-dispose logic can result in a critical destabilization of the earth's life-support systems and may jeopardize the well-being of current and future generations.

Fueled by the environmental movement of the 1970s, public concern about the future of mankind culminated in a wide-spread discussion on inter- and intra-generational justice, represented by Brundtland Report (1897) *Our Common Future*. Commonly known for coining the term "sustainable development", the report further discusses "the possibility for a new era of economic growth" (Brundtland et al., 1987: 5) which sustains and expands natural capital by decoupling economic activities from negative environmental and social impacts.

Ever since, researchers, politicians and businessmen alike have tried to navigate towards "a safe operating space for humanity" (Rockström et al., 2009). Based on this premise, various sustainable development models have emerged in society. One such model is the Circular Economy (CE). Whilst a myriad of definitions for CE exist, they essentially describe an economic system which produces neither waste nor pollution by circulating materials at a high quality within the production system and, if possible, feeding them back into the biosphere to restore natural capital at the end of life.

1.1 Problem Definition

Throughout the last decade, the Circular Economy (CE) has gained increasing attention by policy makers and companies alike. China was the first country to choose and implement the concept as a national development strategy by passing the Circular Economy Promotion Law in 2008 (Geng et al., 2012). More recently, Western countries have followed suit. In December 2015, the European Commission adopted the Circular Economy Package which aims to enhance competitiveness, create employment and transition towards a sustainable growth model within the European Union. The package includes an action plan which mobilizes more than 6 billion EUR in funding and defines specific actions for changing the full lifecycle of products, for instance by promoting eco-design, waste prevention and the reuse of industrial (by-)products (EC, 2015).

Companies extensively rely on performance indicators for managing resources and evaluating targets and objectives. Consequently, transitioning towards CE on the business level will require effective approaches to performance measurement. While some efforts have been taken to conceptualize CE-related indicators on a cross-sectoral and macro-economic level (e.g. Su et al., 2013), Geng et al. (2012: 222) emphasize that "[t]here is an urgent need to set up appropriate indicators for evaluating the performances of various businesses so that managers and entrepreneurs have drivers, indicators, and tools to make internal changes".

An analysis of existing literature on CE and performance indicators revealed a significant knowledge gap in this field. As of today, very few papers address the design of Circular Performance Indicators (CPIs) on the business level. One paper, published by the Ellen MacArthur Foundation (EMF, 2015a), presents a methodology for a Material Circularity Indicator (MCI) that measures product and company performance. Another paper by Griffiths & Cayzer (2016) focuses on product performance only[1].

None of these papers proposes indicators for textile companies in particular. Yet, they highlight the need for sector-specific metrics (EMF, 2015a) and mention the textile industry as a potential field of application (Griffiths & Cayzer, 2016). The lack of CPIs for the textile sector appears especially problematic because it is an economically potent (Lu, 2015) and heavily polluting industry (Blackburn, 2015).

1.1.1 The Textile Industry

Since the phase-out of international export quotas through introduction of the General Agreement on Tariffs and Trade (GATT) in 1949, the textile and clothing (T&C)[2] sector has transformed into a globalized and highly complex industry. Statistics provided by the World Trade Organization (WTO, 2001-2015) indicate that between 2000 and 2014, the export volume of textiles and clothing grew from 157 and 199 billion USD to 314 and 438 billion USD respectively. As of 2014, the compounded export value of T&C products amounted to some 752 billion USD, representing about 4.3% of the world's merchandise trade. This development is presented in Figure 1-1.

Figure 1-1: Global export value of T&C products between 2000 and 2014.
Source: Own illustration based on WTO (2001-2015).

[1] A third party, the Dutch cooperative Circle Economy, is currently working on an assessment tool for circular business performance. According to the developer (personal communication, 2016), this tool shall be applied to the textile sector during its pilot phase.

[2] As per definition, the term "textiles" applies to a wider range of fiber-based products, comprised of household articles (towels, carpets, furnishing etc.), miscellaneous items (that is flags, canvases, sails etc.) and clothing (e.g. shirts or pants, also referred to as apparel, fashion or garments).

Today, the textile sector is perceived as having one of the largest environmental footprints in the world; with regards to fashion, some sources even claim that it is "the world's 2nd most polluting industry, second only to oil" (e.g. Ditty, 2015; Ethical Fashion Forum, 2014)[3]. According to literature, the main environmental impacts of textile products occur throughout fiber production, manufacturing and use phase (Allwood, 2006; Beton et al., 2014; Laitala et al., 2012; Nilsson, 2007; Saouter et al., 2002).

During fiber production, cotton remains "the main contributor among all the fibres due to its large share in the textiles market and to the nature of its production" (Beton et al., 2014: 13). In fact, Clay (2004) estimates that cultivation of cotton fibers solely accounts for 25% and 11% of the global insecticide and pesticide consumption respectively. Moreover, depending on the specific environmental conditions and irrigation techniques applied, it requires between 7,000 and 29,000 liters of water for cultivating one kilogram of cotton (ibid.). During textile manufacturing, Nilsson (2007: 221) states that "wet processing is the most significant textile operation" which results in large volumes of heavily polluted waste water and requires a considerable amount of energy for the heating and cooling of chemical baths and fabrics (Blackburn, 2015; Nilsson, 2007). During the use phase of textiles, washing and laundering cause significant environmental impacts due to their high energy consumption (Beton et al., 2014). In this context, washing temperature (Laitala et al., 2012), tumble drying (Allwood, 2006; Farrant et al., 2010a) and the type of laundry detergents used (Saouter et al., 2002) present the main determinants.

As global fiber consumption is projected to reach 13 kg per capita by 2020 (Eichinger, 2012: 2), the environmental footprint of the industry is likely to grow larger. Circular business practices present a powerful remedy for this challenge; through means of reuse and recycling, they can create significant environmental benefits, e.g. by substituting valuable raw materials (Farrant et al., 2010) and mitigating considerable amounts of carbon emissions (Zamani et al., 2014). Thus, measuring progress towards circularity is sorely needed if these environmental benefits are to be achieved.

1.1.2 The Role of Retailers

Internationally, the textile sector is driven by retailers, brand marketers and trading firms who purchase in low-income countries and sell on Western markets where demand for textile products is high. As a result, intermediaries, suppliers and sub-suppliers are subjected to massive economic pressure, often leaving them "no choice other than to compete at the expense of decent working conditions" (Goto, 2011: 946). This is vividly reflected by countless deadly accidents in textile producing countries, such as the disastrous collapse of the Rana Plaza factory building in Bangladesh on April 24th 2013 which killed more than 1,000 people and left many more injured (Butler, 2013).

This and various other reports on prevailing "sweatshop" conditions, child labor and environmental health and safety risks have contributed to rising public concern about sustainability in the textile sector (Kozlowski et al., 2012). Consequently, textile retailers increasingly incorporate environmental and social considerations into their business strategies (Koszewska, 2010) and now communicate their progress through corporate sustainability reports.

[3] This piece of information is recurringly cited in numerous internet sources and seemingly taken from a publication by the Danish Fashion Institute and Deloitte (2013) which is no longer accessible to this date. To the author's opinion, it appears very doubtful to assess the environmental footprint of the sector as a whole, let alone rank it against another industry. Nonetheless, numerous Lifecycle assessments (LCAs) on textile production and consumption reveal that the industry induces significant environmental impacts.

One of the most widely-applied guidelines for corporate sustainability reporting and performance indicators is provided by the Global Reporting Initiative (GRI). A recent study by GRI (2015: 5) on the future of sustainability reporting acknowledges the growing importance of the Circular Economy (CE) on the public agenda and concludes that prospectively, "companies may consider making an effort to align their business decisions to […] the circular economy, the shared economy or the green economy". Following this argument implies that sustainability reporting would express "the extent to which companies are shifting their performance towards their chosen sustainable model" (GRI, 2015: 8).

The current G4 framework by GRI (n.d.) includes ten sector supplements with industry-specific indicators and reporting guidelines. Until 2008, a supplement for the footwear and apparel industry was developed. However, the supplement remained in the pilot phase and was never published (GRI, 2008). Hence, from the perspective of textile retailers, there is a lack of guidance for designing performance indicators that address CE-related aspects.

In addition to that, volatile commodity prices present a strong argument for textile retailers to close material loops. In fact, a study by the McKinsey Global Institute (Dobbs et al., 2013: 1) speaks of a "new era of high, rising, and volatile resource prices" and argues that, between 2000 and 2013, average annual volatility of commodity prices was almost three times as high as it was in the 1990s. This holds true even for cotton and polyester, the two most important raw materials in the textile industry. With regards to cotton, prices "fluctuated wildly in recent years" (Van Tot, 2014: 6) and volatility was almost 44% higher than in the 1980s (Dobbs et al., 2013: 27). In the case of polyester, prices are strongly linked to oil where volatility was about 50% higher when compared to the 1980s (ibid: 13).

The impacts of such high volatility can be illustrated by the sharp increase in world cotton prices five years ago. In July 2010, cotton was traded at a price of 85 US cents per pound which, within just eight months, surged to an all-time high of 230 US cents (Indexmundi, 2016). For fast-fashion giant H&M, this had dramatic financial consequences and resulted in a 30% drop in net profits during the first quarter of 2011 (Ward, 2011). Although today, cotton is comparatively affordable and lists at a price of 75 US cents per pound (Indexmundi, 2016), strong fluctuations in price levels pose a real threat to textile retailers as they create incalculable risks and can severely hamper long-term investments.

Against this background, Benton et al. (2014: 49) argue that circular business practices help "to mitigate these risks by fostering an in-depth understanding of the supply chain" and can improve the "use of resources by keeping them in the economy for longer". Thus, CE-related business activities can create security of supply and may provide "better control over the future cost base".

Additionally, CE can offer attractive economic opportunities to retailers who manage to tap into previously underutilized material flows. Based on UK prices, the Ellen MacArthur Foundation (EMF, 2013b) estimates potential revenues of 1,975 USD per ton of clothing waste. By subtracting costs of 680 USD for collection and sorting, the profit margin per ton of clothing is calculated at 1,295 USD. Assuming a collection rate of 65% in Europe and North America, this would present an economic opportunity worth of 26 billion USD (EMF, 2013b: 55).[4] For the UK, similar findings have been reported by the British Waste and Resources Action Program (WRAP). By increasing the diversion rate of the UK's textile waste alone

[4] This calculation is based on UK prices and does not take into account capital costs. Instead, only variable costs from collection and sorting are considered. Moreover, estimations are based on UK statistics of collected textile waste and revenues generated from four main applications: reuse (21%), export reuse (52%), cleaning rags or wipers (8%) and shreds (14%).

(including clothing, shoes and household linen) from landfilling by just 10%, WRAP estimates a potential revenue of 25 million GBP (Bartlett et al., 2013: 69). This is equivalent to roughly 33 million USD at current exchange rates.

Mitigating volatility-induced risks and capturing the value of textile waste flows will remain largely impossible if textile retailers refrain from using appropriate performance indicators. Therefore, examining the application of such indicators among textile retailers appears to be particularly valuable and shall be addressed in more detail.

1.1.3 The MQ Case

Internationally, Sweden is well-known for bridging the gap between avant-garde catwalk fashion and mainstream sidewalk culture. One of the country's major fashion retailers is MQ. Founded in 1957, the company sells clothes via its online shop and currently maintains a retail network of 121 stores across Sweden and, to a minor extent, Norway. By marketing high-quality garments in the medium to upper price segment, MQ was able to build a large customer base, as reflected by its growing loyalty club with almost 600,000 members. For the fiscal year 2014/2015, MQ recorded net sales of 1.557 million SEK (i.e. around 173 million EUR) and employed 1,100 people in 590 full-time positions. Thereof, 96 worked in its headquarters in Gothenburg, 22 at procurement offices abroad and 474 in retail stores across Norway in Sweden. Since 2010, the company is listed on NASDAQ OMX in Stockholm. Due to its growing capital base through recent years, MQ was able to grow considerably and now sells products from over 50 external brands, including Elvine, Filippa K, Knowledge Cotton Apparel, Esprit and G-Star Raw, amongst others (MQ, 2015: 3, 11).

In the past, MQ's sustainability efforts have predominantly focused on social aspects and impacts along its upstream processes. Production facilities are mostly located in China, Bangladesh and Turkey. Due to often unacceptable labor conditions in these countries, MQ joined the Business Social Compliance Initiative (BSCI) in 2007 and renewed its supplier Code of Conduct in 2014. It maintains close relationships with its suppliers which are evaluated twice a year. In order to facilitate long-term relationships and keep the evaluation activities within a manageable range, MQ (2015: 13) has steadily decreased the number of suppliers from 73 (fiscal year 2013/2014) to 54 (fiscal year 2014/2015). In addition to that, MQ arranges annual supplier network meetings to facilitate knowledge sharing and dissemination of best practices across the supply chain.

Despite these commitments on the social agenda, MQ is also taking actions for improving its environmental performance along its upstream processes. The company is a member of various industry initiatives, such as the Sweden Textile Water Initiative, the Kemikaliegruppen (Swedish Textile Chemicals Group), the Textile for Recycling Initiative and the Better Cotton Initiative (ibid.). With regards to the company's downstream processes however, MQ has adopted only few individual measures. One of such measures is the cooperation with the Swedish charitable organization Myrorna to which MQ donates samples, prototypes and refund claims from the retail shops. Further, if a refund is claimed, the customer can choose between selecting a new piece of garment and making use of a free repair service, thereby prolonging its lifespan and avoiding excess production. However, these practices do not receive much attention in MQ's current sustainability report and are not yet integrated into its corporate sustainability strategy.

As per personal communication (2016) with MQ, CE-related activities are seen as valuable opportunities. The company is currently preparing its fourth sustainability report in accordance with GRI G4 to be published in December 2016. Hence, the need for meaningful indicators which can communicate progress towards circularity is particularly evident.

1.2 Research Questions

The purpose of this research is to contribute to the advancement of circular business practices by exploring possible design features, the application and the selection of Circular Performance Indicators (CPIs) in the textile sector. A case study for the latter is the Swedish fashion retailer MQ. As part of the MQ's aspirations to become a more sustainable company, the retailer is planning to release its first sustainability report in accordance with the GRI G4 framework in December 2016. Hence, this research is relevant for textile companies in general but creates further value for retailers and MQ in particular.

Based on this background, this paper investigates CPIs within the textile sector by posing three research questions (RQs). In order to further guide this examination, each RQ has been assigned with a set of sub-questions.

Table 1-1: Research questions and corresponding sub-questions.

RQ1	What are possible design features of Circular Performance Indicators in the textile industry?
Sub-questions	- What is the sustainability focus of the Circular Economy? - What are current best practices for designing Circular Performance Indicators? - What is experts' understanding of Circular Performance Indicators with regards to the textile sector?

RQ2	How are Circular Performance Indicators applied among major European textile retailers?
Sub-questions	- Which metrics disclosed in sustainability reports of textile retailers qualify as Circular Performance Indicators? - What are barriers to implementation of CPIs from the perspective of textile retailers?

RQ3	Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ?
Sub-questions	- What are applicable selection criteria for Circular Performance Indicators? - Which aspects of the Circular Economy are of particular relevance for MQ? - From the perspective of MQ, why are some indicators more applicable than others? - What are the strengths and weaknesses of the proposed framework?

1.3 Overview of Methodology

Due to limited theoretical considerations in this field, the level of analysis moves from broad to specific. The literature analysis explores the sustainability focus and design of Circular Performance Indicators (CPIs) on a broader level. These findings are complemented by qualitative content analysis of expert interviews in order to develop a deeper understanding of CPIs with regards to textiles. Based on these findings, content analysis of sustainability reports and interviews with representatives from European textile retailers examines the application of CPIs among textile retailers. Based on the integration of these findings with a set of selection criteria, an explorative framework is proposed. This framework is applied in a focus group session and helps to identify indicators for the Swedish fashion retailer MQ.

1.4 Limitations and Scope

Albeit limitations to this research are manifold, they do not undermine the general validity of the findings. First and foremost, it should be highlighted that the research design is exploratory in nature and as such, does not claim to be statistically representative. Instead, this thesis aims to examine the interplay between the Circular Economy (CE), performance measurement and the textile industry in a qualitative fashion. As of today, the crossroads of these different topics are poorly researched and experts in this particular area are hard to identify; thus, interview participants had to be chosen somewhat less selectively and triangulation was necessary in order to produce warranted findings.

As for the literature analysis, only those references which explicitly propose CE-related performance indicators are included for the category formation. While this surely limits the comprehensiveness of the proposed category system, it was perceived to be a necessary scoping decision which helped to deliver a more clear-cut understanding of CPIs. Further, the contribution of Chen et al. (2009) and Cheng & Du (2009) on the design of CPIs were disregarded due to the authors inability to read Chinese.

When examining the application of CPIs, the analysis mostly focuses on sustainability reports of major European retailers. Whilst the geographical emphasis was chosen to ensure heterogeneity and comparability, the sole focus on sustainability reports presents a limitation of data inputs and is likely to disregard other means of internal performance measurement. In fact, we can expect that retailers disclose certain information only and are unlikely to communicate confidential performance data to external stakeholders. However, given the emerging relevance of CE, sustainability reports present a data source that is easily available and provide valuable insights regarding the application of CPIs across textile retailers.

Before the focus group session with Swedish textile retailer MQ, some participants expressed their concern about their limited experience regarding the CE concept. Indeed, MQ's involvement and interest in CE is relatively new. Hence, the concept has not been explored in much detail yet. In order to compensate this, participants were advised to look at public educational materials from the Ellen MacArthur Foundation's webpage prior to the session. Furthermore, the author provided brief theoretical and conceptual inputs at the beginning of the workshop. For a more thorough explanation of the scoping decisions involved, please refer to chapter 3.

1.5 Ethical Considerations

The author maintained due diligence regarding the ethical implications of this thesis. While this paper was written in partial cooperation with the Swedish fashion retailer MQ, the author did not receive any immediate financial benefits from the research process. The company covered expenses for transport, board and lodge arising as part of the focus session in Gothenburg. The author's participation in this workshop stemmed from purely academic interests and did not impact the intellectual honesty of the outcomes.

Furthermore, the author was duly concerned with maintaining academic integrity through the entire research process. This includes the strict avoidance of plagiarism and the confidential treatment of primary data sources. With respect to the latter, contents from expert interviews and the MQ focus group session were anonymized prior to publication. If participants permitted to make audio recordings, these were used for purely academic purposes and not shared with third parties. If participants withheld permission of being recorded, the author tried to capture the true contents of the interviews to the best of his own abilities by taking manual notes. In this case, interviewees were provided with hand-written transcriptions and asked for final clearance prior to analysis. Likewise, personal information and direct quotes were published upon receiving consent from all participants.

1.6 Outline

This paper is structured as follows: Chapter 2 provides additional context and background information in order to further the reader's understanding of the Circular Economy (CE) and the textile sector.

Chapter 3 presents the research design and underlying methodology. Attention is given to methods for data collection and data analysis, including literature analysis, expert interviews, qualitative content analysis and the MQ focus group session.

A thorough literature analysis on CE and Circular Performance Indicators (CPIs) is conducted in chapter 4. Based on this, a deductive category system is developed which guides the subsequent content analysis of expert interviews.

Chapter 5 presents the results of this paper. It is structured in multiple parts. First, findings from content analysis of expert interviews are presented. Subsequently, the chapter presents results from content analysis of sustainability reports. Finally, an explorative framework for the selection CPIs is proposed and applied in a focus group session with the Swedish fashion retailer MQ.

In chapter 6, the findings are interpreted against the research questions (RQs). First, the possible design features of CPIs are elaborated (RQ1), followed by a discussion regarding their application among textile retailers (RQ3). Lastly, indicators selected during the MQ focus session are scrutinized (RQ3).

Chapter 7 critically reflects upon approaches to CE, the application of qualitative and quantitative indicators as well as the methodology of this research. Further, potentials for future research are provided and recommendations are given to MQ.

The thesis is concluded in chapter 8 which summarizes the findings of this research and explains how they contribute to the on-going discourse about CPIs.

2 Towards a Circular Textile Industry?

2.1 Trade and Market Trends

In her book *Waste and Want: A Social History of Trash,* Strasser (2000) argues that the concept of waste, understood as unwanted or unusable material, was practically unknown before the advent of the industrial revolution. Even in the early ages of industrialization, society maintained a culture of reusing and recycling in order to preserve valuable materials. In fact, resource shortages dictated that "scavenging was essential […], a chore and a common pastime for poor children, who foraged for shreds of canvas or bits of metal on the docks, for coal on the railroad tracks, and for bottles and food on the streets and in the alleys" (ibid.: 13). Eventually, it was the rise of mass production and prolonged economic growth during the post-war decades which "heralded the era of fashion and style" and stimulated a "throwaway-mindset which is today known as linear consumption behavior" (Lieder & Rashid, 2016: 37).

Globally, this evolution is reflected by the steady growth of fiber markets which, since 1960, expanded by an average of 3% annually and resulted in an estimated fiber consumption of 11 kg per capita in 2010. Market developments were mainly driven by industrialized countries where fiber consumption is much higher than the global average; for 2010, Eichinger (2012: 2) estimates a demand of 40 kg and 25 kg per person in the US and Europe respectively. Due to rapid growth in emerging countries, global fiber consumption is projected to reach 13 kg per capita by 2020 (ibid.).

Traditionally, a large fraction of global textile and clothing (T&C) production was located in the European Union. Since the abolishment of quotas however, the international market structure has changed tremendously. The elimination of international trade barriers subjected incumbent companies to increasing competition and led to a significant decline of European T&C production. From 1980 to 2014, the EU's share in world textile and clothing exports fell from 49.4% and 42% to 23.8% and 26.2% respectively (WTO, 2003, 2015). During this time period, most production was relocated to low-income countries, such as Bangladesh, India, Vietnam, Turkey and China. Based on latest available data, the latter is by far the largest exporter and held a share of 35.6% for textiles and 38.6% for clothing in 2014 (WTO, 2015). Table 2-1 depicts this development.

In spite of the significant decline in domestic T&C production, the industry continues to play an important role in the European Union. Based on statistics provided by the European Apparel and Textile Confederation (EURATEX, 2016b), the sector consists of 175,000 companies which employ 1.7 million people and generate a turnover of 169 billion EUR (rounded numbers). Europe's five most populous countries – Italy, France, the United Kingdom, Germany and Spain – account for about three quarters of the EU's production (European Commission, EC, n.d.). Further, the industry is characterized by a high degree of heterogeneity and is largely dominated by SMEs; according to Ditty (2015) and the EC (n.d.), companies with less than 50 employees account for more than 90% of the industry's workforce and create about 60% of the industry's value-added.

Table 2-1: Share of world T&C exports 1980-2014; top 5 countries as of 2014.

Share of world exports (textiles)

	1980	*1990*	*2000*	*2014*
China	4.6%	6.9%	10.4%	35.6%
European Union*	49.4%	48.7%	36.7%	23.8%
India	2.4%	2.1%	3.6%	5.8%
United States	6.8%	4.8%	7.1%	4.6%
Turkey	0.6%	1.4%	2.4%	4.0%

Share of world exports (clothing)

	1980	*1990*	*2000*	*2014*
China	4.0%	8.9%	18.2%	38.6%
European Union*	42%	37.7%	28.7%	26.2%
Bangladesh	0.0%	0.6%	2.6%	5.1%
Vietnam	n/a	n/a	0.9%	4.0%
India	1.7%	2.3%	3.0%	3.7%

*Number of EU member states: 1980: 15; 1990: 15; 2000: 25; 2014: 28.

Source: WTO (2003, 2015).

To secure a leading role on the world market, most European T&C companies have positioned themselves in a high-end niche to develop highly specialized products for technical or industrial applications that entail high added value (EC, n.d.). Nonetheless, a recent in-depth sector assessment by Scheffer (2012: 11) concluded that the EU's T&C industry is likely to be "substantially smaller in 2020 than in 2010" due to increasing import penetration of non-European competitors.

EURATEX (2016a: 12) therefore emphasizes the need for innovation towards "flexible, short-run on-demand production, digital manufacturing and supply chain management, customization and service-based business models, sustainable business operations and the extension of application areas for highly engineered and smartly functionalised textile materials". Here, EURATEX (2016a: 5) perceives the Circular Economy (CE) as a promising approach and encourages the implementation of "incentives to support sustainable production and a circular economy" in order to increase the industry's competitiveness.

2.2 Policy Overview

The growing importance of the Circular Economy (CE) through recent times is reflected by implementation of the Chinese Circular Economy Promotion Law in 2008 (Geng et al., 2012) and the adoption of European Circular Economy Package (CEP) in December 2015.

China's share in the global trade of textile products is growing and makes important economic contributions to the country's development. Consequently, its national CE-strategy from 2013 stipulates specific actions for the textile sector (de Bie, 2016a). As laid out in the National Circular Economy Textile Industry Action Plan, measures focus on the production of textiles and are largely concerned with promoting integrated industrial chains. Along these chains, the by-products of one company present the raw material of another company which leads to, inter alia, lower greenhouse gas (GHG) emissions and energy savings. In this, the industry may, for instance, use petrochemical wastes for the production of polyester-based textile products (de Bie, 2016b).

On the European level, the CEP does not define the textile industry as a priority sector. Instead, textiles are merely touched upon indirectly, e.g. through waste management issues and other product systems, such as bio-based products. Given the comparatively high labor costs of European textile production, this appears understandable; on the other hand, the EU is characterized by a high spending power and remains a leading import market for textiles. Having this in mind, CE-related policy measures are more likely to address the end of life of textile products in order to extract additional value from underutilized post-consumer waste and decrease Europe's dependency on imports of raw materials.

Notable initiatives on the country level can be found in France, the UK and the Nordic region. France currently employs an Extended Producer Responsibility (EPR) scheme for textile products as part of its national CE-strategy (French Ministry of Environment, 2014). The scheme was implemented in 2006 and resulted in the creation of a private, non-profit Producer Responsibility Organization (PRO) named EcoTLC that was established two years later. Between 2009 and 2012, the PRO noted that collection rates of post-consumer textiles increased by 8% annually (Tiard, 2013: 6). From 2019 onwards, EcoTLC aims to collect 300,000 tons per year, representing 50% of annually sold textile goods (EcoTLC, 2014: 5).

In the UK, the "European Clothing Action Plan" (ECAP) was launched in September 2015. It is led by the British Waste and Resources Action Program (WRAP) and funded with 3.6 million EUR from the EU LIFE program. ECAP will run for 3.5 years and aims to establish a pan-European framework for a sustainable clothing sector. The framework will create synergies with actions stipulated by the CEP and entail specific goals which address the whole lifecycle of textile products (WRAP, n.d.-a). In particular, the action plan seeks to prevent 90,000 tons of textiles annually from being landfilled in order "to adopt a circular approach across Europe" (WRAP, n.d.-b).

In April 2015, the Nordic Council of Ministers (NCoM) passed an action plan for sustainable fashion and textiles. The plan includes a "Vision 2050" which aims to counteract the "buy-it-and-throw-it-away culture" and transforms the textile sector into a circular system "in which product life is extended and textile fibers are […] used again and again as part of a toxic-free cycle" (NCoM, 2015: 12). To achieve this, NCoM has defined four major fields of action: first, promotion of sustainable design; second, lowering the environmental impact of production; third, increasing the market for environmentally friendly fashion and textiles; and fourth, encouraging a market trend towards more recycling (ibid.).

Despite these national initiatives, it appears that the policy implications of CE are not yet well understood. In 2015, the European Environment Agency (EEA, 2016: 68) commissioned a number of studies screening European countries' approaches "towards closing material loops in the economy/circular economy". The final report concludes that most European member states have implemented CE-related measures in one way or another, e.g. by focusing on cleaner production, waste prevention, reuse and recycling. Yet, by evaluating these measures across different lifecycle stages, EEA (2016a: 69) finds that the majority of European states seek to implement (or have implemented) CE through better end of life management. In fact, 53% of the responses were related to waste management (including recycling), followed by waste prevention (17%), production and distribution (11%), consumption (7%), design (6%), resource extraction (3%) and lastly, product longevity (3%). Against this, EEA (2016: 8) concludes that "circular economy for most countries still means merely better waste management". Figure 2-1 illustrates these findings.

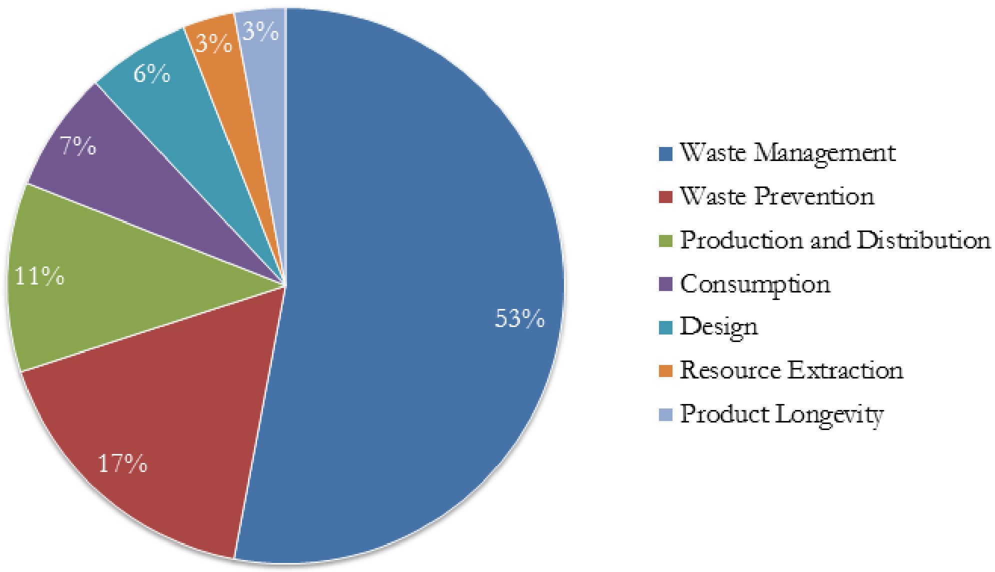

Figure 2-1: Policy approaches to CE in EU states across different lifecycle stages.
Source: Adapted from EEA (2016a: 69).

Given that the most crucial impacts of the textile lifecycle occur during fiber production, manufacturing and use phase (section 1.1.1), a one-dimensional focus on end of life solutions may fail to decouple economic growth from environmental degradation. Hence, business solutions which address the entire lifecycle of textile products are needed. These shall be discussed in the following section.

2.3 Business Models and Environmental Impacts

A comprehensive analysis on the integration of CE in the textile business is lacking to this day. Yet, the Dutch cooperative Circle Economy (2015) has developed a classification of CE business models in the textile industry. Drawing from a list of more than 250 textile-related business concepts, a sector assessment on circular strategies distinguishes between three main categories: circular, servitization and sufficiency. The assessment provides ten in-depth case studies and a number of comparative cases which illustrate the process of value creation across these categories. Appendix I presents these types of business models and provides selected examples for their application.

In the fashion industry, Hvass (2015) distinguishes between two broad approaches for closed-loop business models: in-store tack back schemes versus reuse and reselling platforms.

By pursuing the first approach (i.e. in-store take-back schemes for recycling), companies incentivize customers to return products at the end of life in exchange for a shopping voucher. Such schemes have been implemented by various fashion retailers, such as PUMA, WEEKDAY, Name It and Jack & Jones. Another prime example for this is fast-fashion giant H&M (2015: 89) which recently announced "to move towards a 100% circular business model" by "only using recycled or other sustainably sourced materials and taking a circular approach in how products are made and used". These schemes appear to be more appropriate for companies which offer products of lower quality and lower resell value (Hvass, 2014). Here, creating and maintaining a commercially viable cost-structure largely depends on the handling of reverse logistics, the effectiveness of the collection system, recycling efficiency and the degree of customer engagement (Hvass, 2014, 2015).

Following the second approach (reuse and resell platforms), companies seek to prolong the product life time while capturing the resell value of used textiles. Examples include US brands such as Patagonia and Eileen Fisher as well as Swedish companies like Boomerang and Filippa K. Based on a case study with Filippa K, reselling can attract new customer groups, increase customer loyalty and generate additional income from used products and samples. Yet, the success of such activities depends on a various key conditions, including market maturity, strong brand awareness, high product quality and high perceived resell value. Moreover, the avoidance of cannibalism appears to be of great importance, implying that reselling via external stores is preferable over store-in-store solutions.

An eco-financial assessment of five apparel business models conducted by WRAP concluded that buy-back and reselling models exhibit the greatest financial viability, followed by formal clothing hire. Other models, including repair services, leasing of baby clothes and peer to peer exchange platforms, were deemed as unprofitable even within a ten year timeframe (Buttle et al., 2013). The differences in profitability can be explained by various assumptions for initial capital requirements, labor costs and profit margins for goods and services offered. The report concludes "that there is potential for a business case to be made that combines strong financial performance with reasonable savings in the numbers of garments going to waste" (ibid: 77). Similarly, the Ellen MacArthur Foundation (EMF, 2013b: 60-61) suggests a business model for online clothing rental ("Netflix for clothing") which, according to simplified calculations, is more profitable than conventional online retail due to a decrease in clothing production which results in considerable material savings.

When it comes to resource impacts of circular business models, research suggests that leasing and reselling activities have the greatest saving potential. In the above mentioned eco-financial assessment by WRAP, Buttle et al. (2013: 72) conducted a scenario analysis on potential environmental savings of different business models. Over a five year time frame, absolute reductions across five models[5] are expected to be some 610 tons of clothing, 4,860 tons of carbon dioxide-equivalent (CO_2-eq) and 1,090 m^3 of water. Based on these numbers, leasing has by far the greatest impact and is expected to account for 40% of clothing, 66% CO_2-eq and 66% water saved. Second most effective is buy-back and reselling which accounts for 31%, 10% and 10% of clothing, carbon emissions and water saved respectively.

[5] These include: repair workshop, baby clothes leasing, formal clothing hire, buy-back & reselling and peer to peer platforms.

These results are further substantiated by a recent analysis of MUD Jeans & BLUEdot (2015) which compares the carbon and water footprint of a conventional pair of newly manufactured jeans (industry standard) against a pair of MUD jeans[6] and MUD leasing-vintage model[7]. While a conventional pair of jeans uses about 7,000 liters of water[8] and emits 23 kg of CO_2 through the entire lifecycle, a pair of MUD jeans uses 1,500 liters of water and emits 9 kg of CO_2-eq. The difference is even higher for a leased vintage model where merely 780 liters of water are used and 10 kg CO_2-eq are emitted. Based on these numbers, the analysis suggests that greatest savings can be achieved by reselling and leasing which saves 89% of water and 78% of carbon emissions when compared to the industry standard (ibid.: 6).

A lifecycle assessment (LCA) by Farrant et al. (2010) examines the benefits of second-hand reuse and recycling of post-consumer textiles by comparing the environmental impacts of a cotton shirt and a polycotton trouser (50% cotton and 50% polyester). Based on a survey of second-hand shops in Sweden and Estonia, the study estimates that purchasing 100 second-hand garments saves between 60 and 85 new garments. By examining the environmental burdens of both products along the lifecycle, the study suggests that reusing 100 cotton shirts reduces the impact on global warming by 14%, acidification by 28%, nutrient enrichment by 25% and natural resource consumption of gas and oil by 15%. Moreover, waste is reduced by 30% and human toxicity is decreased by 24% (ibid: 733-734). Similar findings were reported for polycotton trousers. In summary, the study concludes that environmental benefits from reuse "exceed the overall impacts by about 25 times for the T-shirts and by about 20 times for the trousers", implying that "clothes reuse introduces a potential for reducing the environmental impacts generated over the overall life cycle of clothing" (ibid.: 733).

Further, Farrant et al. (2010) mention that recycling reduces environmental impacts to a much smaller degree than reuse. These findings are supported by Zamani et al. (2014) who compare the global warming potential (GWP) and primary energy use of textile reuse and recycling to incineration. For one ton of polycotton material (50/50-mix), LCA suggests that reuse creates much higher environmental benefits than recycling, namely eight tons of CO_2-eq savings in GWP and 45.6 MWh savings in primary energy use as opposed to 0.9-5.6 tons CO_2-eq in GWP and 7.2-32.2 MWh, depending on the recycling technique applied.

Overall, it appears that reusing and prolonging the lifecycle of textile products generates higher environmental benefits than recycling. This may be explained by the fact that recycling, unlike reuse, does not preserve the embodied energy of textiles but uses additional energy for the separation of fibers and consecutive manufacturing steps.

[6] Newly manufactured content: 54% better cotton, 31% organic cotton, 13% recycled cotton, 1% conventional cotton, 1% others (MUD Jeans, n.d.).

[7] Resold via online shop; lifecycle is expected to be twice as long.

[8] Water usage excludes washing during use-phase.

3 Methodology

The RQs presented in chapter 1 encompass three different objectives with respect to the textile sector: first, the identification of design features of Circular Performance Indicators (CPIs); second, the current application of such metrics among retailers; and third, the designing of an explorative framework for selecting meaningful metrics from the perspective of the Swedish fashion retailer MQ. In order to fulfill these objectives, this paper takes a triangulation approach and examines each RQ through a set of complementary methods. Due to the lack of theoretical considerations found in literature, the research process will be exploratory and predominantly inductive in nature. Yet, some deductive elements are employed as well. This shall be described in the following sections. An overview of the methodology is given in Table 3-1.

Table 3-1: Research questions and methods.

Research Question	*Methods*
RQ1: What are possible design features of Circular Performance Indicators in the textile industry? - What is the sustainability focus of the Circular Economy? - What are current best practices for designing Circular Performance Indicators? - What is experts' understanding of Circular Performance Indicators with regards to the textile sector?	Literature analysis Content analysis (*interviews with experts from textile retailers and other institutions*)
RQ2: How are Circular Performance Indicators applied among major European textile retailers? - Which metrics disclosed in sustainability reports of textile retailers qualify as Circular Performance Indicators? - What are barriers to implementation of CPIs from the perspective of textile retailers?	Content analysis (*interviews with experts from textile retailers*) Content analysis (*sustainability reports from textile retailers*)
RQ3: Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ? - What are applicable selection criteria for Circular Performance Indicators? - Which aspects of the Circular Economy are of particular relevance for MQ? - From the perspective of MQ, why are some indicators more applicable than others? - What are the strengths and weaknesses of the proposed framework?	Literature analysis Content analysis (*interviews with experts from textile retailers and other institutions*) MQ focus group

3.1 Literature Analysis

This method systematically examines scientific articles, grey literature and management literature with regards to Circular Economy (CE), performance measurement and the textile industry. The objective of this method is three-fold: first, to discuss the sustainability focus of CE; second, to analyze current best practices for designing Circular Performance Indicators (CPIs); and third, to define selection criteria which can be help to select meaningful metrics from the perspective of MQ.

With regards to research question 1 (RQ1), the literature analysis scrutinizes the concept of CE and its underlying schools of thought. The definition by the Ellen MacArthur Foundation (EMF) serves as a starting point. From there, different strands of thinking are explored which have influenced the formation of the concept in the existing body of literature. In a second step, the analysis looks at best practices for designing CPIs. Here, the main point of attention is directed towards the works of the EMF (2015a) and Griffiths & Cayzer (2016).

To the best of the author's knowledge, both papers are unique in that they explicitly address the formation of CPIs on the (micro-) business level. Other best practices for circular performance measurement can be found on the meso- and macro-level. These were excluded from the analysis. This decision appeared logical because the above mentioned RQs call for an investigation of CPIs on the corporate level; hence, indicators which do not address issues within the realm of corporate management were found to lie beyond the scope of this paper[9]. Ultimately, the literature analysis for RQ1 describes possible design features of CPIs on a general and cross-sectoral level. This description aids in deducting categories for the qualitative content analysis described in section 3.3.

The literature analysis for RQ3 examines peer-reviewed articles and management literature which address the design and selection of environmental performance indicators. This analysis results in set of selection criteria and corresponding guiding questions which can assist in extracting meaningful metrics from the explorative CPI framework (section 5.3.1).

3.2 Expert Interviews

Expert interviews present the primary method for data collection in this study. Representatives were deemed eligible if they had experience in working with the textile sector (necessary condition)[10] and worked with either aspects related to Circular Economy (CE) or performance indicators (complementary condition). A prior screening was conducted on the basis of public information from webpages and LinkedIn profiles. This was complemented by questions via e-mail and during the interviews. If candidates were unsure about whether they could share valuable insights, the interview guide was provided before discussions took place.

Between May 15th 2016 and June 10th 2016, 74 potential interview candidates were contacted by e-mail. Eventually, 22 interviews were conducted between June 13th and June 27th 2016 through Skype and phone. The length of conversations ranged from 13 minutes to 54

[9] Literature anylsis revealed that Cheng & Du (2009) and Chen et al. (2009) published papers on CPIs on the business level. Due to the authors inability to comprehend Chinese however, both papers had to be excluded from the analysis.

[10] Exceptions include interviews with Sven Herrmann, Chris Tuppen who jointly worked on the MCI methodology published by Ellen MacArthur Foundation as well as Shyaam Rumkumar who is lead developer for a circular assessment tool at Circle Economy. Due to the importance of these methodologies for the literature analysis, those three participants were included in the final interview sample. In order to receive relevant inputs, the interview guide was modified to investigate the application of these methodologies to the textile sector.

minutes, depending on the availability and knowledge of the interviewee. A list of interviewees who participated in this study is presented in Table 3-2.

In order to facilitate the conversation with experts, a semi-structured interview guide was developed (please refer to Appendix II). This approach was chosen in order to adapt the questions to participants' knowledge and to explore issues of particular interest arising throughout the interview process. The guide contained 15 questions relevant for answering research questions (RQs) 1-3. The document was peer-reviewed by a fellow student at Lund University and the thesis supervisors. Recommendations from this process were incorporated before the guide was finalized.

Upon prior consent from the participants, audio recordings were made. Otherwise, written notes were taken during the interviews. These were sent to the interviewees to allow for comments and request clearance prior to analysis. Additionally, transcripts of the audio recordings were produced. Following the selective protocol proposed by Mayring (2014), this was restricted to those parts that were interpreted as answers to the core questions of the interviews. For the purpose of this study, this approach seems justified because the analysis focused on the explicit contents of the responses and excluded other meta-information, such as power relations or sender-recipient interactions.

Table 3-2: Interview participants.

#	*Participants*	*Organization*	*Profile*
1	Anonymous	Anonymous	CR Manager; responsible for supply chain compliance and closed-loop innovation.
2	Matti Aistrich	Finnish Innovation Fund Sitra	Senior Lead, Business Development; commissioned a study on service-based business models and circular strategies for textiles.
3	Eleonor Björserud	MQ	CSR & Environmental Manager; responsible for sustainability reports.
4	Lary Brown	Esprit	Vice President – Head of Global Social & Environmental Sustainability; involved in sustainability reporting in accordance with GRI-G4.
5	Eliina Brinkberg	Nudie Jeans	CSR Manager, stewarding sustainability and social reports.
6	Anna Brismar	Green Strategy, Circular Fashion Network	Founder and CEO of Green Strategy (a consultancy firm specializing in sustainability and circularity issues in the fashion and textile industry); Head and Founder of the Circular Fashion Network.
7	Suzi Christoffersen	Closed Loop	CEO and Founder of Closed Loop, a sustainability consultancy specialized in the textile sector; former employee at the Danish Fashion Institute for developing a sustainable fabric data base.
8	Magnus Enell	KTH Stockholm, Enact Sustainable Strategies AB	Co-Founder of GRI, Adjunct Professsor for Industrial Ecology, KTH, Stockholm; Senior Advisor at Enact Sustainable Strategies AB.
9	Annette Hastrup	Vugge til Vugge Danmark	CEO of the Danish Cradle to Cradle assessment body; experience in assessing textile products in accordance with Cradle to Cradle certification criteria.
10	Sven Herrmann	Ellen MacArthur Foundation	Project Manager and developer of the Material Circularity Indicator.

11	Connor Hill	Adidas Group	Sustainability Manager for closed-loop systems.
12	Daniel Hußmann	Otto Group	Sustainability Management; Head of Strategy & Controlling.
13	Kerli Kant Hvass	Jack & Jones (Bestseller Group)	Sustainability Project Manager for closed-loop systems; PhD with a focus on textile reuse and recycling.
14	Norbert Jungmichel	Systain Consulting	Consultant for companies in the textile sector.
15	Thomas Melde	akzente	CEO and consultant; tendering CE-related projects; experience in sustainability reporting in the textile sector.
16	Katrine Milman	Bestseller Group	Corporate Sustainability, CSR Responsible
17	Harri Moora	Stockholm Environment Institute	Program Director and Senior Expert for Environmental Management; development of an upcycling certifications scheme for pre-consumer textile waste.
18	Shyaam Rumkumar	Circle Economy	Knowledge and Innovation Manager; developer of a circular assessment tool that will be applied to the textile sector.
19	Chris Tuppen	Advancing Sustainability	CEO and external co-developer of the Material Circularity Indicator in cooperation with Ellen MacArthur Foundation.
20	Harsha Vardhan	H&M	Environmental Management; responsible for sourcing of sustainable materials and closed-loop production.
21	Dion Vijgeboom	MUD Jeans	Manager of closed-loop systems; prior experience in sourcing of denim-related items at G-Star RAW.
22	Kristin Vorbohle	Celesio Group	Head of Group Corporate Responsibility; experience as a senior consultant (akzente) for projects in the textile sector.

3.3 Content Analysis

Generally, content analysis can be defined as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004: 18). As for this paper, the method refers to the systematic analysis of in-depth interviews with experts from organizations related to Circular Economy (CE), research institutions, sustainability consultancies and textile retailers. In order to answer research question (RQ) 2, materials additionally included 19 sustainability reports of major textile retailers operating on the European market. Criteria for selecting companies and reports are described at the end of this section.

Many approaches to content analysis permeate throughout literature. For the purpose of this study, qualitative content analysis by Mayring (2000, 2014) is employed. This technique is well-established in social science and can be understood as an "empirical, methodological controlled analysis of texts within their context of communication, following content analytical rules and step by step models, without rash quantification" (Mayring, 2000: 2). Hence, this technique is predominantly qualitative but includes some elements of quantification.

Qualitative content analysis commonly employs deductive and inductive approaches by coding individual text units and assigning them to existing or emerging categories. For the purpose of this study, a mixed approach of deductive category assignment and inductive category formation (Mayring, 2014) was applied. This was done for the following reason: while the literature offers some ideas regarding the design features of Circular Performance Indicators (CPIs) on a cross-sectoral level, it clearly lacks further specifications for the textile sector. Hence, a mixed approach was chosen which helps to derive emerging categories and draw additional inferences with regards to textile companies.

Despite the significance of qualitative content analysis in social science, the method can easily become unreliable and yield unwarranted results if conducted without further considerations. Hence, Mayring (2014: 79) calls for a systematic and well-founded procedure that produces "a true description [of the material] without bias owing to the preconceptions of the researcher". In order to achieve this, Mayring (2014: 80, 96) suggests two process models, one for *deductive category assignment* and one for *inductive category formation*. Whilst deductive analysis is based on a theoretical background (in this case, the literature analysis), inductive reasoning aims to identify and summarize new codes and categories that emerge from the analyzed material. In this paper, both approaches are needed. Therefore, the two models by Mayring were merged into a single process model which integrates deductive and inductive reasoning. This model is depicted in Figure 3-1 and subsequently exemplified with process steps for RQ1.

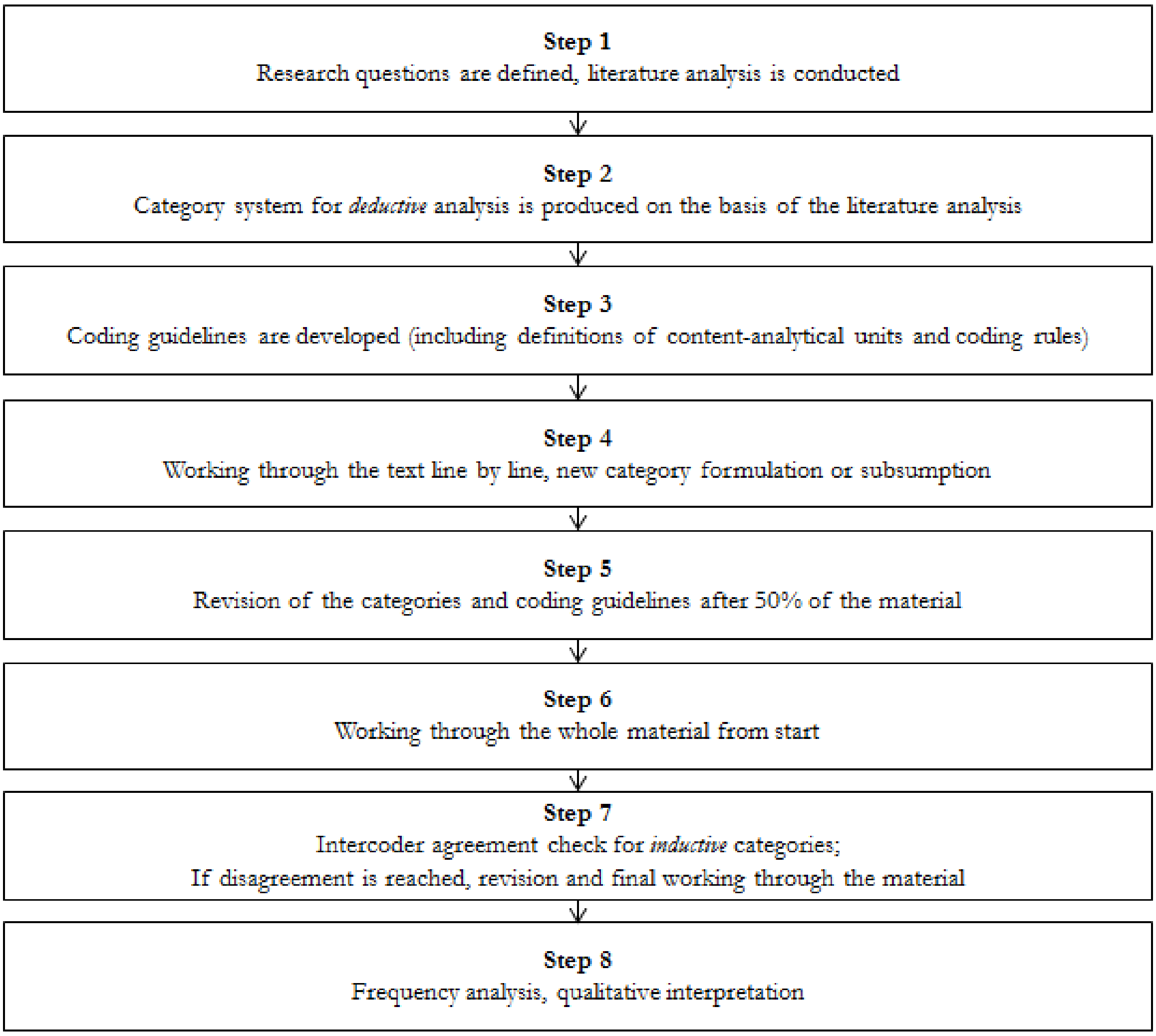

Figure 3-1: Process model combining deductive and inductive reasoning.
Source: Own illustration adapted from Mayring (2014: 80, 96)

Based on RQ1 and the literature analysis (step 1), a deductive category system was derived and assigned with definitions (step 2). In a next step (3), coding guidelines were developed. These assisted the coding process by defining the content-analytical units and content-analytical rules[11]. Based on these guidelines, the interview transcripts were analyzed line by line (step 4). If new types of indicators arose from the interview material that did not fit into existing categories, they were assigned with a new one (*inductive category creation*); otherwise, recurring elements were subsumed under previously created categories (*deductive category assignment*). Categories which were derived from literature but not supported by expert interviews were disregarded from the further analysis. This appeared justified because categories derived from literature suggested general, non-sector specific categories only. Hence, only some types of indicators would apply to the textile sector while others would be irrelevant.

After examining ten transcripts (50%), the categories and coding guidelines were revised (step 5). In a next step (6), the interview material was examined from start to finish. Afterwards, inductively built categories were peer-reviewed by a former co-student from Lund University in order to ensure objectivity and intercoder reliability (step 7). The results from this peer-review were integrated into the final category formation and the material was once again

[11] For specific definitions please refer to Appendix III.

worked through from the start. In a final step (8), the results were interpreted in a qualitative fashion and a basic frequency analysis was conducted, presenting the number of category occurrences among different interviews.

In order to assist the coding process, the qualitative data analysis software NVivo was used. Category systems and lists of indicators presented in this thesis are based on data extracted from the software and were manually converted into tables.

For RQ1, qualitative content analysis of the interview material resulted in a set of 16 categories and 22 corresponding sub-categories which describe possible design features of CPIs in the textile sector. In order to examine the current application of such metrics among textile retailers (RQ2), it was decided to further analyze ten interviews with retail representatives as well as 19 (integrated)[12] sustainability reports of major European textile retailers. In doing so, three parameters were assessed: the numbers of companies working with CPIs; the types of CPIs applied; and finally, perceived barriers to implementation of such metrics.

Selection of textile retailers was based on area of operations and turnover. In order to ensure homogeneity of data inputs, it was decided to focus on European textile retailers only. With regards to turnover, a preliminary screening was based on retail statistics provided by Fung Business Intelligence Center (2015) and Retail-Index (2015). This resulted in a list of 32 textile retailers operating on the European market. Successively, the list was filtered in accordance with two criteria: first, availability of sustainability reports which are either standalone or integrated into annual reports; second, turnover of more than 1 billion EUR per year. Consequently, the final sample consisted of 19 reports. These are presented in Appendix IV.

While the content-analytical procedure remained largely the same, an important distinction can be made. The examination was almost entirely based on the design features of CPIs derived from the qualitative analysis of expert interviews (RQ1). If performance indicators were considered as relevant from a CE-perspective within their reported context but did not fit into the previously developed category system, they were not coded and included in the results in chapter 5[13]. Hence, the process was entirely deductive in nature and it was decided to skip step 7 in the content-analytical process.

With regards to barriers to implementation of CPIs, the analysis was restricted to ten interviews with representatives from textile retailers (Table 3-2). Due to the lack of theoretical considerations in literature, the content-analytical process was entirely inductive, thus omitting step 2 in the process model presented above.

3.4 MQ Focus Group

Based on the above mentioned methods, an explorative framework for Circular Performance Indicators (CPIs) was designed. The framework serves as a practical tool which can assist in defining relevant CPIs. It was applied in a focus group workshop with MQ. In general terms, focus groups can be understood as group interviews which target a particular topic and are characterized by elements of interaction. In order to produce relevant findings, participants of focus groups should have a good knowledge about the matter of inquiry (Walliman, 2006).

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[12] Integrated sustainability reports refer to annual reports which contain sections that disclose sustainability performance data.

[13] A discussion of these incidents was included in section 6.2.

The objective of this session was three-fold: first, to define relevant CPIs for MQ which can be used for internal monitoring and external disclosure; second, to explore why some indicators may be more applicable than others; and third, to discuss strengths and weaknesses of the proposed CPI framework. The session took place on September 1st 2016 between 13.00 and 16.00 at the MQ headquarters in Gothenburg and was attended by four employees. Participants were selected by CSR & Environmental Manager Eleonor Björserud and invited due to their special interest and knowledge in the field of sustainability. Based on the consent of the entire group, an audio file of the session was recorded. Further, written notes were taken during the discussion. A list of participants is presented in Table 3-3.

Table 3-3: MQ focus group participants.

#	*Participants*	*Position*
1	Eleonor Björserud	CSR & Environmental Manager
2	Hannah Persson	Product Manager
3	Rebecca Prosanto	Designer
4	Carolina Reuterving	Product Manager

MQ is currently working on an updated sustainability report in accordance with GRI G4. In order to determine its material sustainability aspects, the company has conducted a stakeholder survey. In this context, the author was given the opportunity to integrate questions that were of particular relevance for the purpose of this research. The survey took place between May and September 2016 and resulted in several in-depth interviews, including representatives from MQ's employees, external brands, board members and investors. All interviews were conducted in Swedish language. Due to the author's limited ability to understand Swedish, the material was not included in the content analysis. Instead, the results were interpreted as complementary information and taken into account for selecting meaningful CPIs during the MQ focus group session.

4 Literature Analysis

4.1 Conceptual Considerations

In general, the term "Circular Economy" (CE) describes an economic system which produces neither waste nor pollution. It is based on the premise that all materials are either circulated at a high quality within the production system or, if possible, are fed back into the biosphere at the end of life. The origins of this concept cannot be traced back to one author or a single point in time. Instead, it can be understood as nexus of different ideas which gradually evolved since the 1950s. An excellent overview is provided by Ghisellini et al. (2016) who argue that the concept is rooted in the realms of environmental economics, general systems theory and industrial ecology.

As for the former, George et al., (2015) and Greyson (2007) mention that the cornerstone for CE was laid by Boulding (1966: 7-8) who, in his essay on *The Economics of the Coming Spaceship Earth*, claims that "man must find his place in a cyclical ecological system which is capable of continuous reproduction of material". The metaphor of the spaceship is used to illustrate the earth as a closed and finite system in which effective use of resources is a key condition to survival. These thoughts also recur in the works of Herman Daly, the father of modern environmental economics. In the 1970s, he envisioned the concept of a "Steady-State Economy" which he describes as follows (Daly, 1992: 17): "[The Steady-State Economy] is an economy with constant stocks of people and artifacts, maintained at some desired, sufficient level by low rates of maintenance 'throughput', that is, by the lowest feasible flows of matter and energy from the first stage of production (depletion of low-entropy materials from the environment) to the last stage of consumption (pollution of the environment with high-entropy wastes and exotic materials)".

Similar notions had previously emerged in the realm of general systems theory. According to its founder Ludwig von Bertalanffy (1950a: 139), this stream of research is concerned with "the formulation and deduction of those principles which are valid for 'systems' in general". His works were mostly based on the study of living organisms. In his view, organisms could be regarded as open systems that maintained stability by interacting with their external environment (Bertalanffy, 1950b). These interactions form the main source of complexity; the entirety of a system cannot be understood by studying its individual components because, as expressed in every-day colloquialism, "the whole is greater than the sum of its parts" (Laszlo & Clark, 1972). Despite its roots in biology, general systems theory was meant to have far-reaching implications for other scientific disciplines, such as psychology, sociology (Bertalanffy, 1950a), industrial chemistry and meteorology (Bertalanffy, 1950b). In fact, it was later taken up by sociologists like Luhmann (1995), system engineers (e.g. Hall, 1962) and critically influenced the research on industrial ecology which emerged in the early 1990s.

Industrial ecology views industries as man-made ecosystems which interact with their natural environment by exchanging flows of material and energy. As Erkman (1997: 1) mentions, industrial ecology aims "to understand how the industrial system works, how it is regulated, and its interactions with the biosphere". Based on the human knowledge of the latter, industrial systems are then redesigned to make them "compatible with the way natural ecosystems function". According to Ghisellini et al., (2016), the CE-concept is rested on the similar ideas but scales them up to the entire economy and establishes a new, comprehensive economic model.

Today, literature is permeated by a myriad of definitions for a CE; yet, the perhaps most widely acknowledged one is provided by the Ellen MacArthur Foundation (EMF). Launched in 2010, EMF (n.d.-a) seeks "to accelerate the transition to a circular economy". According to its website (EMF, n.d.), it has taken insights from various strands of thinking and integrated them into a single, comprehensive definition. Table 4-1 presents an overview of the concepts which have influenced the reception of CE as defined by EMF and provides a brief comparison of their rationale and scope. Due to the comprehensiveness of the EMF's definition, it is not presented in this table but shall be addressed in more detail below.

Table 4-1: Schools of thought in CE as per definition of the EMF.

Concept	*Authors*	*Rationale and Scope*
Biomimicry	Benyus, 2002	Design concept that seeks to create sustainable solutions by emulating patterns found in nature; applied to the micro- and meso-level through product and infrastructure innovations.
Blue Economy	Pauli, 2010	Open-source movement which aims to overcome scarcity by using wastes and residues as inputs for creating new cash flows; emphasizes the use of locally available materials and gravity as the prime source of energy; used to describe case studies on macro-, meso- and micro-level.
Cradle to Cradle	McDonough & Braungart, 2003	Design concept and certifications scheme; differentiates between biological nutrients and technical nutrient cycles; waste should be eliminated, instead, materials should continuously flow within the biological or technical cycle; certification of products and materials (micro-level).
Industrial Ecology	Erkman, 1997	Framework for environmental management of industrial systems; views industries and their environment as man-made ecosystems which are connected through flows of matter and energy; strives for meso-level optimization by closing material loops in industrial complexes.
Natural Capitalism	Lovins, 2004	Economic model which aims to increase the productivity of natural resources through the use of biologically inspired production models and materials; promotes service-based business models and investments in natural capital.
Performance Economy	Stahel, 1998	Economic concept which seeks to reduce environmental impacts by selling services instead of goods; emphasizes longevity of products; highlights the need for innovations at the business-level; demands regulatory changes to create (e.g.) tax incentives.
Regenerative Design	Lyle, 1996	Design approach; focuses on processes rather than single products or system components; systems should be design in such a way that they regenerate their own resource base; rooted in landscape architecture (meso-level).

The EMF defines CE as a "global economic model" which is "restorative by design, and aims to keep products, components and materials at their highest utility and value, at all times" (EMF, 2015b: 2). This definition is often provided in reference to the current economic model which operates in a linear fashion and is rested upon a "take-make-dispose" logic. In contrast, CE aims to decouple economic growth from adverse environmental impacts. In order to achieve this, it distinguishes between two material cycles EMF (2015a). In biological cycles, non-toxic biodegradable products are cascaded within the economic system until they are of no further value and can safely reenter the biosphere, thereby replenishing natural capital. In technical cycles, non-degradable products are cycled at their highest material value for as long as possible. This is achieved through maintenance, reuse, refurbishment and recycling. Incineration and landfilling are the least favorable option because they lead to loss of materials and embedded energy (EMF, 2015a). According to EMF (2013: 6), a functioning CE relies on three principles:

- *Principle 1:* Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows.
- *Principle 2:* Optimise resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles.
- *Principle 3:* Foster system effectiveness by revealing and designing out negative externalities.

Principle 1 focuses on the inputs to the economic system. For the technical cycle, this implies utilizing renewable energies over fossil fuels and managing stocks of finite materials as efficiently as possible. In the biological cycle, nutrient flows are encouraged and optimized in order to support the productivity of natural systems. Preferably, overall material inputs into the economy are minimized through dematerialization. Principle 2 addresses the design features of biological and technical cycles. In general, tighter loops which increase the life time and preserve the embedded energy of products and components (e.g. reuse) are preferred over larger loops which require additional energy for recovering material value (e.g. recycling). Lastly, Principle 3 looks at the economic outputs. This includes reducing damage to ecosystems and minimizing negative externalities (ibid: 5-7). Figure 4-1 illustrates the CE as envisioned by the EMF.

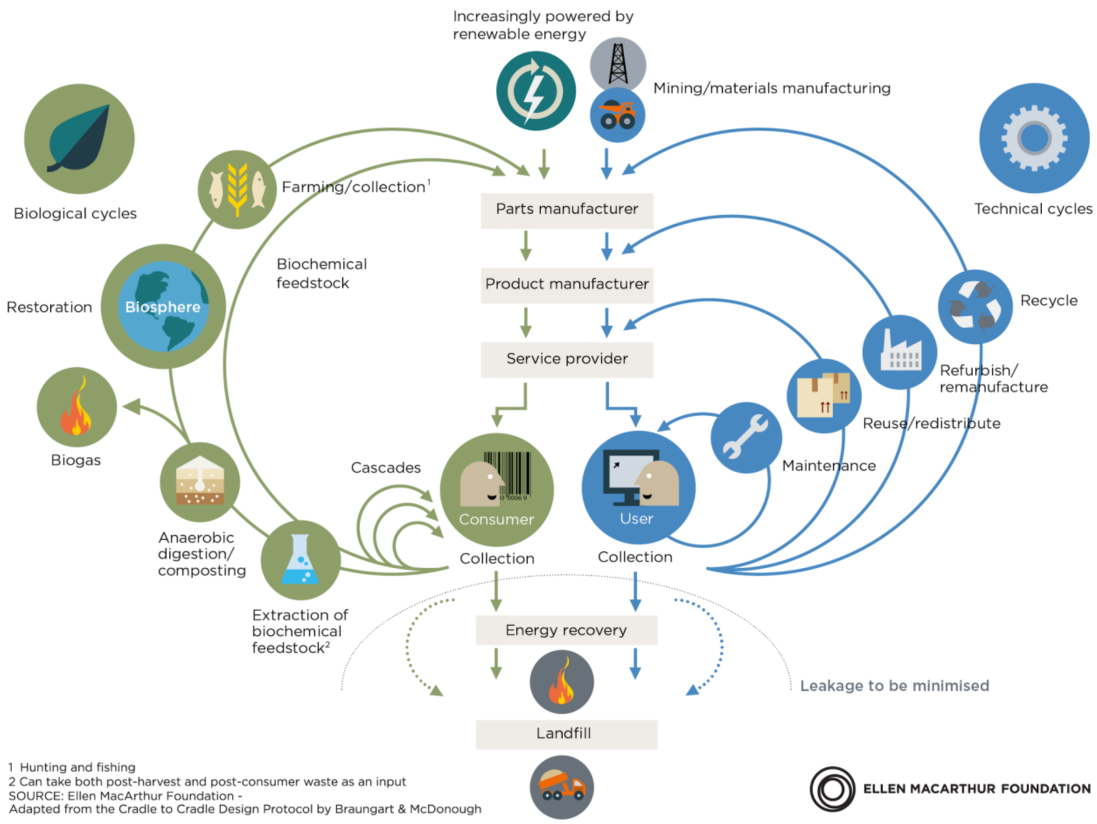

Figure 4-1: CE system diagram.
Source: With kind permission of the EMF (n.d.).

To reflect the need for systemic changes, the EMF (2013: 58) has defined four building blocks for a CE: first, circular design and production; second, new business models for circularity; third, reverse cycles for closed-loop systems; and fourth, enabling conditions in a wider social context.

The first point addresses the product level. Materials should be chosen carefully and in accordance with CE-principles. Further, products need to be designed in such a way that they can be easily repaired and disassembled. Moreover, an emphasis is put on product longevity and standardization. The second point, new business models, refers to the way companies operate on the market place. In this context, it is argued that a circular business conduct will be based on service and contracting solutions as opposed to conventional retail activities. Thereby, a company retains the ownership over the material and can effectively close the material loop when a product has reached the end of life. However, reclaiming those materials relies on the existence of reverse cycles (point three) and demands new skills in the field of delivery chain logistics, sorting, warehousing and risk management. Finally, point four (enabling conditions) describes the necessity of systemic innovations. These range from cross-sectoral collaboration and incentives for investments through to regulatory changes and educational activities (ibid: 58-61).

Based on these conceptual considerations, we can make some important remarks about the rationale of the CE-model and its relation to sustainable development. One of the most widely-accepted definitions of the latter is provided by the Brundtland Report *Our Common Future*. There, sustainable development is defined as a societal trajectory which "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland et al., 1987: 16). This definition contains in itself two important aspects:

firstly, sustainable development strives to reconcile economic, social and environmental dimensions by integrating them into a concept which is commonly referred to as the "triple bottom line" (Elkington, 1997); and secondly, sustainable development aims at both intra- and inter-generational justice; that is, it highlights the need for social equity with regards to current and future generations (Michelsen, 2010).

Against this background, the CE-model can be understood as a means to achieving *ecological* sustainability. As opposed to the concept of sustainable development, it has a more narrowly defined scope and "is virtually silent on the social dimension, concentrating on the redesign of manufacturing and service systems to benefit the biosphere" (Murray et al., 2015: 8). Following this argument, CE addresses the social dimension mainly through aspects of intergenerational justice: by securing ecological survival and the current resource base, we ensure the well-being of future generations. However, despite this predominant focus on environment and economy, the practical application of CE-principles may indirectly create social benefits. For instance, Lehmann & Gawel (2013) highlight that the use of renewable energies entails significant social advantages beyond the mitigation of climate change, e.g. by reducing air pollution and avoiding nuclear hazards. Yet, the considerations presented above suggest that this is not a key intention but a beneficial *side-effect* within the rationale of the CE-concept.

At this point it should be highlighted that CE is not a panacea but an essentially disputed concept. According to Murray et al. (2015: 8) for instance, the lack of social considerations in the CE-mindset may compromise its developmental effectiveness because it is does not specify how it "will lead to greater social equality, […] gender, racial and religious equality and other diversity, financial equality, or in terms of equality of social opportunity".

Further, the application of CE-principles can lead to unintended consequences if implemented without due considerations (ibid.). Here, the rise of biofuels reflects the complexity of socio-economic and socio-ecological systems; while these fuels are often heralded as a prime example for the successful implementation of CE-principles in the energy sector, it has been argued that they have dire consequences for low-income countries due increasing competition for arable land, rising food prices (Monbiot, 2007) and their impacts on deforestation and climate change (Searchinger et al., 2008). Although the author does not wish to make a final judgement regarding the meaningfulness of biofuels, the debate surrounding them serves as a stark example for the complexity of sustainability issues and reminds us that the implementation of CE-principles should not be taken lightly.

4.2 Circular Performance Indicators

"What gets measured gets done" is an often cited management mantra. While the origins of this dictum are debated, it surely is of utmost importance for contemporary management education. In fact, literature is teeming with management handbooks which provide ample advice on how to measure, monitor and evaluate business performance. Notably, at the core of almost all methods lie performance indicators.

Generally, performance indicators can be defined as well-founded measures which provide quantitative or qualitative information about a chosen system. Within management science, the term "system" usually refers to products, processes, facilities, business-units and organizations as a whole (Dada et al., 2013). Quantitative information can be expressed in absolute or relative terms, e.g. by measuring tons of carbon emissions in total or in reference to another relevant unit (e.g. per product). Qualitative information can be provided by using expert judgements and grading system elements with weighted scores (e.g. by using a balanced score-card approach). Through performance indicators, managers are able to control company resources, communicate their performance to internal and external stakeholders and identify potentials for improvement (Franceschini et al., 2007).

In merging the CE-terminology with performance indicators, such metrics will henceforth be referred to as *Circular Performance Indicators (CPIs)*. As of now, only few papers address the design features of such indicators explicitly. Most often, other existing sustainability metrics are proposed which can complement measurements by addressing certain CE-related aspects. Based on this premise, the following analysis differentiates between *core measures* and *complementary measures*. While core measures *explicitly assess circular business performance* and *illustrate the design features of CPIs*, complementary measures come in various forms and are comprised of *tools, frameworks and aggregated metrics* which at least partially reflect the CE-mindset. Albeit complementary measures do not offer a comprehensive view on circular performance, they can help prioritizing the measurement of CE-related aspects or, in some cases, may even suggest specific CPIs.

4.2.1 Core Measures

Benton et al. (2014) distinguish between circular ability indicators, circular use indicators and business process indicators. Circular ability indicators are defined as simple yes/no metrics which illustrate whether a product can be recycled, reused or repaired. Circular use indicators measure the actual circularity of a product, e.g. by providing information about recycled content or by counting how often it is reused. In addition, the use of business process indicators is suggested. These do not assess environmental impacts as such but reflect the level of attention given to and actions taken for Circular Economy (CE)-related aspects.

Stahel (2013) suggests that companies in CE will predominantly rely on servitization strategies. By selling functionality instead of physical products, companies retain ownership of the embodied resources and invest labor to ensure that a product remains intact for as long as possible. From an environmental perspective, investing labor is more desirable than automated, energy-consuming processes because it is considered a renewable resource. Based on this premise, Stahel (2013: 54) proposes two Circular Performance Indicators (CPIs) which measure monetary value per weight (USD/kg) and labor-input per weight (man-hours/kg). In combination, higher value and higher labor-input per weight indicate absolute decoupling of corporate growth from material resource consumption[14].

Funded by the EU Life program, the Ellen MacArthur Foundation (EMF, 2015a) published an elaborate methodology for a so-called Material Circularity Indicator (MCI) which measures circularity of materials flows on the business and product level. The methodology applies to materials from the technical cycle only. Hence, biodegradable components are disregarded. In its most basic form, the MCI measures three product variables: the mass of virgin raw material inputs (V); the mass of waste going to landfill or energy recovery (W); and the product's longevity and use intensity, reflected by a utility factor (X). Figure 4-2 presents the material flows and (sub-) variables addressed by the MCI.

[14] According to Stahel (2013), this requires that renewable resources (e.g. human labor) as well as other value-conserving actitivies (e.g. refurbishing, repairing) receive significant tax incentives. In this case, it would become more profitable for companies to invest labor in order to prolong the life time of products.

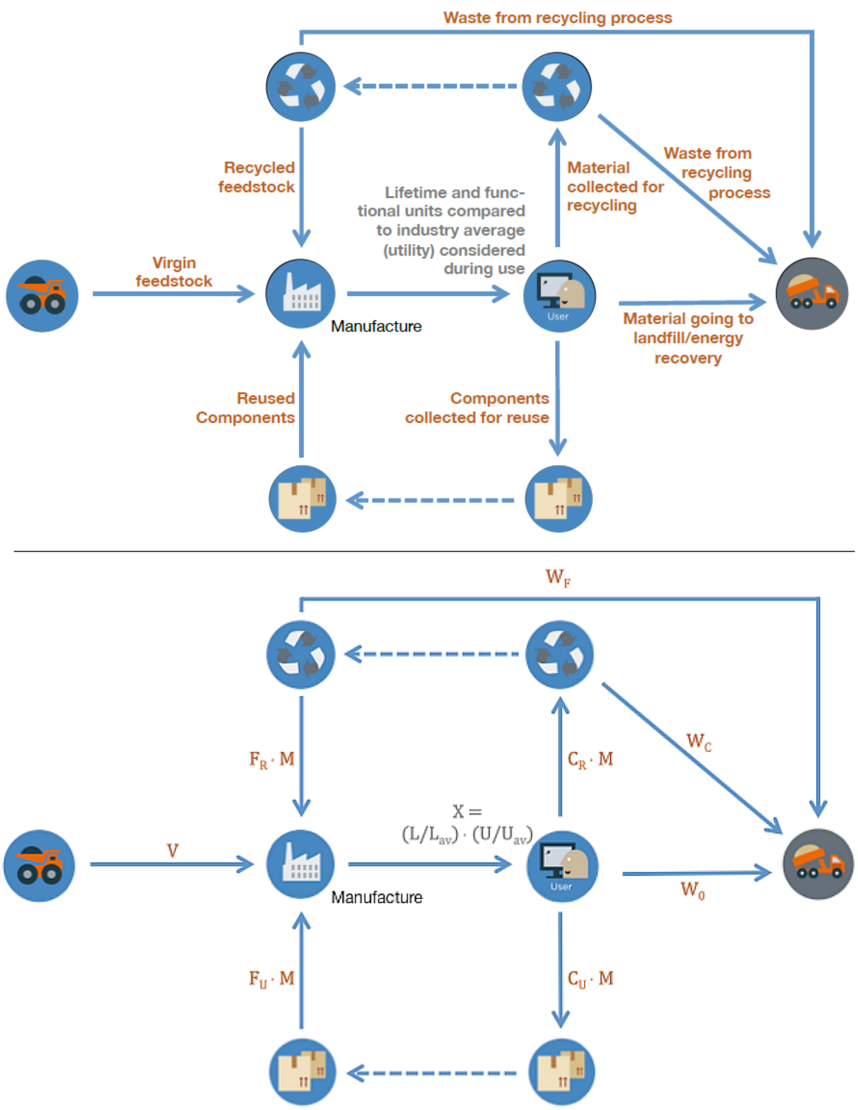

Figure 4-2: Material flows (top) and variables (bottom) addressed by the MCI.
Source: Adapted with kind permission of the EMF (2015: 19-20)

In order to calculate the mass of virgin materials (V), the amount of recycled (F_R) and reused (F_U) materials is subtracted from the mass of the finished product (M). The mass of waste going to landfill or incineration (W_0) is calculated by subtracting the amount of materials collected for recycling (C_R) and component reuse (C_U) from the mass of manufactured product (M). The methodology also takes into account the efficiency of recycling processes by examining the mass of materials entering the recycling process (W_C) and the amount of materials leaving the process (W_F). Lastly, in order to illustrate that a doubling of a product's life time reduces the amount of virgin raw materials used and waste created by half, a utility factor (X) is included. Its calculation is based on two components: first, the actual lifetime of the product (L) divided by the lifetime of an industry-average product (L_{av}); and second, the actual use intensity (U) in relation to the average use intensity of a similar, industry-average product (U_{av}).

Following the distinction provided by Benton et al. (2014), the MCI methodology predominantly relies on circular use indicators, thereby providing hard and measurable metrics for material inputs, outputs as well as product lifetime and use intensity.

Upon calculation, the MCI takes a value between 1 (fully circular) and 0 (fully linear). Whilst the description provided above refers to singular products, the methodology can also be applied to product groups or the company as whole by calculating the MCIs for individual products and combining them into a single, aggregated metric. For the most part, weight is used as a reference unit, the exception being the utility factor (X) which is based on functional units achieved throughout a product's life time. However, since very heavy products with low economic value can provide a distorted picture of a company's performance, it is suggested to use revenue for normalization if necessary. In order to assist the calculation, the EMF provides dynamic modelling tools which can be downloaded from its webpage (EMF, n.d.-c).

As part of the MCI development process, a prototype project with the British home improvement company Kingfisher was launched. In doing so, the application of circular metrics was tested against real products. As a result, the Kingfisher Circularity Calculator was created. Based on this methodology, Griffiths & Cayzer (2016) propose an indicator system for measuring product performance with regards to CE-principles.

The indicator system is comprised of a number of variables along a product's lifecycle. In order to assess a product's performance, each variable is assigned with a guiding question. Successively, the performance is measured on a weighted scale of 2, 5, 10, 15 or 20 points. Overall, a product can score a maximum of 152 points, indicating highest circular performance. As opposed to the MCI methodology presented above, the approach chosen by Griffiths & Cayzer (2016) predominantly uses circular ability indicators and business processes indicators. Using a weighted scale, the indicator system is somewhat more qualitative in nature as it requires experts' inputs in order to translate a product's performance into a measurable format. Table 4-2 presents the indicator system including its weighting and guiding questions.

Table 4-2: CE indicator system based on the Kingfisher Circularity Calculator.

Lifecycle Stage	#	*Guiding Question*	*Variable*	*Weighting*
Design	1	Is the product made from recycled/reused material?	Use of recovered material	20
	2	Is the product lighter than its previous version?	Dematerialization	2
	3	Is there a complete bill of materials and substances for the product?	Presence of bill of materials	5
Manufacturing	4	Is there a complete bill of energy for the manufacturing process?	Presence of bill of energy	10
	5	Is there a complete bill of solid waste for the manufacturing process?	Waste management	15
Commercialization	6	What packaging is being used?	Product packaging	5
	7	What is the product's warranty?	Warranty	10
	8	Is there a rental option for the product?	Rental scheme	15
In Use	9	Can the usage status and identification of the product be established?	Usage status and ID	15
	10	Can the product be repaired?	Repair options	5
	11	Can the product be reused?	Reuse options	10
	12	Does the product help to reduce waste through its use?	Waste reduction	5
End of Life	13	What take-back scheme is available for this product?	Take-back schemes	15
	14	Is the product separated out from other products at the end of its life?	Segregation	10
	15	Are the product's materials passed back into the supply chain?	Materials reintroduction	10

Source: Adapted from Griffiths & Cayzer (2016: 5).

4.2.2 Complementary Measures

Literature suggests a number of analytical tools and related measures which can help tracking progress towards circularity on the business level. Ellen MacArthur Foundation (EMF, 2015a: 34) differentiates between two types of complementary metrics "to help prioritise circularity actions based on business risks or consequential impacts".

On the one hand, *complementary risk indicators* address business risks induced by material toxicity, price volatility, supply chain management and material scarcity. Here, a wider range of indices are suggested, including variations of the Herfindahl-Hirschman Index[15], data published by the British and US Geological survey as well as legislations for the restriction of chemicals (e.g. REACH and RoHS). On the other hand, *complementary impact indicators* convey information about a product's environmental footprint, e.g. by examining energy consumption, CO_2 emissions and water usage. In this context, the application of Lifecycle Assessments (LCAs) is suggested. Here, Benton et al. (2014: 82-83) argue that these can reflect "the relative benefits of circularity strategies such as reusability, remanufacturing and recyclability because aspects like waste of raw materials, and associated carbon emissions and water use can be measured and compared". EPDs follow a similar logic and can provide comprehensive information regarding a product's environmental impacts. EPD documents are often verified in accordance with ISO 14025 standard (EMF, 2015a).

Moreover, Benton et al. (2014) and Geng et al. (2012) consider Material Flow Analysis (MFA) a useful tool in the context of CE. MFA can help to measure the relation of primary (raw) materials to secondary (recovered) materials (Brunner & Rechberg, 2004) within the production process. On the macro-level, MFAs are calculated by applying a variety of material input-output metrics, such as Domestic Material Consumption, Total Material Output and Net Additions to Stock. On the micro-level, MFAs use input data from products and processes to illustrate material flows across the entire company (Geng et al., 2012).

Cheng & Du (2009) use Data Envelopment Analysis (DEA) and the Malmquist Productivity Index (MPI)[16] to measure CE efficiency within the Chinese iron and steel industry. DEA can be applied to compare resource inputs and costs of different business units by identifying best practice examples and using them as benchmarks (Sherman & Zhu, 2006). MPI is used to measure the change in efficiency of business unit performance over a given period of time (Tone, 2004).

Another approach is taken by Geng et al. (2010) who developed emergy-based indicators for assessing the eco-efficiency of industrial parks. Leaning on the principles of thermodynamics, emergy is a metric for *em*bodied en*ergy* which accounts for the cumulative energy and materials flows needed to produce a product or provide a service. Similarly, Benton et al. (2014) refer to a new metric named "Entropic Overhead" that is currently under development. It measures the amount of energy required for maintaining a products' utility or reusing its constituent parts. From the perspective of energy and material conservation, it can help to determine whether or not it makes sense to repair, recycle or replace a product at the end of life.

4.3 Deductive Category System

Based on the core measures presented in section 4.2.1 above, a system of 21 categories describing possible design features of Circular Performance Indicators (CPIs) is developed. In

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[15] For further information, please refer to Rhoades (1993).

[16] Both measures can deliver input data for MFAs.

order to obtain a more clear-cut picture of their characteristics, complementary measures presented in section 4.2.2 are disregarded from the category formation. Table 4-3 below presents the categories in an alphabetical order.

All in all, literature suggests that CPIs mainly focus on environmental performance and material flows. At the sub-company level, CPIs address input materials, product components and singular products. If aggregated, they can further provide information regarding product groups or the entire product portfolio, thereby reflecting the degree of circularity on the company level. Moreover, CPIs address aspects across the entire lifecycle of products. At the design stage, they measure the recycled and reused content of products and provide insights as to what input materials are used. At the manufacturing stage, CPIs indicate what type of energy is used and how much pre-consumer waste is created. As for the commercialization stage, CPIs address the product packaging, warranty and rental options. During the use phase, usage status, repair and reuse options as well as waste reduction are assessed. CPIs can measure to what extent a products' material value is maintained and the longevity is increased, e.g. by measuring the labor inputs invested. At the end of life, CPIs assess the availability of take-back schemes as well as the collection and separation for reuse and recycling. Moreover, the amount of material going to landfill or energy recovery is measured.

Due to the predominant focus on material flows, quantified CPIs are mostly based on weight units, thus making it possible to create mass balances and identify leakages in closed-loop systems. In addition, functional units may be used which reflect the products lifetime and use intensity (EMF, 2015a). In order to reflect a true picture of a company's performance, it is suggested to use revenue (ibid.) or weighted scales for normalization (Griffiths & Cayzer, 2016).

By looking at the descriptions and references provided below, the categories are very much self-explanatory; however, a few remarks can be made in order to further the reader's understanding for the following parts of this paper.

First and foremost, the categories should not be understood as perfectly defined indicators but describe the CPIs in broader terms. They shall be further refined by taking into account the findings from section 5.1 and complemented with examples provided in section 5.2. Second, although not always consistently suggested by Griffiths & Cayzer's (2016) methodology, it was perceived important to clearly differentiate between reuse and recycled when forming the categories. Indeed, both approaches are inherently different from one another. Recycling often requires additional energy inputs and may eventually change the functionality of a products, e.g. by turning cotton fibers from a t-shirt into insulation material for housing. Reuse on the other hand aims to maintain the functional quality of a product and prolongs its lifetime, thereby preserving the embedded energy of a product (Farrant et al., 2010). Hence, Recycled Input (#11) and Reused Input (#12) are listed as separate categories in Table 4-3. Lastly, forming main categories was omitted in order to maintain a sufficient level of detail and allow for a thorough examination of the research materials.

Table 4-3: Category system for CPIs (literature analysis).

#	*Category*	*Description*	*Reference*
1	Energy Usage	Type of energy used.	Covered by #4 in Griffiths & Cayzer (2016)
2	Collection	Extent to which products are collected at the end of life.	Covered by (W) in EMF (2015) and #15 in Griffiths & Cayzer (2016)
3	Dematerialization	Whether the current products are lighter than usual, thus using fewer material inputs.	Covered by #2 in Griffiths & Cayzer (2016)
4	Labor Input	Amount of labor invested into maintaining products' value.	Covered by Stahel (2013)
5	Leasing	Information on renting/leasing options for products.	Covered by #8 in Griffiths & Cayzer (2016)
6	Longevity	Actual lifetime of products.	Covered by (X) in EMF (2015)
7	Material Value	Reflects the material value of a product.	Covered by Stahel (2013)
8	Packaging	Assesses what type of packaging is used for a product.	Covered by #6 in Griffiths & Cayzer (2016)
9	Product Warranty	Examines a product's warranty.	Covered by #7 in Griffiths & Cayzer (2016)
10	Raw Material Input	Overall amount and type of raw input materials used for product manufacturing.	Covered by (V) in EMF (2015) and #3 in Griffiths & Cayzer (2016)
11	Recycled Input	Amount of recycled input materials.	Covered by Benton et al. (2014), (V) in EMF (2015) and #1 in Griffiths & Cayzer (2016)
12	Reused Input	Amount of reused input materials.	Covered by Benton et al. (2014), (V) in EMF (2015) and #1 in Griffiths & Cayzer (2016)
13	Recyclability	Extent to which products can be recycled.	Covered by Benton et al. (2014)
14	Reparability	Extent to which products can be repaired.	Covered by Benton et al. (2014) and #10 in Griffiths & Cayzer (2016)
15	Returnability	Availability of product take-back schemes.	Covered by #12 in Griffiths & Cayzer (2016)
16	Reusability	Degree to which products can be reused.	Covered by Benton et al. (2014) and #11 in Griffiths & Cayzer (2016)
17	Separation	Extent to which products is separately collected at the end of life.	Covered by #14 in Griffiths & Cayzer (2016)
18	Use Intensity	Extent to which products are used to their full capacity.	Covered by (X) in EMF (2015)
19	Usage Status	Assesses a product's status during the use phase.	Covered by #9 in Griffiths & Cayzer (2016)
20	Waste Creation	Waste created which is going to landfill or energy recovery.	Covered by (W) in EMF (2015) and #5 in Griffiths & Cayzer (2016)
21	Waste Reduction	Extent to which products help to reduce waste.	Covered by #12 in Griffiths & Cayzer (2016)

5 Results

Due to the disconnected nature of the methodology, findings from analysis of empirical data are presented in multiple parts. First, results from content analysis of expert interviews are presented in section 5.1, followed by findings from content analysis of sustainability reports are depicted in section 5.2. Lastly, an explorative framework for the selection of CPIs is proposed and applied to a reallife context, i.e. the MQ case study (section 5.3). The reader should note that, in accordance with the definition provided above, the following sections distinguish between *core measures* (presented in tables) and *complementary measures* (explained in the text).

5.1 Content Analysis of Expert Interviews

Experts' understanding of Circular Performance Indicators (CPIs) for the textile sector partially differs from the categories suggested by the literature analysis. Content analysis of 19 semi-structured interviews reveals that some deductive categories received no support whatsoever (i.e. #3, #7, #9, #12, #14, #15, #17, 19# and #21 in Table 4-3 above)[17] while others were supported recurringly. Further, a number of categories had to be created inductively since they were not suggested by the previous literature analysis. In order to accurately reflect the complexity of the CPI categories, some were further divided into sub-categories. This was deemed appropriate for the categories energy, material consumption, material cyclability, waste and water. The category system is presented and explained in Table 5-1[18] below.

In addition to examining the design features of CPIs, content analysis was conducted in order to determine the barriers to implementation of such metrics from the perspective of textile retailers. Due to the specific focus on textile retailers, the analysis excluded interviews with experts from CE-related organizations, consultancies and research institution and included inputs from textile retailers only. Hence, the analyzed material is comprised of ten interviews. Inductive analysis resulted in a system of four categories and corresponding sub-categories. These are presented and described in Table 5-2. For the interpretation of these findings, please refer to section 6.2.

Moreover, participants mentioned several existing frameworks and metrics – *complementary measures* – which can assist circular performance measurement on the business level. According to one expert's opinion, "we don't necessarily have to reinvent the wheel, we can use what is already there and develop it further if needed" (personal communication 2016, participant C). This is in line with findings from the literature analysis and indicates that there is a wide range of measures which can be applied within the context of CE and performance measurement.

One interviewee suggested the Cradle to Cradle (C2C) certification standard for measuring the level circularity of textile products. This standard entails specific requirements within five quality categories, namely material health, material reutilization, renewable energy and carbon management, water stewardship and social fairness. For example, within the category material health, companies need to identify the product inputs and create a bill of materials and all chemicals present at a concentration at or above 100 ppm must be identified, assessed and

[17] Categegories that received no support were disregarded for the analysis of sustainability reports and in the formation of the CPI framework. For more information please refer to the methodology in chapter 3.

[18] The reader should note that the CPI categories vary in scope. For instance, while indicators for water consumption and water cycling exclusively apply to the manufacturing stage of textile products, indicators for energy usage and greenhouse gas emissions pertain to the entire value creation process (including manufacturing, transport and retail activities).

categorized by a Cradle to Cradle Certified™ accredited assessor (trained by the Cradle to Cradle Products Innovation Institute). In order to qualify for certification at any level, products are not allowed to contain any Banned List chemicals on the "Supplier Banned Chemical List". To achieve higher certification levels, companies need to phase out harmful substances (Cradle to Cradle Products Innovation Institute, 2016). With regards to the empirical analysis of this paper, these measures overlap with category 2 (Chemicals). In fact, one expert mentioned that the entire standard was successfully applied by a carpet company, leading to the following conclusion: "I think it can be a very valuable tool because it is the exact same mindset" (personal communication 2016, participant B).

Furthermore, some experts suggested using indicators from the GRI framework which could be adapted to the CE mindset, if necessary. One expert explicitly referred to G4-EN1 and G4-EN2 as potential CPIs. According to the GRI Implementation Manual, G4-EN1 measures "the total weight or volume of materials that are used to produce and package the organization's primary products and services" by non-renewable materials and renewable materials (GRI, 2013: 86). Further, G4-EN2 measures "the percentage of recycled input materials used to manufacture the organization's primary products and services" (GRI, 2013: 87). Hence, G4-EN1 could be applied within CPI category 10.1 (raw material input) and 15 (packaging) while G4-EN2 refers to category 10.2 (recycled input).

In addition to that, several participants considered the Higg index to be useful from a CE-perspective. Developed by the Sustainable Apparel Coalition (SAC), the index is a self-assessment tool which "delivers a holistic overview of the sustainability performance of a product or company" (SAC, n.d.). With regards to CE-related aspects, one interviewee perceived the product section within the brand module as particular important. Therein, indicator USE-B-3.1 assesses whether the brand operates "a Quality Assurance Program aimed at understanding and enhancing the durability and longevity of its products" (SAC, 2015). Referring to the empiric results for CPIs above, this refers to category 8 (longevity).

Further resonating with findings from the literature analysis, various experts advocated lifecycle assessments (LCAs) as means to prioritizing CE-related activities. For instance, one expert argued that for defining important CPIs, companies need to "have some LCA understanding" (personal communication 2016, participant G) in order to comprehend the environmental impacts occurring throughout the entire lifecycle of products.

Lastly, two participants were interviewed to investigate how the Material Circularity Indicator (MCI) can be applied to the textile sector. Both interviewees agreed that the methodology should remain largely the same but would need to account for the different characteristics of synthetic and natural fibers. While polyester, nylon and other synthetic fibers can be regarded as technical nutrients within the MCI methodology, other natural fibers such as cotton or hemp qualify as biological nutrients. As for natural fibers, the extent to which they conserve natural capital should be taken into account. Taking wood as an analogy, one expert expressed these thoughts as follows: "If […] you are taking wood from unsustainably forested rain forest hardwoods versus […] certified sustainably forested softwoods from Scandinavia, is it right, from a circularity point of view, that they are treated the same way? And I would say it is not right. [Non-FSC woods] would not be deemed reused or recycled materials" (personal communication 2016, participant V). Based on this premise, a wider range of sustainability certifications which ensure conservation of natural resources in agricultural processes could be applied as complementary measures. One such example is the Global Organic Textile Standard (GOTS, n.d.).

Table 5-1: Category system for CPIs in the textile industry (expert interviews).

Main Category	*Sub-category*	*Description*	*Referenced Participants*
1. Captured Value Points	n/a	Indicators in this category describe how well value points have been exploited by recycling, reselling or leasing textiles. The category was based on the input of one expert who mentioned that in a CE, "there are other opportunities within reuse and recycling, there is value. Theoretically, you can call them the uncaptured value points. Like in a leasing model […], you can collected the product and earn money twice on that product". As such, a performance indicator was suggested which measures "how much money you can earn from one product" (personal communication 2016, participant J).	J
2. Chemicals	n/a	Metrics in this group refer to the use of chemicals. It was suggested to examine the material health of products and assess the toxicity of chemicals applied during the manufacturing process. Indicators would measure the amount of chemicals used in textile production and assess which substances are applied, restricted or phased out. In this context, using a Restricted Substance List (RSL) was deemed useful.	B, C, E, J, L, S
3. Collaboration	n/a	Metrics in this category would describe the extent to which the company collaborates with its value chain in order to close material loops. Here, consumer involvement was deemed vital because, from a closed-loop perspective, "they are the gatekeepers when it comes to the end of life" (personal communication 2016, participant J).	C, J
4. Energy	4.1 Energy Usage	With regards to metrics for energy usage, interview candidates suggested to measure the type and total amount of energy consumed. Notably, experts referred to energy consumed in manufacturing and other processes. In this context, one expert from a retail company specifically mentioned to measure "how much renewable energy we are buying" (personal communication 2016, participant I).	B, C, E, F, I, J, L, Q

Main Category	*Sub-category*	*Description*	*Referenced Participants*
	4.2 Greenhouse Gas Emissions	In contrast to the previous category, measures for greenhouse gas emissions are focused on the impacts of energy consumption. Metrics in this category describe how much CO_2-equivalent a company emits along the upstream and downstream processes.	C, E, F, G, N, O, R, S, U
5. Land Use	n/a	Indicators for land use refer to the amount of land required for the cultivation of natural fibers. This aspect was mentioned by a single expert who said: "So you have to look into different fibers which do not require the same amount of land because we don't have that much land left if we also need livestock and we also need to grow food on the areas of land that we have" (personal communication 2016, participant E).	E
6. Leasing	n/a	This indicator category was suggested by one participant and refers to clothing companies who offer leasing and renting services. In particular, it was suggested to measure the "number of garments rented out" and "how many times a garment has been rented" (personal communication 2016, participant M).	M
7. Locality	n/a	As for this category, one respondent suggested using indicators for the locality of the production units to determine if they are "close or far away from the market" (personal communication 2016, participant C).	C
8. Longevity	n/a	With regards to longevity, experts proposed to measure the lifetime of textile products. One interview candidate suggested that from a CE-perspective, it would be desirable "to make goods which last for fifteen years" (personal communication 2016, participant K).	K, M, P, Q
9. Maintenance	n/a	This category includes metrics which reflect to what extent the material quality of textile products is maintained. As such, indicators would measure the number of man-hours invested, costs induced by repairing garments and/or the amount of pieces repaired in retail stores.	M, Q

Main Category	*Sub-category*	*Description*	*Referenced Participants*
10. Material Consumption	10.1 Raw Material Input	Indicators covered by this sub-category describe the overall amount and types of fiber materials used during the production of textile products.	E, F, J, M, L, O
	10.2 Recycled Input	Metrics in this sub-category examine the amount of recycled fibers used during textile production. More specifically, one expert mentioned to measure the "recycled content in your products" or "the percentage of recycled goods in your product portfolio" (personal communication 2016, participant R). On the other hand, one expert suggested examining corporate actions for cycling wastes back into its production processes.	B, C, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U
11. Material Cyclability	11.1 Biodegradability	In this context, metrics for biodegradability indicate to what extent a textile product is made from biodegradable components and if it can be fed back into the biosphere upon the end of life.	C, F
	11.2 Recyclability	Indicators for recyclability reflect the extent to which textiles can be recycled and transformed into new products. Here, indicators would assess both the amount as well as the particular types of mono-materials, composite materials and adhesives used. One participant suggested applying a weighted score for choices made during the design phase which influence the recyclability of a product.	E, F, K, M, N, P, Q, S
	11.3 Reusability	With regards to reusability, qualitative indicators would assess the extent to which textile products can be used again at the end of life. One expert responded: "You may find that some really nasty fabrics are highly reusable. Polyester doesn't rot. So therefore, it may score very high on your Circular Economy indicators" (personal communication 2016, participant K).	F, K
12. Packaging	n/a	For this category, some experts suggested to examine the amount of packaging (e.g. parcels, bags and wrapping material) used during the post-production phase. Moreover, measuring "how much [packaging] is being reintroduced at the end of life" (personal communication 2016, participant S) was perceived as a potential indicator.	E, S, T

Main Category	*Sub-category*	*Description*	*Referenced Participants*
13. Product Reuse	n/a	Indicators in this category measure aspects pertaining to textile reuse. On the product level, it was suggested to measure "how many consumer cycles [one textile product] can go through" (personal communication 2016, participant J). For companies engaging in resell activities, an indicator for the "number of garments in second hand" (personal communication 2016, participant M) was proposed.	H, M, N, Q, S
14. Use Intensity	n/a	With regards to use intensity, one interviewee suggested using indicators which reflect the extent to which textile products are used to their full capacity. More specifically, it was mentioned: "In a normal usage, you would probably say it is 10% per year. But then they say: […] we have rented this out for so and so many weeks every year, so we know that it is used 45% of the time" (personal communication 2016, participant G).	G
15. Waste	15.1 Waste Collection	Experts repeatedly suggested applying metrics for waste collection. Here, "the number of textiles being collected in the stores in tons or kilos" (personal communication 2016, participant M) was seen as a potential indicator.	E, I, M, N, R, T
	15.2 Waste Creation	The second sub-category would measure the amount of textile waste created or prevented along the entire value chain, including both pre- and post-consumer phases.	E, F, H, I, J
16. Water	16.1 Water Consumption	Experts proposed metrics for how much water is consumed during the manufacturing process. In this context, one participant suggested to measure "how much water is used when you are dyeing your textiles or when you are heating up the […] machineries" (personal communication 2016, participant E).	E, L, M
	16.2 Water Cycling	Experts proposed to measure the degree to which spent water is reutilized during the textile manufacturing process. One expert responded: "We are […] actively trying to close the water cycle in the production process. We […] try to reuse as much as possible" (personal communication 2016, participant L).	B, E, F, J, Q, R, S, U

Table 5-2: Barriers to implementation of CPIs from the perspective of textile retailers.

Main Category	*Sub-category*	*Description*	*Referenced Participants*
1. Data Collection	1.1 Resource Constraints	Two interviewees mentioned that resource constraints could significantly hinder the implementation of CPIs. One retail representative mentioned that collecting data "takes a lot of time, time that no one has today, right now" (personal communication 2016, participant Q). Similar thoughts were expressed by another expert who further underpinned this as follows: "I'm very sensitive how much work something new is going to be because we are already making choices about what is going to be left undone" (personal communication 2016, participant K).	K, Q
	1.2 Value Chain Complexity	Further, data collection for was perceived as challenging because of the complexity of the textile value chain. With regards to upstream processes, one expert mentioned: "The problem in the textile industry is that the supply chain is highly complex. We have many sub-contractors so it is hard for us to step into the supply chain and change the production processes towards more circularity. […] You see, sometimes you cannot even trace the material back to the fiber level. And if you cannot trace it, you cannot measure it" (personal communication 2016, participant R). According to another expert, similar difficulties would apply to downstream processes where studying consumer behavior was considered necessary in order to adequately measure progress towards CE.	J, L, P, Q, R
2. Importance for Internal Decision Making	n/a	One group of experts critically reflected upon the (potentially) limited importance of CPIs for internal decision making processes. More specifically, it was argued that CPIs might collide with other metrics for (sustainable) management. For instance, one expert mentioned that the uptake of CPIs may depend on how easily they fit into existing management structures. Consequently, "if you come up with a set of indicators that are completely new and have no relationship to data that they are already gathering, then that actually represents a huge barrier to having them adopted". Hence, the expert concluded that the case for implementing CPIs "has yet to be made" (personal communication 2016, participant K). Along these lines, one expert expressed particular concern about the implementation of CPIs within larger companies because "their objective is to grow each year by 20% […] and that doesn't necessarily match with the other objectives" (personal communication 2016, participant R).	K, R

Main Category	*Sub-category*	*Description*	*Referenced Participants*
3. Organizational Development	3.1 General Development	In this context, many representatives perceived that it would be too early to measure circularity. From one expert's viewpoint, this was explained as follows: "You can measure circularity when you have circularity. But to implement circularity is a long-term process, especially in a big company. So the processes have to be looked at from a different angle, we need different data. We haven't implemented it enough so we can start measuring" (personal communication 2016, participant J). Similarly, one expert mentioned that using indicators was simply not necessary yet due to the limited size of the company. It is only now "that we are growing that we realize that we need to have numbers" (personal communication 2016, participant Q). Further, it was argued that "companies are not naturally geared to make these measurements" (personal communication, participant K); hence, building up the organizational structure for CE-related data collection was perceived to be a long-term process.	J, K, M, O, Q
	3.2 Internal Capacity Building	Two representatives mentioned the need for internal capacity building in order to accurately depict progress towards CE. With regards to repairing, one expert mentioned: "Just to get the stores to gather this information has taken quite a while for everybody to understand that this is important. If we say you need to fill in this document, each day on how many jeans you have repaired. Yes some do, but some don't. […] So just to implement all the routines and get them going, I think that's one problem" (personal communication 2016, participant Q).	J, Q
	3.3 Lack of Best Practices	One expert perceived the lack of best practices as a barrier to implementation. In this context, it was mentioned that "the biggest issue is that we do not have any experience or reference to profit from. We need to learn everything from scratch" (personal communication 2016, participant L).	L
	3.4 Strategic Understanding	Further, lacking strategic understanding of the CE-concept was perceived as a challenge. According to one expert, the concept "is still very new and we have to find out how do we approach this" (personal communication 2016, participant I). Similarly, another participant mentioned that the company has not yet developed an internal understanding of CE, leading to the following conclusion: "So without knowing how we should work with it, it is very difficult to measure" (personal communication 2016, participant M).	I, J, M

Main Category	*Sub-category*	*Description*	*Referenced Participants*
4. Product Specificities	n/a	One expert mentioned that indicators should be designed in such a way "that they take into account the complexity and technical requirements of products"; developing such indicators would be a time consuming process and coming up with product-specific metrics was perceived as "a big challenge" for their implementation (personal communication 2016, participant O).	O

5.2 Content Analysis of Sustainability Reports

Based on the analysis of 19 sustainability reports, this section provides insights as to how Circular Performance Indicators (CPIs) are used among textile retailers. Results show that retailers apply indicators for chemicals, energy, land use, material consumption, packaging, waste and water. Indicators pertaining to captured value points, collaboration, leasing, locality, longevity, material cyclability, maintenance, material value, product reuse and use intensity were not included across the sample of reports. A full list of identified metrics is presented in Table 5-3 below.

About one third (that is, six out of 19) retailers mention the Circular Economy (CE) as a means to reducing the corporate environmental footprint. Yet, merely three sustainability reports (H&M, Inditex and Marks&Spencer) include performance data which, from their perspective, are clearly labelled to measure progress towards circularity. Other CPIs were identified without further reference to CE or closed-loop systems. Furthermore, the majority of retailers apply quantitative metrics; one exception is Nike which presents a weighted scorecard method for textile design that includes elements relevant from a CE-perspective. In addition to that, information on fiber usage is often reported without further notice as to how much raw materials are used.

In addition to the indicators presented in Table 5-3 below, retailers apply various *complementary measures*. In this context, the GRI framework appears to be most widely applied with 11 out of 19 retailers reporting in accordance with G4. A list of indicators from the GRI G4 framework and the footwear and apparel sector supplement which measure circularity (as per definition of CPIs provided above) is provided in Appendix V.

Further, analysis reveals that six out of 19 retailers (i.e. C&A, H&M, Inditex, Marks&Spencer, Nike and Otto Group) systematically use Lifecycle Assessments (LCAs) in order to determine the environmental impacts of textile products. In the case of C&A for instance, the company has examined the water and carbon footprint of its product portfolio along various lifecycle stages. The assessment shows that around 14% of greenhouse gas emissions and 84% of water consumption are attributed to the agricultural production of cotton and other natural fibers (C&A, 2015: 11).

Another tool frequently referred to by retailers is the Higg Index. While only four retailers (i.e. Adidas, Bestseller, Esprit and Puma) explicitly report using the Higg Index as an assessment tool, additional four companies (Inditex, H&M, Nike and Associated British Foods) communicated contributing to its further development through active participation in the Sustainable Apparel Coalition (SAC).

When it comes to management of chemical inputs, various retailers work with the bluesign® system (Adidas, Nike, Puma) in order to prevent harmful substances from entering the manufacturing process (bluesign®, n.d.). For instance, Adidas (2015: 48) reports that “65% of dyestuffs and 25% of auxiliaries are bluesign”. Moreover, some retailers work with OEKO-TEX standards (Bestseller, Mango, Otto Group, Puma), an international association of research and testing institutions. As such, the association issues the OEKO-TEX 100 standard which addresses the application of harmful substances across all stages of production (OEKO-TEX, n.d.).

Table 5-3: CPIs across sustainability reports of textile retailers.

Main Category	*Sub-category*	*Applied Metrics*
1. Captured Value Points	n/a	n/a
2. Chemicals	n/a	- Number of chemicals covered by the RSL (Bestseller, 2015: 32; Inditex, 2015: 63) - Amount of chemicals applied per textile product (Puma, 2015: 58) - Number of chemicals used within one product segment (Adidas, 2015: 40) - Amount of chemicals phased out (Esprit, 2015: 31; Marks&Spencer, 2016: 32) - Number of tests for restricted substances conducted (H&M, 2015: 110) - Number of tested products exceeding stipulated threshold levels for restricted substances (Bestseller, 2015: 33) - Number of reported cases for each group of restricted substances where thresholds levels were exceeded (Mango, 2015: 67) - Distribution of frequencies for restricted substances exceeding stipulated threshold levels (Puma, 2015: 58) - Weighted score for chemicals used in textile manufacturing (Nike, 2015: 27)
3. Collaboration	n/a	n/a
4. Energy	4.1 Energy Usage	- Energy consumption (Inditex, 2015: 152, 153; JD sports, 2015: 58; Mango, 2015: 62; Otto Group, 2015: 50; Puma, 2015: 50; Tchibo, 2014: 105) - Reductions in energy consumption (Adidas, 2015: 23; Associated British Foods, 2015: 58; Bestseller, 2015: 29; Debenhams, 2015: 38; Next, 2015: 29; Puma, 2015: 61) - Renewable energy consumption (Nike, 2015: 33; Otto Group, 2015: 50; Puma, 2015: 50; Tchibo, 2014: 105) - Renewable energy generated (Inditex, 2015: 72; Nike, 2015: 37; Otto Group, 2015: 50) - Renewable energy purchased (H&M, 2015: 77; Inditex, 2015: 76; Zalando, 2015; Marks&Spencer, 2016: 17) - Energy intensity of textile products (Inditex, 2015: 2, 152, 153; Nike, 2015: 36; Puma, 2015: 61) - Reductions in energy intensity of textile products (Adidas, 2015: 23) - Energy intensity per square meter (H&M, 2015: 77; Marks&Spencer, 2016: 17) - Reductions in energy intensity per square meter (Adidas, 2015: 49; Nike, 2015: 36; Mango, 2015: 60; Marks&Spencer, 2016: 17) - Reductions in power consumption of non-textile items (Adidas, 2015: 23; Inditex, 2015: 72) - Percentage of suppliers who achieved stipulated energy reductions (Adidas, 2015: 49) - Weighted score for energy consumed in textile manufacturing (Nike, 2015: 27)
	4.2 Greenhouse Gas Emissions	- GHG emissions per garment (Inditex, 2015: 144) - Reductions in GHG emissions per garment (Inditex, 2015: 154) - GHG emissions per ton of textile transported (Puma, 2015: 50) - GHG emissions per turnover (Associated British Foods, 2015: 10; Debenhams, 2015: 39; JD sports, 2015: 58; Sports Direct, 2016: 34, 35) - Reductions in GHG emissions per square meter (Adidas, 2015: 48; Debenhams, 2015: 39; Nike, 2015: 36) - GHG emissions (scope 1) (Associated British Foods, 2015: 10; C&A, 2015: 10; Debenhams, 2015: 38; Esprit, 2015: 45; H&M, 2015: 7; Inditex, 2015: 154; JD sports, 2015: 58; Mango, 2015: 58; Next, 2015: 30; Nike, 2015: 34; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50;

Main Category	*Sub-category*	*Applied Metrics*
		Sports Direct, 2016: 35; Tchibo, 2014: 105, 106; TJX, 2015: 43) - Reductions in GHG emissions (scope 1) (C&A, 2015: 3; H&M, 2015: 7; JD sports, 2015: 58; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50) - GHG emissions (scope 2) (Associated British Foods, 2015: 10; C&A, 2015: 10; Debenhams, 2015: 38; Inditex, 2015: 154; JD sports, 2015: 58; Mango, 2015: 58; Next, 2015: 30; Nike, 2015: 34; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50; Sports Direct, 2016: 35; Tchibo, 2014: 105, 106; TJX, 2015: 43) - Reductions in GHG emissions (scope 2) (H&M, 2015: 7; JD sports, 2015: 58; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50) - GHG emissions (scope 3) (C&A, 2015: 10; Debenhams, 2015: 38; Inditex, 2015: 154; Mango, 2015: 58; Nike, 2015: 34; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50; Tchibo, 2014: 104) - Reductions in GHG emissions (scope 3) (Inditex, 2015: 154; Otto Group, 2015: 48, 49, 50; Puma, 2015: 50) - External costs of GHG emissions (Otto Group, 2015: 15) - Weighted score for GHGs emitted during textile manufacturing (Nike, 2015: 27)
5. Land Use	n/a	- Land use and negative impacts on ecosystem service (Otto Group, 2015: 14; Puma, 2015: 47)
6. Leasing	n/a	n/a
7. Locality	n/a	n/a
8. Longevity	n/a	n/a
9. Maintenance	n/a	n/a
10. Material Consumption	10.1 Raw Material Input	- Amount of fibers used (Adidas, 2015: 12; C&A, 2015: 5; Esprit, 2015: 23, 24; H&M, 2015: 18; Mango, 2015: 10; Otto Group, 2015: 33; Puma, 2015: 63; Tchibo, 2014: 21, 30) - Number of materials used (Nike, 2015: 27) - Number of materials used for one product (Nike, 2015: 27) - Amount of fibers brought to the market (Inditex, 2015: 62) - Number of textile products brought to the market (Bestseller, 2015: 28; Inditex, 2015: 62, 151)
	10.2 Recycled Input	- Amount of recycled materials used (H&M, 2015: 17; Marks&Spencer, 2016: 33; Nike, 2015: 28) - Amount of recycled materials used per textile product (H&M, 2015: 14; Nike, 2015: 91) - Number of textile products using recycled materials (Adidas, 2015: 40; H&M, 2015: 7; Nike, 2015: 25) - Weighted score for recycled materials used during textile manufacturing (Nike, 2015: 27)

Main Category	*Sub-category*	*Applied Metrics*
11. Material Cyclability	11.1 Biodegradability	n/a
	11.2 Recyclability	n/a
	11.3 Reusability	n/a
12. Packaging	n/a	- Amount of packaging materials brought into circulation (Esprit, 2015: 44; Tchibo, 2014: 106) - Reductions in packaging materials (Inditex, 2015: 73; Marks&Spencer, 2016: 20) - Amount of packaging recovered to be sent for recycling (Inditex, 2015: 155; JD sports, 2015: 58; Sports Direct, 2016: 35)
13. Product Reuse	n/a	n/a
14. Use Intensity	n/a	n/a
15. Waste	15.1 Waste Collection	- Amount of post-consumer textile waste collected for reuse and recycling (C&A, 2015: 5; H&M, 2015: 7; Inditex, 2015: 68; Nike, 2015: 91) - Number of post-consumer textile products collected for reuse and recycling (Marks&Spencer, 2016: 19; Nike, 2015: 39)
	15.2 Waste Creation	- Amount of textile waste from manufacturing (Inditex, 2015: 156) - Reductions in textile waste from manufacturing (Nike, 2015: 24) - Landfill diversion rate for textile waste from manufacturing (Nike, 2015: 41) - Amount of manufacturing waste per textile product (Puma, 2015: 61) - Amount of manufacturing waste per textile product going to landfill (Nike, 2015: 91) - Amount of manufacturing waste per textile product going to energy recovery (Nike, 2015: 91) - Weighted score for textile waste from manufacturing (Nike, 2015: 27)
16. Water	16.1 Water Consumption	- Amount of water consumed (Associated British Foods, 2015: 59; C&A, 2015: 10; Inditex, 2015: 157; Nike, 2015: 42; Otto Group, 2015: 14) - Reductions in water consumption (Bestseller, 2015: 29; Nike, 2015: 42, 44) - Water intensity per textile product (H&M, 2015: 103; Inditex, 2015: 157; Puma, 2015: 61) - Reductions in water intensity per textile product (C&A, 2015: 17; Nike, 2015: 44; Puma, 2015: 61) - Water withdrawal by source (H&M, 2015: 107)
	16.2 Water Cycling	- Amount of water recycled (H&M, 2015: 107)

5.3 MQ Focus Group

5.3.1 Framework Proposal

Taking into account the findings presented above, this section proposes a framework that can offer guidance for selecting meaningful Circular Performance Indicators (CPIs) from the perspective of textile companies. The previous analysis addressed possible design features of CPIs by deriving themes from literature and expert interviews. These present the core module of the framework and can be further specified by consulting indicators identified across the analyzed sample of sustainability reports (see Table 5-3 above). Based on this, retailers can develop a more tangible understanding of such metrics and may learn from the current application of CPIs among other companies.

As organizations see themselves confronted with a wealth of different indicators, choosing the right set of metrics becomes a daunting task. Thus, the selection process calls for a well-founded evaluation of individual metrics against an established set of criteria. Having this in mind, the aim of this section is not to provide a comprehensive comparison of existing performance indicators – that would be a project in itself – but to define practical considerations which should be taken into account when choosing meaningful metrics. These shall guide discussions of company representatives when extracting CPIs from the explorative framework presented below. In order to further assist the selection process, each criterion has been assigned with a set of guiding questions. By looking at the literature on performance indicators, seven selection criteria were identified.

In addition to that, the application of an *ex-ante* consideration is suggested. When talking to experts from textile retailers, it was argued that there is a very limited conceptual understanding of the Circular Economy (CE). Looking at H&M's announcement to become a fully circular company, one expert said: "What are the steps on the way? They don't know yet. No one knows the steps, […] we are building the ship while we are sailing it" (personal communication 2016, participant I). Another participant mentioned that "there are no organizations today that have this 100% collective understanding of what Circular Economy is" (personal communication 2016, participant J). Yet another company representative mentioned that it is hard to select CPIs without having a specific definition of CE in mind because the concept "can be many different things" (personal communication 2016, participant M). Based on these inputs, we can argue that a company first needs to develop an understanding of CE in order to delineate the scope of circular activities and select meaningful CPIs. Hence, the corporate understanding of CE can be defined as an *ex-ante* consideration[19].

A summary of selection criteria, including their corresponding guiding questions and references, is presented in Table 5-4. Apart from #1, these are based on a literature review of 12 peer-reviewed articles and management handbooks which address the design and selection of environmental performance indicators on the business level. By closely examining the proposed criteria, it is becomes apparent that some of them overlap (to some extent, consistency is a precondition for comparability) or even contradict each other (we can imagine an indicator which is relevant to an organization but unreliable). Although this may appear problematic from a theoretical viewpoint, it is not perceived as such within the practical context of this paper. In fact, the purpose of these criteria is to frame discussions and provide qualitative guidance when extracting measures from the CPI framework.

[19] Even though this cannot be defined as a selection criterion as such, this aspects shall still be included in Table 5-4 below in order to maintain cohesiveness.

Table 5-4: Selection criteria, considerations and guiding questions.

#	*Criterion & Explanation**	*Guiding Questions*	*Reference*
1	**Corporate Understanding:** In order to determine which aspects of circularity should be measured, a company should first develop a well-defined understanding of what Circular Economy means. This should be discussed *ex-ante*, that is, before the application of the framework. Hence, companies would ideally have a good understanding of how to approach Circular Economy within their business context prior to application of the framework.	- What is the company's understanding of Circular Economy? - Which aspects of Circular Economy are of particular relevance for the company? - Which aspects of Circular Economy are irrelevant from the perspective of the company?	Participants I, J, M
2	**Comparability:** This criterion implies that indicators reflect changes in performance over time and, in the case of relative measures, need to be normalized by appropriate reference units. Often times, indicators are at the heart of management systems which follow a PDCA (Plan-Do-Check-Act) cycle. Within this cycle, results are monitored and documented in such a way that they can be compared to a previously established baseline. Hence, the comparability is of utmost importance if an organizations aims to track its progress and achieve continuous improvement along the PDCA management cycle.	- Can the indicator reflect changes in performance over time? - Is the indicator based on a meaningful reference unit?	Johnson, 1998; Jasch, 2000; Veleva & Ellenbecker, 2000; Dada et al., 2013; Anderson, 2014
3	**Consistency:** In order to be comparable, indicators also need to be consistent. This criterion requires consistency in a two-fold sense: first, the methodological assessment of information which allows for continuous documentation and unambiguous interpretation of performance data; and second, the compatibility with the given organizational structure and its prevalent system for data management.	- Can the indicator be based on the methodological assessment of data? - Is it compatible with the organizational structure? - Does the indicator fit into the existing processes of data management?	Jasch, 2000; Veleva & Ellenbecker, 2000; Carlin, 2004; Franceschini et al., 2007; Dada et al., 2013; Joung et al., 2013
4	**Data Availability:** The selection of performance indicators fundamentally relies on the availability of data. Naturally, organizations can define many relevant indicators; however, if they cannot access the information needed, they are practically worthless. Ideally, the data can be accessed within a short period of time and without imposing excessive costs. Otherwise, organizations may run the risk of wasting valuable resources which could be allocated more efficiently.	- Is the required data for this indicator easily obtainable? - Is the data accessible in a timely manner? - Can the needed data be acquired in a cost-effective way?	Johnson, 1998; Veleva & Ellenbecker, 2000; Franceschini et al., 2007; Feng et al., 2010; Joung et al., 2013; Anderson, 2014; Issa et al., 2015; Wolf et al., 2015

#	*Criterion & Explanation**	*Guiding Questions*	*Reference*
5	**Relevance:** Indicators need to be relevant. Obviously, the amount of physical products sold in a consulting company is not a good indicator for success; hence, relevant metrics are closely related to the system under evaluation and address material aspects which are in line with the organizations' strategic targets and objectives. Moreover, relevant indicators refer to controllable aspects within the organizations' reach and pay attention to risks. The GRI (2013) Implementation Manual offers extensive guidance on how to assess the relevance of sustainability aspects and indicators through the Principle of Materiality. In the context of this paper, this may provide a framework for deciding whether an indicator conveys useful information or not.	- Does the indicator address material aspects? - Does is correlate with the organizations' strategy? - Is it needed for measuring important targets and objectives? - Does it convey significant information needed for decision making?	Johnson, 1998; Veleva & Ellenbecker, 2000; Jasch, 2000; Carlin, 2004; Diakaki et al., 2006; Franceschini et al., 2007; Feng et al., 2010; Dada et al., 2013; Joung et al., 2013; Anderson, 2014; Issa et al., 2015; Wolf et al., 2015
6	**Reliability:** This criterion is used for describing the degree to which an indicator can be trusted. To be trustworthy, an indicator must be transparent and verifiable. Moreover, reliable indicators provide an accurate description of the performance by avoiding subjective judgments and uncertainties. Only if this criterion is met can organizations be certain that a metric conveys meaningful information.	- Can the information for the indicator be obtained from a trustworthy source? - Can the data be verified? - Does the indicator provide an accurate description of the system's performance? - Does the indicator avoid subjectivity and uncertainty?	Johnson, 1998; Jasch, 2000; Veleva & Ellenbecker, 2000; Franceschini et al., 2007; Feng et al., 2010; Dada et al., 2013; Joung et al., 2013; Anderson, 2014; Wolf et al., 2015
7	**Understandability:** This criterion implies that the indicator is easy to comprehend and corresponds to the users' information needs. Further, the indicator can be understood without the help of experts. Understandability is of particular relevance when choosing reference units. For instance, using unfamiliar weight units such as "cubic tons" or "metric ounces" can create confusion and might further compromise the indicators' comparability.	- Is this indicator easy to understand? - Does the use of the indicator require experts? - Do the chosen (reference) units create confusion?	Johnson, 1998; Jasch, 2000; Veleva & Ellenbecker, 2000; Carlin, 2004; Franceschini et al., 2007; Feng et al., 2010; Joung et al., 2013; Anderson, 2014; Issa et al., 2015
8	**Balance:** Finally, balance can be mentioned as a seventh criterion. This refers to the final set of indicators and is thus applied *ex-post*. Balance implies that a collection of metrics addresses all levels of interest and adequately represents the performance of the analyzed system. In order to be balanced, the set of indicators needs to account for all relevant aspects within the system's boundaries. However, it should further aim to limit the amount of metrics to a manageable number in order to ensure their cost- and time-effective application.	- Does the set of indicators reflect the performance of the analyzed system in a balanced manner? - Does the set include a manageable number of indicators or are they too many?	Jasch, 2000; Veleva & Ellenbecker, 2000; Carlin, 2004; Feng et al., 2010; Dada et al., 2013

** It is noteworthy that some authors mention measurability as an additional criterion (e.g. Anderson, 2014; Feng et al., 2010; Joung et al., 2013). However, based on the definition of indicators as "measures which provide quantitative or qualitative information" (section 4.2), measurability cannot be considered a criterion but a* key feature *and is therefore disregarded.*

By integrating the indicator categories and complementary measures with the above mentioned selection criteria, an explorative framework for selecting CPIs within the context of the textile sector is proposed. This is depicted in Figure 5-1.

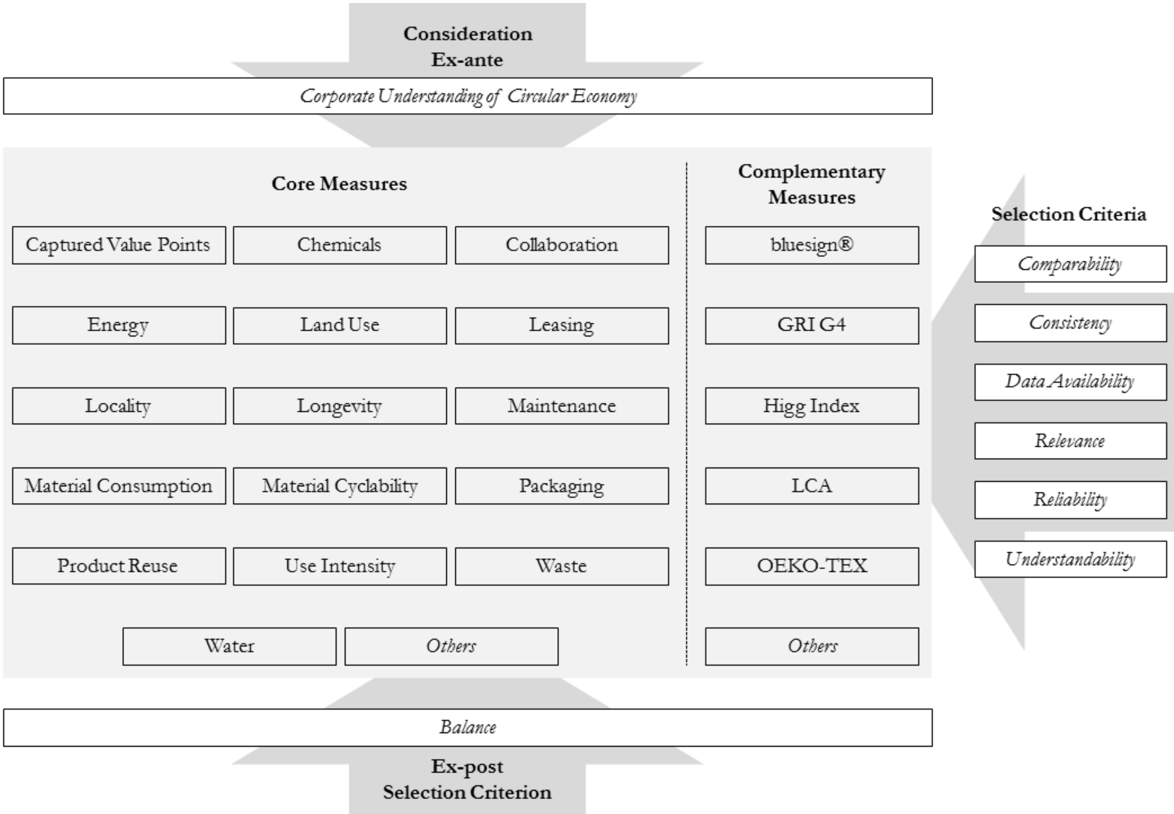

Figure 5-1: Explorative framework for selecting CPIs in the textile sector.
Source: Own illustration.

At this point, a few remarks regarding the application of the framework should be made. First and foremost it should be highlighted that, due to the exploratory research design of this paper, the suggested elements are inexhaustive. Companies may define other CPIs which reflect their understanding of CE – hence the inclusion of *Others* as one constituent element. Moreover, based on the methodological approach of this paper, the framework distinguishes between *core measures* and *complementary measures*. In order to avoid confusion, it appears worthwhile to reiterate the difference between the two.

Core measures essentially *reflect the design features of CPIs* suggested by the previous analysis. Hence, they should be understood as specific indicator categories which pertain to circular performance of textile companies. Complementary measures are comprised of *existing tools, frameworks and aggregated metrics* which at least partially reflect the CE-mindset. These may provide further guidance when working with CPIs or, in some cases, even suggest specific metrics which are relevant from a CE-perspective.

Naturally, the line between both measures is blurred and in fact, it seems that most complementary measures are much more comprehensive than all suggested core measures combined. From the perspective of a company, some complementary measures may thus constitute the main tools through which CE is managed. Therefore, it should be emphasized that the CPI framework is not supposed to replace existing frameworks but is simply meant to provide practical guidance for textile companies interested in measuring progress towards CE.

5.3.2 Framework Application

The MQ focus group session took place on September 1st 2016 between 13.00 and 16.00 in Gothenburg, Sweden and was attended by the author and four company representatives. The session was loosely structured in five parts.

After participants had introduced themselves (part 1), the author provided brief theoretical inputs about the concept of Circular Economy (CE) and its implications for the fashion and textile industry (part 2). These inputs were followed by discussions about MQ's understanding of CE[20] and led to the application of the CPI framework (part 3). For this, participants were asked to examine the framework and discuss indicator categories that could be of particular interest for MQ. The discussions were framed by the selection criteria and corresponding guiding questions presented in Table 5-4 above. After that, strengths and weaknesses of the framework were discussed (part 4). Finally, the workshop was closed and recapped in a one-on-one session between CSR Manager Eleonor Björserud and the author (part 5).

The application of the indicator framework identified a set of 16 indicators (core measures) which may be relevant for MQ. These are presented in Table 5-5 below. Discussions further revolved around some complementary measures, including the GRI framework, the Higg Index and Lifecycle Assessments (LCAs). While MQ is currently working on its new sustainability report in accordance with GRI G4, the Higg Index was mentioned to be of potential future interest. Since fast-fashion giant H&M is beginning to integrate the Higg Index into its assessment practices, some of MQ's suppliers have started to transmit data for the Higg Factory module. Furthermore, LCA was perceived as a promising way for identifying environmental hotspots along the value chain; yet, MQ currently uses LCA data from third party and, due to resource constraints, is not planning to conduct an individual assessment in the immediate future.

[20] Due to the limited amount of time and number of participants, these discussions did not aim to produce a comprehensive and well-defined understanding. Instead, they revolved around aspects of circularity which appeared interesting from the perspective of MQ.

Table 5-5: Potential CPIs for MQ.

Main Category	*Sub-category*	*Potential Indicators*
1. Captured Value Points	n/a	n/a
2. Chemicals	n/a	- Number of chemicals covered by the Restricted List of Substances (RSL) - Number of tested products exceeding stipulated threshold limits for restricted substances
3. Collaboration	n/a	n/a
4. Energy	4.1 Energy Usage	- Energy consumption in organization - Energy consumption outside of organization (selected factories)
	4.2 Greenhouse Gas Emissions	- Greenhouse gas (GHG) emissions from transport - GHG emissions from transport per garment
5. Land Use	n/a	n/a
6. Leasing	n/a	n/a
7. Locality	n/a	n/a
8. Longevity	n/a	- Average lifetime of fashion products
9. Maintenance	n/a	- Cost for repairing garments - Number of garments repaired
10. Material Consumption	10.1 Raw Material Input	- Amount of fibers used - Amount of sustainable fibers used
	10.2 Recycled Input	- Amount of recycled materials used

Main Category	*Sub-category*	*Potential Indicators*
11. Material Cyclability	11.1 Biodegradability	n/a
	11.2 Recyclability	n/a
	11.3 Reusability	n/a
12. Packaging	n/a	n/a
13. Product Reuse	n/a	n/a
14. Use Intensity	n/a	n/a
15. Waste	15.1 Waste Collection	n/a
	15.2 Waste Creation	- Amount of textile waste from manufacturing - Landfill diversion rate for textile waste from manufacturing
16. Water	16.1 Water Consumption	- Amount of water consumed in factories - Amount of water consumed in factories per product
	16.2 Water Cycling	n/a

6 Discussion and Analysis

Based on the literature analysis and results presented above, this chapter discusses the following three research questions (RQs):

- *Section 6.1 – RQ1:* What are possible design features of Circular Performance Indicators in the textile industry?
- *Section 6.2 – RQ2:* How are Circular Performance Indicators applied among major European textile retailers?
- *Section 6.3 – RQ3:* Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ?

6.1 Design Features of Circular Performance Indicators

Content analysis of interview materials suggests that experts have a mixed understanding of what Circular Performance Indicators (CPIs) are and which sustainability aspects they address for the textile industry in particular. Predominantly, experts answered that CPIs would measure aspects which are relevant from an environmental point of view. Thereby, they almost entirely neglected social aspects. Moreover, it was perceived that indicators would mostly pertain to material flows. Exceptions include the categories of captured value points and collaboration which are to some extent linked to economic and social aspects respectively. Hence, suggested indicators are largely in line with the conceptual sustainability focus of the Circular Economy (CE) and classify as circular use indicators as per definition in section 4.2.1.

Notably, there is a discrepancy between categories suggested by literature analysis and interview candidates. While most deductive categories presented in section 4.3 were mentioned by experts in one way or another, the categories #3, #7, #9, #12, #14, #15, #17, 19# and #21 received not support whatsoever. Due to the limited scope of this thesis, reasons for this discrepancy remain purely hypothetical; however, it can be assumed that some of these categories appear irrelevant within the context of the textile industry and hence, are likely to receive no attention from experts. For instance, using reused input materials (#12) is rather unusual among textile companies because, from a closed-loop perspective, textile products are either reused as a whole or recycled into new products. Similarly, providing customers with product warranties (#9) appears more common for other consumer goods, e.g. electronic and electrical equipment.

With regards to the design features of CPIs, experts predominantly proposed measuring circularity in a quantitative manner, suggesting weight units (e.g. kilograms and tons) or pieces of textiles (e.g. number of garments) as suitable reference units. In order to ensure comparability and representativeness among different product groups, normalization through monetary units was seen as most appropriate. However, some experts also advocated somewhat more qualitative approaches, e.g. by applying a weighted "score between 0 and 10 where 0 is fully linear and 10 is fully circular" (personal communication 2016, participant P). Although it can be argued that certain CE-related aspects should be measured in a rather qualitative way (e.g. collaboration, leadership and innovation – see reflections in section 7.2 below), quantitative measures can provide a clear picture of material flows.

According to experts, CPIs would mostly focus on manufacturing processes or end of life management of used textiles; other stages of the textile lifecycle (e.g. distribution, fiber production and use phase) did not receive much attention. Most notably, there appears to be consensus among experts that measuring recycled inputs in textile production would be valuable from a CE-perspective. In fact, every single expert suggested this aspect, making it the least common denominator among all interviewees. Similarly, recyclability received considerably more support among experts than reusability and biodegradability.

Considering that CE is often described to address the entire lifecycle of products (chapter 4), the strong emphasis on recycled input materials and end of life aspects is rather curious. Indeed, it may indicate that the core characteristics of such indicators in the textile industry are not yet widely discussed and need to be further developed.

Other categories recurringly mentioned by interview experts include waste and energy. While these categories are largely in line with the CE concept as such, both are somewhat more generic in that they do necessarily pay attention to the characteristics of the textile industry but could be applied to other sectors as well. For instance, indicators for energy consumption and greenhouse gas (GHG) emissions may apply to any other sector, e.g. the iron and steel industry which is considerably more energy intensive than textile production. Again, the focus on such generic metrics may point towards a limited understanding of what CPIs should look like with regards to textiles.

Besides this, some experts mentioned other metrics which are of particular relevance for the textile sector. These encompass water and chemicals, both of which are often regarded as key inputs along the textile value chain (Blackburn, 2015; World Bank, 2007). While most experts agreed that it is desirable to reduce water consumption, the use of chemicals was seen somewhat more ambiguous. One expert said: "You can also have really good chemicals, […] that help you so you don't have to use the same amount of dyestuff for instance". Yet, it was considered important to avoid those chemicals which are not compatible with the principles of CE, e.g. due to their toxicity and potentially adverse impacts on human health. Hence, identifying, controlling and restricting chemicals inputs by using a Restricted Substance List (RSL) was deemed useful. Similar arguments were brought up for fiber inputs where it was deemed necessary to have extensive knowledge about applied materials and fiber-blends in order to ensure effective recyclability of outworn textile products.

Lastly, some indicator categories did not receive much attention from experts but, from a CE-perspective, deserve further attention. Here, categories such as captured value points, leasing, longevity and product reuse are particularly interesting as they may allow companies to measure new revenue streams which have previously been underexploited. By keeping products in use for longer (e.g. through product reuse) and providing access over ownership (e.g. leasing), textile retailers can capture additional value from singular textile products, thusly increasing their overall revenue and profitability.

However, it appears likely that these CPIs apply to certain companies only. With regards to the fashion industry for instance, Hvass (2015: 14) highlights that reselling and reuse channels are "mainly chosen by premium and high fashion brands with higher quality products as this strategy requires the highest quality possible to ensure that garments retain their value and can be re-bought many times". Hence, these indicators might be less useful for fast-fashion companies whose business model is fine-tuned for selling ever more low quality products. In contrast, the only way of extracting additional value from short-lived fast-fashion products appears to be recycling which is not yet profitable on a larger scale and thus, remains hypothetical at this point in time.

6.2 Application of Circular Performance Indicators among Textile Retailers

All in all, the application of Circular Performance Indicators (CPIs) among textile retailers seems to be in an early stage. The examination of 19 annual and sustainability reports identified indicators for merely half (that is eleven out of 22 in total) of the proposed categories. Moreover, none of the interviewed retail representatives mentioned to explicitly measure progress towards circularity. Instead, it appears that certain aspects of the Circular Economy (CE) are captured by already established means of sustainability performance measurement. In this context, barriers to implementation of CPIs were perceived as manifold and interviewees often emphasized difficulties in data collection and the need for further organizational development in order to accurately measure progress towards CE.

Among the sample of sustainability reports, quantitative CPIs are most frequently applied. These address the categories chemicals, energy, material consumption, waste and water. With regards to energy usage and greenhouse gas (GHG) emissions, the scope of measurements taken varies considerably; the majority of textile retailers use indicators pertaining to energy consumption inside the organization as well as the corresponding GHG emissions only (scope 1 and 2). Measurements beyond that scope which reflect impacts in the manufacturing and end of life stage are communicated by a limited number of retailers only.

A similar logic applies to other categories. For instance, indicators for waste and water mainly pertain to sources which are under direct control of retailers. This includes, inter alia, paper and water used in office or retail operations (e.g. Puma, 2015). Often, indicators for manufacturing of textile products are not applied. As for product reuse, not a single retailer communicates indicators addressing textile products as such; at the maximum, they provide information regarding the amount of hangers reused. This is the case for Mango (2015), Marks&Spencer (2016) and Inditex (2015: 73), the latter of which claims to have reused 87 million plastic hangers in 2015, thus "actively promoting a circular economy". Yet, from a sustainability standpoint, focusing on hangers as opposed to textile products is rather questionable because it does not address the company's core business and hence, neglects the its most significant impacts.

One explanation for the differences in scopes of measured aspects may be the varying level of vertical integration among retailers. Inditex for example is known for possessing a considerable number of its Spanish textile suppliers. Naturally, receiving performance data for upstream processes is much easier in this case. Hence, it appears logical that Inditex is able to report performance data in more detail than other retailers, e.g. by covering a larger amount of chemicals in its Restricted List of Substances (RSL), the energy intensity of textile products, GHG emissions per garment or water intensity per textile unit (Table 5-3). Supporting these thoughts, Esprit's (2015: 31) sustainability report refers to the following challenges for applying quantitative metrics across its supply base:

1. Many suppliers do not collect data to the levels required to gain sufficient consistency and quality to allow effective performance assessment.
2. Reporting energy savings in industrial manufacturing sites can be complex because a large number of variables need to be normalized, such as production type and operating capacity.
3. Some suppliers might consider elements of this data to be commercially confidential.

Likewise, interview candidates from textile retailers frequently mentioned that data collection could pose a significant barrier to the implementation of CPIs. Here, internal resource constraints where seen as particularly problematic. One expert said: "You see, I have a team of nine that handles all sustainability issues globally. […] I'm very sensitive how much work something new is going to be because we are already making choices about what is going to be left undone" (personal communication 2016, participant K).

Other representatives perceived that barriers to data collection are further augmented by the complexity of the textile value chain; one expert expressed such concerns as follows: "[F]or a huge company like Bestseller or C&A [data collection] will be a huge challenge because they have thousands of suppliers; and then first-tier, second-tier, third-tier… For them it will definitely be a huge challenge". Consequently, the interviewee concluded that vertical integration may offer one solution for larger companies as it would allow retailers "to get involved in the whole supply chain [and to] follow all the processes" (personal communication 2016, participant R). For medium-sized, sustainability-driven companies, data collection was perceived to be less of a problem due to their smaller supply base and their ability to maintain close relationships with their upstream business partners.

Albeit data collection may be difficult for quantitative metrics in general, it appears that the lifecycle character of CPIs may augment these challenges. For instance, one retail expert mentioned that the application of CPIs would require new types of data from use phase which captures fiber use, product longevity and consumers' washing-, wear- and care-habits (personal communication 2016, participant J). According to another interview candidate, yet a different problem is that "textile companies […] know very little about where their products go at the end of life" which makes it difficult "to design an indicator because you do not have the relevant information" (personal communication 2016, participant P). Hence, it seems that the lifecycle mindset of CE – requiring data from fiber production up until the end of life – makes it especially challenging to implement CPIs.

Further, many retail representatives indicated that it would be too early to apply CPIs and highlighted the need for further organizational development before such metrics could be implemented. This is largely in line with the assessment of sustainability reports provided above, supporting the conclusion that the implementation of CPIs is still in an early stage. According to retail experts, developing a strategic understanding of how to work with circularity and creating the necessary organizational structure as well as personal routines for collecting CE-related data was perceived to be a time-consuming process. One expert provided an interesting and curious example: "In 2012, when we started installing the take-back scheme for consumers, then many […] internally asked the question: 'Why do we do that? Why do we have a trash bin in the store?' It's a good thing and it's a good way of engaging with consumers; but in the retail store where every square meter has a price, then why do we have that trash bin? And people put banana peels in there. So the message [that Circular Economy is an important part of the business] really has to be embedded in our organization. […] And when it is a big company, that can take time" (personal communication 2016, participant J).

This quotation vividly illustrates the reallife challenges that textile retailers face when implementing novel business approaches. Resonating with the analysis of sustainability reports presented above, it further indicates that for many textile retailers, CE is a relatively new concept and is not yet widely integrated into corporate sustainability strategies. Consequently, measuring progress towards circularity remains a challenging activity and will need further attention from textile retailers.

6.3 Selecting Circular Performance Indicators for MQ

The application of the Circular Performance Indicator (CPI) framework during the focus session resulted in a set of 16 metrics which are relevant for MQ. Notably, more than half of the proposed CPI categories (that is, 12 out of 22) were either considered irrelevant or did not receive attention from workshop participants.

Indicator categories of interest for MQ pertain to chemicals, energy, maintenance, material consumption, waste and water. Moreover, discussions indicate that MQs business model impedes the use of certain CPIs. Workshop participants were interested in the idea of leasing or reselling clothes because these aspects were considered largely compatible with MQ's focus on high-quality garments and the CE-mindset. Interestingly, one participant mentioned that the resell value of MQ's products on Swedish consumer-to-consumer trading platforms (e.g. tradera or blocket) is close to their original retail prices. Thus, capturing additional economic value through leasing or reselling activities was seen as a significant economic opportunity. However, such activities are currently neglected due to a one-dimensional focus on conventional retail activities. Hence, indicators for leasing and product reuse are irrelevant at present state.

Following the selection criteria and guiding questions suggested in section 5.3.1, discussions first revolved around MQ's understanding of Circular Economy (CE). When asked which elements of CE were perceived as most important for MQ, participants addressed the use of chemicals, energy usage, carbon emissions, material consumption, product design, and finally, product durability. In this context, it was pointed out that one of MQ's core values and cornerstone of its corporate strategy refers to product quality. This was seen as largely compatible with a CE-mindset that "aims to keep products, components and materials at their highest utility and value, at all times" (section 4.1).

Subsequently, participants applied the CPI framework. First, metrics in the category chemicals were discussed. At present, MQ uses a Restricted Substance List (RSL) which stipulates specific threshold levels for a number of chemicals. This was interpreted as a valuable tool for the application of CPIs. Since the company runs randomized tests on it collections, an indicator for the number of tested products and the number of products exceeding stipulated substance limits was considered.

Second, experts discussed the category energy where measuring both energy usage and greenhouse gas (GHG) emissions were considered valuable. While MQ currently measures energy consumption across all stores, participants mentioned that it would be difficult to do the same for the manufacturing process. Here, limited data collection via factories was perceived as the main barrier. In contrast, GHG emissions are already measured to a larger extent, taking into account both direct (e.g. office buildings) and indirect sources (e.g. transport). Based on these assessments, MQ presently calculates the carbon intensity of textile products from transport.

Another category of interest was waste. Participants agreed that, due to MQ's close cooperation with the Swedish charitable organization Myrorna, waste *collection* should receive no attention in the immediate future. Instead, it was argued that consumers could find more efficient ways for the disposal of outworn textile products, e.g. by using already existing curbside collection points by charitable organizations. Thus, indicators in this category were disregarded. In contrast, the category for waste *creation* received more interest. Here, it was argued that suppliers should ideally measure the amount of waste created during the manufacturing process. Expressing this in absolute terms (i.e. tons of waste) or relative terms (i.e. rate of landfill diversion) was considered feasible. Similar to CPIs on energy usage and GHG emissions, receiving the necessary data from suppliers was seen as a potential challenge.

Further attention was directed towards indicators for material consumption. Currently, MQ measures the overall amount of sustainable fibers used. Data on other materials are not captured, however. In order to achieve this, MQ is currently updating its internal software infrastructure so that, in the near future, both inputs from sustainable materials (e.g. recycled polyester) and conventional fibers (e.g. cotton) will be measured. Further, this update will enable MQ to rank all purchased fibers in against its internal sustainability criteria.

Subsequently, participants debated the application of CPIs for water consumption in textile manufacturing. While the application of such metrics was generally seen as feasible, some participants expressed their doubts about the possibility to retrieve the necessary data. Here, suppliers' willingness to install water meters was seen as a bottle neck.

Lastly, participants jointly discussed indicators for longevity and maintenance. It was mentioned that measuring a product's *actual* lifetime would be difficult since MQ might not able to retrieve the necessary information. Hence, assessing a product's *average* lifetime by conducting a consumer survey was considered. Moreover, it was assumed that tailors employed by MQ would have a good understanding of how long a product would last and could provide further insights as to how many products were repaired. According to participants, the latter could be difficult to assess because, as part of its tailoring services, MQ offers to customize previously bought garments (e.g. shortening or changing the cut of a dress). As such, customizations and repairs are both reflected in the labor costs for tailors. For assessing the number of repaired garments in particular, MQ would need to document the tailors' work more thoroughly. Figure 6-1 depicts those main categories for which potential indicators were discussed during the MQ focus group session.

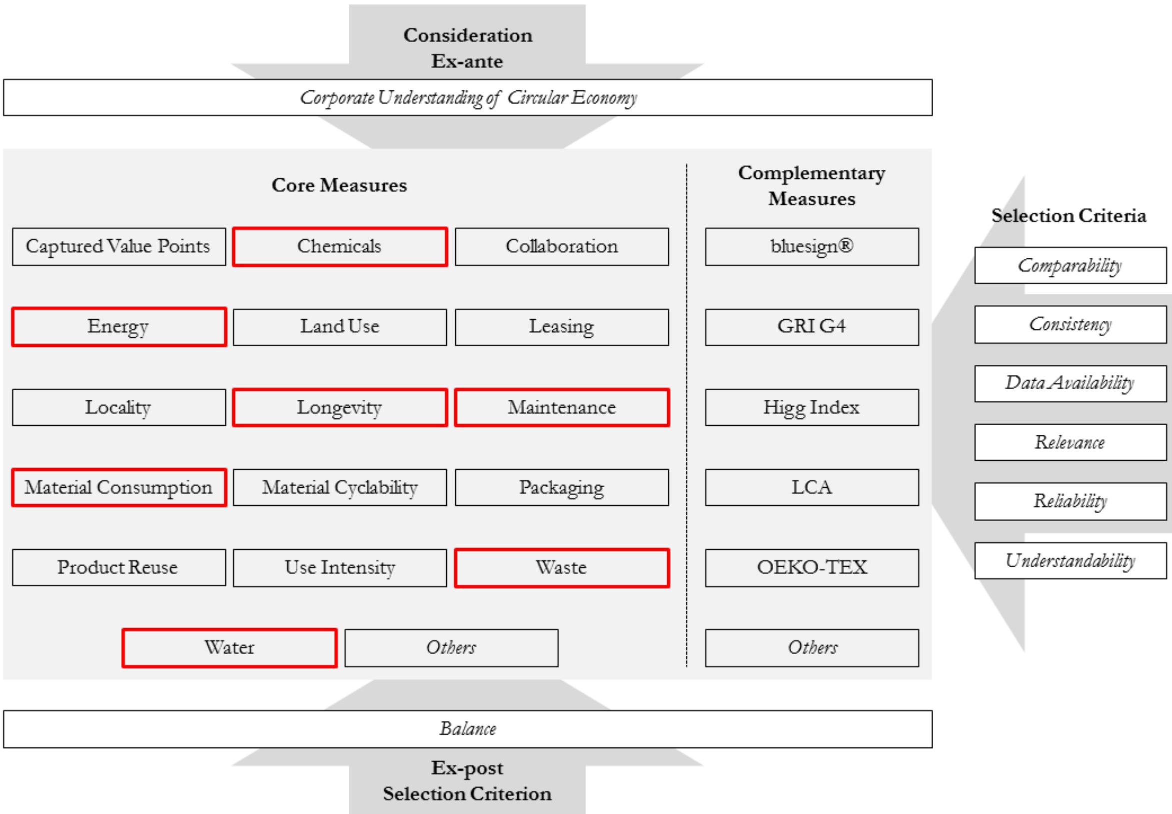

Figure 6-1: CPI categories identified as relevant for MQ.

Prior to closure of the session, the participants shared their candid opinions regarding the usability of the CPI framework. All in all, it was perceived that the framework was easy to understand and covered most important aspects from the perspective of MQ. However, considering participants' limited pre-knowledge about CE, this feedback should not be overestimated. Moreover, the workshop was held within a rather short timeframe. Consequently, participants cannot be expected to examine the framework's constituent elements in much detail. Indeed, it was noticed that both selection criteria and guiding questions as per definition in section 5.3.1 were applied to a very limited extent. However, according to feedback provided from CSR & Environmental Manager Eleonor Björserud, these elements would be valuable when working with the framework in more detail after the workshop.

7 Reflections, Recommendations and Future Research

7.1 Pathways to a Circular Economy: One Concept, Many Approaches

The Circular Economy (CE) is propagated as a means to decoupling environmental impacts from economic growth. In theory, the concept is based on many assumptions and best case scenarios. In practice however, it can be difficult to apply because it can involve trade-offs and means different things to different actors (hence the inclusion of "Corporate Understanding of the Circular Economy" as an ex-ante consideration in the framework).

During the analysis of expert interviews, the author gained the impression that representatives from large textile retailers argued for incremental, process-oriented innovation while smaller companies also questioned existing economic paradigms and aimed for disruptive change. For instance, one representative from a larger retailer mentioned the following: "Of course, you can talk about changing the underlying business models and so forth… But as long as we lack scalable and economical solutions on the ground, making the case for a circular business model will be difficult. What we really need at the moment are technical solutions which can be implemented in the production line and bring down costs". By highlighting the need for profitable closed-loop production, the expert continued: "If production costs for circular fashion remains high, it will never reach the mass market. Then it will be only small brands which operate in niche markets and sell their products at a very high price to a very limited number of consumers" (personal communication 2016, participant L).

In contrast, a medium-sized retailer mentioned that from a CE-perspective, recycling is only one solution which, just by itself, does not eliminate the need for stopping "the growth of textile consumption in the first place" (personal communication 2016, participant Q). Thus, the participant made a strong argument for repairing garments and keeping them in use for as long as possible. Similarly, another small retailer emphasized the importance of changing consumption patterns so that consumers would not "get the latest fast-fashion t-shirt for five bucks which is going to be thrown away after two weeks". Looking at the implications from a business perspective, the same participant concluded: "[I]f you lose money, you will not be able to sustain your business very long. You need to make profit in the end anyhow. That will always remain – but not on the cost of everything. You also need to perform on other indicators" (personal communication 2016, participant R).

From a sustainability standpoint, both approaches are valid and, to some extent, can be understood as two sides of the same coin. Resonating with Schumpeter's (1950) concept of "creative destruction", Hockerts & Wüstenhagen (2010) have termed this the struggle of "Greening Goliaths versus Emerging Davids". They argue that the transformation of an industry needs to be understood as a dynamic co-evolution of sustainability start-ups and market incumbents. In a nutshell, their argument goes as follows: In an early stage of development, start-ups ("Emerging Davids") would launch sustainability innovations and trigger substantive growth in niche markets. Successively, this attracts incumbent market players ("Greening Goliaths") who aim to capitalize on the growing trends. Due to highly efficient process innovations and economies of scale seized by market incumbents, this leads to the gradual sustainability transformation of an industry and internalization of external costs over time, as reflected by the growth in organic food segments, the renewable energy sector and electric vehicles in the automotive industry (ibid.). Figure 7-1 illustrates this in a schematic fashion.

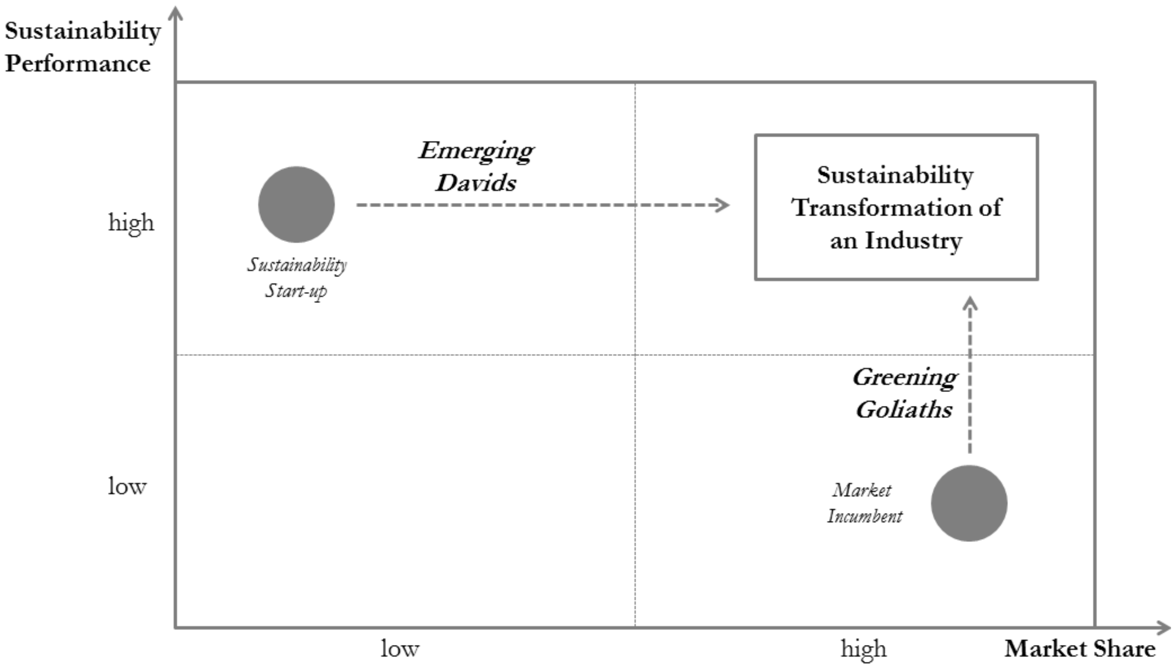

Figure 7-1: Sustainability transformation of an industry.
Source: Adapted from Hockerts & Wüstenhagen (2010: 488)

Yet, considering the urgent need for change in the textile sector (and others), merely relying on the evolutionary powers of the free market and providing unlimited leeway for corporations to innovate will simply not suffice. Hence, market developments need to be supported by swift changes in consumer behavior and proactive policies which kickstart and maintain such transformations. During the MQ focus group session, it was highlighted that legal provisions are often too low for facilitating wide-spread change across the industry. One participant said: "But the government does not think that we can do that. We can change really quickly if we have to. [Take] banning of chrome tanned leather for instance. We could do excellent without it. […] No problem. We can handle more restrictions easily" (personal communication 2016, MQ focus group). Considering that these words come from an employee of a publicly listed and internationally operating fashion company, the need for effective policy interventions appears especially dire.

Since both incremental and disruptive innovations are valuable approaches, future research could scrutinize whether the transformation of the textile sector towards CE is reflected by companies' chosen means of performance measurement. Resonating with the inputs provided in the MQ workshop, exploring the (potential) correlation between business models and the performance indicators would shed further light on the implementation of CPIs among different textile companies. In addition to that, examining to what extent internal (e.g. opportunity-driven) and external (e.g. policy-driven) context factors influence the implementation of CPIs among textile retails offers valuable research opportunities.

7.2 Quantitative vs. Qualitative Indicators

One expert had the strong opinion that quantitative indicators alone would not suffice to adequately depict progress towards Circular Economy (CE). Instead, the use of qualitative metrics which are based on expert judgements, guiding questions and weighted scores was proposed. This stands in stark contrast to most of the other interviewees who suggested to measure circularity in a quantitative fashion.

According to this expert's understanding, CE is not a static state but rather a "path to follow" (personal communication 2016, participant D). In order to adequately assess corporate progress towards CE, it was argued that indicators need to give a holistic picture of a company. Hence, there would be a need for including a range of intangible aspects, such as collaboration, leadership and innovation. In the expert's words, this was expressed as follows: "So if you were to think about the circularity of the textiles industry, it is kind of dependent on the extent to which all the organizations within the industry are circular and the extent to which they collaborate with each other, they innovate, they make efforts to reduce material and resource inputs and try to cycle wastes etc.". Consequently, it was perceived that CPIs would need to focus less on quantifiable end-state impacts because "circularity is a bit hard to quantify [and] not so much a state [but] more of a strategy or a way to do things" (ibid.).

Indeed, it can be argued that the concept of CE puts a much stronger emphasis on aggregated cross-sectoral and cross-corporate indicators which, for instance, reflect the degree to which companies close material loops and extract value from industrial (by-)products. Due to the interconnectedness and often high degree of competition along industrial value chains, acquiring the necessary quantitative data can be challenging. Here, qualitative indicators may have multiple advantages.

For once, they would avoid the need for extensive data collection by using expert judgements and employees' inputs, both of which are often more easily available than quantitative data. Further, both retail and non-retail experts recurringly mentioned that making progress towards CE can be challenging if information conveyed by CPIs do not receive attention from higher management levels. Using CPIs to measure progress towards CE would be one thing; however, "whether anybody cares" (personal communication 2016, participant F) and whether these indicators are "linked to certain targets" (personal communication 2016, participant H) would be much more important. Having this in mind, the above mentioned expert suggested the use of guiding questions in order to determine "to what extent the board, employees, management are talking about the concept and really integrating it into their work" (personal communication 2016, participant D). Naturally, measuring these aspects could depict a company's progress towards circularity more accurately because it reflects the integration of CE into everyday business.

However, we can assume that qualitative indicators have certain shortcomings, too. Per definition, qualitative information is incomparable and expert judgements would unavoidably introduce elements of subjectivity during the assessment process. Ultimately, this would raise questions regarding the validity of qualitative indicators. Since neither literature analysis nor expert interviews provided a clear and tangible definition for qualitative indicators with regards to textiles, further research is needed in this field. Here, developing a robust understanding of design features of such metrics and how exactly they would be validated appears useful.

7.3 Reflections on Methodology

When reflecting upon the research process, it should be highlighted that the approach taken in this thesis is inherently exploratory. In order to develop a more fine-grained understanding of Circular Performance Indicators (CPIs) in the textile sector, future research should draw inferences based on statistically representative samples. Due to the lack of available data and the emerging relevance of Circular Economy (CE), this thesis almost entirely focused on the examination of sustainability reports when examining the application of CPIs among textile retailers. Hence, the analysis is likely to omit confidential data. In order produce a better understanding of the application of CPIs across textile retailers, further research should also scrutinize means of internal performance measurement. Moreover, it appears worthwhile to conduct comparative studies which address the design features of CPIs across other industries since this may deliver a deeper understanding of sector-specific metrics.

This thesis employs qualitative content analysis by Mayring (2014) as a primary means of data examination. This method can be defined as an "empirical, methodological controlled analysis of texts within their context of communication, following content analytical rules and step by step models, without rash quantification" (section 3.3). Overall, this method was perceived as a valuable technique for the exploratory research design of this study; however, it also entailed certain shortcomings which shall be discussed in more detail below.

The content analytical procedure was guided by a step by step process model which, at first sight, suggests a fairly rigid analytical process. However, the actual analytical procedure turned out to be rather fluid and the author often found himself going back and forth between the lines, repeatedly revising the coding guidelines and changing inductive categories. Based on this experience, one could disregard the process model as nothing more than "hot air"; yet, the author perceived this approach as helpful because it increased his understanding of the constituent parts of content analysis and created an overview of the process.

Mayring argues that intercoder agreement checks and step by step process models would help to produce "a true description [of the material] without bias owing to the preconceptions of the researcher" (section 3.3). However, it is highly doubtful if content analysis can really meet these expectations; after all, it can be argued that knowledge as such is a relativistic phenomenon and will never reflect the true nature of reality. In their seminal piece *The Social Construction of Reality,* Berger & Luckmann (1966: 15) argue as follows: "What is 'real' to a Tibetan monk may not be 'real' to an American businessman. The 'knowledge' of the criminal differs from the 'knowledge' of the criminologist. It follows that specific agglomerations of 'reality' and 'knowledge' pertain to specific social contexts, and that these relationships will have to be included in an adequate sociological analysis of these contexts".

Albeit this citation specifically refers to the discipline of sociology, it very much resonates with the author's understanding of scientific knowledge in general. Yet, it should not be interpreted as a radical constructivist statement which neglects the importance of the scientific method per se. Instead, the author firmly beliefs that scientific rules and principles are indispensable for producing findings which deliver a closer approximation of what might be termed "true" or "real".

Having this in mind, the content analytical procedure in this paper is seen as an act of subjective interpretation which will never be able to produce "a true description without bias" (section 3.3) – even when following step by step process models and thoroughly conducting intercoder agreement checks. Nonetheless, following such a model and bringing in the outside perspectives of a former co-student provided valuable inputs and helped the author to critically reflect upon the interview material. While some categories were revised or entirely eliminated, the agreement check resulted in a more fine-grained category system and now includes sub-categories which reflect the richness of participants' answers to a greater extent.

Mayring further suggests the use of coding guidelines in order to define underlying content-analytical units and content-analytical rules. While creating these guidelines took additional resources during the research process, it was felt that writing and revising them helped to reflect upon what type of information to look for in the analyzed material. During the analysis of expert interviews for instance, defining the level of abstraction in the coding guidelines led to the realization that it were not specific indicators that should be identified, but rather different *themes* and *types* of indicators.

Since literature provided a basic understanding of what CPIs may look like but neglected the specificities of the textile sector, the content analytical procedure called for a hybrid approach of deductive category assignment and inductive category formation. At times, the author felt that the value of such mixed approach was unclear; similar to the coding guidelines, building the deductive category system consumed additional resources and had to be revised repeatedly in order to fit the suggested features of CPIs identified in literature. Over time however, it was perceived that the hybrid approach had a real impact on the coding process and ultimately resulted in a more robust analysis because it further included previously conceived notions of CPIs.

7.4 Recommendations for MQ

MQ is a successful textile retailer with a loyal customer base which offers high-quality products in the medium- and upper-price segment. The company provided an interesting case study for the application of Circular Performance Indicator (CPIs) in the retail business. Based on the author's experience with MQ, a few recommendations regarding Circular Economy (CE) and performance measurement shall be given.

The analysis of literature and expert interviews resulted in an explorative framework for the selection of CPIs (section 5.3.1). Together with experts' inputs (section 5.1) and the list of indicators applied major textile retailers (section 5.2), this may provide valuable guidance for MQ's upcoming sustainability report. Moreover, the analysis revealed a set of indicators from the GRI G4 framework which are interesting from a Circular Economy (CE) point of view. These are presented in Appendix V. The management of MQ is cordially invited to consult and utilize these materials for the current reporting period and beyond.

An underlying intention of the CE is to "keep products, components and materials at their highest utility and value, at all times" (section 4.1). As such, the concept very much resonates with MQ's aspiration to provide customers with durable, high-quality garments. In the short term, it is recommended to focus on low-hanging fruits, i.e. indicators which are in line with MQ's strategy and for which data is easily available. Thus, measuring the number of garments repaired and the number of products exceeding threshold levels as per stipulation of MQ's Restricted List of Substances (RSL) might be of interest.

In the intermediate future, MQ may apply indicators for which data is not immediately available but which provide insights regarding the company's environmental performance and resource consumption. Hence, indicators which measure material inputs, energy consumed outside of the organization (i.e. in factories) as well as metrics for waste created and water consumed during manufacturing may be considered.

In the long term, leasing and reselling strategies may offer valuable opportunities for tapping into yet underutilized value streams while remaining consistent with MQ's core values. At present state however, the company has decided to pursue conventional retail activities only. Should MQ be willing to further explore CE-related business opportunities, one could consider the application of indicators which measure the potential of such leasing and reselling schemes – as, for instance, suggested by category 1 in Table 5-1 (captured value points). Hence, conducting market research on current resell frequencies and prices of MQ products on consumer-to-consumer trading platforms (eBay, tradera, blocket or else) may provide insights regarding the actual profitability of such activities.

8 Conclusion

The paper at hand was concerned with Key Performance Indicators (KPIs) in the context of the Circular Economy (CE) and their application in the textile industry. Using the term *Circular Performance Indicators (CPIs)*, research investigated three overlapping areas: first, possible design features of CPIs in the textile industry; second, their current application among textile retailers; and third, the selection of specific indicators for the Swedish fashion retailer MQ based on an explorative framework. Having this in mind, the following three research questions (RQs) were posed:

- *RQ1:* What are possible design features of Circular Performance Indicators in the textile industry?
- *RQ2:* How are Circular Performance Indicators applied among major European textile retailers?
- *RQ3:* Based on an explorative framework, which Circular Performance Indicators can be applied by the Swedish fashion retailer MQ?

By following a triangulation approach, this thesis addressed each question through a set of complementary methods, including literature analysis, qualitative content analysis of expert interviews and sustainability reports in accordance with Mayring (2014) and a focus group session with MQ.

As for RQ1, analysis found that CPIs would focus on environmental impacts and material flows across the entire lifecycle of textile products. Indicators are classified across 16 main categories and 22 corresponding sub-categories. In 19 semi-structured expert interviews, indicators for the manufacturing and end of life were mentioned most frequently. Notably, measuring recycled input in textile manufacturing constitutes the least common denominator among all respondents. Other CPIs mentioned during interviews pertain to earlier lifecycle stages (e.g. the use of chemicals, raw material inputs and water consumption in production), the use phase (for instance, measuring the lifetime of products or the amount of garments repaired) and the end of life (e.g. by measuring the amount of post-consumer textile waste created or collected). Based on the analysis of 19 expert interviews, it appears that experts still have a limited understanding of CPIs and the design features of such metrics need to be further developed and discussed.

Regarding RQ2, examination of 19 sustainability reports from major European retailers suggests that the implementation of CPIs is still in an early stage. The investigation found indicators for merely eleven of 22 proposed categories, most of which pertain to chemicals, energy, material consumption, waste and water. Further, content analysis of ten interviews with textile retailers revealed various challenges for the implementation of CPIs. Most frequently, experts highlighted the need for further strategic and organizational developments before CPIs could be implemented. Moreover, limited data collection was perceived as a significant barrier. In this context, the author argues that the lifecycle character of CPIs could further augment these challenges, e.g. by requiring data from upstream *and* downstream processes which are not easily available to most retailers.

By integrating the above mentioned findings, a framework for the selection of CPIs in the textile sector is proposed. The framework is explorative in nature and contains an inexhaustive list of 16 textile-specific CPI categories. Based on eight selection criteria and a number of corresponding guiding questions, the framework helps textile companies to define meaningful metrics when measuring progress towards CE.

During the MQ focus group session, the framework was used for facilitating answers to RQ3. This resulted in the identification of twelve categories and 16 corresponding indicators which are of potential interest for MQ. CPIs identified pertain to chemicals, energy, longevity, maintenance, material consumption, waste and water. As MQ is currently updating its internal software infrastructure, the company will soon be able to measure both raw material inputs and recycled inputs. In the intermediate future, measuring energy and water consumption as well as waste creation in MQ's upstream processes was seen as particularly worthwhile to pursue, although limited accessibility of data could pose a barrier to implementing such CPIs.

One of MQ's core values is quality. During the focus group session, this was taken to be largely in line with the CE-mindset which "aims to keep products, components and materials at their highest utility and value" (Ellen MacArthur Foundation, 2015b: 2). Hence, indicators pertaining to longevity, maintenance, leasing and product reuse were considered interesting. While using CPIs for longevity and maintenance was deemed feasible, metrics for leasing and product reuse were considered irrelevant due to MQ's singular business focus on conventional retail activities.

Last but not least, recommendations were given to MQ. On the one hand, findings presented in this paper may be of value as such and may be considered for MQ's current (and future) sustainability reports. Should MQ consider integrating CE-thinking into its core business activities and seizing business opportunities from second hand or leasing, it appears advisable to assess the extent to which further value can be captured from individual products. This may provide insights regarding the overall feasibility of such business activities.

As the planet has entered the age of the Anthropocene (Crutzen, 2002), exploring new means of performance measurement is merely one of many missing jigsaw pieces in humanity's defiant conquest for "a safe operating space" (Rockström et al., 2009). Naturally, this paper only aims to make a humble contribution by examining the subject of CPIs in the textile sector. However, to the author's deepest hope, the contents of this thesis will trigger discussions and eventually support textile companies in minimizing their footprints and adopting more circular business practices.

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Appendix I. Business Model Typology

Typology for Service-based Business Models and Circular Strategies in the Textile Sector based on Circle Economy (2015: 12-14; 20-61).

Typology	*Circular*	*Servitization*	*Sufficiency*
Description	Creates value by closing material loops; focuses on reuse and recycling; aims to generate new revenue streams from underutilized waste flows; implementation of take-back schemes for post-consumer textiles; production follows principles of industrial symbiosis and Cradle2Cradle product certification standards.	Sells services instead of physical goods; emphasizes access over ownership; often referred to as Product Service Systems (PSS); allows for decoupling of revenue from production volume; customers use services that satisfy their needs while service providers retain ownership of their products; may include repair and warranty services as well as renting and leasing models.	Seeks to actively reduce production and consumption of textiles; emphasizes product longevity and self-conscious consumer behavior; business case is based on strong brand attachment, premium pricing and gaining market shares from offering high quality products; utilizes demand management in order to predict the demand for products; exploits co-creation to create opportunities from customer heterogeneity.
Application	**Dutch aWEARness Infinity Workwear:** B2B start-up which produces company workwear made from recyclable 100% polyester; material can be effectively recycled by combining a track & trace software with measures of value chain management. **I:Collect:** German B2B company which offers an EPR scheme to international textile brands; aims to offer secondary textile resources at competitive prices; runs vertically integrated collection, sorting and recycling within the SEOX group; partners include, among others, H&M, PUMA and Levi's. **G-Star RAW:** Dutch B2C clothing company; various projects for recycling of cotton and polyester; entails both high value recycling into new fashion products and downcycling to industrial applications.	N**udie Jeans:** Swedish B2C company for denim fashion; offers a free repair service in 19 shops worldwide; for consumer who are unable to visit the store, Nudie offers to send a free repair kit that includes denim patches, needle, thimble, yarn and a repair guide. **LENA the fashion library:** Dutch B2C start-up based in Amsterdam; for women only; offers a lending service of high-quality, seasonal vintage clothes; subscriptions run on a point-based system and include monthly payments. **Vigga:** Danish B2C start-up; offers a leasing service for children' clothing for the maximum age of 27 months; subscriptions run on a monthly payments scheme.	**StageLabel:** Australian B2C start-up; operates a crowdfunding platform for fashion designers; helps designers to estimate demand for products. **ZARA:** Spanish B2C company; owns a large fraction of production companies in its value chain (vertical integration); from design to retail, new products can be reach the market within 10-15 days; manufactures small product quantities; sales data is tracked in real time and, if needed, larger quantities are produced. **YR Store:** British SME in the B2C segment; uses a design tool which allows customers to customize the design of products; pre-made designs are selected from a databank and text can be inserted manually; before sale, design is printed on the garment within ten minutes.

Appendix II. Semi-Structured Interview Guide

Opening questions

Depending on time and availability of public information.

1. What are your professional responsibilities within your current organization?
2. What is your experience regarding
    a. Circular Economy (CE),
    b. sustainability reporting and performance measurement,
    c. the textile sector?
3. What is your understanding of a CE?

Core questions: Circular Performance Indicators in the textile sector

4. How do you perceive the importance of CE for the textile sector?
    a. *For experts from textile companies:* What role does CE play for your company?
5. From your point of view, what are actions that textile companies need to take in order to become more circular?
6. From your perspective, what does the CE imply for performance measurement in the textile sector?
7. In your opinion, what sustainability aspects would CPIs in the textile industry refer to?
8. Performance indicators are often expressed in relative terms (e.g. profit per product). With respect to the just mentioned sustainability aspects, what are suitable denominators/reference units for CPIs?
9. Do you know of any indicators used in the textile industry that address CE-related issues?
    a. If yes, could you provide any examples for such indicators?
10. Do you think GRI or other frameworks suggest indicators that are relevant from a CE perspective?
    a. If yes, could you provide any examples for such indicators?
11. *For experts from textile companies:* Does your company measure progress towards circularity?
    a. If yes, which indicators or metrics do you apply?
    b. If no, what are the reasons for not doing so?
12. What do you perceive as the main barriers to the implementation of CPIs from the perspective of textile companies?
    a. *For experts from textile companies:* What do you perceive as the main barriers to the implementation of CPIs from the perspective of your company?

Closing questions

These questions are optional, depending on time and prior correspondence.

13. Is there anything else you would like to add or ask?
14. May I contact you for follow-up questions and clarifications?
15. Would you like to have a copy of the audio and/or the final thesis?

Appendix III. Coding Guidelines

Content-analytical units

The *coding unit* determines the smallest component of material which can be assessed and what the minimum portion of text is which can fall within one category. In this paper, the coding unit is defined as *clear semantic elements in the text* and refers to *explicit content only*.

The *context unit* determines the largest text component, which can fall within one category. For this thesis, the context unit refers to *transcripts and notes from expert interviews* (Table 3-2) as well as *sustainability reports from major textile companies* (Appendix IV).

The *recording unit* determines which text portions are confronted with one system of categories. For the purpose of this study, the recording unit includes *all interviews for which audio copies have been obtained*. For interviews without audio recordings, *manual notes* are used instead.

Content-analytical rules

Selection criteria are based on the *research questions* presented in chapter 3.

The *level of abstraction* refers to the following units:

- *Themes of Circular Performance Indicators* (CPIs) for the textile industry
- *Perceived barriers to implementation* of CPIs among textile retailers

For further information about the methodology, please refer to chapter 3.

Appendix IV. List of Sustainability Reports

Analyzed sustainability reports from textile retailers.

#	*Company*	*Turnover in Billion Euro (Year)*	*Latest Report (Year)*
1	Inditex	20.9 (2015)	Annual Report (2015)
2	H&M	19.2 (2015)	Sustainability Report (2015)
3	Otto Group	9.9 (2015)*	Sustainability Report (2015)
4	Nike	7.8 (2015)	Sustainable Business Report (2015)
5	C&A	7.2 (2015)	Sustainability Report (2015)
6	Primark	6.3 (2015)	Associated British Foods CSR Report (2015)
7	Next	4.6 (2015)	Annual Report (2015)
8	Marks&Spencer	4.5 (2015)**	PlanA Report (2015)
9	TK Maxx	4.2 (2015)	TJX CSR Report (2015)
10	Adidas	4.2 (2015)	Sustainability Report (2015)
11	Puma	3.4 (2015)	Annual Report (2015)
12	Tchibo	3.4 (2015)	Sustainability Report (2014)
13	Sports Direct	3.3 (2015)	Annual Report (2016)
14	Bestseller	2.9 (2015)	Sustainability Report (2015)
15	Zalando	2.8 (2015)	Annual Report (2015)
16	Mango	2.3 (2015)	Sustainability Report (2015)
17	Debenhams	2.2 (2015)	Annual Report (2015)
18	Esprit	2.2 (2015)	Sustainability Report (2015)
19	JD Sports	1.8 (2015)	Annual Report (2015)

* only retail
** only clothing & home

Source: Compiled information from websites, annual reports and sustainability reports.

Appendix V. GRI Indicators

GRI Indicators Qualifying as CPIs as per definition in Table 5-1.

GRI Indicator	*GRI Definition*	*CPI Category (Table 5-1)*	*Reference*
G4-EN1	Materials used by weight or volume	Raw material input	C&A, 2015; H&M, 2015; Inditex, 2015; Marks&Spencer, 2016; Otto Group, 2015; Puma, 2015
G4-EN2	Percentage of materials used that are recycled input materials	Recycled input	Inditex, 2015; Marks&Spencer, 2016; Nike, 2015; Puma, 2015; Tchibo, 2014
G4-EN3	Energy consumption within the organization	Energy usage	C&A, 2015; H&M, 2015; Inditex, 2015; Marks&Spencer, 2016; Nike, 2015; Otto Group, 2015; Puma, 2015; Tchibo, 2014
G4-EN4	Energy consumption outside of organization	Energy usage	Inditex, 2015; Marks&Spencer, 2016; Nike, 2015
G4-EN5	Energy intensity	Energy usage	C&A, 2015; H&M, 2015; Inditex, 2015; Marks&Spencer, 2016; Puma, 2015
G4-EN6	Reduction of energy consumption	Energy usage	C&A, 2015; Inditex, 2015; Marks&Spencer, 2016; Nike, 2015; Puma, 2015
G4-EN7	Reductions in energy requirements of products and services	Energy usage	Inditex, 2015; Marks&Spencer, 2016; Otto Group, 2015; Puma, 2015
G4-EN15	Direct greenhouse gas emissions (scope 1)	Greenhouse gas emissions	C&A, 2015; Esprit, 2015; H&M, 2015; Inditex, 2015; Mango, 2015; Marks&Spencer, 2016; Nike, 2015; Otto Group, 2015; Puma, 2015
G4-EN16	Energy indirect greenhouse gas emissions (scope 2)	Greenhouse gas emissions	C&A, 2015; H&M, 2015; Inditex, 2015; Mango, 2015; Nike, 2015; Otto Group, 2015; Puma, 2015; Tchibo, 2014

G4-EN17	Other indirect greenhouse gas emissions (scope 3)	Greenhouse gas emissions	C&A, 2015; H&M, 2015; Inditex, 2015; Mango, 2015; Nike, 2015; Otto Group, 2015; Puma, 2015
G4-EN18	Greenhouse gas emissions intensity	Greenhouse gas emissions	C&A, 2015; Inditex, 2015; Nike, 2015; Puma, 2015
G4-EN19	Reductions of GHG emissions	Greenhouse gas emissions	C&A, 2015; Inditex, 2015; Marks&Spencer, 2016; Nike, 2015; Otto Group, 2015; Puma, 2015
G4-EN23	Total weight of waste by type of disposal method	Waste creation	(Inditex, 2015; Nike, 2015; Puma, 2015)
G4-EN28	Percentage of products sold and their packaging materials that are reclaimed by category	Packaging	(Inditex, 2015)
G4-PR1	Percentage of significant product and service categories for which health and safety impacts are assessed for improvement	Chemicals	(Inditex, 2015; Puma, 2015)
AF20	List of environmentally preferable materials used in apparel and footwear products	Chemicals	(Inditex, 2015; Tchibo, 2014)
AF21	Amount of energy consumed and percentage of the energy that is from renewable resources	Energy consumption	(H&M, 2015; Inditex, 2015; Tchibo, 2014)

Source: Definitions of GRI-indicators based on GRI (2008, 2013).