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**SUPPORTING ECO-INNOVATIONS TOWARDS  
CREATING ENVIRONMENTALLY NEUTRAL  
MATERIAL FLOWS IN ESTONIAN TEXTILE AND  
APPAREL INDUSTRY**

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I hereby confirm that I have written this master thesis independently. The sources of any work or ideas of other authors, as well as any literature or other sources that have been used for the purposes of writing this thesis, have been referenced.

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## INTRODUCTION

Global population is growing with high speed together with the welfare, purchasing power and consumption in major developing countries creating extreme pressure on the global environment to “serve” all the needs of the human population. The global greenhouse gas emissions are once again growing faster than GDP after years of active global cooperation to find joint solutions for “green growth” - decoupling of economic growth from material throughput and conventional energy use (Hoffmann, 2011). Although green growth and eco-innovations are seen as the most promising means for the necessary technological and structural changes, there is a growing scepticism in the ability to reduce the environmental load fast enough. This scepticism can refer to the fact that eco-innovation theories are still young and not processed and practiced enough.

The modern innovation theory, which is the foundation for current policy development around the world, has grown out of the evolutionary economic theories by Schumpeter. While describing the fundamental impulses of the capitalist engine he also said (1950: 81):

*[And this evolutionary character of the capitalist process is not merely due to the fact that economic life goes on in a social and natural environment which changes and by its change alters the data of economic action; this fact is important and these changes (wars, revolutions and so on) often condition industrial change, but they are not its prime movers. Nor is this evolutionary character due to a quasi-automatic increase in population and capital or to the vagaries of monetary systems of which exactly the same thing holds true.]*

However, time has proven, that the evolution of our society is influenced not merely due to the capitalist engine and innovation, but rather in the co-evolution of all these issues. Although understanding the need to make system-wide changes in society functioning, we are facing a lot of uncertainties and lack of knowledge, how to make this happen.

Global public discussions tend to generalize the topic of eco-innovation and look at it as a wider concept. On company level, there is a lack of understanding what is actually going on in terms of a specific industry sector or geographical location. There is a variety of literature discussing eco-innovation from single company level discounting the systemic changes and the wider context. The current thesis takes the view in between the general wider concept and the single company level – focus is put on the global systemic changes taking place in one industry sector. In terms of environmental impacts, textile and apparel industry is a good example having seen the effects of globalisation thoroughly and hiding most of the impacts behind its complex global value chains. Although being a daily part of every single person, the environmental impacts of textiles have no owner.

Porter, one of the leading thinkers of eco-innovation, has always described the innovation as the positive balancing mechanism for dealing with the negative environmental impacts, calling it the “innovation offset” (Porter and van der Linde, 1995). From there onward, most related literature focuses on looking for the balance in between the positive and the negative approaches. At the same time most innovation-related literature discusses the challenges and opportunities of innovation from a very positive angle without considering possible negative or unexpected side effects (other than economic at least). Following the ideas of McDonough and Braungart (2013) in their book “The Upcycle” the current thesis takes a position in between the positive and the negative. Using the commonly accepted evolutionary economics and innovation theories for the basis of the analysis, the thesis focuses on describing the opportunities rising from the environmental concerns rather than look for faults and drawbacks.

The aim of the thesis is to offer recommendations how to support eco-innovations to move towards environmentally neutral and economically vital material flows in the textile and apparel industry in Estonia considering the wider global context and long-term dynamics of the industry sector. To understand the long-term changes rising from environmental concerns in the industry sector, a new value chain model is developed for the basis of further analysis and recommendations. The results of the thesis can then be used by NGO Reuse to play the intermediate role between different stakeholders to

improve the cooperation and build new services to support successful eco-innovations in the industry sector.

To achieve the goal, the current thesis takes the first task to describe the characteristics and mechanisms of eco-innovation from the viewpoint of the private sector. It is important to avoid the measurement of outcomes prior to strategic planning of future development of a company or an industry sector. While the literature related to eco-innovation is often biased towards public sector push to reduce impacts, the thesis covers a variety of approaches related to eco-innovation to clarify the window of opportunities rising from environmental concerns for the private sector.

The second task of the thesis is to describe the long-term systemic changes rising from eco-innovations and environmental thinking in the textile and apparel industry sector. This will be done by analysing the current general value chain model of the industry sector, describing the eco-innovations taking place in the value chains and developing a new model to describe the long-term systemic change. To avoid earlier mistakes in innovation and environmental theories, all social, environmental and economic aspects have to be considered.

It is only possible to test this long-term development model retrospective. Evolutionary economic theory says that, in principle, it should not be possible to predict future changes brought along with constant creation, replacement and transformation processes. However, environmental concerns are in fact offering the privilege of moving into one certain direction, which makes it possible to predict the major changes in general. Still, to make practical use of the model, it is possible to analyse the current situation and opportunities for long-term development from an organisational perspective based on the model.

Therefore, to put the new model into practice for offering recommendations, the fourth task of the thesis is to demonstrate the usability of the model in practice. To do that, the focus is put on new value proposition, which aims to create environmentally neutral material flows. Two case study examples will be analysed from social, environmental and economic aspect.

The final task of the thesis is to analyse the current situation and future opportunities for the Estonian textile and apparel industry to build recommendations based on that. In more detail, the strengths and weaknesses of the industry sector, the practice of eco-innovations in the sector, the material flows in and out of Estonia and the demand for environmentally improved products and services will be discussed. To give a better context for the opportunities in the export markets, comparison is made with the Nordic countries, which are known for their higher awareness of sustainable issues. Finally, recommendations for long-term development are built upon the roles of different stakeholders in Estonia.

The master thesis does not follow a classical structure of thesis – the empirical input by the author is relatively wide spread throughout the thesis. In theoretical part, different literature approaches are compared and analysed their intersections and thereby an improved definition is offered for eco-innovation. When talking about the global industry sector, the contribution by the author is developing a model to describe systemic changes. And the description of the local industry sector is based on surveys done by the author: 6 interviews with large companies and a consumer questionnaire with 482 responses and calculations (based on publicly available information) to describe the volumes of textile material flows in Estonia. In addition being a part of the team behind NGO Reuse and Aus Design Ltd, the thesis describes the author's personal experience and the results of the teamwork.

The structure of the thesis is the following. The first chapter explains the meaning and dynamics of eco-innovation leading to wider systemic changes. Different possible practice approaches by companies are described by describing three different theoretical concepts. The chapter explains why should companies be motivated to deal with eco-innovations using it as a part of the core strategy of a company rather than dealing with compliance or cost-savings.

From theoretical background the thesis goes on to the global industry level in chapter 2. The main characteristics of the industry sector and the major changes, trends and diffusions of eco-innovations are explained with the help of practical examples from around the world with the main focus on Europe. The second chapter ends by offering an environmentally, socially and economically balanced model based on the theoretical

background and three former approaches, could serve as the long-term development framework.

The third chapter unfolds the situation in Estonian textile and apparel industry at current state and describes the textile material flows in comparison with Nordic countries. It also explains the opportunities rising from the current changes in global industry sector considering the local strengths and weaknesses. The chapter analyses two start-up initiatives in Estonia in the context of the new long-term value chain model. The chapter ends with analysing the roles and making recommendations for different stakeholders on how to support the development towards environmentally neutral material flows.

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# **1. THE CONCEPT AND DYNAMICS OF ECO-INNOVATION**

## **1.1. Main theoretical concepts to be considered in the paper**

"The essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process", said Schumpeter (1950: 81), creating the basis for the understanding that innovation, as a social phenomenon, is the main factor behind the long-term economic development. It was only few years later in 1948 when Leopold wrote his famous text "The Land Ethic", which is one of the cornerstones in the development of environmental ethics. He described the development of ethics also as an evolutionary process – ethics has evolved from dealing with the relation between individuals to dealing with the relation between the individual and society and now to the relations between the society and the environment. It is changing the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it. (Leopold, 1948: 1-3) "No important change in ethics was ever accomplished without an internal change in our intellectual emphasis loyalties, affections, and convictions. [...] We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in." (Leopold, 1948: 3-4).

For the past half a century, environmentalism has grown from many different sources: grass-root movements for protecting nature; scientifically inspired movements to protect biodiversity; more politicised movements to counter the pollution of big companies; movements of direct action like Greenpeace; and the various Green Parties around the world (Mulgan *et al*, 2007: 15). Environmental concerns started influence the economic theories only in the end of 1980s with the famous Brundland report (1987: 37) defining sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The process

has been slow to understand the need to consider the possible negative consequences of the innovation as part of the theoretical models; and not only focus on the technological and market side of the development work (Lindell, 2012: 174). However, while environmental economics focuses on policy development from the angle of reducing negative environmental impacts, the literature of innovation economics increasingly focuses on environmental aspects as a positive opportunity. For example, as McDonough and Braungart (2013) put it: “Human beings don’t have a pollution problem; they have a design problem. [...] People don’t need to have less of a negative environmental footprint: they can have a positive footprint” (2013: 145, 510).

Many economists and policy makers advocate a fundamental shift towards “green growth” – decoupling of economic growth from material throughput and conventional energy use – to be the new, qualitatively different growth paradigm (Hoffmann, 2011: 1). It can be explained and governed by using the theory of evolutionary economics. Schumpeter’s theories of long-term economic cycles (long wave theory) and creative destruction has been well complemented by Freeman (1991) with his description of changes in “techno-economic” paradigm, to bring out the relations of incremental and radical changes in the long-term changes in society. Freeman explains (1991: 224): “a change of this kind [...] has pervasive effects throughout the economy, i.g. it not only leads to the emergence of a new range of products, services, systems and industries in its own right, it also affects directly or indirectly almost every other branch of the economy”. It develops initially within the old, shows different rates of change and inertia in various parts of the system, spreads from one industry and service to another and will become successful new paradigm when relative costs are falling and long-term supply becomes available. A paradigm change is a radical transformation of the prevailing engineering and managerial common sense for the best productivity and most profitable practice, which is applicable to almost any industry. However, its spread to other areas is usually heavily dependent on organisational and social changes. (Freeman, 1991)

Ignoring the fact that Freeman concentrated on interactions between society, industry and technology, leaving environmental aspects aside, the concept of paradigm change explains well the irreversible changes in global economy currently taking place.

“Clearly, this approach implies a framework for evolutionary development which stresses the systems context rather than just the individual product or firm” (Freeman, 1991: 225). In modern innovation discourse, Freeman’s description of paradigm change can be classified as one of the methods to describe the essence of system innovation.

Evolutionary approaches are appropriate to explain long-term, radical changes including path-dependencies, irreversibility, and discontinuous and unpredictable transition processes. However, evolutionary economics has its limits in explaining some aspects of eco-innovation, for example neoclassical approach can better explain the role of regulation for triggering eco-innovation (the double externality problem, market failures and the regulatory push/pull effect). And the co-evolutionary approach has been used to explain the interactions of ecological, social and institutional systems. The main research methods to study eco-innovation are case studies and ex post analysis because predictions regarding which option will succeed are recognized as being impossible. (Rennings, 2000: 327-330) For empirical studies, resource-based approach is often used to be able to add metrics and do statistical analysis related to innovation in organisations.

Resource-based approach as a new paradigm of corporate strategy emerged in 1990s to help companies compete more effectively in the ever-changing and globalizing environment. This approach sees competencies, capabilities, skills, or strategic assets as the source of sustainable competitive advantage for the firm (Nonaka, 1995: 46). The theory has been developed by Prahalad and Hamel, who discuss the "core competencies" (1990); by Teece and Pisano, who developed the concept of "dynamic capabilities" (1994); by Stalk, Evans and Shulman's on "capabilities-based competition" (1992); and several others. These discussions have lead to wider acceptance of the knowledge-based approach discussed a lot by Lundvall (e.g. Lundvall and Borrás, 1997).

What might be noteworthy in this context here is how Nonaka (1991), bringing Japanese success in innovations as an example, criticised the Western tradition to focus too much on measuring new knowledge in metrics like increased efficiency, lower costs or improved return on investment. Repeated later by many authors, Nonaka (1991) brought out the importance of the articulation of tacit knowledge - the subjective

insight, expertise “at his fingertips”, intuition and hunches of individual employees – to explicit knowledge and the internalization the ideals - the personal commitment turned into the collective sense of identity – as the successful fuel of innovation for a knowledge-creating company.

Understanding the importance of individual and collective movement of knowledge as an important factor of changes in society towards more idealistic world view (instead of focusing on metrics) is also one of the keys to understand the dynamics of eco-innovation, the need for proactive approach. In case of eco-innovation the social and ethical change is triggering economic and technological more strongly than the scientific/technological discoveries, which mainly drove the previous paradigm changes (e.g. steam power, electricity, etc).

Since the beginning of 1990s enormous amount of research has been concentrating on finding calculated proof to justify environmental changes of firms with increased economic performance or lowering costs (e.g. Palmer, Jaffe, 1997; Schaltegger, Synnestvedt, 2002), instead of regarding the changes in social and environmental values as the opportunity for new competitive advantage. But “internationally competitive companies are not those with the cheapest inputs or the largest scale, but those with the capacity to improve and innovate continually. Competitive advantage rests not on static efficiency nor on optimizing within fixed constraints, but on the capacity for innovation and improvement that shift the constraints” (Porter, van der Linde, 1995: 97).

Public environmental concerns do not set limits or enforce restrictions on firm behaviour and innovations; they give a focused long-term direction for innovation and help to understand the systemic changes we are already experiencing.

In current thesis, evolutionary economics and innovation theories are used for describing the wider context and processes of eco-innovation on system level as a source for learning. It is like building the absorptive capacity, as Cohen and Levinthal (1990) explained the need for an organisation to identify, assimilate and exploit knowledge from the environment to ensure the long-term survival and success of an organisation. Resource-based view is used to give metrics and track the changes in single firms (operationally). Environmental economics and innovation economics are

considered in parallel to build bridges between the positive and the negative approaches of the same topic.

## **1.2. Eco-innovation in the framework of system innovation**

More than 60 definitions of innovation can be found from literature due to different disciplines viewing innovation from a different standpoint (Baregheh *et al.*, 2009: 1325), which is why the current thesis does not attempt to pick any of them, rather bring out some of the key aspects necessary for the analyses here. In general, innovation means implementing something new in an organisation or offering something new to the market. Innovation is often distinguished from research and development (R&D) to stress that it has to have the potential to become widely accepted, create new (commercial) value and bring along some change either for the company, the market or the whole world.

The theoretical approach, the political aims and the practical outcomes of the dominant innovation discourse tend to be rather diverging. For example, although not initially described in theory, speed and racing are a common part of the dominant innovation discourse. In innovation as practice, the speeding up of work processes as part of the continuous introduction of new organizational routines, projects, and information systems may endanger communities' ability to critically reflect on their innovative activities and ensuring consequences (Hasu *et al.*, 2012: 88). Similarly many other unexpected side effects of global innovation society are being noticed and described, mostly related to not considering the basic values of nature and society, but rather making use of human desires.

There are several hints in the literature (e.g. Rennings, 2000; Horbach, 2008; Hasu *et al.*, 2012) about the need to widen and improve innovation theory framework for several reasons. The following overview of definitions makes the attempt to clarify the definitions that are part of the literature of eco-innovation.

A commonly accepted definition for eco-innovation (further developed from the one offered by OECD Oslo Manual, 2005), is offered by Kemp and Pearson (2007: 7):

*[Eco-innovation is the production, application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resource use (including energy use) compared to relevant alternatives.]*

The best description of how eco-innovation is perceived in the wider society is how OECD (2009) explains it bringing out two differences compared to conventional innovation:

- eco-innovation emphasises the reduction of environmental impacts, whether intended or not, and
- eco-innovation can extend beyond the conventional organisational boundaries involving changes in social norms, cultural values and institutional structures.

Horbach *et al.* (2012: 113) explain it like this: “It does not matter if environmental improvements have been the primary goal of a new product or process, or came about as a by-product or simply by chance. Eco-innovations can be the result of other economic rationales such as increasing market share or reducing costs.” Defining eco-innovation so broadly enables measuring the outcomes well (how much environmental impact reduction is caused by the change). But it might undermine the need to deal take the focus from “less bad” to rather long-term systemic changes related to intentional long-term strategic planning (see chapter 1.3).

In terms of being related to changing social norms and cultural values, eco-innovation is closely related to social innovation, defined as “new ideas that meet unmet needs”. Social innovations for example include fair trade and restorative justice, hospices and kindergartens, distance learning and traffic calming. Environmentalism is said to have spawned a huge range of social innovations, from urban recycling to community owned wind farms. (Mulgan *et al.*, 2007: 15) And the opposite, eco-innovations might be driven by social innovations. However, a distinction should be made between the terms – in case of social innovation the main focus is on processes in society (whether eco-friendly or not); in case of eco-innovation, the main focus is on how social and economic processes relate with environment.

Although the change in norms and cultural values take place out of the borders of a single organisation or group of organisations, the term eco-innovation is usually still discussed on organisational level, rather than as a term describing a wider systemic change. But to be successful in creating the change, eco-innovation must be supported by a corresponding evolution of social arrangements and institutional support structures (Hellström, 2007: 157) and can co-evolve with any other type of innovations and influencing factors.

Such multilevel eco-innovation processes involving several stakeholders is described using the term system innovation, referring to need of complex cooperation and co-ordination of work between stakeholders. System innovation is the large-scale transformation in the way societal functions (such as transportation, communication, housing, feeding, etc.) are fulfilled. It involves changes in technology, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks, supply networks, new functionalities, etc. (Geels, 2004: 19). System innovation is often referred to (e.g. by OECD, 2009) as the ideal towards what eco-innovations should be heading to for creating a major shift for decoupling economic growth from environmental impacts.

The description of eco-innovation in an organisational context can sometimes be misleading in the literature. Schumpeter originally distinguished between five types of innovations: new products, new methods of production, new sources of supply, exploitation of new markets and new ways to organize business (Fagerberg, 2003b: 4). However, in the context of eco-innovation, Rennings (2000: 322) used following categorisation of innovations: technological, organizational (for example, management instruments at the firm level like eco-audits), social (for example related to changes of lifestyles and consumer behaviour); and institutional innovation (ranging from local networks to global organizations). But compared to the classification offered by Schumpeter, some of these types could be called sub-categories (e.g technological innovation can be related to both new product, new method or else), others tend to diffuse to the level of system innovation moving beyond the reach of a single organisation or group of organisations (e.g. changes in lifestyle being should be

considered a factor that influences a company to innovate or opposite, new product or service leading to behaviour change).

Instead of looking for better ways how to classify different cases of eco-innovation, it is more useful to understand the wider context of the changes. For example, Rennings (2000) distinguished between curative and preventative environmental protection. But if we talk about fundamentally redesigning product-service life-cycles, it might not be possible to classify an innovation to either categories. Here the concept of functional economy, discussed by Stahel, offers a framework for understanding the difference (1997: 91):

*[Functional economy, ..., is one that optimises the use (or function) of goods and services and thus the management of existing wealth (goods, knowledge, and nature). The economic objective of the functional economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible. The functional economy is therefore considerably more sustainable, or dematerialised, than the present economy, which is focused on production as its principal means to create wealth and material flow.]*

When we think about the five classical types of innovation, functional innovation could be again discussed as one sub-category. It means that in terms of eco-innovation, the qualitative aspects of innovation (the “how”, what is the impact) can be at least as important as the quantitative aspects (the “what”, e.g. product or process).

In the innovation literature traditionally the magnitude of influence created by the innovation is described by distinguishing between incremental and radical innovations.

Incremental innovations occur more or less continuously, although at different rates in different industries, but they are concerned only with improvements in the existing array of products, processes, organisations and systems of production. They are therefore closely linked to the development of market demand and the experiences of users. They are reflected in the conventional statistical measures of economic growth by changes in the coefficients in the existing input-output matrix. Although their combined effect is extremely important in the growth of productivity, no single incremental innovation has dramatic effects, or induces structural change in the economy. (Freeman, 1999: 223)



In practice, there appears to be a certain bias in the way that eco-innovation has been conceptualized. Incremental eco-innovation is closely related to the term eco-efficiency, which is widely used in policy documents referring to more efficient use of resources and energy. Surveys of innovation in firms demonstrate that this is the dominant form of innovation and eco-innovation in industry (OECD, 2012: 3) – improving existing processes and substituting components or products with alternative of less impact (Hellström, 2007: 152).

However, it has been argued that in the long run incremental eco-innovation cannot be sustained without radical innovation due to decreasing marginal returns on its incremental eco-efficiency efforts (Hellström, 2007: 150).

Radical innovations transform existing markets or create new ones, transform the relationship between customers and suppliers, restructure marketplace economics, displace current products, and create entirely new product categories. The radical-innovation life cycle is often long term (a decade or longer), unpredictable, sporadic (with stops and starts, deaths and revivals), non-linear, and stochastic (with unpredictable exogenous events), dependent in corporate culture and informal relationships. The chaos and uncertainty that come with commercializing new technologies for markets that may not yet exist require vastly different competences compared to just introducing next generation products. Radical innovation is more likely to involve non-technological changes and mobilise diverse actors. All these characteristics require that radical-innovation projects be managed quite differently from incremental ones. (Leifer *et al*, 2001: 102-14; OECD, 2012: 3) But radical innovations provide the engine for long-term growth that corporate leaders seek.

In terms of eco-innovation, “radical” refers to the kind of reconstruction that is necessary for moving towards a systems shift for absolute decoupling of economic growth from environmental impacts discussed by several sources (e.g. OECD, 2012; Kemp, Nill, 2009; Hellström, 2007). It is not only about the development of breakthrough technologies but also the reconfiguration of product-service systems, for example, by closing the loop from resource input to waste output (“cradle to cradle”), and the development of business models that reshape the way consumers receive value on the one hand and reduce material use on the other (OECD, 2012: 3).

However, this does not mean that eco-innovation can only be effective in terms of absolute decoupling if it is radical innovation. Disruptive innovation hereby refers to changing how things are done or specific functions fulfilled without necessarily changing the underlying technological or fundamental regime itself (OECD, 2012: 3).

In conclusion, to widen the concept of eco-innovation from dealing simply with typology to considering also the depth and context of the changes, the following definition is offered by the author:

**Profound eco-innovation** is the successful introduction of such a new or significantly improved good, service, process, or system, which has the clear potential to create, throughout all its material cycles and functionality, a long-term neutral or positive value for both natural environment, and human-friendly society.

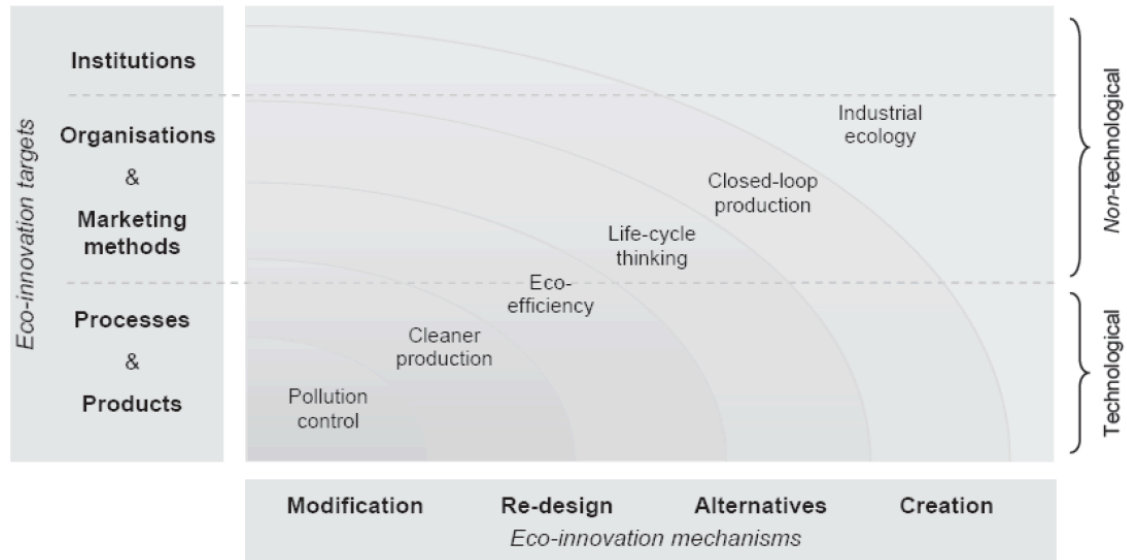
The aim of this definition is not to simplify measurement but to help set long-term goals for companies.

### **1.3. The quantitative, qualitative and temporal scales of eco-innovations**

The “green” business literature usually makes a distinction between firms that are compliance driven or reactive (merely aim to meet legal requirements or prevent losing market share) and those that adopt more proactive environmental strategies (taking into account a variety of forces other than government regulation) (OECD, 2005: 16). In addition, defensive and accommodative attitude towards corporate social responsibility (CSR) have been discussed in the literature (Buysse, Verbeke, 2003: 453). However, to simplify, we only discuss the two extremes here.

Several research papers (e.g. Hart, 1995; Nidumolu *et al*, 2009) describe the path or the development phases that companies follow. Once stepping over the very first level of simply reacting to environmental regulation - from the mode of “do as few as necessary” (e.g. pollution control, end-of-pipe solutions), environmentally friendly changes are seen as an opportunity to build a new competitive advantage upon it.

OECD (2009: 47) gives a good overview with the following graph (with focus on manufacturing) describing the shifts in environmental initiatives facilitated by eco-innovation.



**Figure 1.** Shifts in environmental initiatives facilitated by eco-innovation

The following list defines the terms used on the graph based on description given by OECD (2009), additions are made by the author.

- **Pollution control** –implementing non-essential technologies, end-of pipe solutions aimed at reducing waste or emissions on site.
- **Cleaner production** – modifying products and production methods e.g. process optimisation, substitution of material: non-toxic and renewable, improvements in logistics (e.g. shipping instead of plane transport), reduction in packaging, or other similar changes which enable to cut costs.
- **Eco-efficiency** – systematic environmental management (environmental strategies and monitoring, environmental management systems) to locate the inefficiencies and make adaptations. The aim here is to minimize resource input while maximizing output. More long-term planning and product/service improvements are done on this level while still conserving the basic economic structures.
- **Life-cycle thinking** – extending environmental responsibility by implementing eco-design (green supply chain management, upstream corporate social responsibility,

upstream CSR<sup>1</sup>). CSR does not mean simply reporting on social concerns<sup>2</sup>, but regular targeted efforts to find ways to reduce the impacts in the whole life-cycle of a product or service.

- **Closed-loop production** – restructuring of production methods, minimising or eliminating virgin materials, taking the responsibility for creating a function for a material after being discarded by the end-use (solution developed in-house, outsourced, sometimes product/service has to be adapted by eco-design).
- **Industrial ecology** (also referred to as industrial symbiosis) – integrated systems of production, environmental partnership, eco-industrial parks, cooperation between organisations from very different type of industry sectors where the side-product or leftover from one production can be used in another raising the efficiency for both. The NISP<sup>3</sup> network is a good example of an intermediate partner for the industry.

OECD claims (see figure 1) the first three levels to be mainly related to technological improvements. It does not mean, that the next three levels are not related to technological changes, it rather means that they expect other type of changes (design process, cooperation, system planning etc.) prior to finding the technical solutions. Statistics show that the primary focus of current eco-innovation in manufacturing industries around the world tends to rely on technological advances (OECD, 2009: 261), which refers to acting mainly on the first three levels. However, the environmental and economic benefits are much higher at the upper stages of the stairs described above.

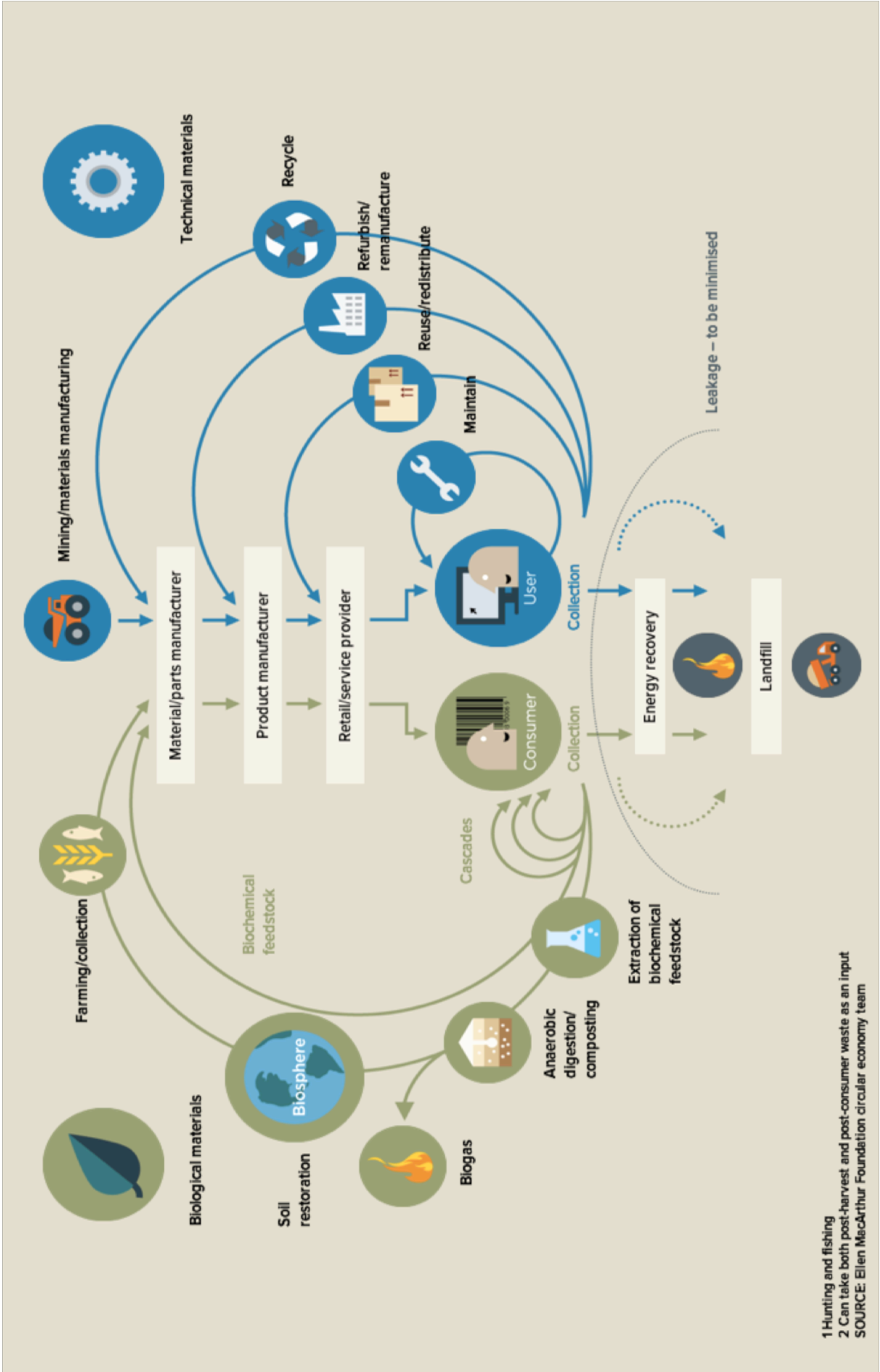
There is another well-known model to describe the long-term aims of environmentally friendly production and services: the model of circular economy (see the following page).

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<sup>1</sup> Kogg (2009) describes it as upstream CSR when a company focuses in developing the supply chain that it is dependent on. A good example being H&M with massive network of suppliers while most of the environmental and social impacts are hidden for the brand.

<sup>2</sup> Porter and Kramer (2006) describe that the active public debates about corporate social responsibility (CSR) has caused publishing a lot of CSR reports with no real change being made.

<sup>3</sup> [www.nispnetwork.com](http://www.nispnetwork.com)



1 Hunting and fishing  
 2 Can take both post-harvest and post-consumer waste as an input  
 SOURCE: Eileen MacArthur Foundation circular economy team

Taking the lead from the “cradle to cradle” concept (McDounough and Braungart, 2002), it provides a coherent framework for systems level re-design and as such, offers an opportunity to harness innovation and creativity to enable a positive, restorative economy (Ellen McArthur Foundation, 2012). The model describes the two main types of material cycles – technical (man-made materials need to be kept in circulation without influencing the environment) and natural (taken from nature and going back to nature without extra impacts).

When we compare the graph by OECD and the circular economy model, we see that the first is rather quantitative (enables to describe path dependencies, resource allocation issues and give measurable framework). The second aims to add also the qualitative aspects and deals with the issues rather on the system level. It might be difficult to reach such systemic targets by one single individual or organisation or a limited group of them. It means, for further analyses we need to consider both of them – the OECD model to describe the tools and measurement system and the circular economy model to describe the wider context and environmental aims.

In addition to these models dealing with quantity and quality, a third one should be considered dealing with time and speed – the concept of functional economy (already mentioned in chapter 1.2. It stresses the need to reduce the volumes and speed of materials flowing through the economy. Although using the similar elements brought out previously here, Stahel (1997), with his functional economy concept adds some different aspects. For example, he explains that increasing the volumes of recycling (in terms of simply closing the loop and conserving existing economic structures) and thus the amount of secondary resources, causes oversupply of materials both virgin and recycled (Stahel, 1997: 93).

Stahel (1997) therefore claimed that in contrast to the manufacturing economy, economic success in the sustainable service economy should not arise from mass production but from good husbandry and stewardship. “Economic rewards come from minimizing tasks needed to transfer a product from one user to the next.” (Stahel, 1997: 96). The smallest possible cycle represents the most profitable strategy. The systemic approach described by Stahel (1997) was illustrated with a rather complicated scheme

(see annex 1), which does not add value at this point but will be indirectly considered while developing the model in chapter 2.5.

The functional economy concept, by stressing the need to reduce recycling, is closely related to making a distinction between upcycling and downcycling of materials. The first is referring to making most use of already existing materials, and thus prolonging life-cycles of materials. The latter means converting them into new materials with less quality (McDounough and Braungart, 2002) e.g. by adding new design value (both commercial and aesthetical) for a material while also prolonging its life-cycles (McDonough and Braungart, 2002; Aus, 2011). However, the terms lack of theoretical discussion and are mostly used in describing practical context-specific examples of material reuse in certain industry sectors or materials (plastics, electronics and textiles mainly) rather than give clear-cut definitions. Due to being closely related to the type of materials and processing methods, upcycling will be discussed more thoroughly in chapter 2.4 in relation to global textile and apparel industry practices.

When we put together the three models, we can picture a three-dimensional scheme combining types of measurable action (the OECD model), environmental quality (the circular economy model) and time scale (the slow-down effect of the functional economy model). These can be called the quantitative, qualitative and temporal scales of profound eco-innovation. This refers to the need to measure the outcomes rather differently compared to conventional approach. It is most common to measure the outcomes of innovation in terms of labour productivity, resource efficiency, innovation activity, growth in turnover etc. But to consider also the circular economy model and the functional economy concept, it means that the measurement of outcomes should be related to the functionality of the goods and services offered for the end-user, their durability and the ability to circulate. However, the measurement systems stay out of the scope of the current theses and could be a follow-up topic for the thesis.

Coming back to the reactive and proactive approach, on this three-dimensional scheme the aims is to measure how deeply organisations absorb the environmental issues in their corporate strategies and on how high level of profoundness each eco-innovation is targeting. However, it is rather difficult to measure that. For example, some firms that report the use of life-cycle analysis (LCA) do not appear to be more proactive on

average when judged by other criteria. In contrast, a number of firms with otherwise relatively strong environmental practices do not apply LCA. (Hart, 1995; Buysse, Verbeke, 2003: 456). There seems to be consensus on accepting that environmental leadership, as a strategy, has been rather uncommon in earlier times (e.g. Buysse and Verbeke, 2003; Porter and Kramer, 2006). But now, depending on the year of publication, articles related to comparing organisations with proactive approach dealing with radical eco-innovations start to appear more and more.

A study done by Nidumolu *et al.* (2009) shows that companies usually go through five stages of change on their way towards sustainable development facing different challenges on each stage.



**Figure 3.** The path dependency of eco-innovative companies. (Nidumolu *et al.*, 2009: 5; figure composed by the author.)

Creating next practice platforms here refers to fundamental shifts derived from radical innovations that start influencing a series of other businesses. A good example could be how smart-grid technologies create the need for fundamentally rethinking any kind of electric appliances and create the window of opportunity for new type of services.

The scheme shows well, what is often mentioned in the literature, that in proceeding to the next level of solutions, each organisation (as well as industry sector, in fact) is linked to a certain path dependency. However, there are several ways of describing the path dependency mechanisms:

- the need to go through certain stages of development (Nidumoly et al, 2009)
- the process being intrinsically organisation-specific (Coombs and Hull, 1997)
- “innovation breeds innovation”: innovative firms in the past are more likely to innovate in the present (Horbach, 2008: 164) and in the future (Leifer *et al.*, 2001).



Implementing sustainable measurement is the first step in being able to making adaptations (Porter, van der Linde, 1995: 114). But similarly, successful implementation of a radical innovation can help developing capacity for implementing radical innovations repeatedly.

Such capacity building for eco-innovations, derived from the proactive approach and environmental leadership, is inseparably related to the knowledge-creation and learning processes of a company, spatial mobility of tacit and explicit knowledge, importance of building social capital, and other related issues, which have been discussed widely in modern innovation literature. (Lundvall, Borrás, 1997; Nonaka, 1991).

However, the topic of knowledge-creation exceeds the boundaries of the current thesis and is therefore not analysed more thoroughly here. But it is important to keep in mind in the final analysis that social interactions between stakeholders can be one of the key elements for the continuous source of new knowledge creation and innovation.

Now that we have discussed the “what” and the “how”, the next chapter will give a literature overview of the “why” companies eco-innovate and “why not”– what drives eco-innovation and what sets the limits to it.

#### **1.4. Drivers and barriers of eco-innovation**

While innovation economics discuss positive spillovers of basic research and development (R&D) efforts in firms (e.g. knowledge spillover between cooperation partners in R&D), environmental economics focuses on negative external costs. “An important peculiarity of eco-innovations is that they produce positive spillovers in both the innovation and diffusion phase. Positive spillovers in the diffusion phase appear due to a smaller amount of external costs compared to competing goods and services on the market. This peculiarity of eco-innovations is called the double externality problem.” (Rennings 2000: 325).

The double externality problem has been widely discussed in relevant literature and is the key aspect of the well-known Porter the porter hypotheses: “Firms can actually benefit from properly crafted environmental regulations that are more stringent (or are

imposed earlier) than those faced by their competitors in other countries” (Porter, van der Linde, 1995: 98). The Porter’s hypothesis has gained a lot of attention, empirical proof and many followers in the public sector internationally. In addition to technology push and market pull effects, it is the peculiarity of eco-innovation to be dependent of the regulatory push/pull mechanism. Regulation is necessary to identify inefficiencies and cost reduction opportunities in companies.

Different push and pull factors have proven to have rather different importance on which level eco-innovation is practiced in companies being a matter of complex co-evolution processes.

Compared to conventional innovation mechanisms, technology can rather be seen as the enabler of environmentally considered changes, while the social change and market demand need to prepare the playground here first. Technological innovations without social and regulatory mechanisms are more likely to be related to other ambitions rather than environmental. However, the econometric estimations by Horbach (2008) show that the improvement of the technological capabilities (“knowledge capital”) by R&D does help triggering environmental innovations.

Studies show that the strategic market behaviour of firms can have significant importance on product innovation both during the initial development phase as well as in diffusion phase and can be more important than environmental regulation or price advantage. (Rennings, 2000: 327; Beise, Rennings, 2005: 9) While the increase in the expected future demand triggers (environmental) innovations, demand for more sustainable products does not outbalance price issues. Customer benefits play a key role in eco-innovations as soon as a product delivers added value to the customer or if the performance is given together with the ecological criteria at no, low or even negative cost (Kammerer, 2009; Beise, Rennings, 2005). The stimulus for eco-innovation from the demand side is often missing since eco-friendly products are still too expensive (Rehfeld *et al.*, 2007). While it may be difficult to get added value from green electricity for example (except if it is labelled and thus differentiated for consumers), there are certain environmental product innovations with substantial customer benefits such as food or baby clothes. (Horbach *et al.*, 2012)

In terms of regulatory push and pull, there are two types of regulation mechanisms to support eco-innovation:

- 1) motivation to reduce environmental impacts and overcome the double externality problem as described in chapter 1.4 (regulation push), and
- 2) driving demand and overcoming the market failures specific to innovations (regulation pull), both being equally important.

While the current thesis does not attempt to make thorough analyses of different types of policies, no line is drawn in between the pull and push mechanisms. The aim here is to give a short introduction to the interconnections between innovative behaviour in companies and regulation supporting or triggering that, to consider this in the final discussion of the thesis.

Factors of technology push and market pull alone steer the industry in random direction in respect of environmental impacts. Literature review of empirical studies shows that strict regulation plays more important role in the following cases:

- Regulation can be more effective in triggering environmental process-innovation compared to product innovation (Rennings, 2000: 327). Regulation does stimulate manufacturers to environmentally improve their products as well, but this effect is stronger for the diffusion of improvements that have already been invented by others (Kammerer, 2009: 2292).
- Creating lead markets and building (international) competitive advantage for environmentally friendly general technologies in comparison to conventional technologies (e.g. wind energy), can be supported by global demand or regulatory trends. However, for consumer goods, environmental regulation can still be outweighed by consumer preferences that steer in an opposite direction. (Beise, Rennings, 2005: 5-9)
- Reducing the information deficits to detect cost saving potentials (specifically material and energy savings) by providing environmental management tools. (Horbach, 2008:164)
- Motivating towards cost reduction (see table 1) and offering different kind of support to overcome market failures. Cost savings are the dominant trigger of eco-

innovations. The majority of eco-innovations (80.4% based on a German CIS 2009) lead to lower or constant cost but are often not associated with higher turnover (Horbach *et al.*, 2012: 118).

- Regulation also plays different role in relation to different types of emissions being reduced (e.g. CO<sub>2</sub> emissions vs recycling). It depends on how strong focus is given by present political discussion, and the type of activity necessary for compliance. For example, product recyclability significantly reduces turnover because of higher cost within the firm whereas material savings within the firm and energy saving products lead to an increase in turnover, thus being also differently sensitive to regulation push. (Horbach *et al.*, 2012).

In contrast to the prescriptions of Porter and van der Linde (1995), responsiveness to government regulation is insufficient to push firms to move beyond pollution prevention towards proactivity. Environmental leadership is not associated with a rising importance of environmental regulations. It builds upon a very different approach to strategy: it is associated with a long-term vision of the company, close cooperation with different stakeholders, and allocation of resources in various parallel activities and capacities. Environmental leadership is associated with actively managing the changing norms and expectations of a broader range of stakeholders at a time compared to pollution preventing or reactive firms. Voluntary cooperation between firms and government is more important than regulation in these cases. (Buysse, Verbeke, 2003: 453-467)

McDounough and Braungart (2013) put it that way: bouncing onto regulation is an indicator that something needs to be redesigned. Nevertheless, given that many firms are still in the reactive and pollution prevention stages, the Porter hypothesis is still empirically proven and valid. Further shifts from pollution prevention toward environmental leadership may require conventional environmental policy (e.g., command and control measures, economic incentives) to be complemented by cooperative efforts between industry and regulatory agencies (Buysse, Verbeke, 2003: 467) as well as motivation mechanisms.

OECD has been doing a thorough research to put together a package of suggestions for countries for their set of policy actions to drive green innovation. Some keynotes can be highlighted here (OECD, 2011):

- 1) Interventions to overcome specific market failures associated with green innovation, notably those linked to the dominance of existing technologies, systems and incumbent firms. Support for private investment in innovation and for general-purpose technologies; fostering the growth of new entrepreneurial firms and facilitating the transition to green growth in SMEs have been suggested.
- 2) Policies focusing on the diffusion and take-up of green innovations in the market place, e.g. fostering diffusion of green innovation; strengthening markets for green innovation; changing consumer behaviour.

These policy suggestions refer to several types of failures described in literature much more thoroughly. Varblane and Tamm (2012), analysing the system failures<sup>4</sup> in catching up economies, suggest that in helping to eliminate transitional, institutional and governance failures in society, intermediaries (e.g. brokers, third parties, agencies) play a very important role. Intermediaries may help facilitate technology transfer and through that, technology diffusion; be creators of linkages, interactions and networks to facilitate information and knowledge exchange (Varblane and Tamm, 2012). They can also help overcoming the general drawbacks and problems, which stay out of the competence or daily activities of a company. Which problems they will solve depend on the reasoning behind their creation. If they do not fulfil their functions properly, intermediaries may also create system failures (Varblane and Tamm, 2012: 15).

Regardless of public sector pressure or intermediary action, each company needs to find its own motivation to be proactive in terms of eco-innovation and have its own strategy for action. The table in annex 2 gives a concentrated overview of possible motivators. The list is probably still not covering all possibilities.

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<sup>4</sup> System failures include a variety of systemic problems creating disturbances in the market dynamics: infrastructure failures, capabilities failures and institutional failures (incl. market failures in the common terms), read more from Varblane and Tamm, 2012.

There is a variety of literature looking for characteristics, which give advantage or higher likelihood for companies to eco-innovate. Some studies claim that there is a correlation between firm size and uptake of upstream corporate social responsibility, larger firms being more active. Larger firms often have more organisational slack and they are more visible in society and thus prone for pressure for environmental improvement (Kogg, 2009: 233; Hall, 2000: 456). Others suggests that smaller firms may be more responsive to stakeholder pressures (e.g. Darnall *et al.*, 2010) due to being more responsive to value-chain, internal, and regulatory stakeholder pressures (Darnall *et al.*, 2010: 1072). Regardless of size, eco-innovation frequently requires the companies to acquire competence that is not directly addressed to its area of business (Kogg, 2009: 233). This makes the task difficult to both small and big companies resulting in varieties of strategies and stakeholder pressure (Darnall *et al.*, 2010: 1072). The effects of capacity utilization and economic situation in the past are also not significantly helping in that matter (profit situation, overtime, demand) (Horbach, 2008).

Literature review refers to several criteria, which gives a relative advantage for introducing successful eco-innovations:

- Large share of radical eco-innovations, emerge from new firms (OECD, 2011b), because radical innovations challenge the business models of existing firms. (OECD, 2012: 13)
- Proactive approach is more usual among companies with stronger influence from international stakeholders. (Buysse, Verbeke, 2003: 468)
- Most likely to succeed in realizing sustainability goals are companies that incorporate the social dimension in their implementation, i.e. innovations that also affect organizational or consumption practices (Hellström, 2007: 156).
- Innovative firms in the past are more likely to innovate in the future (Horbach, 2008: 164).
- Transfer and export advantages are important and relate to similarities between market conditions at home and abroad. (Rennings, 2000: 327; Beise, Rennings, 2005: 9)

Regardless of the force of different drivers and advantages, there may be still reasons for not starting innovation activities at all, factors that slow such activities or affect them negatively (OECD, 2005: 19). Traditionally, innovation barriers are divided to internal and external from a company perspective. The external barriers are mainly related to the lack of push and pull mechanisms as described above. The literature review by the author (FORA, 2010; Tukker and Tischner, 2004; Carrillo-Hermosilla, 2008, Leifer et al., 2001) shows that the internal barriers can be classified under three topics: abundance of uncertainties, lack of capabilities and knowledge; and reluctance to change which is related to path dependencies, locked-in effect (future decisions being limited by former choices) and systemic failures. We have already talked about capabilities and knowledge and proactive approach in chapter 1.3, the following here will discuss the issues related to uncertainties.

One of the major sources of uncertainties is the fact that eco-innovations and systemic changes are commonly and globally leading all industry and services to unknown fields of experience and the concept is developing in hand with practical experiences. On company level, Leifer *et al.* distinguish four types of uncertainties (2001: 103):

- Technical: validity of the underlying scientific knowledge, whether the technology will work, technical specification of the product, ramping-up issues.
- Market: related to customer needs and wants
- Organizational: recruiting the right people; managing relationships with the rest of the organization; dealing with variability in management support; overcoming the short-term, result oriented orientation of operating units, and their resistance to products that might jeopardize existing product lines; and counteracting vested interests in the current business model.
- Resource: finding out what funding and competencies were required to complete the project, whether there are sources other than those allocated through the normal corporate budgeting process, who the right partners were, and how to manage their partnership most effectively.

Leifer *et al* (2001: 104) also explain, based on empirical study that reducing the controllable resource and organizational uncertainties in a systematic way can be done

through leadership and organizational and managerial approaches. If firms learn to do that, then radical innovation team would be better able to address the less controllable and more chaotic market and technical uncertainties. It is possible to overcome these uncertainties and develop capacities to enable greater quantity, shorter project life cycles, and increased project success of radical-innovation projects.

Based on the overview of the external and internal drivers of eco-innovation, it can be concluded that there is actually no other characteristics, except being proactive, that leads to a clear advantage for introducing a successful eco-innovation to the market. It is easier for a new start-up to step on the path towards radical innovations with the potential to create a system-wide change towards environmentally friendly practices. However, to actually be able to create the change, new companies need very good cooperation system with all possible stakeholders from the whole cycle of the industry sector as well as outside the sector. Dominant market players, to scale up the diffusion, can finally swallow start-ups, when some of the major uncertainties have been surpassed. Such new start-up can also be grown from under the roof of a mature company. But for a mature company it can be much more difficult to notice the system-wide change potential. It is because of the preservation instinct, the need to hold on to the existing already (or still) operative business model and practice habits and market structures – the existing system.

Thus, to accelerate a systemic change, different kind of attention has to be given for dominant market players and small new initiatives. But the rate of speed and effect in this change is dependent on the quality and quantity of cooperation between all stakeholders holding different values in the change.

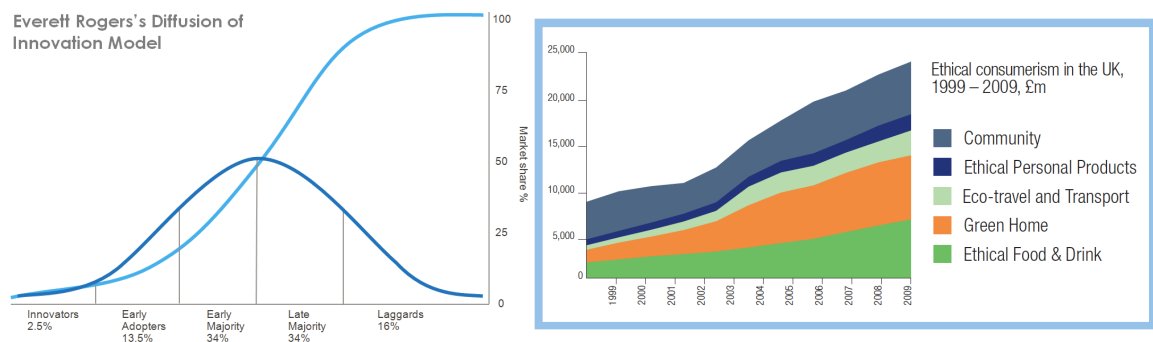
The discussion above explained “why” a company could be motivated to work towards eco-innovations assuming that it is clear that eco-innovations can, in principle, bring along competitive advantage for a company. This assumption is related to the explanations given in chapter 1.1 – considering environment is becoming a norm due to evolutionary processes and being among the first to understand this, creates an advantage. The next chapter will explain this assumption better by showing the market value of eco-innovations in international scale and describing “when” could it be a good time for a company to start acting.



## 1.5. Diffusion of eco-innovation towards systemic change

The evolutionary processes are characterized by strong regularities in the literature. There is a sequence of innovation and imitation, i.e. innovators are amply rewarded at first, but these advantages vanish when imitators enter the scene. An important innovation opens up "a window of opportunity" that primarily facilitates the development of certain types of applications in certain types of context, and leads to links between innovations or technologies sharing the same context ("clustering") (Fagerberg, 2003a: 152).

Such processes create the opportunity for innovations to grow from single innovations to the level of systemic changes. One of the most well known approaches for innovation diffusion is the one introduced by Everett Rogers (1995) - the adoption curve, whereby the customers are divided into five categories: innovators, early adopters, early majority, late majority, and laggards. On the graph below, the blue line describes the accession of consumers by groups while the yellow line shows the cumulative market share.



**Figure 4.** The adoption curve introduced by Everett Rogers (1995, via Matthews, 2012) in comparison with the market share of ethical consumption in UK in 1999-2009 (Co-operative Bank, 2010)

In comparison, there is the graph illustrating the market share of ethical consumption in the United Kingdom (UK) (1999-2009), which is known to be one of the market leaders in that matter (Gaye, 2013). When we follow the trend-line, we can say that by 2009, UK was still in the “early adopters” phase and just about to really see the growth of the ethical market. Surprisingly, compared to other type of products, the ethical personal

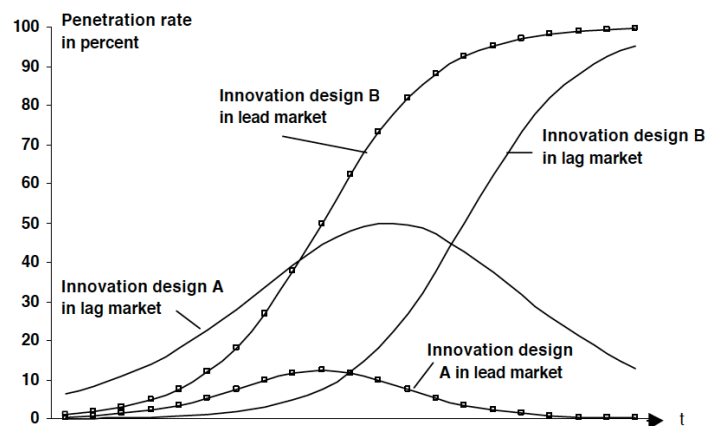
products (includes clothes), has shown relatively smaller growth rate. It can refer to the lack of supply in that area.

There are several other approaches to describe the diffusion of innovations leading to systemic changes related to that. Geels (2004: 20) makes a review describing:

- point source approaches (change begins as a point source, initiated by the emergence of a (radical) novelty, which subsequently conquers the world by going through different life-cycle stages);
- replacement approaches (competition between old and new technologies); and
- transformation approaches (the new is perceived as growing out of the old).

While one of the aims of this thesis is to understand the international position and opportunity for the whole industry sector in a country, the author hereby chooses the description of international diffusion of innovations as described by Beise and Rennings in 2005 primarily in the context of eco-innovation, which could be classified under the replacement approaches (together with the long-wave theory).

Countries that are first in adopting an internationally successful innovation may be referred to as lead markets and countries, which follow the lead as lag markets. (Beise, Rennings, 2005: 7)



**Figure 5.** A generalised pattern of the International diffusion of innovations with competing designs (Beise, 2004: 1000)

Figure 5 depicts two countries, a lead and a lag market, that initially favour two different innovation designs A and B (Beise, 2004: 1000). An innovation design is a specification or configuration of an innovation idea. Different designs of an innovation fulfil the same function, but may have different modes or specifications. (Beise, Rennings, 2005: 7) Over time, design B, favoured by the lead market, becomes adopted in the other market, the lag market, as well. Design A, initially preferred by the lag market, is squeezed out of the market. The lag market in this pattern is not a country that adopts innovations late, but one that adopts the dominant design late. (Beise, 2004: 1000)

In globally successful innovations, penetration rates tend to be higher in the leading country for a considerable period of time, and this supplies firms with long-term user feedback and market knowledge, which enables them to constantly improve the innovation and retain their lead. But discoveries and inventions often occur in countries other than the country where the innovation is first widely adopted. In these cases, local firms usually use technical knowledge from abroad to meet local demand. (Beise, Rennings, 2005: 6-7) New context for the same issue can be the basis for offering an alternative solution and thus create a new lead market with a better design.

The lead and lag market theory gives additional confirmation that the competitive advantage of an eco-innovative company does not arise from external criteria but is more related to internal strategies of a company. The more the company is able to have the helicopter view of the systemic change happening, the better advantage can be built on that. When we add here the proactive approach, strategic capacity building for radical innovations, and the ability to involve a variety of stakeholders, as discussed above, we get a list characteristics, which can create a clear advantage for an organisation for successful eco-innovation.

But the basic characteristics of the innovation process differ from sector to sector (Pavitt, 1984). Company specific characteristics are strongly related to the industry sector, the geographical region (because the environmental impacts are location-specific) and other similar aspects to be considered. The following chapter thus concentrates on one single industry sector to reduce the level of generalization.

## **2. THE CHANGING VALUE CHAIN MODEL OF THE GLOBAL TEXTILE AND APPAREL INDUSTRY**

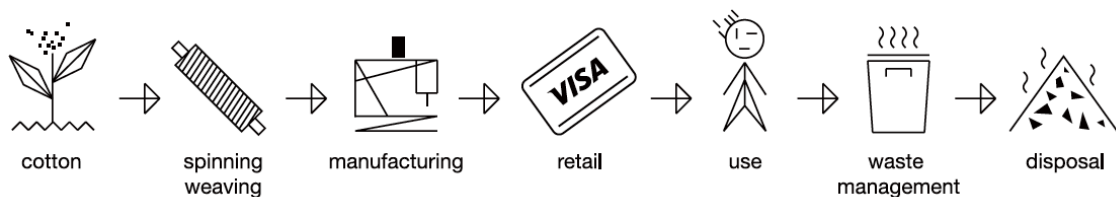
### **2.1. Overview of the global textile and apparel industry sector**

Apparel and textile industry is one of the most mature industry sectors in the world characterised by very dense global competition, relatively low (but currently increasing) entry barriers, standardised technology and requirements, where cost is the main differentiating factor (Noor-Evans et al, 2012; Gereffi and Frederick, 2010). Textile industry covers a wide range of production starting from yarn production, dealing with cloth, home textiles and technical textiles and ending up in fashion business (designer and basic clothing, footwear and accessories) and the distribution issues. It has one of the most complicated industrial value chains of the manufacturing industry involving actors from the agricultural, chemical fibre, textile, and apparel industries, retail and services sector, and waste treatment (Beton *et al.* 2011: 23). The clothing and textile industry together with footwear sector is a significant global economic force, the fifth largest sector, employing up to 40 million worldwide, of which up to 19 million are employed in China, 2,7 million in the European Union (EU) and 400,000 in the UK (excluding retail) – around the same as the aerospace and automotive sectors combined (Black, 2012: 9).

The fashion system operates across a broad range of market levels: individuals and small designer businesses working in bespoke or small-batch production for niche luxury markets; mass-market commodity clothing, such as T-shirts, sold in supermarkets and “value” stores; the “fast fashion” of high-street brands that aim to be exactly on trend and on time; and higher priced designer-branded fashions that lead the trends. (Black, 2012: 9).

The following scheme illustrates the current global value chain of textile and apparel industry. The scheme is extremely simplified – geographically the supply chain is

hardly linear and many additional actions could be added in terms of the life cycle. For example, during the manufacturing phase, the fabric goes through several stages of processing before and after a garment sewn, using a lot of chemicals and other materials, which also have their own little supply chains behind them. The more realistic picture of the supply chains of one single brand can be found from annex 3, the example of H&M. Again, the illustration there has to be simplified, because it would not be possible to illustrate the geographic linkages of all the 2500 subcontractors and the logistics between them.



**Figure 6.** The main phases of the life cycle of a typical garment (Aus, 2011: 30)

Textile industry is one of the best examples of globalisation – multinational companies source its raw materials and base its production operations in cheaper, developing countries whilst maximizing prices and market reach in more affluent, developed markets (Frumkin *et al*, 2012: 7). At the same time many trade restrictions in the industry have contributed to the extremely high level of international fragmentation of the apparel supply chain, whereby low-wage countries typically sew together imported textile components and re-export the finished products. Higher-income nations generally predominate in more capital-intensive segments (fiber production, machinery manufacturing, yarn and fabric production), while lower-income countries dominate labour-intensive segments (apparel production). (Gereffi and Frederick, 2010: 158-175) A fragmented supply chain contributes to a lack of clear ownership of problems between consumers, designers, manufacturers, suppliers, retailers and legislative bodies (Black, 2012: 9).

To illustrate the major changes due to globalization processes: between 1970 and 2000, the adjustment process in the textile industry has resulted in the net loss of 2.7 million jobs in five OECD countries, e.g. France (-337 000), Germany (-333 000), Japan (-997 000), the United Kingdom (-486 000) and the United States (-585 000), and a further

loss of 1.4 million jobs in the clothing industry of these five countries (OECD, 2004: 37).

The geographic logistics in the apparel global value chain (GVC) is dependent on the very different levels of development of countries leading to the regional division of labour forming a multitiered production hierarchy with a variety of export roles. For example, the US generates the product designs and large orders, Japan provides sewing machines, the East Asian newly industrializing economies (NIEs) supply fabric, and low-wage Asian economies (like China, Indonesia, or Vietnam) sew the apparel. Industrial upgrading occurs when countries change their roles in these export hierarchies. Advanced economies like Japan and the East Asian NIEs do not exit the industry when finished products in the chain become mature, but rather they capitalize on their knowledge of production and distribution networks and thus move to higher value-added stages in the apparel chain. (Gereffi and Frederick, 2010: 176)

Consumption in the global apparel industry has been concentrated in three main regions: the US (22 per cent of the market in 2008), the EU (47,3 per cent), and Japan (6,9 per cent). However, it has been understood that the focus of consumption is moving vigorously to Asian fast developing countries. The top importers into the EU in 2009 were China (24 per cent), Turkey (6,3 per cent), Bangladesh (4,7 per cent) and India (3,9 per cent). (Gereffi and Frederick, 2010: 159-162) All leading apparel suppliers, with the exception of China and Hong Kong, China, receive either duty-free or preferential tariff treatment. Whereas the US excludes textiles and apparel items from its GSP<sup>5</sup>, the EU 15 includes textiles and apparel, thereby favouring many of the least-developed exporters in the global economy (Gereffi and Frederick, 2010: 165) and thus supporting the fragmentation and globalisation of the industry sector even more.

The most valuable activities in the apparel global value chains are related to design, branding, and marketing. Therefore the apparel industry has a buyer-driven production

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<sup>5</sup> GSP – The Generalized System of Preferences extends duty-free treatment to certain products that are imported from designated developing countries. The primary purpose of the program, which the United States and other industrial countries initiated in the 1970s, is to promote economic growth and development in these countries by stimulating their exports. (Cooper, 2006: 2)

chain, marked by power asymmetries between the producers and global buyers of final apparel products. (Gereffi and Frederick, 2010: 172)

The major globalization and fragmentation processes and the unbalance of value chain in the industry sector has lead to the situation where one end of the cycle does not support close communication between the different stakeholders in the value chains. It is usual for brands to cooperate with their subcontractors mainly through merchandizers or by electronic communication channels. This makes the exchange of the tacit knowledge relatively rare between the value chain phases existing mainly between the direct links between two following phases shown on figure 6. For example, a description of the supply chain review of the US fashion industry by Sen (2008) illustrates well how the latter end of the chain can perceive the industry: from the brand perspective production activities are limited to choosing the best geographical location for subcontracting and the CAD programs that can be used and the role of the designer is to investigate the end-user based on feedback from sales and following trends in metropolis. Designers most often do not relate to real production and the user is considered as a passive “investigation” object. Implementing life-cycle thinking in design in such case would mean radical change in the work of an organisation. The ability to address sustainability issues such as waste, traceability and transport miles, in addition to the design factors and constraints they already need to consider, adds a burden that many fashion designers and design teams, already working under strong time pressures, are currently unwilling or unable to take (Black, 2012: 9). Achieving greater efficiency and a faster speed of production requires producers to minimise costs, including reducing the role of the designer and the creative component. (Aus, 2011: 28)

Considering this, it is quite understandable why it can be relatively difficult also for an end-user to realize the scale and complexity of production cycles and the enormous social and environmental impacts related to each phase in the life-cycle of the garment – the knowledge does not flow through the value chain together with the products.

The dominant system described here is based on the fast fashion model, which does not consider either the consumer’s natural needs nor the garment’s design value, but rather the emotional need to experience an ever-faster changing of trends (Aus, 2011: 27). However, being considered a great innovation economically, fast fashion model is one

of the reasons why the environmental impacts of the industry sector started to grow exponentially.

Fast fashion started to spread widely since the end of 1980s when Zara took the “quick response” manufacturing model to play the key role in its retailing strategy. Since 2008, after taking over Gap, Zara's parent company Inditex become the world's largest clothing retailer delivering new products up to twice each week to its 1,670 stores around the world. Zara has reduced design-to-store time from an industry norm of 6-9 months to 2-4 weeks. Once in the store, the clothing lines stay there for no longer than four weeks, which means Zara's customers visit the stores up to 17 times a year (the industry average is 3 times a year). To enable that, rather than subcontracting all of its manufacturing to Asia, Zara built 14 highly automated Spanish factories, where robots work around the clock cutting and dyeing fabrics and creating unfinished “gray goods,” the foundations of their final products. (King, 2010; Petro, 2012). Close behind leading the global fast fashion business is the Swedish fashion group H&M, although taking a bit different approach to the model with the focus on vertical integration of its distribution network.

Both of these market dominants have been enjoying the rapid growth of the industry, which started already in 1970s. However lately the industry has also experienced two major crises since 2005 with extensive impacts on the industry on global scale (Gereffi and Frederick, 2010: 157):

- Regulatory crisis – global quotas and preferential tariffs (since 1970s, established by MFA) on apparel and textile items imported by the US, Canada and several EU countries, were phased out by the World Trade Organization (WTO) causing tremendous change in global geography of apparel production and trade
- Economic crisis – global recession, sparked by the banking meltdown in the US in 2008 and spread to most of the major industrialized and developing countries, leading to factory shutdowns, sharp increase in unemployment and growing concerns over social unrest. The economic crisis has also reinforced many of the trends occurring after the phase-out of quotas.



The two crises brought along several adjustments in global value chains, i.e. reducing number of exporting countries; reduction in the complexity of value chains; or fall in demand in developed countries together with new emerging markets in developing countries (Gereffi and Frederick, 2010: 165-182; Black, 2012: 9). In addition to coping with outcomes of the crises described above the textile industry is currently in the middle of a third one – caused by climate changes and environmental concerns. Continuous rise in fast fashion consumption together with government policies (e.g. in India, China) to protect national supplies and resources has caused cotton prices rise several times in the past few years. At the same time labour prices are rising as well in China.

The apparel and textile industry is currently at the doorstep of major global changes. From one hand, it creates new opportunities in the market. On the other hand, the situation changes fast. Coping with such changes is vitally important for many developing countries to maintain market shares and thus a major income source. Competition among sustainable manufacturing solutions is already dense, although being still just at the early adopter's level among developing countries.

## **2.2. Main environmental impacts of the industry sector**

Taken holistically, the textile and clothing life cycles consume more energy and water than do the product life cycles of any other industry other than construction or agriculture. (Black, 2012: 9) Lately, the number of studies revealing these impacts has been starting to grow exponentially. Considering that UK is one of the leading countries in dealing with the waste problem, a lot of statistics is available for UK while most other EU countries lack of comparative data.

In recent years, the world per capita textile fibre consumption increased by 35% between 2000 and 2007, from 8.3 kg to 11.1 kg (FAO and ICAC, 2011) with big differences between developed and developing countries. For example, consumers in the UK spent £780 per head for purchasing 35 kg of textile materials per person in 2005 (Allwood *et al.*, 2006). Considering that the share of cotton has been falling (33% in

2011<sup>6</sup>) while that of synthetic materials – which are lighter than cotton – have increased (FAO and ICAC, 2011), the consumption of textile per capita is increasing even more. The increase in consumption means the increase of environmental impact arising at the upstream as well as the use phase of the textile product chain.

It also means the increase of textile waste in consuming countries. Globally, around 60-70 billion kg of textile waste is disposed annually, roughly 20% of this gets recollected out of which 30% goes to waste directly after sorting (Doerthenbach, 2013). The average yearly amount of textile waste per person in EU was 25 kg in 2006 (Morley, 2013). On average in EU, 56% of the textile waste went to reuse, main export markets outside EU being Tunisia, Ukraine, Pakistan, Ghana, Cameroon, India and others. 10% were used as wipers, 11% got recycled, 15% was used in incineration and 8% got landfilled.

The lead countries in the ability to gather, redistribute and recycle the textile waste in EU are the Netherlands, UK, Italy, Sweden (Morley, 2013) and Germany with the collection rate even up to 70% of potential tonnage (Beton *et al.* 2011: 128). However, these results are based on country-based statistics without actually following the tracks of the materials after being exported. Considering the usual practice most of the reused clothes still become waste some time after selling them at the second-hand market considering that there are many countries where there are no collection systems established.

Study in UK (Morley *et al.*, 2009) mentioned above shows that next to reuse of clothes, textile waste has market as recycled material or fibre in the production of mattresses and upholsteries (68% of the market), carpet underlay (13%), automotive sector (11%) and some other areas (8%). It is estimated that the volume of recycled textiles for use in upcycled products rarely exceed 10% of the total available recycled material. It means there is a strong lack of methods to enable upcycling of textile waste on larger scale than just as a do-it-yourself method or a niche of designer clothing.

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<sup>6</sup> Data taken from a presentation done by the representatives of G-Star Raw and KICI in November 2012 at the “Closing the loop” conference in Amsterdam.

The same study (Morley *et al.*, 2009) also shows that due to declining quality of textiles in residual municipal waste the share of those textile materials, which can be recollected, only 43% is reusable as clothes and shoes (and falling: 55% in 2005 and 60% in 2006). It means that the recycling options for clothes are becoming more important to prevent the materials being incinerated or landfilled. Or to put it in another way – there is a growing need to create the inflow of high-quality materials, which can be reused as a material without reprocessing for several times, to speed down the material flows and volumes (see chapter 1.3 about the importance of speeding down recycling). It has been calculated based on UK that the sector could halve its material flow without economic loss if consumers pay a higher price for a product that lasts twice as long (Allwood *et al.*, 2006: 4).

Although insufficient in practice, the extensive environmental effect from solutions on the highest hierarchy levels has been researched widely. A study done by EU Commission in 2011 compared a large variety of different (existing) methods for environmental improvements in the industry sector to look for most promising change options. It was concluded that compared to any other improvements in production, distribution or use phase, most promising effect can be raised from reuse and recycling in terms of impacts on human health (can reduce impacts by 8,1%), ecosystem diversity (5,7%) as well as resource availability (7,7%). These scores were only exceeded by water recycling in production for reducing the impacts on ecosystem diversity (11,3%). (Beton *et al.*, 2011: 135)

Next to reuse and recycling, consumer behaviour is targeted as a key issue for reducing impacts. Several studies indicate the environmental impact of a garment, during its whole life-cycle, is the largest at the user's end of the cycle. For example, based on a massive empirical study on UK textile consumption and life-cycle analyses done by Allwood *et al.* (2006), it can be said that an average cotton T-shirt, which gets washed 25 times with 60°C (and tumble dried each time) before disposal and incineration, uses 109 MJ primary energy out of which 16% is used for raw material production, 24% in apparel production and 65% by the user. At the same time, 93% of the toxicity of an average t-shirt is related to the raw material production phase. However, when comparing single use of 50 T-shirts with 50 uses of a single T-shirt, the environmental

impact can be 25 times smaller per reused shirt calculated based on CO<sub>2</sub> emission. This effect is especially big, if the user treats the shirt differently – washing with 30°C with no ironing and tumble-drying. The toxicity of a T-shirt also falls during repeated washing. It is also interesting to know that the full impact of a garment during its life-cycle is not much different if organic cotton is used instead of conventional cotton (Laitala, 2013).

The end-of-life phases (use, reuse, recycle) are well perceivable in developed countries dealing with environmental issues the most. It is thus easy to underestimate a variety of hidden impacts of the industry sector being “exported” to developing countries<sup>7</sup> – the immense use of water, electricity, raw materials and chemicals during the different phases in the value chain, not to mention the social issues.

Negative environmental impacts are strongly location-specific. For example, extensive use of water only is a problem if there is a lack of clean drinking water in the country. Therefore, generalizing the production methods without considering the local restriction is one of the reasons for extensive environmental impacts of the industry sector. The concentration of mainly two raw materials – cotton and polyester – is reasonable economically because it is cost-efficient way produce large amounts of textile products (NICE, 2009). But the global value chains do not currently consider that in each geographical location there are environmentally much better choices available.

It is most common to estimate full environmental impacts by conducting life-cycle analysis (LCA) either on certain products, companies or industry sectors. Using carbon dioxide (CO<sub>2</sub>) emission as the metrics (as well as some other common atmospheric pollutants) is common to sum up the impacts from each stage of the life-cycle and each substance used in a product. For example a case study done by Steinberger *et al* (2009) describe total CO<sub>2</sub> emission of a cotton T-shirt and a polyester jacket considering cotton agriculture in India, textile manufacturing in China, electricity emissions in China and India, different transport stages, retail in Germany, use phase in Germany and landfill

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<sup>7</sup> There are several sources referring to estimating the hidden impacts and exchanging goods with environmental impacts while importing: REUSE *et al* (2013) discuss importing land embodied to products; OECD (Schreyer, 2012) developing demand-based measures of CO<sub>2</sub> productivity, etc.

and incineration. While the LCA is rather complex method, it is more common to generalize the calculations using ready-made calculator (e.g. offered by Hammond and Jones, 2008). The product weight can be calculated by the coefficient of kg of CO<sub>2</sub> emission per kg of the material used in the product. That way, it is possible to get a rough estimation of the full global impact of a product. However, such generalized LCA still does not help considering many local issues like lack of clean water and uncontrolled use of chemicals.

At the end of 2012, Greenpeace published its thorough study on potentially harmful chemicals used in textile and apparel industry. First, it revealed that out of the 141 products gathered for analysis from 29 countries, it was not possible to track the manufacturer for 25 of the items. This illustrates well the typical lack of transparency of the system now. 63% of all tested items included inherently hazardous chemicals, none of the 20 large brands in scope were spotless. (Greenpeace, 2012)

Although EU regulation describes the list of prohibited harmful chemicals and sets rules for safe management of chemicals, the supervision and control mechanisms can never be efficient enough. There are approximately 8 000 chemicals commonly introduced in the textile industry and the usual way to reduce toxic load is to filter out dangerous substances at the end of the design process (McDonough and Braungart, 2013: 998). Irregular monitoring and expensive lab tests are the main methods for tracking the use of harmful chemicals. When we consider the amount of chemicals in single items, the quantities may actually be low per product. But this becomes a big environmental problem when we consider the full amount of textiles produced yearly that go through washing cycles in the hands of consumers daily and discharge these chemicals to local water system on regular basis.

Setting up a general obligation for companies to list all substances used in textile products (similar to the system in place for food products) has been discussed in EU (e.g. Danish Fashion Institute being an active partner in the discussion). Another forceful means under development is the international law for criminalizing ecocide, which gives personal responsibility of large-scale environmental impacts to a company CEO, a board member or others behind major decisions leading to extensive environmental impacts (e.g. chemical companies can then be hold responsible for

extensive impacts, even if it reveals in a random phase of a supply chain) (Higgins, 2013). However, currently there are no highly efficient means to deal with such sliding-away problems – it is easy for global leading brands to move their production to a new location or change suppliers to the ones with a better imago rather than actually deal with fundamental design problems<sup>8</sup>.

In conclusion, we can see that it is possible to demonstrate that proactive approach to look for radical changes in the production methods and business models could be much more effective compared to dealing with problems afterwards. In both cases described above – waste and chemicals – the key to radical reduction of impacts is related to how these problems are addressed, either as a problem to solve or an opportunity to prevent. The environmental concerns are creating a huge window of opportunity for local production and services considering local environmental aspects and building value based on local personalized consumer preferences as was actually suggested by the functional economy concept as well.

### **2.3. Main trends in the global industry sector rising from environmental concerns**

“In comparison with other creative industries, such as architecture and product design, the fashion and textile industries have been slow to tackle the thorny problems of sustainability” (Black, 2012: 10). Eco-fashion labels started to appear in 2004-2005 on niche level among higher priced designer-brands. In 2010 there was a clear understanding that the whole manufacturing industry is slowly going to be sustainable. Smaller producing countries in Asia (e.g. Sri Lanka, Thailand) started to use sustainable approach to beat the competition from China. The US was moving ahead from Europe with lots of changes happening in 2010 already. “Once Italy will wake up to the phenomenon then Europe will have a place to produce sustainably and it will centralise it.” (de Castro, 2010) By now we can say that it is under central attention of the industry also in Europe, fast improvements have been taking place in the past 2-3 years with Italy, Germany, UK and Scandinavia leading the way in sustainable practices.

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<sup>8</sup> For example, after a series of large tragedies in Bangladesh production sites, H&M is now looking for opportunities to move their production to Africa and South America (Milne, 2013).

The changes are happening in parallel in the industry, the research institutions and the public sector. For example, in the UK the bigger movement started with setting up the think-tank Forum For the Future, which helped the government establish action plans for sustainable production and consumption in several key product areas. In Scandinavia the academic and industry networks have grown very active<sup>9</sup>. And global brands and retailers are creating joint cooperation platforms with research institutions, non-profit and public sector (e.g. The Sustainable Apparel Coalition; Organic Cotton Initiative) to tackle major systemic issues. (Black, 2012: 10)

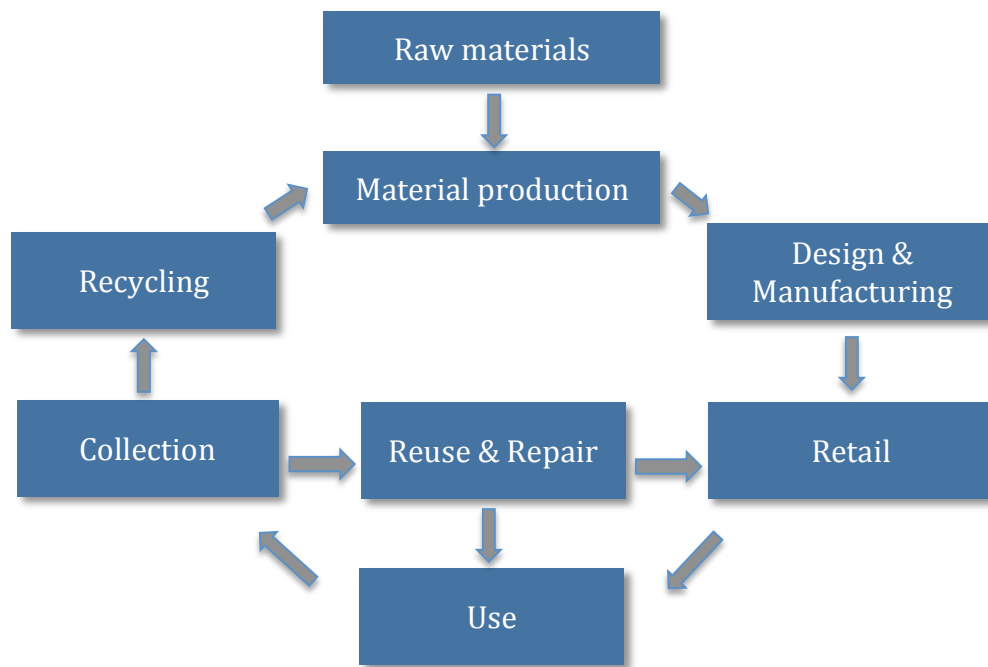
Sustainable fashion market is growing in size and product breadth, the number of ethical brands is increasing, as is the number of retailers, those exclusively stocking sustainable fashion as well as those stocking ethical products amongst a wider selection. Ethical fashion is concentrated at the mid-market price level, dominated by womenswear, and increasingly available online. Ethical Fashion Forum, an online market developer for sustainable fashion, introduced 160+ exemplary sustainable brands and designers from all over the world. (Market Report, 2012)

To make an overview of the main focus of different eco-innovations taking place on the research level as well as already in the market, the following scheme illustrates the most common value chain (as described by WRAP<sup>10</sup>) of the industry sector considering also the closed-loop cycle of the materials, which is currently a fast-growing sector.

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<sup>9</sup> For example, NICE - Nordic Initiative Clean and Ethical; the Future Fashion project funded by Mistra; the Foundation for Strategic Environmental Research, etc.

<sup>10</sup> WRAP is the leading research and support organisation in UK in terms of textile recycling topics.



**Figure 7.** The usual supply chain model of global textile and apparel industry (WRAP, 2013)

The following table describes the major trends in textile and apparel industry concentrating on eco-innovations (reducing environmental impacts of the industry sector, intended or not). In addition to the eco-trends listed in the table, there are several other innovation patterns to be seen (mainly in developed countries): wearable electronics and the integration of electronic technologies in smart textiles<sup>11</sup>; biomedical textiles (textile structures used in implantable products); biomimetic and nano-textiles (e.g. swimwear mimicking sharkskin, self-cleaning fabrics); marriage of artisan techniques and synthetic technologies, etc. But due to the scope of the thesis these are not discussed here any further.

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<sup>11</sup> For example, clothes which can reflect, hide or generate mood; clothes used as a channel of communication; clothes as part of social gaming; heart rate monitoring textiles; garments with integrated heating and lighting; development of soft electronic goods or controllers which can be easily attached to clothing



**Table 1.** List of eco-innovation possibilities and examples in textile and apparel industry (put together by the author based on [www.nicefashion.org](http://www.nicefashion.org), other on-line news media and presentations at relevant workshops in Oslo, Copenhagen and Amsterdam in 2012)

Phase	Description	Examples
Whole value chain	Mapping and measuring; using consultants and cooperation platforms to locate improvement possibilities in the value chain;	Many large corporations individually (e.g. H&M, IKEA, NIKE, KappAhl etc.) and cooperation platforms like Sustainable Apparel Coalition.
Raw materials	<ol style="list-style-type: none"> <li>1) Improving the use of conventional raw materials</li> <li>2) Many new materials have been developed, some of them already commercially available.</li> <li>3) Several old materials are being re-introduced for the market (e.g. etc.)</li> <li>4) Using recycled raw material from other industries</li> <li>5) Big brands sourcing for alternative raw-materials</li> </ol>	<ol style="list-style-type: none"> <li>1) Better Cotton Initiative as the roof organisation for many large brands for cooperation in reducing the use of chemicals in cotton growing.</li> <li>2) Antimony-free polyester (EIP; can be recycled without by-producing antimony); bio-polyester (based on CO<sup>2</sup> and biobased succinic acid instead of oil) ; Eco-nylon by Premiere Fibers (has no separate dyeing process)</li> <li>3) Nettle, wool, hemp have become very popular among small design brands.</li> <li>4) Coffee grounds (e.g. Singtex in Taiwan, perfect for sportswear); soybean fibre (e.g. Uranus underwear company), recycling PET (already a common practice).</li> <li>5) Puma with its InCycle range (using innovative new materials such as APINATbio, a biodegradable plastic)</li> </ol>
Material production	Improving material processing methods	Using enzymes for desizing, scouring, bioblasting; eco-friendly denim abrasion technique and grey-shade bleaching (Novozymes); washing with air (Jeanologia); textile laser for creating vintagelike looks without chemicals (Jeanologia); low-impact dyes (Dystar); chemical modification of natural dye molecules (University of Leeds).
Design	1) Slow fashion movement - focus on organic materials, sustainable processes and fair	1) Very many small brands around the world use local and well reusable materials or reused materials together with time-less design. Products are relatively high-priced.

	<p>trade practices</p> <p>2) More durable, flexible, lightweight, easy-care (wrinkle-resistant, stain repellent, preventing odour, quick-drying), antimicrobial, insulating etc.</p>	<p>Eco-design is only done in niche level.</p> <p>Among big brands some trials have been made (e.g. H&amp;M) without enough profit, quality or enough environmental impact reduction to call this eco-design.</p> <p>2) Durability and flexibility is part of conventional innovation done by many companies without the intention to reduce environmental impacts</p>
Product manufacturing	<p>1) Adapting conventional technology for new raw materials or the opposite</p> <p>2) Raising resource efficiency in production</p>	<p>1) Material based on linen and hemp which can be manufactured using same technology as for cotton (CRAILAR® Organic Fibers)</p> <p>2) Most manufacturing companies due to the need to cut costs while resource prices are rising. Levi's® Water&lt;Less™ has put a lot of attention to using less water in the production of jeans.</p>
Retail and services	<p>1) Improvements in retail and services to rise transparency and adapt to real consumer needs</p> <p>2) Services considering product life-cycle</p> <p>3) Mass customization and customer co-creation, thus reducing inventory costs significantly (see annex 4 for a longer explanation)</p> <p>4) Improving logistics</p>	<p>1) More informative hangtags, marketing-strategies, sizing, office politics, store interiors, packaging, costumer bags, back-up stocks, warehouse facilities. Many small companies offering improved services like that.</p> <p>2) Products together with complete life service and maintenance, products designed for reuse (Lindström); leasing jeans offered by Mud Jeans</p> <p>3) www.threadless.com enabling customer co-design for t-shirts</p> <p>4) Zara has been cutting fabric before transportation to reduce volumes; companies cooperation for product shipping from Asia</p>
Use	<p>1) Research on consumer behaviour</p> <p>2) Campaigns to reduce the impacts from use phase</p>	<p>Several research institutions in Europe (e.g. SIFO, Copenhagen Business School)</p> <p>2) "I do 30" campaign; Levi's Wash less campaign</p>
Collection	<p>1) Developing collection systems in countries</p> <p>2) Developing reuse systems as part of the retail service</p>	<p>1) Leading countries in improving their collection systems are UK, Germany, the Netherlands, Scandinavian countries etc.</p> <p>2) I:Co (a company under Soex Group) offering solution for H&amp;M, Patagonia and several others</p>

Reuse / repair	<ol style="list-style-type: none"> <li>1) Popularising second-hand and vintage</li> <li>2) New business models related to rental and leasing, maintenance etc.</li> </ol>	Mainly small-scale actions based on grass-root enthusiasm.
Recycling and closing the loop	<ol style="list-style-type: none"> <li>1) Using textile materials as materials for redesign and upcycling</li> <li>2) Mechanical reprocessing and making new fabric of textile waste: solutions are already in the market</li> <li>3) Chemical reprocessing – melting polyester back to granules and reusing in producing new fabric: solutions are already in the market</li> <li>4) Developing technology to enable large-scale recycling</li> <li>5) Research on other possibilities for closing the loop while both previous are still very limited in practice</li> </ol>	<ol style="list-style-type: none"> <li>1) Many small companies and designers are dealing with upcycling on niche level, some initiatives are growing fast e.g. <a href="http://www.wornagain.co.uk">www.wornagain.co.uk</a></li> <li>2) Patagonia, G-Star, Mud Jeans as brands, Calamai in Italy as a manufacturer of mechanically recycled fabric (mixing new and old fibres)</li> <li>3) German outdoor wear company vaUDE has a brand Ecolog: all is made from polyester, retailers are responsible for the return of the garments which get granulated by Ecolog GmbH and turned back to new products. Several other examples like this.</li> <li>4) Textile 4 Textile sorting machine is being developed in the Netherlands to enable automatic textile sorting based on chemical content and color</li> <li>5) Chalmers University of Technology is dealing a lot with these issues; a lot of research is co-funded by big brands but not many cost-effective solutions reach the market</li> </ol>
Industrial Symbiosis	<ol style="list-style-type: none"> <li>1) Developing the market for textile as the secondary raw material in other industries</li> <li>2) Research to find alternative solutions for textile waste</li> </ol>	<ol style="list-style-type: none"> <li>1) Soex Group is one of the biggest developers of the secondary market taking sorted post-consumer materials to Africa for resale or to Asia for reprocessing; several other companies in this business all over Europe</li> <li>2) Research study by Borås University on producing biogas out of post-consumer waste</li> </ol>

In addition to the trends described in the table above, there are some broader keywords referring to the (potential) response to the changing demand and increasing environmental concern by consumers:

- **Transparency and traceability** – several small brands have built up their business model on this.
- **Diversity** – instead of cotton (33% of the world total fibre production in 2011<sup>12</sup>) and polyester (around 50% of the world’s total fibre production<sup>13</sup>) there is a growing number of good alternatives (herbal materials like, flax, nettle, hemp; bestial materials like milk fiber, wool; recycled materials etc.). For example, at the Future Fabrics Expo, a trade show held in autumn 2012 for the second time, introduced 52 companies around the world offering more than 450 different sustainable fabrics.
- **Locality** - production moving back to local has been predicted and some claim this to be happening e.g. industry has started growing again in Finland (Aus, 2013) and a growing number of local service providers prefer local producers. Current market changes (growing prices in China as the market leader; environmental concerns; improving technology reducing the need for labour in production; emerging new markets taking the focus of Asian producers away from Europe) point to the trend.
- **Eco-services** – growing number of innovative business models (with the aim of reducing environmental impacts) have been created based on the inspiration from eco-services already well-known in other sectors (see annex 6).
- **Personalization** – to reach a variety of demographics (e.g. ageing population, generation Y<sup>14</sup>), it is the second wave of the growth in services sector in developed countries, aimed at tailoring and targeting services. The trend is existent both in the context of traditional textile production cycles as well as when looking for environmentally friendly solutions (e.g. minimizing inventory costs by customer co-creation).
- **i World and e-services** – due to the development of social media marketing, sales and getting customer feedback becomes more and more easy via Internet. Customer co-creation as a business model is enabled by the development of e-channels. The number of fashion brands using Facebook/Twitter/Instagram is growing and the

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<sup>12</sup> Data taken from a presentation done by the representatives of G-Star Raw and KICI in November 2012 at the “Closing the loop” conference in Amsterdam.

<sup>13</sup> Data taken from <http://nicefashion.org/en/professional-guide/raw-materials/syntetics.html>

<sup>14</sup> Generation Y is a willing young market for e-textile products – they use technology as part of their social fabric; they are more adept at interfacing with unusual forms for devices. It is a generation that has grown up with light-up personal shoes, personalized cell phone rings, instant messaging, glow sticks and electronic candy. (Wilson and Teverovsky, 2012: 158)

integration of digital strategy across the entire brand is becoming more common (e.g. Burberry by Christopher Bailey, Ralph Lauren pioneering mobile marketing) (Tyler, 2013).

When we analyse these trends together with the examples above, we can see that there is a major difference between the approaches taken by big brands and the one taken by smaller initiatives. It is rather common for big brands to act in the existing framework of the value chains and business models already in place. There are both disruptive and radical innovations happening on the level of closing the loop (developing collection systems, introducing new technologies for refibering and material processing) that is initiated by big companies. But it is still happening as a protective means to support the already existing value chain model. Closing the loop seems like being an add-on to existing systems, which is strongly driven by the fast increase in the prices of raw materials. Reminding chapter 1.3, this is in fact the same effect, which Stahel (1997) described as the process of speeding up material flows if existing economic structures are conserved while closing the loop.

The focus by larger brands and companies is often put on technological improvements and measurement systems with less attention on direct communication and personalised approach to customers. Customer is usually seen as a passive stakeholder “investigated” by designers ending up with standardising personal needs and creating more waste (unsold pre-consumer waste, fast discarded post-consumer waste).

It is less common for big brands to deal with innovations that are concentrated on one single step in the value chain. Thus, targeting the whole value chain at once, the investment needs are bigger, the scale of problems are bigger and the companies are thus much slower to introduce effective results in environmental performance. It is valuable for big brands to find cooperation with small initiatives offering new alternatives in these single stages e.g. new raw materials (e.g. Calamai, a family company in Italy, offering refibering and recycling fabric for Patagonia) or material processing methods (e.g. I-Collect, a specialized small spin-off of the large SOEX group offering post-consumer collection and distribution services for big brands like H&M). Small initiatives focusing on single problems in the complex system help

making disruptive improvements and move towards systemic changes in mass-production.

Based on the theoretical background we can conclude that big brands are more likely to be reactive and concentrate more on compliance than put effort in proactive strategies. There are several examples of big brands with proactive approach (Patagonia, Levi's, Puma, NIKE, G-Star) that are dealing with more radical innovations to be able to protect their existing business models in the long-term perspective. It is clear that the effort being made is significant offering important new technology and knowledge in the sector. But it is only a matter of time to know if any of these companies could reach zero or positive emissions throughout the several life-cycles of a product or not.

When we look at small initiatives, there are a variety of approaches with many new business models, value creation for consumers and radically innovative products and processes, which can sometimes but not often be later implemented by dominant market players. It is more likely for smaller initiatives to introduce zero or minimum impact solutions to consumers among local communities right from the beginning of introducing a new product or service. But on the opposite to large companies, it is often questionable if the innovative approaches could be grown to larger scale either by repeating the model, the approach, the product or some other aspect.

Considering that due to environmental concerns, small initiatives have a fundamental intersection in their approaches, it could be possible to accumulate this effort to grow joint competitive advantage and outperform dominant environmentally inefficient market models. Supporting cooperation, joint actions and bring down the costs of identical operations in different start-up companies could be the key here. A good example here is the Ethical Fashion Forum platform, which offers significant support for small-scale initiatives in the marketing activities and creating cooperation opportunities for them.

Coming back to conclusions from chapter 1.4 it can be said that there is evidence that both dominate market players as well as small new initiatives hold an important value in the systemic change already happening. It is not possible to estimate to what extent the new dominant model will arise from the proactive approach of some large company

with strong market power or from extensive repeating of small-scale local-level initiatives. It is probable that the new model is a combination of different values already offered by different stakeholders. Dominant market players need small-scale initiatives to be active in offering radical solutions on the level of single phases in the value chain while small scale new initiative need the proactive approach and openness by dominants so that the clever ideas and business models could be picked up and accelerated. These interconnections can better be explained with the model described in the next chapter.

## **2.4. Upcycling in the context of the industry sector**

The rising raw material prices together with environmental concerns and public push has been fast increasing the waste value making it beneficial to be collected, recycled and used as a secondary raw material. In UK for example, it is already usual to find 7 competing collection bins for clothes next to each other at a collection point resulting in falling material supply for recycling companies causing lack of resources for innovation (Morley, 2013). In terms of post-industrial waste, the industrial symbiosis is a growing area (e.g. promoted by interim agents like NISP). But as said before, the growth is mainly related to downcycling and there is huge lack of industrial upcycling practices globally.

In theory, to enable the longest possible life-cycle of the resources used for production and thereby prevent the growth of textile waste, the EU waste directive 2008/98/EC defines the recommended hierarchy for waste management: prevention (materials are not yet classified as waste), preparing for reuse, recycling, recovery and disposal. Reuse is defined as reuse and/or repair of appropriate discarded products or of their components (EUR-Lex, 2008). The waste hierarchy follows the logic of least environmental impact while the global market power (without regulation) drives exactly the opposite direction.

In terms of textile products, the waste hierarchy could be expanded and material reuse and recycling could mean the following:

- 1) Maintaining or improving the original function of the item (e.g. second-hand, repair and maintenance);

- 2) Upcycling by maintaining or improving the function of the material (e.g. redesign, upcycling design);
- 3) Upcycling by reprocessing the materials (can be done by chemical processes (a good example here is vaude's brand Ecolog, products get granulated back to the original raw material and the same outwear can be produced again);
- 4) Downcycling by maintaining the material but using it in a way, which reduces the life-cycle of the material (e.g. reusing as rags);
- 5) Downcycling by reprocessing materials and reusing the fibres (e.g. shredding and using as "shoddy" for upholstery or isolation materials).

This hierarchy here considers the amount of new resource input in the material processing as well as the potential to prolong the material life-cycle with the processing method. But the list does not have empirical proof and calculations to support the exact order, which hereby raises an issue for further research to improve the waste hierarchy in more detail. In practice, upcycling is still rare in mass solutions due to relatively low value added for a company compared to recycling and reprocessing, which means there might be yet a lack of best practice examples to investigate the issue.

There are three main types of waste flows distinguished in the global textile industry – post-industrial (leftovers from production), pre-consumer (leftovers from retail that never reach a consumer), and post-consumer waste.

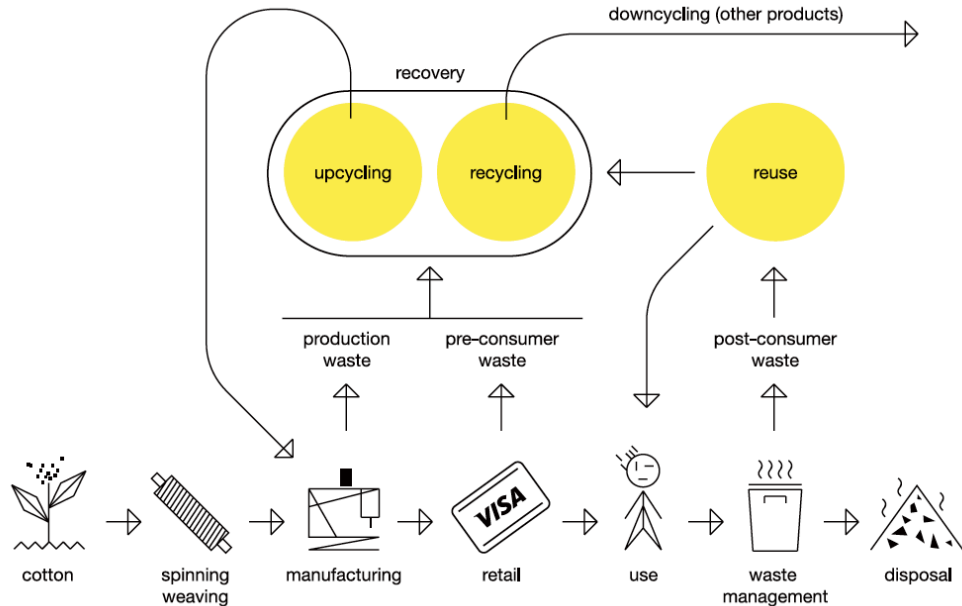
Post-industrial waste from textile and apparel production consists mainly of cutting waste, fabric and yarn roll ends, scrap fabric, fibres, fittings and overproduction (is planned on purpose to reduce risks in delivery). If there's a lack of incentive to sort the materials on site, the leftovers are usually mixed with each other but also with paper, plastic and municipal waste. According to the type and location of a producer the amounts can be very different but in general, textile and apparel production companies in Europe and in Asia generate relatively similar type of waste. (Reuse, 2011; waste mapping data collected by the author together with the NGO Reuse team for the [www.reuse.ee](http://www.reuse.ee) database in 2011-2013)

Pre-consumer and post-consumer waste are mainly generated close to user and far from mass-production, being rather the problem for developing countries. Pre-consumer



waste is more preferred as a secondary raw material being more homogeneous (more similar material available) and with higher fibre quality due to not been worn out. On the other hand, pre-consumer waste flows are very hectic (e.g. a full series of clothes can become unsold due to some defect once a year). Being a growingly popular type of material for local designers, pre-consumer waste needs a interim service provider for material gathering and distributing, a function not usually fulfilled either by second-hand sorting facilities, waste management companies nor waste generating producers.

It has been discussed and demonstrated by Aus (2011) how all three types of textile waste can be taken back to the same value chain and give them new value by design so that the material can be reused (not as clothes but as materials) without the need for reprocessing (i.e. level 2 in the textile waste hierarchy explained above). Even more, throughout her work, Aus has also demonstrated how upcycling can be implemented in all three methods for manufacturing clothes – as an individual sewing at home (DIY), as an independent designer or a small producer working in a studio (one-off or small-scale manufacturing), or as mass production (Trash To Trend, 2011).



**Figure 8.** The upcycling concept described by Reet Aus (2011: 42)

The scheme above illustrates the textile waste upcycling concept developed by Aus (2011). It is fundamentally similar to a fraction of the circular economy model, however

it stresses the need to make difference between upcycling and downcycling, first being a part of the same value chain, second could mean transfer to another value chain (e.g upholstery in the production of furniture).

Based on the upcycling concept, Aus also suggested a model, called Trash To Trend (TTT), for improving upcycling possibilities in local communities (Aus, 2011: 117):

*[The purpose of the Trash to Trend model is to provide a practical solution, which allows a designer to create fashion using local textile waste in a way that minimises the environmental impact of the garment but still allows for its serial production. Web-based platform makes direct communication between waste generator, designer, and client possible. This way a transparent product chain is created, waste data is accessible, techniques are shared, and upcycled products can be sold and marketed. This also facilitates general awareness.]*

The TTT model consists of three elements: waste mapping database for designers to know the waste flows, the design techniques database for designers to learn the methods; and the web-based platform to demonstrate the transparent value chain for consumers while creating the market-place (Trash To Trend, 2011).

In practice, the TTT model means setting the scene relatively different compared to the convenient processes in the value chains of textile and apparel industry. It means, in addition to waste mapping, regulating the material flows and information in a way that materials become available for designers, and the opposite – designers for materials. For a designer, upcycling means having a radically different initial task to begin with, creating the need for new type of training and new type of linkages between producers and designers. And to be able to also use post-consumer waste more effectively, it means changing the role of the consumer from passive user of what is provided to him/her towards active partner in planning his/her wardrobe. This again means, to be able to have competitive advantage, building new clever and convenient service and information system, which adds new value for consumers without creating the feeling of being bereaved of their usual comfort zone offered by fast fashion.

Although the TTT model still has many questions left without an answer until it has not been actually put to successful practice, the model together with the upcycling concept

in general have several values that should be considered in the framework of the current thesis.

First, as discussed before, upcycling is a method that can have minimal environmental impact due to avoiding the growth and production of new raw materials (Aus, 2011) as well as in some cases due to avoiding additional use of resources for reprocessing the material before the next use.

Second, the concept demonstrates creating new economic value from small material cycles, local services and new value from the personal relationships between the stakeholders, as described also by the concept of functional economy. For example, to enable the mass-producer create value of the waste flow both for itself (reducing landfill or incineration costs) as well as the brand (rising production output and sales income), an on-site design service is necessary. The trials done by Aus Design at Beximco show that the output can be grown up to 15% per one product line while reducing the input of water and energy by 10% (Aus Design & Beximco, 2013). Similarly, if you offer one-off design for a customer using her own waste materials, you create extra emotional value through personalized service while the materials come for free.

Third, the upcycling concept, by representing the highest levels of waste hierarchy (reduce and if not possible, then reuse), serves as a benchmark to ask if existing practice methods can be improved. For example, when the company strategy focuses on improving the life-cycle of a product, the term can be sometimes diffusing by definition – where does the cycle start and end (in value chain and in geographical reach), and is the life-cycle about one cycle or should we talk about several cycles? How do we know if the item will reach the second round planned for it, or not? In case of upcycling, such issues can be very practical – can the material be used in the same form without reprocessing for longer and in which function or how should the material be improved and used for prolonging the functionality of the material?

And finally, the upcycling concept assumes direct communication between stakeholders in the value chains creating opportunity for person-to-person learning. (e.g. direct communication between producer in Asia and designer in Europe or a customer knowing more about the origin of the post-industrial waste material). If knowledge-

creation, derived from sharing tacit knowledge, is the basis for innovation, the concept also carries an in-built engine for continuous innovation processes. At the same time direct communication between stakeholders builds trust, transparency and flexibility among stakeholders by being able to see, feel and understand the value creation behind a product.

The concept helps understanding the long-term opportunities for new type of value creation in the global textile value chains to be considered in developing new business models or strategy. However, the concept only describes taking waste back to initial production or the same type of production. In the following chapter the author expands this concept to cover a wider variety of new type of business models and eco-innovations taking place in the industry sector globally.

## **2.5. Developing new value chain model for the global industry sector**

The fundamental problem that the upcycling concept reveals in the conventional circular model of the textile industry seen in figure 7 is related to the role of the designer (or the design thinking). Design is traditionally seen as one function before the manufacturing phase. Designer typically only “uses” or investigates stakeholders of other phases of the cycle (customers, retailers, producers) for gathering information when needed. But when we look at the variety of new small-scale initiatives described broadly in table 2 (using local raw materials, offering slow fashion design, offering vintage and repair or personal tailoring services or giving fully transparent information together with products), we see that these are most often with strong design focus. As said before, this is in fact the way innovation in the fashion industry works – new high-priced designer-brands lead new trends. But it is common in mass-production to lose the central role of the designer to reduce costs.

McDonough and Braungart (2013) discuss that it is the matter of bad design if a material can not be kept circulating without negative environmental impacts. But it might be a too difficult task for a designer to be able to consider all possible use cases for the product or material throughout its first life-cycle, not to mention next ones. The product might be designed for easy repair or easy recycling, but if the product is

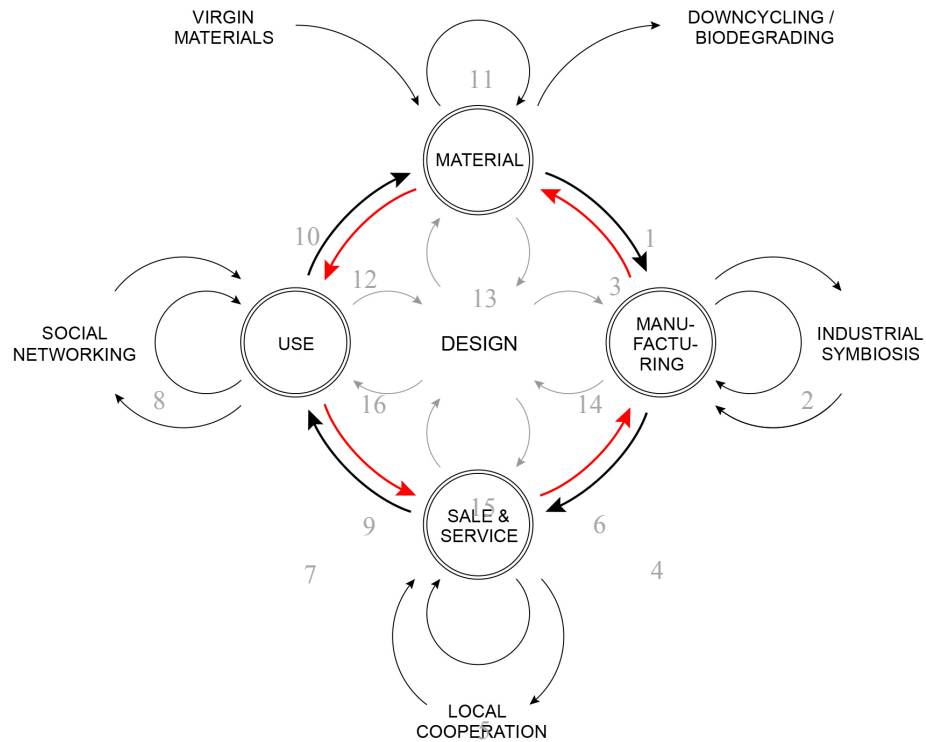
discarded far away from the infrastructure set up for such recycling, the extra merits give no real value.

Therefore, the new model should move towards centralizing the design-based thinking throughout the whole global value chains and grow new value based on that in smaller service and material cycles locally. It does not actually mean competing with the existing dominant model rather creating new add-ons to the model by adding design input in every stage where currently waste is generated. New type of business models and strategy of companies should work towards rising the efficiency and reducing design cost per item without losing the design-based thinking throughout the material cycles.

The following scheme illustrates the possible model behind the design-based value chains. Due to the discussion above we could call this a socially, environmentally and economically balanced (SEE) model describing the eco-innovation processes and long-term path of the global textile and apparel industry.

On the scheme the one single fast clockwise round through the whole circle represents the current conventional value chain in the industry sector. Each smaller circle and counter-clockwise movement represents new value offerings that can be done by adding new design input. Waste disposal means sending waste out of the cycle and this is not illustrated on the scheme, being unreasonable in the long-term. As a matter of fact, the model discards the term “waste” focusing on continuous material circulation.

The movement throughout the cycles is not limited to a single organisation or group of them, it rather represents the roles and interactions between a variety of stakeholders in the global value chains. It means that the model illustrates a new possible system creating a long-term systemic target for individual eco-innovations.



**Figure 9.** Socially, environmentally and economically balanced (SEE) model of the global textile and apparel industry (offered by the autor)

1. Environmentally neutral materials (durable, with high quality, environmentally neutral)
2. Upcycling post-industrial waste

Industrial symbiosis: Using the waste materials by other companies without reducing the material value

3. Post-industrial waste not suitable for upcycling (e.g. small-cut fabric pieces)
4. Semi-manufactured mass-production or small-scale local production
5. One-off design using pre- and post-consumer waste

Local cooperation: local virgin organic materials added to the cycle; subcontracting different services; any type of cooperation growing efficiency

6. Bigger amounts of similar pre-consumer waste (e.g. scrap mass-products)
7. Personalised multifunctional and timeless products
8. Do-it-yourself (DIY) redesign and maintenance

Social networking: sharing, swapping clothes/materials with friends; joint sewing events, etc.

9. Sharing and leasing services, redesign services
10. Collection of post-consumer waste
11. Sorting, redistributing, reprocessing low-quality materials
12. Second-hand, reuse of materials as rags
13. Design input to improve material quality and properties in certain functions; learning the restrictions rising from environmentally neutral material production; creating the link between local services and availability of waste material from any of the cycles
14. Design input to enable upcycling of post-industrial waste; learning the flexibility necessary to work with post-industrial materials available; creating the link between user and manufacturer (e.g. for mass-customization, see annex 4)
15. Design input for using post- and pre-consumer waste in one-off design; learning the flexibility necessary for using pre- and post-consumer waste available
16. Learning customer wishes; getting feedback to design ideas prior to production

As it can be seen from the scheme, the design thinking plays an intermediary and proactive role between all other stakeholders in the cycle. This design role has to fulfil the following tasks:

- Material: which eco-friendly materials help closing the loop, prolonging the material cycles and offer the functionality necessary for users? Materials should be moving back and forth in the cycle as much as possible.
- Manufacturing: how to improve production processes for using the materials in the form they already are thus radically reducing the use of resources for reprocessing?
- Sale and service: how to enable design and supportive production globally but offer personalized clothes locally?
- User: how to offer multifunctional, flexible/convertible, timeless and personalized design for users so that they can value what they already have instead of valuing the speed?

The material cycles represents several kinds of activities: sorting (e.g. pick out materials which can still be used as fabrics; sort by material type and colour, etc.); detaching fittings; refibering materials that cannot be used as fabrics; using recycled fibres (add new fibers) to produce new materials used in garment manufacturing. This description is not limited to any specific type of material, the only limit is that before reprocessing material it should be analysed if the material has a value in the same form to send it to the next cycle. Sending material out of the cycle means downcycling (using in other industry sectors as upholstery or some other function), incineration or biodegradation. It means that the material outflow as well as the inflow of virgin materials should be minimized and environmentally harmonized.

In the manufacturing cycles the post-industrial waste can be either used in the same company as a raw material, sent to some other company for raw material (industrial symbiosis, link to other industries without reprocessing) or if not usable as the same material, only then sent back to the material level for reprocessing. To be clear here – industrial symbiosis can offer opportunity but does not guarantee that materials are upcycled.

The role of retail in the classical model has to be expanded to being an active sales partner and service provider for users to help them in understanding, maintaining, reusing and prolonging the life-cycle of their clothes and the materials at hand. A strong cooperation and partnership is necessary to keep the link between sales and production so that upcycling pre-consumer waste would be possible. The material flow directly from sales to materials (a logic approach to pre-consumer waste now) has intentionally left unmarked in the scheme to stress that the materials left unsold are of higher quality and more homogeneous in respect of material type (thus should be left out from sorting and refibering process) than those coming back from users as post-consumer waste.

Link between sale/service and materials could also be discussed in the context of the retail of second-hand clothes. It is also left unmarked due to lack of service input in transforming the materials in conventional second-hand clothing business, which is stressed in the model otherwise. Actually, retail in its traditional meaning could be skipped out of the model entirely due to being a help function in between several of the cycles – as said in 2.3, sales of ethical fashion is thrivingly moving online. From that perspective, all kind of info-technological support functions can be seen as the helping functions for the model. However, in terms of needing also a traditional contact point between wholesale, retail and the client, sale is kept in the model.

The material outflow from the service level can be in the form of local cooperation for art and handicraft or using local materials and local craftsmen from small-scale production.

The user is seen as an equal partner in the cycle expressing the personal interests and needs, giving feedback to design ideas and being active in planning his/her wardrobe instead of being a passive consumer. Social networking is an important factor for learning as well as swapping of clothes and materials.

Changing the movement from one straight line through the circle to continuous little cycles and movement both clockwise and counter clockwise in the bigger circle represent the slowing down effect in the circle. Competitive advantage can be created for companies by minimizing tasks needed to transfer a product or material from one user or stakeholder to the next by using the most profitable strategy to cover the



smallest possible cycles, as explained by Stahel (1997). A business model does not have to be limited to one cycle, it can cover several cycles close to each other or even, through the design link, cross through the circle by leaving some steps aside.

When we look at the eco-innovation examples in the textile and apparel industry already introduced to the market, we can actually see most small cycles being already covered. For example, a small design company offering slow fashion products (e.g. made of local wool) and maintenance services next to that has built up the business model combining the circles of sale/service, the user, and the local communities. The material can keep on circling in these same cycles without ever reaching the bigger circle. The value created for the user is very personal and she is ready to pay the higher price for the garment meeting her personal needs and adding the social value from local community. The role of the designer can be played there by the service-provider, but can be added by another stakeholder e.g. a magazine or web portal offering design ideas.

To clarify how social, environmental and economic aspects are covered in the model, here is a small conclusion derived from the upcycling concept:

- Social – the model aims to build new value out of communication between all phases in the cycle creating personal contact and care about the system; the model also creates the potential to create new jobs locally to support the improvement of the global value chain (smaller cycles inside the big circle)
- Environmental – reusing materials in the form that they already are reduces the need for virgin raw materials as well as the need for reprocessing and adding new resources; the model thereby works towards slowing down the material cycles
- Economically – creating new design- and service-based value in each small additional cycle or combination of cycles while keeping the material cost low; growing resource efficiency and production output while limiting input of new materials; adding personalized value for customers; sustaining the most of the existing infrastructures and capabilities already available (i.e. the investment cost is lower)

The truthfulness of the model can be tested in time retrospectively. Currently the model enables to analyse long-term business strategy and clarify environmental value of the

strategy. The “vertical” growth opportunity for a company can be seen from expanding the number of smaller cycles covered by a single company while the “horizontal” growth is related to expanding globally inside one or limited number of cycles. The strategy for existing mature market players could be adding new smaller cycles to their existing business model (moving from general to more detailed levels). Small start-up initiatives can move in the opposite direction, starting from innovations in single small cycles and move from detailed level to more general. Thereby a contact point for cooperation between large dominant market players and small new initiatives can be seen in adding the small detailed cycles to the larger dominant circle. Thereby the model describes also the conclusions from chapter 1.4.

In the following chapter the SEE model is used for analysing the opportunities for Estonian textile and apparel industry. For a better focus, the analysis will concentrate on improving environmentally neutral material flows in Estonian industry sector.

### 3. TEXTILE AND APPAREL INDUSTRY IN ESTONIA

#### 3.1. General overview of the industry sector and innovations in Estonia

Estonian textile and apparel industry has a long history and it has been traditionally one of the strongest industry sectors in Estonia. However, after gaining the independence, the sector has seen constant difficulties being influenced by rising labour costs (especially after joining the EU) and the global shifts of the industry sector as described in previous chapter. The following table illustrates the position of the industry sector compared to manufacturing industry on the whole in Estonia.

**Table 2.** The development of Estonian textile and apparel industry compared to manufacturing industry sector in total (Statistics Estonia)

	No. of comp.	Net profit	No. of empl.*	Salary cost per emp.	Export share	Productivity per empl.**	Share of exports	The share in total industrial production
<b>Manufacturing industry in total</b>								
In 2005	4 850	371 883	122 939	7 376	55,0%	44 106	51,4%	100
In 2011	5 564	632 285	96 986	12 680	68,7%	93 180	65,0%	100
Growth or reduction	14,7%	70,0%	-21,1%	71,9%	24,9%	111%	+13,6%	
<b>Textile production</b>								
In 2005	144	10 379	9 168	5 760	83,3%	26 772	81,8%	4,1
In 2011	192	15 900	3 779	9 777	88,4%	60 561	85,8%	2,3
Growth or reduction	33,3%	53,2%	-58,8%	69,7%	6,1%	126%	+4,1%	-43,9%
<b>Apparel production</b>								
In 2005	451	9 183	11 611	5 009	66,8%	13 447	60,3%	2,6
In 2011	387	10 096	6 352	7 440	67,9%	21 459	69,6%	1,3
Growth or reduction	-14,2%	9,9%	-45,3%	48,5%	1,6%	59,6%	+9,3%	-50,0%

\* Calculated per full time employment.

\*\* The amount of production per employee at constant prices compared to last year (=100). The growth or reduction is calculated as an average over the years 2005-2011.

The table illustrates that the perceived “fall” in the textile apparel industry is actually related to comparison with other sectors, the falling share in total industrial production rather than actual fall in the number of companies or profit. But considering that the share of textile and apparel production out of all manufacturing industries used to be 15% in 1992, the fall has been dramatic. The profit level of the sector is more than 40 times lower compared to the manufacturing industry in general caused by relatively low productivity level. And the salary difference between industry sectors has been constantly growing illustrating the need to cut costs as much as possible in the sector. Due to high concentration of exports, the industry sector is very sensitive to external influences and was thus strongly influenced by the economic crisis of 2008-2009 (Virkebau, 2012).

Being able to show growth again after the crisis illustrates that the industry sector is innovative and vital and is benefitting from the industry shifting slowly back to local, as described in chapter 2.3. The last decade has brought along major profile change of the sector pushing some type of production (e.g. fabric weaving) out of competition but created several opportunities for high-quality niche products, small production with short lead times as well as high-tech mass production of home textiles. Most successful business models are related to own brand development, special products (e.g. sportswear, military wear) as well as cooperation in product development or marketing (Virkebau, 2012). However, the main drawbacks in the sector are low in-house product development capability, lack of internal financing opportunities, lack of qualified employees, uncertainty of demand for innovative products/services. (Kütt, 2007: 65).

The Business Register data on 2009-2010 shows that the industry is a highly concentrated – 80% of the turnover is created by just 8% of the businesses. The situation in both textile and apparel sector is comparable. 43% of all textile and apparel companies have registered none or only one employee, the share of companies with more than 20 employees is 17%. The majority of the turnover is generated by companies producing pillows, blankets, mattresses and other home textiles but also from producing children wear and waterproof outdoor clothing.

The majority of output is exported, main export markets still being Scandinavia and West-Europe (58% of the export in 2011). However, the focus has shifted strongly from West-Europe to Central-Eastern Europe between 2004 and 2011 with 25% of the export shifted. At the same time the share of export in sales has remained relatively stable (between 64-67% in apparel production and 79-83% in textile manufacturing in 2005-2009), being relatively higher than the overall export rate for processing industries (55-59%).<sup>15</sup>

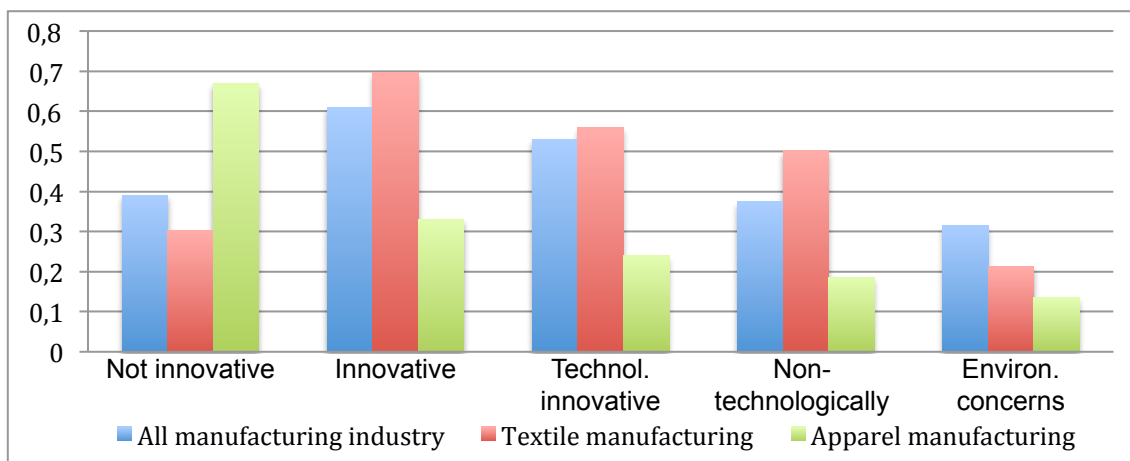
A good insight in the innovation level of manufacturing industries is given by the Community Innovation Statistics survey repeated in the EU countries in every two years. Based on that, the European Innovation Scoreboard places Estonia among the so-called innovation followers being close to European average level (Heinlo, 2010: Heinlo, 2012).

The results of the CIS studies are in compliance with what has already been discussed in the theoretical part here – the main bulk of innovation expenditure is tied to investments in new technology, machinery and equipment; technologically innovative enterprises introduce a non-technological innovation with 2–4 times higher probability than technologically non-innovative ones (innovation breeds innovation). The CIS 2010 survey concluded that companies with higher export rate tend to innovate more (Heinlo, 2012) which might have been the saving factor for the textile and apparel industry after the crisis. While textile industry is comparable with the average innovation level of manufacturing industry, the apparel industry falls far behind.

The following figure illustrates the level of innovation and the role of environmental concerns as a driver for innovations in textile and apparel industries in comparison to manufacturing industries on the whole.

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<sup>15</sup> Author's calculations based on a business register enquiry using data from 2009-2010 and public database by Statistics Estonia.



**Figure 10.** Share of innovative companies in textile and apparel sectors compared to the average of manufacturing industries (Statistics Estonia, 2010)

In general, half of technologically innovative enterprises introduce an innovation that among others creates environmental benefits. The share of such enterprises is nearly twice higher in industry compared to services — 61% and 35%, respectively (Heinlo, 2010: 72) due to concentrating on technological pollution control and cleaner production rather than product or service development and life-cycle thinking. However, when textile industry is often comparable to the average of manufacturing industries, in environmental aspects it falls clearly behind (see the last block on figure 10). This can be explained with the fact that textile and apparel companies rate the existing and future environmental regulations much lower than manufacturing industry on the whole while market pull factors are more important (voluntary codes or agreements and demand from customers). It refers to public pressure for dealing with environmental issues being relatively low in this sector, due to the main environmental issues being hidden in global value chains, being thus “exported”.

To better understand the attitude towards eco-innovation in the industry sector, 6 interviews were made by the author in spring 2011. The sample included only large textile and apparel companies covering a variety of production areas and both local and foreign capital companies<sup>16</sup>. The interviews confirm that, event though most of the companies are highly innovative in terms of their main product line or competitive advantage; the level of eco-innovation is low in textile and apparel industry. It is mainly

<sup>16</sup> The sample included Qualitex, Wendre, Baltika Group, Ilves Extra (ISC), Coats Eesti and Marat. The interview questions can be found from annex 4.

targeted to pollution control (e.g. reducing packaging or co-operating with small producers to recycle waste materials) and higher production efficiency (reusing waste in production) reducing also environmental impacts. Although knowing that environmental issues are creating an important trend in the industry sector, none of the companies saw any business opportunity due to that except for the possibility to cut costs. High quality of products was mentioned several times as the main means of reducing product life-cycle impacts. Follow-up questions done in spring 2013 among the same companies showed no improvement in that matter except the interest in the topic had grown evidently in one apparel company.

The interviews did, however, reveal an interesting aspect. It showed that large companies in Estonia are, in terms of eco-innovation, very much dependent on their substantial stakeholders in West-Europe or Scandinavia. A dominant client, an owner or board member or the overall market dynamics of the main exporting market of the company can give a strong impulse leading to relatively fast action. But, as mentioned by two companies, the substantial stakeholders have much bigger environmental concerns compared to the impacts created by Estonian companies. Without understanding the importance or the opportunity behind the environmental concerns, only cosmetic changes or reactive incremental company-level eco-innovations are being done due to that.

It can be concluded from the interviews that the main barriers for moving forward with eco-innovations among mature textile and apparel companies are:

- Low (perceived) customer demand (incl. readiness to pay more) or public interest in next level improvements;
- Low knowledge of the eco-innovation topic or information to compare the environmental impacts of different products or choices;
- No external support, systemic approach nor encouragement; lack of appropriate general solutions for solving certain problems (e.g. most interviewees emphasised the lack of waste recycling solutions – sending waste to landfills means paying waste tax; no public control or measurement methods for upstream CSR);

- Successful existing business model, product or process, leading to the unwillingness to change it until the competitive advantage can be kept.

The reasons for low level of eco-innovation in Estonian manufacturing industry in general can be related to the results of Estonian management survey, a thorough research to analyse the awareness and capabilities of company managers in Estonia. The survey concluded that mainly owners and CEOs do planning in Estonian companies; middle management is insufficiently engaged. Although companies realise the need for planning, it is mainly done in short-term. Plans are mainly related to financial factors and insufficient attention is paid to future needs, incl. to market, technological and workforce possibilities. Demand for consultation and training services is, in addition to cost issues, influenced by critical attitude towards available services and also by the desire of company leaders to manage on their own. Even though businesses sense the need for consultations and training courses that are targeted to their field of work, these pay little mind to the specific traits of their company. Course contents are to large extent determined by fashion and the wishes of employees, and less by the development plan of the company. (EAS, 2011: 5-6)

This refers to a cultural climate in companies which does not support noticing long-term major trends in the global market; systematic search for competitive advantage through innovation nor even developing new (random) ideas in-house – all being important aspects for driving eco-innovation.

### **3.2. Analysis of the current material flows and the strengths and weaknesses of the industry sector**

It has been described in chapter 2.2 how environmental impacts are very often location specific, but it is important to also be able to take into consideration the hidden impacts being exported with materials being imported. In Estonia, when talking about local impacts, it is most common to focus on the energy sector – using oil shale energy is related to around 80% of Estonian CO<sub>2</sub> emissions, waste generation and use of water not to mention physical damage to landscapes (Ministry of Environment, 2013).



The energy sector and its impacts are very well covered and under active and wide discussion while it is hardly no good data available to describe the full environmental impacts of the local textile and apparel industry. It is most commonly assumed that reducing the use of energy (as well as water and chemicals) is locally one of the key methods to address environmental impacts. The following analysis makes an attempt to use all available information to estimate the material flows of the textile and apparel industry to use this for the basis for understanding environmental impacts.

To do that, example is taken from a survey published by Nordic Council of Ministers in 2012 describing the textile material flows in Denmark, Finland and Sweden. It was explained in the survey that the domestic production<sup>17</sup> in all three countries is quite low (2-9% of domestic use) (Tojo *et al.*, 2012). Therefore material flow schemes in the Nordic study excluded the local production. In the current theses however, it is important also to consider the production and the methodology is therefore changed accordingly and simplified according to the availability of data. While the Nordic survey went through the quantities of different types of items, this thesis only looks at full volumes in tonnes. Although data on 2011 would be available, 2010 is used for analysis to enable better comparability with the Nordic study. Following the example of the Nordic study focus here is taken on home textiles and clothes describing other type of textile products as “other industries” in figure 11.

The author used following data and calculation methods to create a comparable scheme to the Nordic countries:

- Import and export by product groups (raw materials, yarns, fabrics, ready-made apparel products, ready-made textile products and used clothing) is available in tonnes by Statistics Estonia – 61 million tonnes of textile materials was imported to Estonia in 2010 in total.
- From export statistics of Statistics Estonia it is possible to calculate that 82% of the production of local textile and apparel industry was exported and the total amount

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<sup>17</sup> The number of textile and apparel companies in Nordic countries is relatively high (4600 companies in Sweden, 1867 companies in Finland), but the majority of the companies are one-person companies (80% in Sweden) or have less than 5 employees (91% in Finland). (Tojo *et al.*, 2012)

of export was 21,9 million tonnes of textile materials without considering second hand, which gives 5 million tonnes extra. While there is no solid data available about the total volumes of domestic production in tonnes, the export share and volume can be used for estimating the local production and the amount of textiles going from local production to local sales. Products, which are only travelling through Estonia, are not reflected in the statistics.

- There is no data available about how much textile materials (in tonnes) is sold in Estonia therefore an estimation was made based on the Nordic survey setting the amount of textiles sold per capita on equal level with Finland (13,0 kg per year).
- There is almost no local raw material production in Estonia (except for wool, which is used in handicraft rather than in production), thus the same calculation can be used as in the Nordic study: domestic use = import + domestic production – exports. Except, the post-industrial waste is also considered. Waste management data was taken from the public database of Estonian Environment Information Centre<sup>18</sup> showing that the amount of post-consumer waste sent to landfill was 762 tonnes. Based on the import, export, export share in local production, per capita sold amounts of textiles and waste data it is possible to estimate the material flow through local textile and apparel production.
- A study to estimate the material proportions of mixed municipal waste showed that on average the amount of textiles in such waste is 4,4% (Moora, 2008). Although this proportion is used in the calculations here, there are several reasons to believe that the proportion can be relatively bigger. Textile waste is often given to waste management under the name of municipal waste although being highly concentrated with textiles (e.g. pre-consumer waste from shops who do not want to let the brand name spread in second-hand market; or post-industrial waste mixed with household waste<sup>19</sup>). This assumption can find support in the fact that

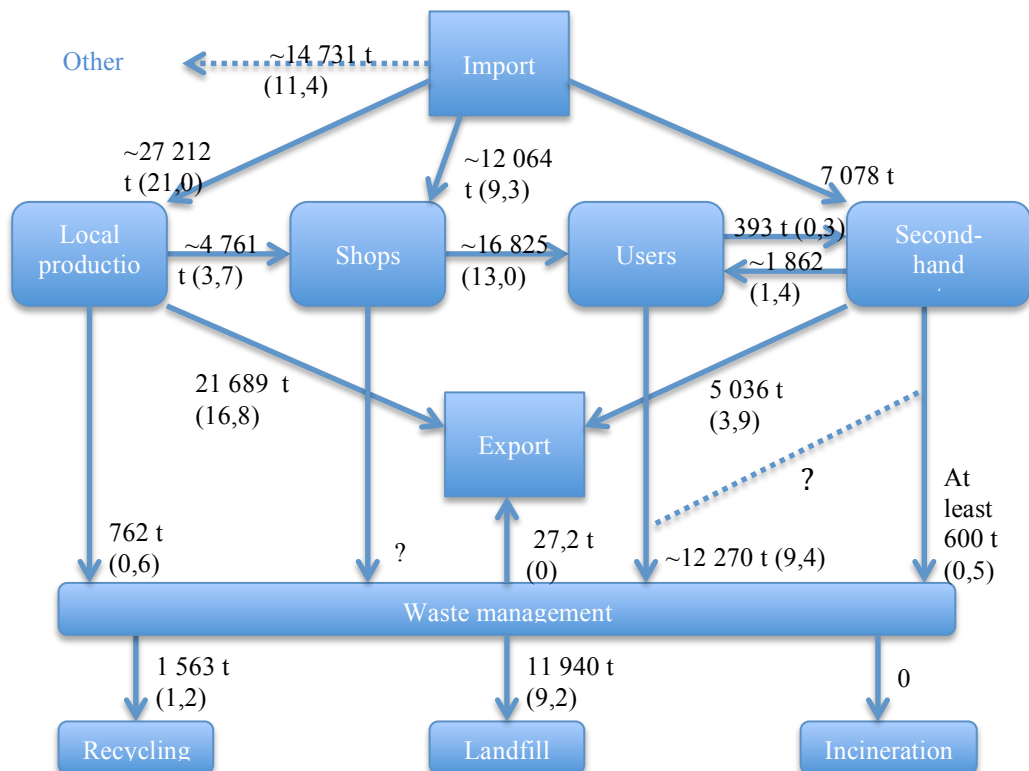
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<sup>18</sup> <https://jats.keskkonnainfo.ee/main.php?page=content&content=summary>

<sup>19</sup> In 2011 the author was involved in creating the waste database up at [www.reuse.ee](http://www.reuse.ee). Gathering waste data from only 30 companies involving companies with various sizes and areas of production or service already gave the rough estimation that 19% of the officially registered 762 tonnes of industrial waste was covered. Several of the companies responded that they do not separate textile waste from plastic, paper and other types of municipal waste generated by the employees at their work site. At the same time, waste statistics describes 510 tonnes of waste “sorted out of household waste”, while there is actually no special textile waste sorting system developed by either of the two dominant waste management companies.

- Yearly reports of Humana Estonia and New Use Centre describe 780 tonnes of second-hand sold annually in Estonia. However, the import, export and waste data (584 tonnes can be calculated based on the two reports) indicate is a 1083 tonne difference in second-hand materials. It can include a combination of several different flows. For example, there are a wide variety of small-scale independent second-hand shops, who also import second-hand clothes and who can in total generate a considerable addition to the Humana as the market leader. Also, there is no distribution data available about charity donations from abroad. And there is no statistics for the volumes of textile waste imported under the name of second-hand clothes (is either resold, reused as a material or discarded as municipal waste).

The following scheme concludes the calculations described above followed by a table comparing the material flows in Estonia with those in the Nordic countries. Each material flow is described both in total volume in tonnes as well as in kilograms per capita given in brackets.



**Figure 11.** Textile flows in Estonian textile and apparel industry (composed by the author). Number in brackets show the amount in kg per capita.

The scheme (compared to the ones for Finland, Sweden and Denmark available in annex 7, conclusion in table 4) illustrates well some major differences of the material flows in Estonia. The total material import is by 31-34 kg/per capita higher than in Finland, Sweden or Denmark. The domestic production in Estonia is almost two times bigger than in Finland or Sweden in full volume and is covering 28% of domestic use with the potential to cover all of it if exports volume is considered as well. And the potential availability of secondary raw material is also relatively bigger per inhabitant (being probably underestimated due to lack of statistics for pre-consumer and post-industrial waste). However, the total volume of potential local secondary raw materials explain and justify the low motivation of local investment in the collection systems.

**Table 3.** Comparison of textile material flows in Estonia and the Nordic countries (tons / kg per inhabitant)

	Estonia	Finland	Sweden	Denmark
Total material inflow	61 085 / 47,2	70 210 / 13,0	131 830 / 14,2	89 034 / 16,0
Domestic production	~27 212 / 21,0	2 382 / 0,44	2 590 / 0,28	8 178 / 1,47
Potential for secondary raw material (waste + second hand and charity)	21 103 / 16,3	75 000 / 14,0	96 000 / 10,4	59 300 / 10,7
Material outflow	26 725 / 20,7	6 230 / 1,0	19 000 / 2,1	26 000 / 4,7

\* Source: calculations done by the author based on Tojo *et al.*, 2012)

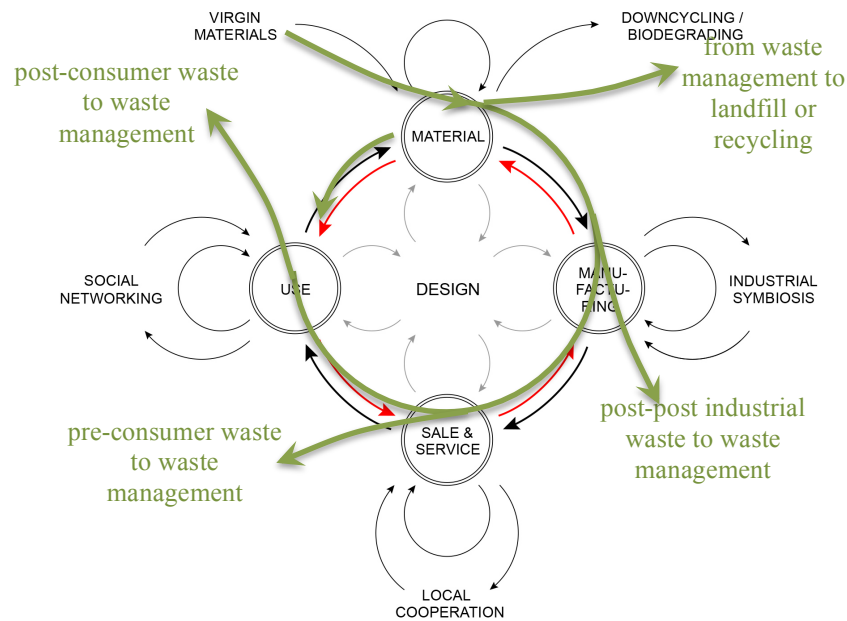
The lack of data and the results of this analysis illustrate material flow analysis is rather uncommon approach to analysing the textile and apparel industry in Estonia. It is even less common to evaluate environmental impacts based on that. Using the generalized LCA approach based on the coefficients offered by Hammond *et al.* (2008), a very rough estimation can be made that, the embodied CO<sub>2</sub> in the materials imported in Estonia (without second-hand) can be around 11 times bigger than the CO<sub>2</sub> emission reported in total by energy production companies in Estonia in 2010 (14,5 million tonnes<sup>20</sup>) and 5 times bigger if we only consider the textile volumes of domestic use.

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<sup>20</sup> Data taken from the official website of Estonian Ministry of Environment:  
[http://www.envir.ee/orb.aw/class=file/action=preview/id=1172349/KP+2008-2012+ja+aastad\\_alloc+ja+VE\\_+ja+tagastamine\\_10.05.12.pdf](http://www.envir.ee/orb.aw/class=file/action=preview/id=1172349/KP+2008-2012+ja+aastad_alloc+ja+VE_+ja+tagastamine_10.05.12.pdf)

However, more thorough research needs to be done to give a more trustworthy estimation on the hidden impacts.

Figure 12 illustrates the current dominant material flow in Estonia based on the SEE model showing how the material cycles are actually broken down in every possible manner. This also illustrates well the global dominant model, except on global scale the cycle has been closed by established material collection systems.



**Figure 12.** Current dominant material flow in Estonia based on the SEE model

Similarly to the global market, there can be found growing activity among small designers and service providers in Estonia who do follow the new model. There is a growing number of individual designers and craftsmen concentrating on local wool and waste materials (e.g. Villapai, Aprilapril, k00d.ee), redesign and vintage are growingly popular (e.g. Paavli second-hand, New Use Centre, several new vintage stores, HULA brand etc.), swapping and user-to-user sale events (e.g. Müürilille flea market, fairs for second-hand children’s wear) are rather usual and growingly popular. But it is difficult to systemically track or measure this type of activities due to lack of research and statistics.

To estimate the consumer demand and market pull in Estonia for environmentally improved products and services, the author performed a questionnaire among local

consumers in spring 2012. A comparative survey done in Norway in 2011 by Laitala and Klepp was used for comparison to prepare the questions and measure results. The results of either survey can not be called representative for the population – both were biased towards female respondents and higher education. But they were well comparable to each other with 482 answers in Estonia and 546 in Norway. From the comparison of these two consumer polls it can be concluded that:

- Giving away clothes for second-hand or charity is much less common in Estonia than in Norway (due to the lack of collection, as described above). But throwing away old clothes is also less common being rather worn out or used as rags. In fact, any kind of reusing old clothes (own clothes, buying used clothes, making something new of used clothes) is much more popular in Estonia than in Norway. The economic incentive is only a bit higher for Estonians for using clothes for longer (46/31<sup>21</sup> per cent agreed, 31/43 disagreed).
- All together 91% of the respondents said that they would be willing to take their textile waste to gathering points (12% among them would need extra benefit for that) if such solution was offered and 87% said that they are willing to pay more money for an eco-friendly long-lasting product. These results were a bit lower but still at comparable level for respondents without higher education.
- Although the environmental concerns (related to textiles<sup>22</sup>) was not high among Estonians nor the topic is not an issue during purchasing clothes, the survey clearly shows that it is the matter of low knowledge level.
- Most listed reasons why a person might use his/her clothes longer for Estonians were bad quality of clothes (agreed on by 90/61 per cent) and unsuitable cut (fit) and size of clothes. Neither Estonian nor Norwegian consumers are strongly influenced by changes in fashion (only 12/17 per cent agreed to using clothes for longer if fashion didn't change so often). Consumers are most often bothered about the high prices and low quality of apparel; not finding clothes (function, colour, desing) they are looking for and they do not often like searching for what the currently need.

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<sup>21</sup> The first number shows the result in Estonian survey, the second one in Norwegian survey. Same in following cases.

<sup>22</sup> One of the respondents commented that environmental issues are important for her but she had never thought about the topic in the context of textiles assuming textile industry has no big environmental issues to talk about.

When we pull together the discussion from above, we can conclude that in Estonia compared to the Nordics there are very low amounts of waste flows, but high capability to professionally process much larger amounts of material flows. The consumer behaviour is already favouring recycled materials, but the knowledge level of eco-innovative solutions and understanding of the importance and opportunities rising from the topic is very low among existing companies. This reveals a clear conflict between local supply and demand both among local consumers as well as the demand in close-by export markets.

To analyse the current situation, opportunities and challenges in Estonia more thoroughly, the following table uses the example of the SWOT analysis and follows major cycles in the SEE model.

**Table 4.** SWOT analyses of the industry sector in Estonia based on the SEE model

	<b>Strengths and opportunities</b>	<b>Weaknesses and threats</b>
Design	High-level design, brand development and e-solution competences available; Growing interest among designers in secondary materials.	Designer has a fixed role in the value chain rather than seen as the source of opportunities; The knowledge of environmental aspects in long-term perspective is low among designers as well as companies.
Manufacturing -> industrial symbiosis	Experience with in-house waste reduction; High technological capabilities for improving efficiency; The existence of full vertical industry sector; Good established cooperation networks (local industry and global market leaders; local and foreign research organizations); Best practice examples of industrial symbiosis available in West-Europe.	Almost no industrial symbiosis practice and know-how in the sector in Estonia, Reluctance to change and cooperation with newcomers; Lack of proactive approach; Dependence of the decisions and actions of international industry leaders; The sector is waiting for the first mover among mature companies in Estonia.
Sales & service -> local cooperation	Active interest and growing number of examples of following the SEE model among local small-scale stakeholders;	No good solution for organizing logistics for uneven material flows (post-industrial, pre-consumer) between big and small companies

	Good know-how with tailoring services and small-production, opportunity to build personalized e-services and customer co-creation solutions based on that	and initiatives
Use -> social networks	High willingness to accept any type of community-based products and services; high expressed interest in eco-friendly solutions;  Growing public/NGO/market-leader push in Europe to educate the consumer and support behaviour change of consumers, opportunity to offer services supported by e-solutions to meet that demand.	Strong lag time for local consumers to follow the trends (incl. environmental concerns related to textiles);  Low population to be a good test-market for innovative services.
Material	Post-consumer waste sorting available (Humana);  Textile waste reprocessing being started up industrially (Toom Tekstiil, Viljandi) which enables closing the loop locally and creates a channel for post-industrial waste;  Strong public push in the Nordic countries and lack of solutions for upcycling (pre- and post-consumer textile waste), opportunity to cooperate;  Plenty of agricultural land to develop new materials based on local resources.	Introduction of incineration (supported by the law <sup>23</sup> ) undermines attempts to look for better solutions for materials;  Relatively small waste flows in Estonia offering no economic incentive to create collection systems for secondary materials.  Lack of wool processing services (although slowly improving).
General infrastructure	High interest in the topic by several research institutes in Estonia <sup>24</sup> ;  Experience with e-solutions to improve communication (e.g. customer co-creation);  Public sector support for innovation-facilitating culture; good availability of start-up funding;	No public authority to specially focus on eco-innovation and green growth, reluctance to deal with these issues systematically among existing public sector authorities;  Low belief in the future success of the sector both in public and private sector – lack of long-term vision; lack of necessary education.

<sup>23</sup> Estonian Waste Act (§ 15 p. 1) categorises incineration under recycling activities.

<sup>24</sup> Estonian Art Academy (sustainable fashion design); Viljandi Cultural Academy (heritage technologies); Tartu University (new business models); Tallinn Technical University (material technology); Stockholm Environmental Institute Tallinn, etc.



Reminding the conclusions from chapter 1.4 and chapter 2.5 we can see that there are several important competencies and resources available among the mature companies (from general to detail level of the cycles) as well as enough activity, competence and interest among small-scale initiatives (from detail to general level of the cycles). There are a variety of important competencies available for creating the bilateral synergy to move towards the new long-term model in Estonia. Therefore the most important systemic drawback currently could be concluded as the lack of intermediary action and public support to create a roof and joint action to create this synergy between the stakeholders.

It can be concluded from the theoretical part of the thesis that creating environmentally neutral material flows in Estonia is not about simply developing collection system for textile materials and conserving the existing economic structures. Neither is it economically feasible considering the small volumes of waste materials. Collection systems are a helpful means to regulate the material flows (e.g. correct the location and volumes of materials, create contact point between material generator and material user), but considering the SEE model, it is not an obligatory function to be fulfilled centrally. It is rather the question of changing the way of thinking among the stakeholders and analysing systemically, which services and production can be developed in (or from) Estonia to help improve material quality and circulation possibilities. It is not necessary to concentrate on the material flows only inside Estonia, rather deal with the issues on the level of neighbouring countries and export-import partners. Local material flow is part of the global flows and cannot be looked at in isolation. It means increase in new type of eco-services and value provision. Statistically it should mean shifting the export from Central-Eastern Europe back to West-Europe and the Nordic countries, which due to already higher knowledge level among consumers, should be the primary target markets for eco-services.

In 2011, 60,6% of all textile materials were imported to Estonia from outside the EU, being relatively constant throughout the last 3 years (calculations by the author based on data from Statistics Estonia). 68,5% of all the materials were either raw materials, yarns or fabric, 27,5 % were ready-made clothing or textile items and 16% was second-hand clothing. There is no data available how much of the raw materials were organic and

environmentally improved, but considering the overview of the industry sector in Estonia, it can be assumed to be rather minimal.

Following the SEE model means exchanging the materials from virgin materials to secondary materials, using more local eco-friendly high-quality materials or increasing the material diversity in other ways. Statistically it should result in some reduction in the inflow of raw materials from far away locations. But to be able to evaluate the transition in material type and quality, more thorough research will be necessary.

To illustrate better, which new services can be offered in Estonia to improve material flows, considering both local opportunities as well as global dominant market models, the following chapter discusses two start-up initiatives in Estonia.

### **3.3. Demonstrating the SEE model based on two start-up initiatives in Estonia**

As said before, there are already several examples available in Estonia among small-scale initiatives and start-ups, which offer new value in respect of the SEE model. The author would hereby focus on two examples to illustrate, how local start-up initiatives can influence the material flows towards being environmentally neutral by implementing the upcycling concept. First example demonstrates action on global scale, the second focuses on systemic changes on rather local scale (although still building clear export value in Europe). Both examples have been evolved from the work of Reet Aus by continuing the work presented in her doctoral thesis discussed in chapter 2.4.

The chapter is composed based on the manuscript materials and the calculations done by the team of Aus Design Ltd & Beximco Ltd (since autumn 2012) and NGO Reuse (since 2007). The Estonian team behind both initiatives involve Reet Aus as the creative designer, Aili Aamisepp as the technical designer, Markus Vihma as the environmental specialist and the author of the thesis as the project manager. Although using the same team up until now, both organisations have rather different aims as discussed below.

Aus Design Ltd was established due to an opportunity offered by Beximco, one of the biggest fabric and garment producer in Bangladesh, to analyse its waste flows and help develop processes for reducing the waste volumes as an integrated mechanism in parallel to conventional production. The factory is producing 56 million clothing items a year and

covers a wide range of production from yarn spinning to ready-made clothes. Among their clients there are several well-known brands like H&M, Zara, Calvin Klein, Macy's and many others. Around 5-30% fabric waste is generated next to each different product line, 3-5% of overproduction is planned as part of regular work to reduce risks at delivery. Most of the waste is generated even despite different means for rising production efficiency is used (e.g. computer program to minimize the waste fabric while placing the garment pattern on the fabric). But due to huge production quantities; the fundamental problem in the value chains where designer can not really consider production efficiency in design; a large proportion of manual work; the lack of economic incentives – these are all reasons for the waste management to be chaotic and traditionally not seen as part of the main production cycles in the industry sector. The waste materials in Beximco are currently mainly sold in unofficial market, incinerated or landfilled. The upcycling project, targeting the waste issues and carried through with Aus Design, is one of the many sustainability projects for Beximco, who sees great future market for value offerings like this.

The upcycling method being implemented in the production is not technologically new – additional design input is given in each stage of the production where waste is generated. The complexity of the innovation is rather related to changing the common habits throughout the value chains and adapting process cycles accordingly. Each type of waste – cutting waste, roll ends, scrap fabric and overproduction – has to be dealt with a bit differently. For example, the cutting waste can be reduced as part of the regular process while scrap fabric (due to hectic volumes) needs a separate production cycle to be reused. But to do that effectively and on full scale, it means not only adapting the production on site in Bangladesh, it also means good cooperation with the brand, who is ordering the production and who has already paid for the fabric that becomes wasted.

Although still in the trial phase, several initial results can already be shared to demonstrate both the environmental as well as the economic value from such a start-up initiative. Economic value can be created both for large fashion brands, apparel mass-producer as well as small upcycling design brand. Initial estimation shows that for a large brand, production can be increased by 2-14% per each product line (without considering irregular scrap waste)

resulting in the growth of sales. The waste fabric has relatively lower price compared to new fabric<sup>25</sup> while working with waste materials means lower productivity for the producer as well as additional design input. Therefore, due to the fact that the material cost makes around 75% of the final production price of the conventional product, the upcycled product price should stay on similar level compared to conventional products.

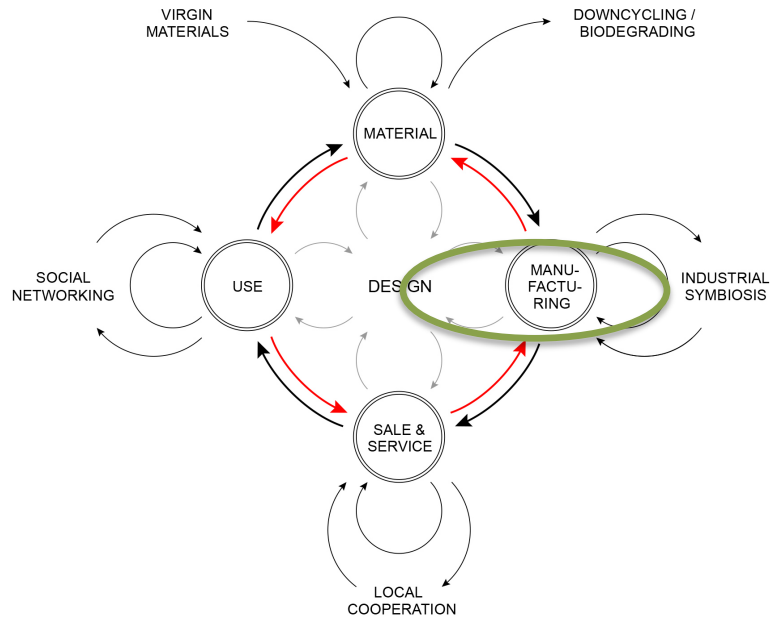
For the producer, in addition to growth in output, reduction of cost comes from avoiding landfill taxes (if any established) and cost; being able to sell the material with a higher price when making new garments instead of selling as waste to secondary market (increase in the efficiency of upcycling design will give additional income opportunity); and building new value from mixing the emerging new trends with mass-solutions and thus creating a new lead market for garments made of secondary materials. Both the producer and the brand can have additional value from the improved marketing message – for brands it is important in business-to-customer communication, for producer in business-to-business communication.

For Aus Design team there are several ways to scale up the economic value rising from this cooperation opportunity. First, the upcycling concept can be offered as a valuable marketing message for a bigger brand, which is looking for ways to reduce environmental impacts without the need to go through long R&D process and make big investments. Second, the new know-how can be shared as a consultation and upcycling implementation service (based on revenue sharing scheme for example) to large brands and mass-producers. Third, Aus Design can build economic value by presenting the industrially upcycled fashion design from under the Reet Aus brand name. And finally, the know-how can be used for creating an improved communication channel between mass-producers in Asia and designers in Europe to share the opportunity with other designer brands or companies for using the waste materials as a secondary resource material.

The following scheme illustrates the new value proposition by Aus Design according to the SEE model.

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<sup>25</sup> Price of the secondary material = (the price of roll-ends and overproduced items on the secondary market) – (the savings from the landfill cost of the cutting waste)



**Figure 13.** Value created in the cooperation between Aus Design Ltd and Beximco (scheme composed by the author)

As seen from the scheme, new value is built from binding design with manufacturing and use of post-industrial waste. Also the user (when acting as a partner for a larger brand) as well as sales (when acting under its own brand name) are involved in the business model but are not marked on the scheme due to maintaining the passive roles of these phases in the value proposition. However, special attention is put on transparency and building awareness – each unique product is delivered together with the calculations on environmental impacts. This leads us to the environmental value created by the new initiative.

The initial calculations done in Bangladesh by the Aus Design team show that upcycling has the potential to reduce ~50-65% of the production waste. Even more, each upcycled garment can on average use 3600 litres / 85% less water and create 1580 g / 84% less CO<sub>2</sub> emission per one garment compared to usual mass-produced item (i.e. considering that the upcycled product does not include the resources initially put in material production). If we calculate the full reduction of the environmental impact per one product line it means increasing the efficiency in the use of water and energy by 2-10% (i.e. if whole CO<sub>2</sub> emission and water use of the product line was divided by the increased number of products). Although still in trial phase, the calculations enable to demonstrate the fundamental environmental value of the upcycling concept.

The social value rising from the Aus Design activities is related to the fact that Beximco has 30 000 employees who, compared to the average in Bangladesh, have very good wage level<sup>26</sup> and working conditions. Preserving the long-term competitive advantage without the need to exchange manual work with technology helps maintaining the employment for the workers.

To take the industrial upcycling method from the trial phase to regular part of the production process, a lot of work is still to be done. Main difficulties (barriers for proceeding faster) are rising from the lack of funding opportunities for the trial phase (funding schemes available in the EU for innovation are mostly offering support for innovation inside the EU). There are also difficulties in communication between Aus Design and Beximco so that design input can be given on regular basis from long-distance. And it is a challenge to find the first cooperation partner from among large dominant market brands to put the concept in full production as a regular part of the process.

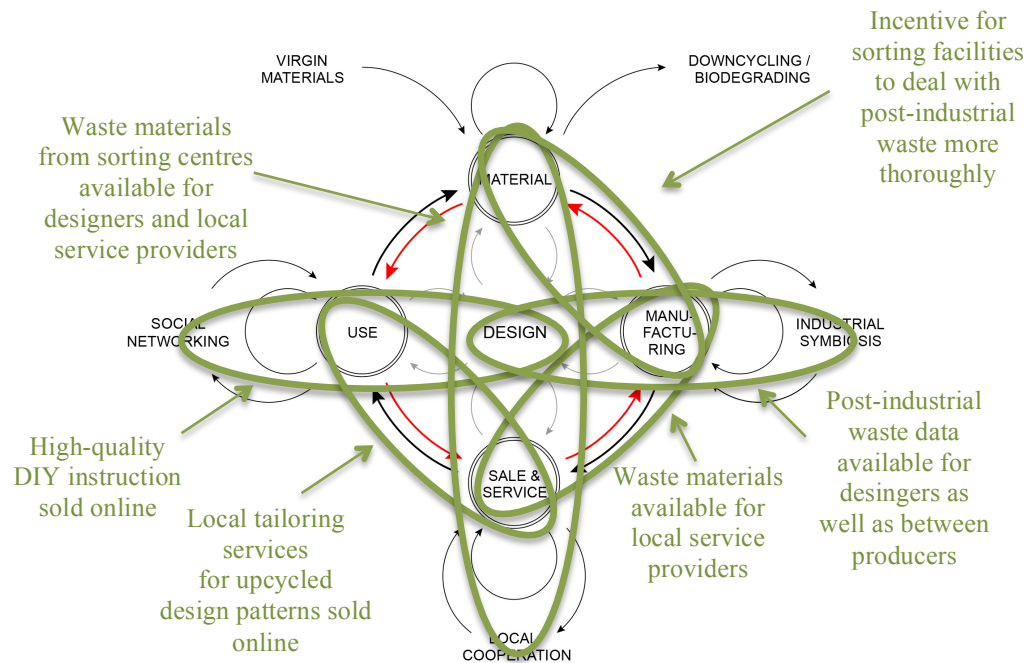
In terms of environmentally neutral material flow, the industrial upcycling only targets a minor section in the full value chain leaving many other issues (e.g. reducing material toxicity) for other initiatives. NGO Reuse, on the other hand, aims to build new value from covering a wider proportion of the cycles in the SEE model. For that, the NGO aims to take into practice the Trash To Trend web platform, suggested by Aus (2011) and mentioned also in chapter 2.4.

The Trash To Trend web platform aims to target 5 types of stakeholders: designers, textile and apparel production companies, textile sorting facilities, local service providers and end-users. The aim of the platform is to reduce the entry barriers for different stakeholders to work with waste materials both locally and globally and offer general-purpose services (both virtually online and physically offline) for that. By opening a channel for direct communication of the stakeholders, the platform enables new innovative ideas (e.g. new business models, new type of products and services, new institutional structures etc.) to be generated and fulfilled. The more detailed list of the planned functionality of the platform can be found from annex 8.

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<sup>26</sup> The average monthly income in Bangladesh is 37 USD. Together with the taxes, the average salary cost in Beximco is 100 USD (Aus Design & Beximco, 2013)

In terms of the SEE model, Trash To Trend aims to cover the active participation of the following parts of the value chain.



**Figure 14.** Value proposition by the Trash To Trend web platform (composed by the author)

Economically, the platform creates new value both locally and globally, both for NGO Reuse (to keep the platform developing) as well as to all stakeholders actively involved in the platform. The value offered for stakeholders is related to growing productivity – by not being limited by joint drawbacks, it is possible for designers, waste generators and local service providers to concentrate on their core competencies (e.g. designers can more easily outsource production and get support in marketing, tailors don't need to offer design services, etc.). Opening up an information channel between the stakeholders can decrease system failures – finding suitable cooperation partners will become much easier inside the circles marked on the figure 14.

For NGO Reuse it is possible to earn income from creating an online marketplace for upcycled design products with transparent product information (e.g. taking 20% sales fee) as well as for waste materials. It is also possible to gain revenue from matching cooperation between waste generators and material users. Other options are creating news feed for designers related to customer feedback and trends; intermediating targeted design services for waste generators (e.g. based on monthly fee), or offering other type of support services to stakeholders. As the platform is still in analysis phase, the business model

behind the platform is not yet finalised. New functionality will be added to the platform step-by-step. The aim of earning income here is to be able to keep the platform in development as well as reinvest in overcoming systemic drawbacks in environmentally neutral material flows in the industry sector globally.

The environmental value of the Trash To Trend platform will rise from the effect of slowing down the material cycles by creating new additional value for the secondary materials. The platform includes a calculator to enable measurement of the environmental impact per each item on sale, thus the full impact created by the platform can be calculated over time. The more users are participating in the platform daily, the higher the environmental impact, thus the key to reducing impact is related to the attractiveness and usability of the platform.

The social value rises from personal communication between different stakeholders in the value chain. Offering active environmental feedback and instant reward to their actions can create emotional incentive between the participants towards ethical behaviour change. Therefore, the platform needs to enable interactive participation by all targeted stakeholders, especially end-users to be able to give feedback on their needs and wishes. In the end, the platform only becomes effective if the end-user is offered additional value not only in environmental terms but also solving some drawback of the current dominant market model. It can be done either by the platform itself or by the service providers introduced through it to the end-user. It is currently a matter of analysis for the platform to solve this issue.

There is a large variety of different stakeholders who are already offering the services, which TTT aims to create a roof for. Most active are the designers and service providers in the UK and Germany. Therefore, a major difficulty (next to the funding issues to finance technology development) for developing a highly usable platform, is to gather the know-how and the joint drawbacks faced by the existing or emerging service providers, the waste generators as well as the end-users. It is not simply about gathering information but also changing the habits, processes and the way of thinking among the stakeholders.

In conclusion, the two examples demonstrate that there is a huge opportunity to create major economic, environmental as well as social value out of building up smaller material cycles inside the dominant global material circle. But considering that it is a matter of a



radical change involving a lot of stakeholders and creating a systemic change, there is a high level of uncertainties and new problems emerging daily to be solved, which slow down the process. Therefore, radical innovations, to be effective and on time to react to emerging market opportunities, need to have a very good back-up support system either by mature companies, from a research institute or from the public sector.

### **3.4. Recommendations for the industry stakeholders in Estonia**

The systemic changes taking place globally, as discussed in chapters 1 and 2, indicate that the global textile industry is only starting to wake to go through major changes during the next decade or two. The question is, what would be the best action plan for Estonian entrepreneurs to participate in this change to win a competitive advantage. How could a company or the industry sector in Estonia as a whole participate in creating a lead market or the first best design for a radical innovation? Chapter 2.3 indicates that there is a huge variety of possible paths to choose for a company even when environmental concerns do create the focus and direction in some ways. Then again, the SEE model, suggested in chapter 2.5, creates a possibility to see through these changes in long-term perspective and start analysing the possible business strategy and new business models to ride the tide. The current chapter discusses the opportunities for the industry sector in Estonia analysing the role of different stakeholder groups: the public sector organisations; the NGOs offering general support system; other type of intermediaries offering targeted support (e.g. international organisations, research institutions); the mature companies in the sector; the new start-ups; the foreign cooperation partners; and the end-users.

The role of the public sector organisations, in the current context, seems probably most clear – helping to create incentives for companies to innovate and support mechanisms to overcome systemic failures. The list of public sector organisations in Estonia, who could play the key role in the support system, is as follows: Ministry of the Environment (KKM); Ministry of Economic Affairs and Communications (MKM); Estonian Chamber of Commerce and Industry (ECCI); the Estonian Development Fund; the foundation Environmental Investment Centre (KIK) and Enterprise Estonia (EAS).

When we look at the objectives and major activities of these organizations (see annex 9), we can see that there is a strong opposition between the environmental and economic

support. The two ministries should hold the role of setting long-term objectives. But in terms of eco-innovation there's currently a lack of joint focus, one driving towards innovation without systemic view for environmental aspects and the other concentrating on nature protection and impact reduction rather than innovation and the positive message. MKM should rather hold the role of pushing eco-innovation and KKM regulating the outcomes. EAS and KIK now concentrate on financing mechanisms whereas the ministries regulate the aims and measurement of outcomes of the financing. Thus the systemic changes need to be approached from the ministry level.

ECCI and Development Fund have the role to support public and private sector cooperation and exports. Being a middleman in between the stakeholders means offering focused research and analysis, training, consultation, motivation events, general services, etc. But in terms of eco-innovation, both organisations now have a relatively limited viewpoint – only some types of eco-innovation is promoted, e.g. eco-friendly building, energy efficiency, renewable energy sources, best possible technology, etc. However, clear message from the ministry level or a clear consensus from among companies could result in several available intermediary roles covered by them to improve the eco-innovation practices.

As seen above, the approach should be much more systemic covering all industry and service sectors. These issues do not apply to textile industry only but go above all industry sectors as discussed in Lahtvee *et al.*, 2013). Currently most public environmental funding in Estonia goes to water management, energy efficiency, technology improvement, or waste management (i.e. pollution control activities) (Lahtvee *et al.*, 2013: 34). This gives the public sector organisations the notion of having a well-established funding mechanism. But the funding for more profound eco-innovation competes with all innovation projects and is considered to be a too difficult or unachievable funding mechanism for textile and apparel companies (conclusion based on the 6 interviews made by the author).

The best way to improve the organisational structures would probably be concentrating the role of eco-innovation supporting mechanisms under one roof or by redefining the roles of the existing organisations. However, the analysis of structures and institutional cooperation go beyond this thesis. Currently it is only important to stress that it is not enough to create intermediate action to raise awareness and help develop general-purpose services for companies – it is also important for clear public sector support and stable signals to be effective in developing eco-innovation practices in Estonia. It is necessary to declare on the

government level that there is a huge potential to develop the competitive advantage of companies by practicing profound eco-innovation and having long-term strategic approach in that matter throughout all industry and service sectors in Estonia.

Coming to the intermediate level between public and private sector, the list of NGOs and foundations which could be related to eco-innovations in the textile industry can be listed as following (see more in annex 9): incubators of Estonia (at least 9 in 4 towns); Estonian Clothing and Textile Association (ECTA), Stockholm Environmental Institute Tallinn (SEIT); Estonian Association for Environmental Management (EKJA); Estonian Council of Environmental NGOs (EKO), New Use Centre; and NGO ReUse. Among the intermediate action between the public and private sector, also news media (e.g. Bioneer) and universities (especially Estonian Academy of Arts, Viljandi Cultural Academy, Tallinn Technical University and the University of Applied Sciences) have to be listed.

Again, the conflict interests and lack of focus on promoting eco-innovation can be well seen in the objectives of most of the local organisations mentioned. Systemic support towards eco-innovation can mostly be seen in the aims of SEIT and EKJA, however, their focus is on research and relatively soft consultation (initiated by research and member interest) without having a long-term strategy and business-thinking towards systemic change. They carry the role of clarifying the systemic failures in Estonia and communicating the interests between stakeholders (including the environment), but currently lack of influence and scale to create the necessary change through industry sectors. However, they play an important supporting role if other stakeholders initiate any kind of action.

ECTA and New Use Centre, although being very different on scale, are organisations focusing on industry specifics. The former creates the roof for mature companies; the latter offers interim services for regulating material flows (although in very small amounts compared to all material flows in Estonia). Both play very important role in participating in the systemic development of the industry sector.

While the first 5 are well-established organisations, NGO Reuse has been till now carried through only two small projects to create textile waste database online and improve cooperation with other interim action in the Nordics and Baltics. The organization is about to be built up in terms of the role, objectives as well as people. Considering that the existing organisations do not yet cover all necessary roles of intermediate action between

stakeholders (no targeted support for eco-innovation in textile industry is offered), the future role of the NGO Reuse could be defined here.

The NGO Reuse should be focusing on creating a roof for start-up environmentally positive initiatives with the aim to incubate new solutions for the dominant market value chain. It is important to develop the organisation in close cooperation within the network of all other organisations listed in this chapter. For example, cooperation with Clothing and Textile Association creates the possibility to build bridge between the fresh approach among start-ups and the capacities already available in mature companies.

One of the aims of the NGO should be developing general-purpose services i.e. training for active designers to learn upcycling techniques, improving access to waste materials, dealing with toxicity issues, offering product development, process analysis or environmental impact analysis, promoting new start-up activity, offering any type of consultation etc. Many of such general-purpose services can be enabled through the Trash To Trend web platform in the long-term as described in the previous chapter. But action outside the virtual world is equally important. The best way to fulfil the role of offering general-purpose services is to be active in looking for public funding for these issues.

Another important role is to be the promoter of communication between stakeholders. Among them international partners of all public sector, intermediary level and private sector should be targeted. For example, cooperation with NICE, the roof for sustainability textile industry topics in the Nordic countries, is very helpful. It is important to help companies in finding new potential international partners in terms of sustainable improvements.

Communication between stakeholders also means taking the lead role in raising the awareness of joint opportunities. There are several possibilities for that: joint workshops, media campaigns, targeted cooperation offers, etc. However among more innovative approaches would be:

- Following the example of the NISP network to introduce industrial symbiosis among companies (creating one-to-one meetings between stakeholders to map common interests and thus make targeted offers, revenue sharing scheme is used);
- Offering a public database of available competencies and services in Estonia in relation to eco-innovation (e.g. in cooperation with EAS or the Development Fund);

- Organizing events similar to Garage48 to bring together potential partnering organisations or competencies with the aim to initiate new start-ups.

To be able to scale up the effort and take the support from a limited number of members to wider acceptance, it is highly important to use entrepreneurial thinking and aim towards global cooperation. The NGO must plan the organisational development in a way that it will not be depending on public funding schemes rather follow the framework of a social enterprise. Both TTT platform as well as developing the network for industrial symbiosis creates a good basis for that.

Moving on from intermediary action and support for small initiatives, there are several suggestions raising from the thesis for mature companies to move a step forward in terms of proactive and disruptive or radical eco-innovation:

1. Self-educating the management to understand the topic of eco-innovation and related problems in/around the company thoroughly;
2. Self-analysis and mapping of competences, looking for the possible business model or development strategy based on the SEE model considering the strongest existing or possible capabilities of the existing company. Here it is important to include all management and employee hierarchy levels to also consider in-house competencies not yet known for the company.
3. Look for cooperation possibilities, other on-going research, already available solutions as well as best practice examples to add on to the competencies available in-house.
4. Put the available competencies in action for developing a new product/service/business model following the lead of the SEE model.
5. Develop transparency for the customers as part of the new business model not as a separate activity using resources. Educating the consumer and initiating a social change as part of the business model has been proven to give an advantage to be successfully eco-innovative company (see chapter 1.4)

While the global industry sector is still in search for the next equilibrium point in the production and service systems, there is a huge window of opportunities open to offer the “first best design” for eco-friendly solution to the market. It is the opportunity for local mature organisations to pick up the good business models or clever eco-friendly product or

service ideas introduced by small initiatives in local communities either here or abroad, help scale them up and build new competitive advantage in the global market.

For small initiatives, on the other hand, it can be suggested to be proactive to look for cooperation among mature organisations and have the courage to think on bigger scale. If a new start-up deals with radical innovation, large market dominants have the opportunity to help overcome several uncertainties, open up access to existing social networks and mature competencies. It is also important to start a dialogue with the potential cooperation partners from among public sector and intermediary level to help express the joint grass-root objectives of the industry sector as well as give incentive and support for joint action in overcoming general system failures.

And finally, as for one of the most important stakeholders, the active role of the end-users (either individuals or business-to-business buyers) has to be stressed. It is not only due to the need to create demand, it is even more due to the need to reduce waste by delivering products, which are expected and welcomed by end-users. In Estonia, due to the work of Reet Aus, the upcycling concept is already well-known. However, there are many other opportunities for following the concept as a client. For selecting, which product is following the concept and which is not, the following could be suggested:

- the product quality should be clearly high in terms of durability and the work quality;
- timeless design enables to hold the value of the product for longer either for the first buyer or for the second-hand buyers;
- minimal amount of trimmings account for better recyclability after being worn out;
- when upcycling, the value of the product can be higher if the product is decomposed and new design is based on the material, rather than simply decorating a product;
- during decoration, redesign or upcycling, the material should always be spared as much as possible so that also those materials, which stay without use during the process can have value in a next product
- a good way of evaluating good design quality is to analyse if the same product could be remade in production or does it only have one-time artistic value

If the stakeholders could follow such suggestions, it could be possible to demonstrate environmentally neutral material flows in Estonia. There is no such thing as waste, there are only valuable materials we now destroy.

## **CONCLUSIONS**

Growing public awareness of the environmental impacts of the increasing consumption is currently driving a major systemic change throughout all industry and service sectors in the world. For example, there is nothing new about the idea that circulation of materials can create both economic and environmental value. It has become a common practice with materials like glass (reusing bottles), paper, metal and also plastics. The environmental issues have historically not been highlighted in such cases, compared to profitability and raised resource efficiency. But now the co-evolution of social, political, ethical, scientific and technological development is also creating new economic value to such practices.

Such paradigm change is creating a huge window of opportunities for entrepreneurs among any type of industry or service sector to introduce eco-innovations. The market demand for ethical products and services is just about to reach the stage of early majority acceptance in developed countries whereas the developing countries as well as the dominant market leaders are waking to meet the new (expected) demand.

The current thesis analysed the opportunities for the Estonian textile and apparel industry sector to take part in these systemic changes in global markets. The topic was approached from the angle of creating environmentally neutral material flows and the opportunities to build new competitive advantage upon it. First, the literature review was made to analyse and improve the concept of eco-innovations from the private sector viewpoint. Then the thesis looked at the global textile industry characteristics, environmental problems and market trends rising from that. Following the lead of the upcycling concept, a new long-term value chain model was constructed to describe the systemic changes happening in the global value chains. Then the situation in the Estonian industry sector was analysed. Comparison was made with the Nordics countries in terms of the total material flows and the potential market demand for eco-

friendly textiles to create a better understanding of the opportunities for Estonia to build new value proposition for neighbouring export markets, which are known for their higher public awareness of ethical issues. Then two case studies were discussed to demonstrate how the new value chain model could be followed by Estonian start-ups. And finally, the roles of different stakeholders in Estonia were analysed and recommendations made in the context of supporting successful eco-innovation in the future.

As it becomes clear from the thesis, that the key to understanding the opportunities rising from environmental concerns is taking a proactive and positive approach to the environmental issues. It is not about “reducing” production, consumption, economic benefit or setting any other types of limits, which tend to stay on the level of incremental innovation and often seems to be the focus of public discussions. It is rather the question of dealing with completely new design tasks and building value upon it by implementing radical innovations. Instead of calculating economic value based on labour productivity, efficiency of resources or growth in turnover, it means measuring value also based on the functionality and durability of the goods and services, the social gains from it as well as the ability of the materials to circulate. Even if the future economic gains seems to be indistinct, taking a proactive approach (at least by information gathering and communication) can enable setting the scene suitably for a company in the long-term, and get involved in building a lead market.

Environmental concerns offer a long-term strategic focus for innovations, which should be integrated in strategic planning on regular basis to build continuous competitive advantage from these issues. The size, structure, location, productivity, market position, access to financing or any other traditional characteristics of a company do not give advantage for introducing successful eco-innovations. Relative advantage can rather be gained from fresh approach to business models in start-ups; incorporating social dimensions in the new value offering and proactive approach to overcome a variety of possible barriers related to radical innovation processes (which can be easier for mature companies). Abundance of uncertainties, lacks of capabilities and knowledge as well as reluctance to changes are creating the major difficulties in these processes. However, by strategic approach to knowledge-creation and dealing with uncertainties enables to step



on the path where innovation breeds innovation and relative long-term advantage for introducing radical innovations is created.

Studying the literature of eco-innovation and related concepts brings to the understanding that there are three important axes in the process towards systemic change – the quantitative, the qualitative and the temporal dimensions. The quantitative axis can be considered as the question of what types of actions are being done and what are the measurable impacts from it (the way OECD approaches it). The qualitative scale (in the example of the circular economy model) means considering the full environmental impacts of the products, services, processes and systems in terms of improving the full life-cycle, closing the loop, creating material circulations and having neutral impact throughout the cycles. And the temporal scale (the concept of functional economy) also considers the slowing-down effect from the innovation – how long time does it take for a material to make one whole round in its life-cycle and thereby how much additional resources are put in material reprocessing. Targeting all three scales of the eco-innovation, with all social, environmental and economic value propositions being considered, can be called the most profound level of eco-innovation.

According to these scales, environmentally neutral material flows, do not mean simply regulating the inflow or outflow of materials (i.e. the question of quantity or efficiency). It rather means focusing on increasing material circulation possibilities and developing services to enable that (i.e. the question of environmental quality and speed of life-cycles). Increasing the use of secondary (or even third-round cycle or more) resources at each stage of the value chain and building new services based on that, enables to slow down the material circulation while creating new economic value.

However, when we look at the dynamics of the global textile industry, it can be seen that most market leaders are innovating on the quantitative scale while small-scale start-ups demonstrate the qualitative and temporal approaches. It is understandable why the market leaders are aiming to preserve the existing market structures to sustain the strong competitive advantage they have built up. Innovation focus is mainly put on closing the material loop globally. The new start-up initiatives, on the other hand, are active in the fields of new materials, eco-design, niche products and markets, transparency, new type of services and a local focus. Although having similar long-term ambitions, they all

together lack a joint platform to scale up the effort and create equal competition to the dominant market model. The literature review, the industry sector analysis as well as the practical experience of the author all refer to mutual gain possibility for those initiatives where mature companies and new start-ups find joint objectives and build joint value.

The textile industry is globally very fragmented and the roles in the value chains have been very strongly fixed over the time. At the same time, several crises influencing the industry sector globally have demonstrated that still many structural changes are constantly taking place. The sector is capable for fast adaptations to changing circumstances. The on-going adaptation process now is mainly driven by the concerns about the huge waste problems as well as hidden (indirect) impacts of the industry sector. In Europe, the focus is mainly put on post-consumer waste, in Asia, on the post-industrial waste while the pre-consumer waste is a mutual issue. Many of the other environmental issues (toxicity, water and energy consumption) can be narrowed down to slowing down the material flows.

It has been commonly accepted (e.g. in EU waste directive, in several research studies, etc.) that environmentally the most promising way to deal with waste and improve the material flows is by following the waste hierarchy. The thesis improved the description of the hierarchy levels by adding the distinction between upcycling and downcycling, which are known terms in practice, but not so much in theory yet. Even more, upcycling was described in two categories where the higher level considers the use of the materials in the same or a new function without the need for mechanical or chemical reprocessing. More than 80% of resources can be saved per garment if the new garment was made of waste materials without reprocessing (Aus Design & Beximco, 2013). In practice, the lower levels in the hierarchy are considered to be the most profitable whereas the higher levels remain unachievable in mass-solutions.

In chapter 2.5 the literature review and analysis, the overview of eco-innovation trends in the textile industry sector and the global long-term environmental interests were combined to a new value chain model for the industry sector. The model considers all social, environmental and economic ambitions and was thus called a SEE model. The model gives a central role to design-based thinking in terms of both material, process, product as well as service improvements and changes the roles and interactions between

the stakeholders throughout the value chains. It also considers the need to sustain the existing infrastructure and available capabilities worldwide. New value is mainly demonstrated by adding small new material cycles to the one major global material circulation (materials are moving back-and-forth between stakeholders with minimal processing need) and gain economic rewards from personalised and case-by-case services. The model creates a framework for understanding the position and the new value proposition of new business models or strategies of radical eco-innovations. Together with the model, the social, environmental and economic impacts should always be discussed. In general, following the model can build trust, social capital and employment (i.e. the social impacts) and radically reduce the use of resources (i.e. the environmental impacts). It creates additional economic value from reusing materials, growing product functionality and offering additional personalized services locally instead of focusing on speeding up material flows.

Following the theoretical discussions and the analysis of the industry sector globally, the third part of the thesis concentrated on the textile and apparel industry in Estonia. In the past 20 years the sector has gone through major profile change and major reduction in production volumes and employment, but demonstrates now the capability for new growth after the crisis (mainly by focusing on high-tech or niche production). However, the major export focus has over the past few years been slowly shifting from the Nordics and West-Europe towards East-Europe. In addition to other barriers discussed above, this helped to explain why eco-innovations, which are mainly driven by cooperation with developed countries, are rather reactive and concentrated on pollution control in the industry sector in Estonia.

The analysis of Estonian textile flows shows that, per inhabitant, Estonia has three times larger inflow of materials (47,2 kg per inhabitant in a year) compared to the average in the Nordic countries due to local production and offering sorting service for second-hand clothing. The total volume of the inflow of the textile materials is only a bit lower than in the Nordics. Although total volumes are lower, environmentally it still means considerable impacts. Based on rough calculations, the embodied CO<sub>2</sub> in all imported textile materials in 2010 was more than 10 times higher than the direct emissions of CO<sub>2</sub> from local energy production, which is creating 90% of Estonian CO<sub>2</sub> emissions.

The availability of secondary materials is very poorly covered by statistics and therefore refers to rather small quantities compared to the Nordics. Due to waste mapping action done by NGO Reuse, the availability of local post-industrial waste can be estimated to be much higher than registered. The lack of statistics is the result of mixing textile waste with municipal waste and having no good solutions for reusing or reprocessing them. Due to small total quantities there is no incentive for waste management companies to invest in material collection, sorting and redistributing services, which makes the qualitative approach to improving material flows more valuable in Estonia.

There are several hints in the thesis (e.g. questionnaires among consumers in Estonia and Norway, the market shares of ethical products in UK, trends in the sector) that refer to a relative conflict in the value proposition by local companies compared to the consumer preferences both in Estonia and Norway – the acceptance of environmentally improved offers could be much higher than perceived or taken into consideration by mature companies. But the industry sector in Estonia has various strengths at hand – the capability to process relatively large amounts of textile materials, the good technological capabilities, the availability of good design and the full vertical coverage of the value chains. The main opportunities rise from the relative cultural similarity, close location to developed export markets with high demand for ethical propositions as well as good established cooperation networks, which are available for different stakeholders in Estonia. While the sustainable fashion business is losing country barriers and increasingly moving to virtual dimension world-wide with local services supporting this change, our good access to the know-how of developing e-solutions is important. In case of better public coordination and motivation together with focused help from intermediary action, these strengths and opportunities can be used for starting up new business models and value offerings for the global market.

To illustrate the opportunities for Estonian entrepreneurs better, two examples of new start-up initiatives were analysed in the thesis. They help to demonstrate, based on the SEE model, how adding extra material cycles to the dominant value chains can create new value through the economic, environmental and social scope. Aus Design Ltd is a start-up company cooperating with Beximco, the largest fabric and garment producer in Bangladesh. In cooperation they are demonstrating new value creation by adding

upcycling fashion design to mass-production. And the Trash To Trend web platform is aiming to focus on improving material circulation by building communication between stakeholders to grow most new value by adapting market structures without changing physical infrastructure. Both concepts are bringing the role of the designer more to the forefront compared to conventional market structures.

The thesis brings to the conclusion that the main keys to accelerating successful profound eco-innovation is the close thematic cooperation between all type of stakeholders of the industry sector or those who offer some support system for that. It is easiest to hope for public sector drive or market reaction to demand, but it is most important to be proactive in improving the communication between the stakeholders and look for possibilities to overcome general drawbacks between the stakeholders. The third chapter of the thesis ended by discussing the roles of different stakeholders in Estonia and giving recommendations for the future. NGO Reuse, which currently has no objectives or organisational structure defined, was recommended to take the intermediary role of offering targeted support for eco-innovations in the industry sector. The main tasks should be creating a roof for sustainable start-ups of the industry sector, developing general-purpose services and take action for improving communication and cooperation between all stakeholders (can be done partly through the TTT platform).

The thesis brought out several questions, which need to be researched in the future. For example, it is can be discussed how the public statistics could be adapted so that all three dimensions of the eco-innovations could be considered without overestimating incremental innovations. Even more, the topics discussed here can be expanded to other public policy topics in several ways. Also, a continuous side-topic systematically ignored in the thesis was the process and mechanisms of knowledge-creation in an organisation to implement profound eco-innovation (e.g. the concept of initiating viral change through leadership in the textile industry). From the practical side, it is the matter of future research to understand if the SEE model can be put to practice with real long-term value-creation and which are the outcomes for stakeholders. And finally, it is to be analysed if the new value chain model could be overtaken by other industry sectors. In the context of the SEE model, industry could be in the long-term seen as the mechanism for circulating valuable materials, without the concept of waste.

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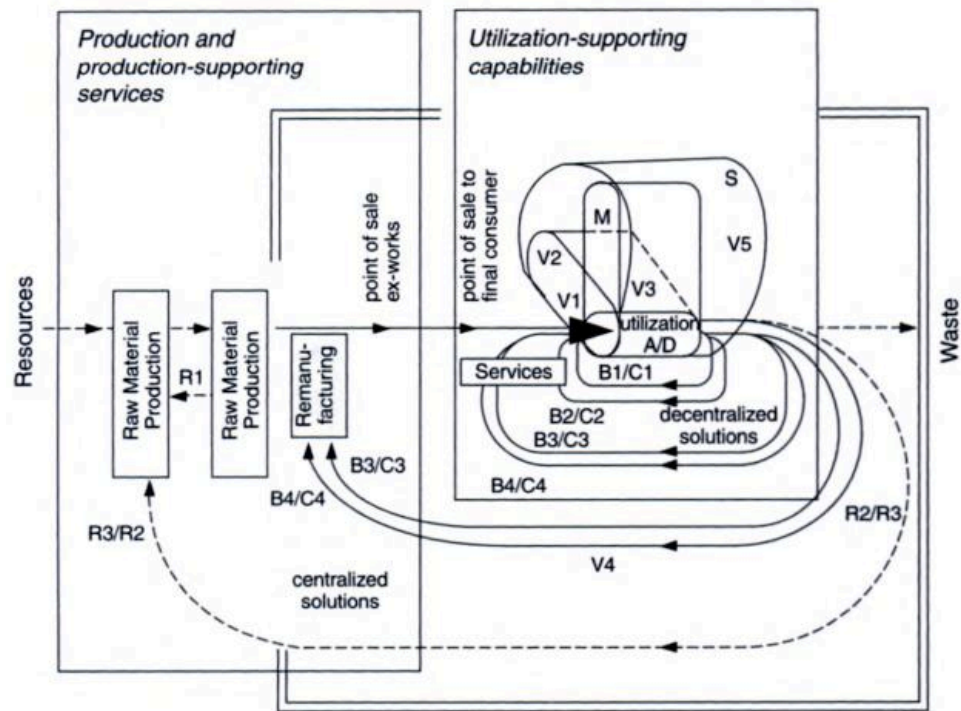
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## ANNEX 1. FUNCTIONAL ECONOMY MODEL



**Figure 15.** Functional economy model by Stahel (1997: 97)

### CLOSING THE MATERIAL LOOPS

- I. Strategies for slowing down the flow of matter through the economy
  - A. Long-life goods: Philips induction lamp, Ecosys printer
  - B. Product-life extension of goods:
    - B1. Reuse: reusable glass bottles
    - B2. Repair: car windscreen, flat tire
    - B3. Rebuild: retreaded tires, renovated buildings
    - B4. Technology upgrading: Xerox copier 5088, PC-AT,
  - C. Product-life extension of components:
    - C1. Reuse: refill printer cartridges, roof tiles
    - C2. Repair: welding of broken machine parts
    - C3. Rebuild: revacuum insulating Windows
    - C4. Technology upgrading: upgrading of jet engines to new noise standards
  - D. Remarketing new products from waste (product-life extension into new fields)
- II. Strategies for reducing the volume of matter through the economy
  - M. Multifunctional goods: Siemens 'FAX', Swiss Army knife, adaptable spanner
  - S. System solutions: micro cogeneration of cold or heat and power, road rail

### CLOSING LIABILITY LOOPS

- I. Strategies for a cradle-to-cradle product responsibility
- V. Commercial or marketing strategies
  - V1. Selling use instead of goods: operational leasing of cars, aircraft, trucks, construction equipment, Medical equipment, photocopiers, apartment rentals
  - V2. Selling shared-use services: laundromat, hotels (beds),
  - V3. Selling services instead of products: lubrication quality instead of engine oil
  - V4. Selling results instead of products: pest- and weedfree fields instead of agro chemicals, individual transport instead of cars
  - V5. Monetary bring-back rewards: 10-year cash-back guarantee

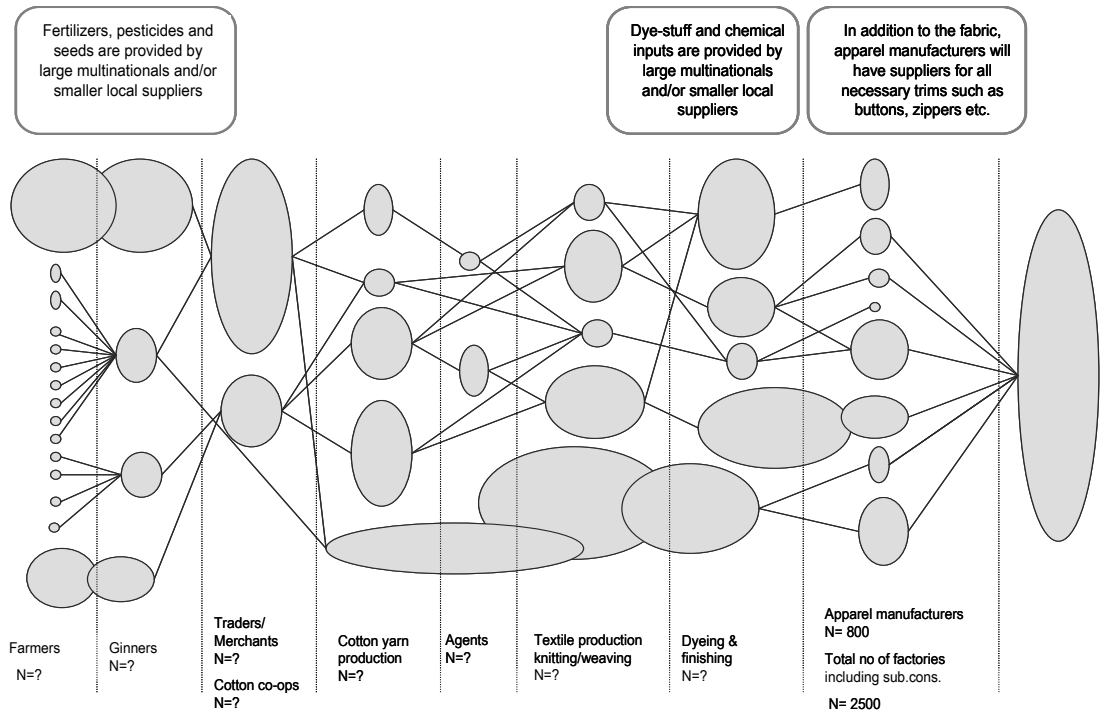
## ANNEX 2. INTERNAL DRIVERS FOR COMPANIES TO ECO-INNOVATE

The list is composed based on Belmane et al, 2002; 2003; Lewis et al, 2001, Buysse, Verbeke, 2003; additions by the author.

Category	Description
Regulation	<ul style="list-style-type: none"> <li>• Compliance with law, directives, regulations</li> <li>• Reduction of environmental costs (waste tax, fines)</li> <li>• Reduction of insurance costs</li> <li>• Improvement of workplace health and safety</li> <li>• Avoiding future surprises (they want to „anticipate“ the changing regulatory and market context rather than to „react“ to changes)</li> <li>• Desire to influence the direction of regulation and legislation (in partnership with government and to secure their investment)</li> </ul>
Demand from stakeholders	<ul style="list-style-type: none"> <li>• Taking (possible) customer/buyer demands into consideration</li> <li>• Improvement of relations between interest groups</li> <li>• Better access to the international market</li> <li>• Need to offer eco-friendly solutions in case of public procurement or foreign subcontracting</li> <li>• Investors demand e.g. CRS reports</li> <li>• International voluntary agreements (e.g. in industry sector)</li> </ul>
Capturing new markets	<ul style="list-style-type: none"> <li>• Eco-innovation as a chance to launch a new product/service or to ensure competitive advantage</li> <li>• To improve competitiveness (lower price, differentiated product, quality)</li> <li>• To increase market share or secure existing markets</li> <li>• Want to position themselves as market leaders and innovators</li> <li>• Recognise the emergence of new business paradigm</li> <li>• Desire to strengthen technical competence and develop new areas of technical competence („handling environment“)</li> <li>• In the Baltics privatization and foreign investments (owners) have brought along a reasonable level of environmental know-how and technologies.</li> </ul>
Cost reduction	<ul style="list-style-type: none"> <li>• Management of the supply chain</li> <li>• Cost reduction related to resource efficiency</li> <li>• Improved general management</li> <li>• Economic recession – falling demand together with cutting costs</li> </ul>
Personal values	<ul style="list-style-type: none"> <li>• Internal motivation in a company, incl. ethical leadership</li> <li>• Employee motivation, desire to act responsibly</li> <li>• Built in knowledge-creation strategy, knowledge as the driving force</li> </ul>
Image	<ul style="list-style-type: none"> <li>• Improving company reputation</li> <li>• Achieving ISO14001 certification, eco-label certifications, eco-friendliness awards or other accreditation etc.</li> </ul>



## ANNEX 3. ILLUSTRATION OF H&M SUPPLY CHAIN



**Figure 16.** A rough illustration of the complexity of the H&M supply chain. This image only includes the cotton alternative in the fibre producing stages of the supply chain. Source: Kogg, 2009: 153.

## ANNEX 4. DIFFERENCE BETWEEN POSTPONEMENT, MASS-CUSTOMIZATION AND CUSTOMER CO-CREATION

Postponement, mass-customization and customer co-creation are three possible strategies for reducing inventory costs. Mass customization and postponement are discussed broadly in the management literature, but few companies have implemented these strategies successfully today (Piller and Lindgens, 2012: 181). However, collective customer commitment method has been introduced as a successful business model by several companies around the world: [www.cuusoo.net/en](http://www.cuusoo.net/en); [www.threadless.com](http://www.threadless.com)

**Table 5.** Comparison of postponement strategy, mass customization and collective customer commitment (customer co-creation) (Piller and Lindgens, 2012: 182)

<b>Postponement strategy (delayed differentiation)</b>	<b>Mass customization</b>	<b>Collective customer commitment method</b>
New product development by manufacturer (based on market research input)	Development of product architecture and customization options by manufacturer	Development of new product design by some (expert) customers
↓	↓	↓
Prefabrication of (some) components	Customer co-design process (elicitation)	Evaluation and refinement of design by manufacturer and customer community
↓	↓	↓
Access to better market information (based on market research input)	Placing of order by each individual customer	Presentation of selected design concepts and obtaining commitment of potential customers
↓	↓	↓
Final assembly of product variant	Custom (on-demand) manufacturing	Only if minimum lot size is pre-sold, (mass) production of product starts
↓	↓	↓
Mass distribution	Custom	Mass distribution

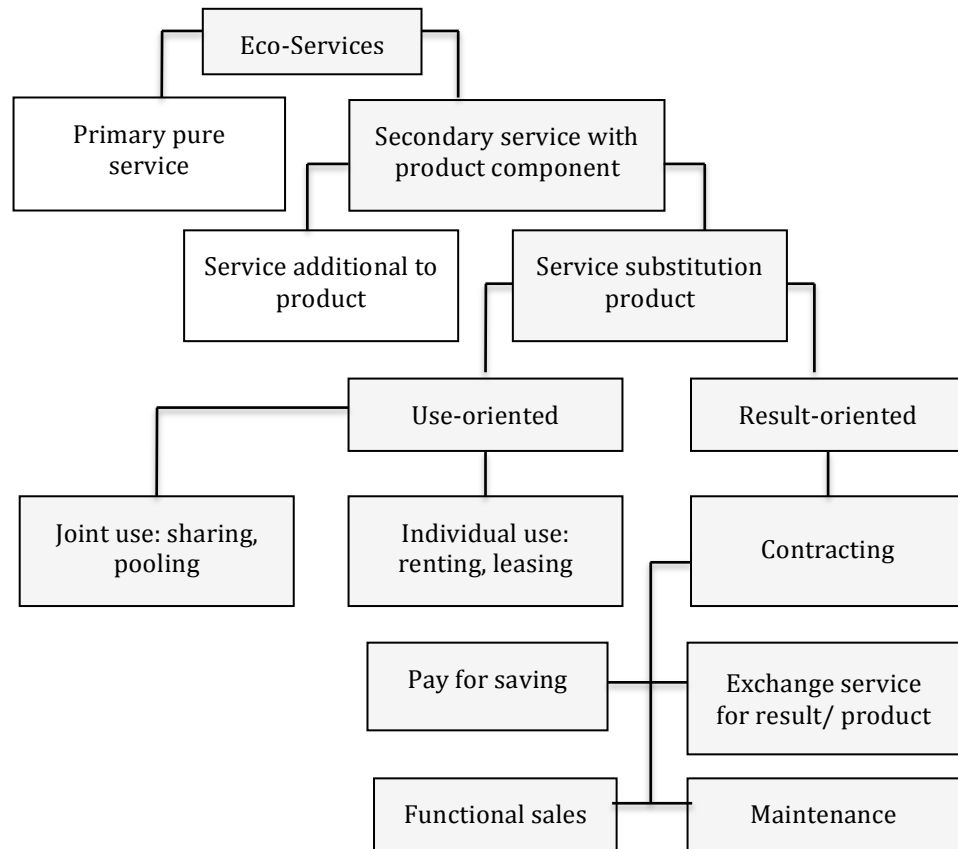
Co-creation builds on the integration of customers in an open innovation process. This demands on open, transparent development process, contrary to the conventional practice of keeping innovation closed and secret. (Piller and Lindgens, 2012: 187)

## ANNEX 5. INTERVIEW QUESTIONS FOR COMPANIES OF ESTONIAN TEXTILE AND APPAREL INDUSTRY

1. What do you consider being the biggest environmental impacts of your company? Inside the production cycle as well as during the whole product life-cycle.
2. Which innovations/changes have been done in recent years (or being planned) which also help decreasing environmental impacts?
  - Management system: certificates, calculation of parameters, training, feedback, changes in responsibilities, new goals, improvement etc.
  - Production and sales: decreasing pollution *versus* optimizing processes *versus* innovation in design; technological *versus* non-technological; main processes *versus* auxiliary processes
  - Innovations in input: water, energy, material spending, choice of materials, choice of methods
3. Which have been the most important impacts from these innovations for the company?
  - Reducing costs
  - Success of the product/service, quality increase
  - Increase in capacity, process speed, flexibility, productivity
  - Employer satisfaction, improvement in working conditions
  - Influence to other companies or interest groups
4. How are the impacts calculated? Any method, indicators, measuring tools? Do you calculate environmental costs? Which indicators could be used for presenting the environmental improvements of your company to interest groups outside the company?
5. How big (magnitude, % of turnover) could be the investment in reducing environmental impacts in last 2 years (including investments where the environmental impact was a side-effect)?
6. Do you have a person or team (e.g. development team) who deals with environmental issues or design? In Estonia or on corporate level?
7. Are the abovementioned changes innovative internally for the company, innovative in Estonian market or innovative on global market? Any patents?

8. What are the main drivers for making such changes? (law, regulations, standards; client interests; market conditions; competitive advantage; owners interests; trends and unwritten agreements inside the industry sector)
9. Are the changes mainly internal developments (in Estonian company); on corporate level; based on cooperation with research organisation, consultation company etc. or a bought-in solution? Are you satisfied with the cooperation?
10. What has been or could be the best support for you, what could be improved? Cooperation possibilities; positive examples, benchmarking; databases, information; consultation, training; financial support; infrastructure; eco-labels, consumer campaigns.
11. Have you done or ordered any research as a pre-study for innovation? Is there a good possibility to do that (potential partners) and enough information?
12. Where do you gather information about new developments, market possibilities, market changes etc. E.g. cooperation partners, fairs, research, industry union, media, internet etc.
13. What kind of information is lacking? E.g. material specific, technological, marketing information, cooperation possibilities, environmental issues, etc.
14. What are the main barriers for implementing changes (slowing it down, plan has been dropped etc.)? Internal vs external; regulations; financial issues; lack of knowledge; lack of motivation; lack of possibilities (employment, suppliers, partners)
15. Have you reached your expected goals while implementing a change or innovation?

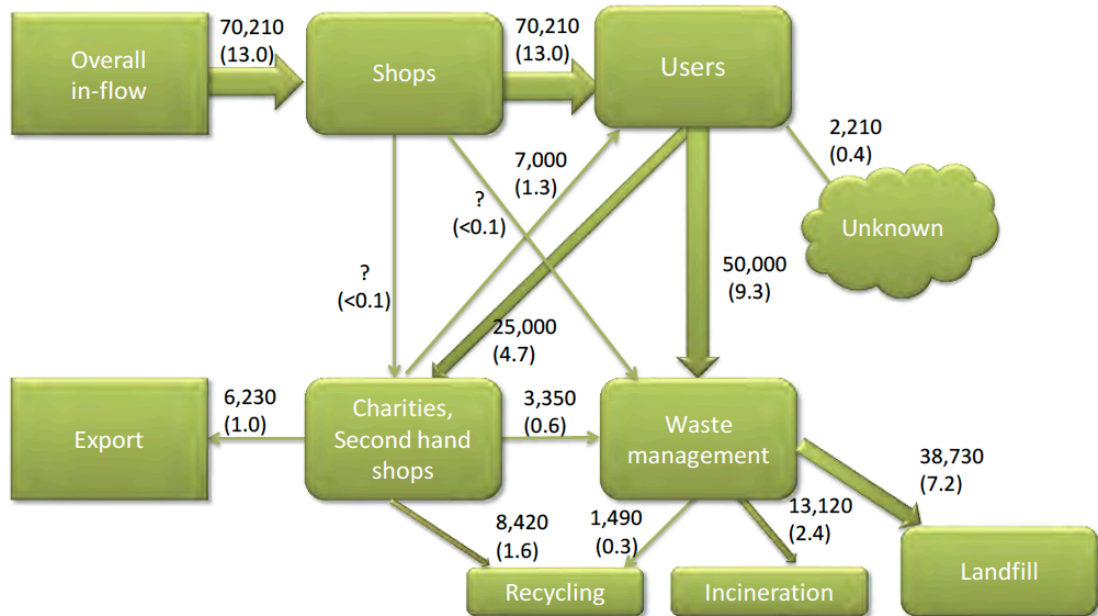
## ANNEX 6. FRAMEWORK OF ECO-SERVICES



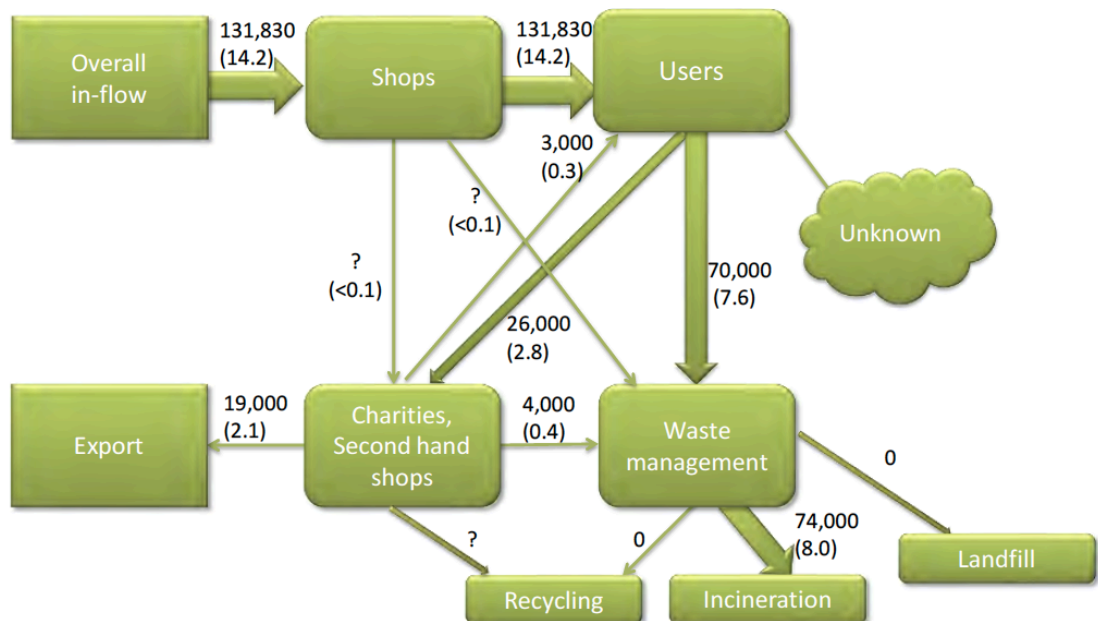
**Figure 17.** Classification of different types of eco-services. Source: Behrendt et al, 2003: 15; additions made by the author

## ANNEX 7. TEXTILE MATERIAL FLOWS IN FINLAND, SWEDEN AND DENMARK IN 2010

Figures are taken from the survey done by Tojo *et al* and published by Nordic Council of Ministers in 2012. Each flow is described in full amount (tonnes) and kg per capita given in brackets.

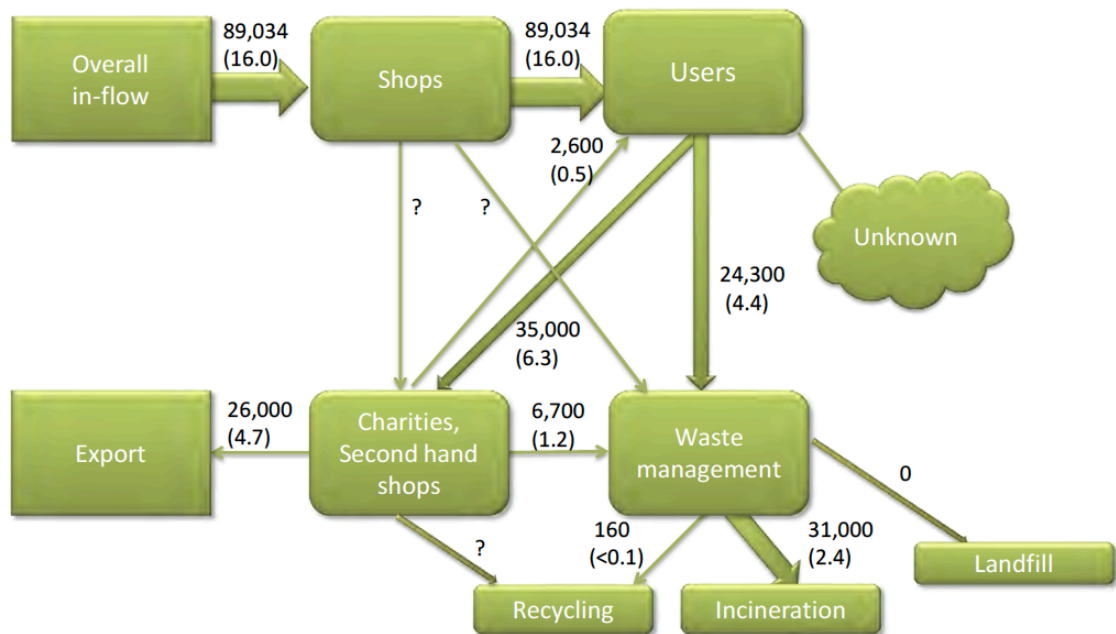


**Figure 18.** Estimated textile flow in Finland in 2010 (Tojo *et al*, 2012: 40)



**Figure 19.** Estimated textile flow in Sweden in 2010 (Tojo *et al*, 2012: 45)

## Annex 7 continues



**Figure 20.** Estimated textile flow in Denmark in 2010 (Tojo et al, 2012:30)

## **ANNEX 8. FUNCTIONAL DESCRIPTION OF THE TRASH TO TREND PLATFORM**

The Trash To Trend web platform will be offering the following services in the future (NGO Reuse, 2013):

- 1) Designers:
  - Information about textile waste flows both locally and globally;
  - Feedback on design ideas from potential clients (producer or end-user);
  - Online store for selling ready-made products, or professional DIY instructions;
  - Learn and get support: workshops, instructions, access to materials and specially targeted support services (e.g. environmental impact calculator).
- 2) Textile and apparel production companies
  - Find output for their waste (either by implementing upcycling in-house, offering materials to small textile and apparel production locally, finding opportunities for industrial symbiosis);
  - Find support in selling upcycled products with less marketing effort.
- 3) Textile sorting facilities
  - Get the opportunity to sort out materials with good fabric quality for material reuse and have a market value for it.
- 4) First pioneers in sustainable fashion, followed by early majority
  - Give feedback on design ideas
  - Purchase highly sustainable products with high design value and transparent story
  - Find nearest tailor to get a design item made from your own or other local waste materials
- 5) Local service providers
  - Build new business models based on value added by the platform (e.g. improved tailoring services whereas design is purchased from TTT to lower design cost; interim storage of materials for local designers and tailors; focusing only on design without the need to offer related services etc.).
  - Have a market-place to introduce the local services to targeted audience



## **ANNEX 9. THE PUBLICLY CLAIMED ROLES OF SUPPORT ORGANISATIONS IN ESTONIA**

**Ministry of the Environment** - national environmental and nature protection: utilisation of natural resources and environmental protection, balanced development of economic and social spheres, ensuring a well-functioning system necessary for the achievement thereof as well as the purposeful and well-considered use of resources allocated to environmental protection. ([www.envir.ee/67244](http://www.envir.ee/67244))

**Ministry of Economic Affairs and Communications** – creating overall conditions for the growth of the competitiveness of the Estonian economy and its balanced and vital development through the drafting and implementing Estonian economic policy and evaluating its outcomes. ([www.mkm.ee/326384/](http://www.mkm.ee/326384/))

**Estonian Chamber of Commerce and Industry** – developing entrepreneurship in Estonia by providing business-related services (consultation, information services, training and foreign trade documents), speaking actively on the behalf of the Estonian business community in policy developing; 3200 members. ([www.koda.ee/en/chamber-of-commerce/about-chamber-of-commerce/](http://www.koda.ee/en/chamber-of-commerce/about-chamber-of-commerce/))

**Enterprise Estonia** – strategic objectives: increase in the number of sustainable and quickly growing companies; increase in the export capability and internationalisation of Estonian companies; increase in the product development and technological capabilities of Estonian companies; increase in revenue from tourism; integrated and balanced regional development. EAS is one of the agencies implementing EU structural funds in Estonia. ([www.eas.ee/en/eas/overview](http://www.eas.ee/en/eas/overview))

**Estonian Development Fund** (since 2007) – initiating and supporting changes that would accelerate modernisation of the economic structure, lead to growth in exports and contribute to creating new jobs requiring high qualifications. They organise foresight projects and make venture capital investments. ([www.arengufond.ee/eng/about/aboutus](http://www.arengufond.ee/eng/about/aboutus))

**Environmental Investment Centre** – channelling the proceeds from the exploitation of the environment into environmental projects, to perform as the implementing agency for

the environmental projects funded by the European Structural Funds and to lend money for the implementation of environmental projects. ([kik.ee/en/about-us](http://kik.ee/en/about-us))

**Incubators of Estonia** – supporting the growth of start-up companies and accelerating business opportunities: 3 technology incubators, 3 creative incubators and 3 other type of incubators. ([www.eas.ee/et/alustavale-ettevotjale/eas-i-lahendused-ja-toetusvoimalused/ettevotlusinkubatsiooni-programm/tule-inkubaatorisse](http://www.eas.ee/et/alustavale-ettevotjale/eas-i-lahendused-ja-toetusvoimalused/ettevotlusinkubatsiooni-programm/tule-inkubaatorisse))

**The Estonian Clothing and Textile Association** (since 1993) – promoting the development of the clothing and textile industry and represent and protect the common interests of Estonian clothing and textile producers; 57 members who employ ca 4 400 people and constitute over 75% of net sales of clothing and textile industry of Estonia. (<http://www.textile.ee/en/about-ecta>)

**Stockholm Environmental Institute Tallinn** (SEI, since 1992) – part of international SEI network, is engaged in environment and development issues at local, national, regional and global policy levels offering scientific insights to give guidance through change and inform decision-making and public policy. ([www.sei-international.org/about-sei](http://www.sei-international.org/about-sei))

**The Estonian Association for Environmental Management** (since 2003) – acts as moderator and brings together enterprises, organisations and individuals, who need help, support and information related to corporate environmental management for solving environmental problems, reducing impact to the environment and ensuring sustainable development of the society, 51 members. ([www.ekja.ee/index.php?m=269&l=36&ava=1](http://www.ekja.ee/index.php?m=269&l=36&ava=1))

**Estonian Council of Environmental NGOs** (since 2002) helps environmental activists jointly achieve the environmental protection goals that are important for all of the members, main actions in forestry, agriculture, and energy policies and planning decisions, 9 members (<http://www.eko.org.ee/in-english/>)

**New Use Centre** (since 2010) – enabling the second use round for household items and textiles, offering training programmes for schoolchildren, mapping waste and helping to reduce waste generation (<http://uuskasutus.ee/meist/>)

## RESÜMEE

### **ÖKO-INNOVATSIOONI EDENDAMINE TAGAMAKS NEUTRAALSE KESKKONNAMÕJUGA MATERJALIVOOD EESTI RÕIVA- JA TEKSTIILITÖÖSTUSES**

Maailma rahvastiku, heaolu ja tarbimise pidev ja kiirenev kasv tekitab globaalselt järjest suuremat keskkonnakoormust. Avalikus diskussioonis avaldatakse sageli kahtlusi, kas globaalne tööstus on suuteline piisavalt kiiresti tootmise ja tarbimisega seotud keskkonnamõjusid vähendama (Hoffmann, 2011). Kui Schumpeter (1950), evolutsioonilise majandusteooria rajaja, kirjeldas majandusprotsesside tõukejõuna peamiselt kapitalistlikku mõttelaadi ja innovatsiooni, siis nüüdseks on mõistetud, et evolutsioonilise arengu puhul mängivad samaväärselt tähtsat rolli ka looduskeskkond ja sotsiaalsed aspektid – erinevate tegurite koostoime. Tõhusaimaks meetmeks vajalike süsteemsete muutuste tekitamiseks peetakse seega innovatsioone, mis võtavad arvesse ka negatiivseid kõrvalmõjusid. Käesolev magistritöö keskendus eelkõige öko-innovatsiooni temaatikale jättes sotsiaalse innovatsiooni tahaplaanile.

Öko-innovatsioon kui kontseptsioon on küllaltki uus - teoreetilise kirjanduse üheks teerajajaks võib pidada Porterit (1995). Teemat käsitletakse enamasti kas avaliku sektori vaatenurgast või üksikute organisatsioonide tegevuse analüüsimisel. Ettevõtete ja organisatsioonide tegevuse toetamiseks on aga vajalik ka tegevusharu põhise vaatenurga pakkumine erasektori huvisid silmas pidades. Seeläbi läheb rõhuasetus keskkonnamõjude vähendamisele ja ressursside kokkuhoiult (negatiivne lähenemine) hoopis sellele, kuidas kogu maailmas aktuaalseks muutunud keskkonnateemad ettevõtetele uusi võimalusi pakuvad (positiivne lähenemine).

Käesoleva magistritöö eesmärgiks oli välja töötada soovitusel, kuidas pakkuda tuge öko-innovatsioonideks Eesti rõiva- ja tekstiilitööstuses, et liikuda neutraalse keskkonnamõjuga kuid majanduslikult elujõuliste materjalivoogudeni võttes arvesse globaalset olukorda ja pikaajalist arengudünaamikat sektoris. Selleks, et paremini mõista tööstusharus toimuvaid keskkonnateemadest tingitud pikaajalisi muutusi, oli vajalik välja töötada uus mudel tööstusharu väärtusahelate kirjeldamiseks. Töö tulemusi on plaanis rakendada MTÜ Reuse tegevuse eesmärkide ja ülesannete sõnastamisel, et oma igapäevatöö abil öko-innovatsiooni tööstusharus võimalikult tõhusalt edendada.

Eesmärgi saavutamiseks püstitati neli ülesannet. Esiteks oli vajalik lahti kirjeldada öko-innovatsiooni olemus ja toimemehhanismid luues seejuures selgust erinevate lähenemiste hulgas. Teiseks kirjeldas töö öko-innovatsioonidest ja keskkonnatemaatikast tingitud muutusi globaalses rõiva- ja tekstiilitööstuses pakkudes olemasoleva olukorra ja trendide põhjal välja uue tulevikuperspektiivi kirjeldava väärtusahela mudeli. Kolmandaks ülesandeks oli hinnata mudeli rakendatavust. Selleks kitsendas autor teemat ning uuris kahe näite abil teenuseid, mis keskenduvad materjalivoogude tõhustamisele. Ning viimaseks ülesandeks oli analüüsida Eesti rõiva- ja tekstiilitööstuse olukorda ja arenguvõimalusi, et selle põhjal anda soovitusi tulevikuks. Täpsemalt uuriti tööstusharus öko-innovatsioonide esinemist, materjalivoogusid, nõudlust uut tüüpi toodete ja teenuste järele ning erinevate osapoolte rolli öko-innovatsiooni edendamisel. Kuna tegemist on väga tugevalt ekspordile orienteeritud tööstusharuga, toodi mitmeid võrdlusi Põhjamaadega kui oluliste olemasolevate eksportturgudega, kus keskkonnateadlikkus ühiskonnas on suhteliselt kõrge.

Töö esitas teoreetilist materjali, varasemate uuringute tulemusi ja autori omapoolset panust läbisegi põimides, et anda sujuvamat ülevaadet teemast. Empiiriline panus sisaldas muuhulgas intervjuude tegemist (kevad 2011, lisaküsimused kevadel 2013) kuue suurema rõiva- ja tekstiilitööstuse ettevõttega Eestis, tarbijaküsitlust 482 vastusega, arvutuskäike avalikult kättesaadavate andmete põhjal, et kirjeldada tekstiilmaterjalide voogusid ja mahtusid Eestis ning autori kogemust osalemisel MTÜ Reuse ja Aus Design OÜ meeskonnatöös.

Põhiline järeldus, mille töö teoreetilisest osas võiks esile tõsta on seos ennetava (proaktiivse) ja võimalusi otsiva suhtumise ja öko-innovatsiooni saavutuste vahel. Täpsemalt, mida rohkem organisatsioon juurtab keskkonnateemasid oma strateegiasse ja pikaajalistesse plaanidesse, seda suurem on tõenäosus, et tulemusena pakutakse turule neutraalse keskkonnamõjuga ning majanduslikult edukaid tooteid, teenuseid, protsesse või süsteeme. Ühtlasi eeldab see rõhuasetuse panemist pigem radikaalsetele uuendustele, mis paraku on oluliselt keerulisemad saavutada võrreldes täiendinnovatsioonidega.

Organisatsiooni suurus, struktuur, asukoht, tootlikkus, turupositsioon, finantseerimisvõimalused ja muud sarnased traditsioonilised parameetrid ei anna ettevõtetele olulist eelist radikaalse keskkonnainnovatsiooni edukaks turule toomiseks. Märksa olulisemaks võib pidada uudset lähenemist ärimudelitele või väärtuspakkumisele, mis on tavaline pigem uute algatuste hulgas ning ennetav suhtumine radikaalsete uuendustega kaasneva ebakindluse vältimiseks. Samuti annab eelist see, kui uuendus sisaldab endas keskkonnateemade kõrval ka sotsiaalseid aspekte.

Põhilisteks takistusteks on aga väga suur ebakindlus erinevate teemade lõikes, oskuste ja teadmiste puudumine ning vastumeelsus muutustele. Näiteks on olemasolevatele ettevõtetele takistuseks nende huvi hoida kinni oma juba toimivast ärimudelist, mistõttu ei märgata uusi võimalusi radikaalseteks muutusteks. Kuid rakendades teadlikke meetmeid ebakindluse vähendamiseks ning võttes eesmärgiks keskkonnateemadest uut konkurentsieelist kasvatada, on võimalik saavutada olukord, kus üks innovatsioon toob kaasa järgmise ning pidev edasi liikumine loob pidevat eelist ja õppimisvõimalust võrreldes konkurentidega. Juhul kui majanduslik tulu tundub esialgu ebaselge, võib eelise saavutada isegi vaid info kogumise ja avalikus dialoogis osalemise teel, et tingimusi ettevõtte jaoks sobivamas suunas kujundada ning ettevõtte jaoks sobivaid lahendusi leida.

Kirjanduse ülevaade võimaldas selgitada, et öko-innovatsioonide puhul võib rääkida kolmedimensionaalsest mõõtkavast, kus üks telg on kvantitatiivne, teine kvalitatiivne ja kolmas ajaline. Kvantitatiivselt saab kirjeldada öko-innovatsiooni nii, nagu teeb seda OECD (2009), kus keskkonnategevused on mõõdetavad. Kvalitatiivselt saab kirjeldada öko-innovatsiooni nii nagu seda teeb ringmajanduse mudel, mis keskendub

keskkonnamõjudele läbi kogu materjalide elutsükli ja aineringluse ning mille puhul tulemuste mõõtmine on märksa keerulisem. Ning ajalist mõõdet kirjeldab funktsionaalse majanduse teooria (Stahel, 1997), mis selgitab vajadust materjalide ringlust aeglustada. Kui öko-innovatsioon tegeleb korraga kõigi kolme mõõtmega, võiks seda nimetada põhjalikuks öko-innovatsiooniks.

Selle kolmedimensionaalse mõõtkava põhjal võib öelda, et keskkonna suhtes neutraalne materjalide voog ei tähenda lihtsalt sekundaarsete materjalide paremat kogumist ja rakendamist või kasutatavate ressursimahtude korrigeerimist st. keskendumist kvantiteedile ja efektiivsusele. Pigem on vajalik rääkida paljudest uutest materjaliringluse võimalustest, selleks vajalikest teenustest ning materjalide täiustamisest st. keskendumist keskkonnakvaliteedi ja materjaliringluse kiiruse teemadele.

Kui vaadata, mis toimub globaalses rõiva ja tekstiilitööstuses, siis enamasti keskenduvad turuliidrid justnimelt kvantitatiivsel skaalal tegutsemisele (sekundaarse materjali kogumine ja taaskasutusse suunamine, sh. uuesti kangaks ümbertöötlemine). Uued algatused pakuvad aga lahendusi kvalitatiivselt ja materjaliringlust aeglustavalt (keskkonnasõbralikud materjalid, öko-disain, niššitooted ja turud, läbipaistvad uued teenused ja keskendumine kohalikele turgudele). Kuigi uutel algatustel on üldjoontes sarnased pikaajalised ambitsioonid, siis ei ole omavaheline koostöö ja sünergia veel piisav, et tekitada domineeriva turumudeli suhtes konkurentsivõimelist alternatiivset mudelit. Nii kirjanduse ülevaade, sektoris aset leidvad muutused kui autori kogemus viitavad sellele, et suhteliselt kiire ja eduka radikaalse öko-innovatsiooni eelduseks võiks olla sünergia tekitamine uute väikeste initsiativide vaatenurga ja olemasolevates küpsetes ettevõtetes leiduvate kompetentside vahel.

Rõiva- ja tekstiilitööstus on globaalselt väga killustatud ning väärtusahelas on erinevad rollid tugevalt fikseerunud. Samal ajal on erinevad sektorit mõjutanud kriisid näidanud, et struktuursed muutused on valdkonnas pidev protsess ning kohanemisvõime muutuva olukorraga on tegelikult väga kiire. Üks hetkel suuri muutusi põhjustavaid teemasid on kasvavad jäätmemahud ning materjalivoogudes sisalduvad peidetud keskkonnamõjud (sh. kemikaalide ning vee ja energia kulu). Kui Euroopas tegeletakse peamiselt

tarbijajääkidega, siis Aasias on probleemiks tootmisjäägid, kasutamata või praaktoodang (ehk nn. tarbija-eelne jääk) on probleemiks aga mõlemal pool.

Üldlevinud on arusaam, et keskkonna seisukohalt oleks parim viis jääkide kasutamiseks liikumine nn. jäätmehierarhia põhiselt (vaata nt. EL jäätmedirektiiv, Beton *et al.*, 2011). Käesolevas töös täiendati jäätmehierarhiat tehes vahet väärtust tõstval taaskasutusel ja väärtust kahandaval taaskasutusel, kasutades seega termineid, mis on küll palju praktilist rakendust leidnud, kuid mida teoreetilises kirjanduses vähe kasutatakse. Veelgi enam, töös tehti väärtust tõstva taaskasutuse puhul vahet ka sellel, kas seejuures on vajalik materjali ümbertöötlemine või mitte, st. mil määral on vajalik täiendavate ressursside kasutamine taaskasutusel. Tegemist on olulise vahega – juhul kui tekstiilijääke taaskasutatakse ilma ümbertöötlemata, võimaldab see säästa üle 80% vee ja energiakulust võrreldes tavalise masstoodangust tuleva tootega (Aus Design & Beximco, 2013). Praktikas peetakse hierarhia madalamaid astmeid (nt. jäätme põletust) üsna kasumlikuks ja kõrgemaid astmeid mass-lahendustes küllaltki kättesaamatuteks.

Kirjanduse ülevaate, tööstussektoris toimuvate arengute ja globaalse pika-ajalise keskkonnahuvi taustal on peatükis 2.5 esitatud uus väärtusahela mudel (SEE), mis arvestab nii keskkonnavalaste, majanduslike kui sotsiaalsete huvidega. Keskne roll on antud disainipõhisele mõtlemisele nii materjali, toote, protsessi kui teenuse edendamisel. Samuti on kohandatud huvigruppide vahelisi seoseid ja rolle kogu väärtusahela lõikes. Samas arvestab mudel vajadusega säilitada olemasolev infrastruktuur ja kättesaadavad kompetentsid. Mudel kirjeldab kuidas uut väärtust saab luua materjaliringluse võimalusi suurendades, tempot aeglustades (materjalid liiguvad huvigruppide vahel edasi-tagasi minimaalselt ümbertöötlemist eeldades) ning personaliseeritud teenuseid pakkudes. Mudel loob raamistiku ärimudelite väärtuspakkumise hindamiseks, kui kirjeldada seejuures nii majanduslikku, sotsiaalset kui keskkonnavalast mõju. Lühidalt võib öelda, et mudelist lähtumine võimaldab sotsiaalse väärtusena kasvatada usaldust, sotsiaalset kapitali ja vähendada töötust. Keskkonnavalaselt tekib väärtus esmase tooraine kasutamise vähenemisest. Ning majanduslikult tekib väärtus kulude kokkuhoiust, toote funktsionaalsuse kasvust ja personaalse lähenemisega kaasnevast lisatulust.

Välja pakutud SEE mudeli ja tööstusharus toimuvate muutuste taustal analüüsis magistritöö kolmas osa olukorda Eesti rõiva- ja tekstiilitööstuses. Viimase 20 aasta jooksul on sektor läbi teinud väga suured struktuursed muutused ja kahanenud mitmekordselt. Pärast kriisi on aga tekkinud selgus, et tööstusharu on endiselt elujõuline ja innovaatiline keskendudes eelkõige tehnoloogilistele lahendustele ja niššitoodetele. Valdakonna ekspordi fookus on mõne viimase aasta jooksul Põhjamaades ja Lääne-Euroopas vähenenud ning Kesk- ja Ida-Euroopas samas selgelt suurenenud. Muude eelkirjeldatud takistuste kõrval aitab see selgitada, miks öko-innovatsioon on tööstusharus vähe esindatud – öko-innovatsiooni põhiliseks tõukejõuks Eesti ettevõtetes on see, kui tuge annab mõni tugev huvigrupp Skandinaaviast või Lääne-Euroopast.

Eesti tekstiilmaterjali voogude analüüs näitas, et ühe elaniku kohta on Eestis ligi 3 korda suurem materjalide sissevool (47,2 kg elaniku kohta aastas) võrreldes Põhjamaade keskmisega. Põhjuseks on kohalik suhteliselt suur tootmine ja osaliselt ka teise ringi rõivaste sorteerimiskeskuse paiknemine Eestis. Materjalide kogumahud on võrreldes Põhjamaadega vaid veidi väiksemad, kuid vaatamata sellele sisaldavad väga suurt peidetud keskkonnamõju. Umbkaudne arvutuskäik autori poolt ütleb, et 2010 aastal Eestisse imporditavate materjalide kogumahuga kaasnev CO<sub>2</sub> emissioon võis olla enam kui 10 korda suurem kui samal aastal kohaliku energiatootmisega kaasnenud tõestatud CO<sub>2</sub> kogus kokku (mis tekitab ca 90% kogu riigi CO<sub>2</sub> emissioonist).

Sekundaarsete materjalide kohta on statistilist infot Eestis üsna vähe, mis tuleneb võrreldes naaberriikidega väga väikestest materjalikogustest. MTÜ Reuse poolt tehtud jäätme kaardistus viitab sellele, et tekkivat tööstusjääki võib olla tegelikult märksa rohkem. Kuna aga jääke ei sorteerita sageli olmeprügist eraldi, siis on info puudulik, kuid tekstiilijääkide kontsentratsioon võib olmejääkide hulgas olla kohati väga suur. Vaatamata sellele ei paku väikesed kogumahud kohalikele jäätme käitlejatele huvi materjalide kogumise, sorteerimise ja ringlusse saatmisega tegeleda. Seetõttu võiks magistritöös käsitletud kvalitatiivne ja personaliseeritud teenuste (sh. ka äripartnerite vahel) pakkumisele keskenduv lähenemine olla Eestis hästi rakendatav.

Töös leidub mitmeid viiteid (nt. tarbijauuring, eetiliste toodete turuosa Suurbritannias, sektoris toimuvate trendide analüüs), et Euroopa kohalike tootjate ja tarbijate huvide vahel on teatav konflikt (nii ka Eestis). Uusi keskkonnaalaselst täiustatud lahendusi



oodatakse tarbija poolt enam, kui tootjad on suutelised hetkel pakkuma. Kuid rõiva- ja tekstiilitööstusel Eestis on mitmeid tugevusi ja võimalusi, et uusi tooteid ja teenuseid turule pakkuda ja uut konkurentsieelist luua. Tugevustena võiks nimetada suutlikkus suhteliselt suurte materjalivoogudega toime tulla, kogu vertikaalse tootmisahela olemasolu, head tehnoloogilist suutlikkust ning tugevat disaini kompetentsi. Võimalusi pakub suhteliselt lähedane asukoht ja kultuuriline sarnasus keskkonnateadlike turgudega ning erinevate huvigruppide tasemel head sotsiaalsed võrgustikud rahvusvaheliste partneritega. Kuna keskkonnateadlik mood ei arvesta tegelikult riigipiiridega ning on esindatud pigem virtuaalkeskonnas, on Eesti tugevuseks ja võimaluseks ka e-teenustega seotud kogemus ja IT kompetents. Parema koordineerimise, omavahelise koostöö ja motivatsioonisüsteemi olemasolu võimaldaks neid tugevusi hästi ära kasutada, et uusi ärimudeleid ja väärtuspakkumist luua.

Nagu öeldud, oli töös vajalik tõestada uue SEE mudeli toimimist näidete põhjal. Ühtlasi võimaldasid kaks esitatud näidet aga selgitada, milliseid võimalusi mudel pakub Eesti ettevõtjatele. Esmalt vaadeldi Aus Design OÜ tegevust, mis pakub lisaväärtust Bangladeshis suurima kanga- ja rõivatootjaga koostööd tehes. Tootmises täiendavat disainisisendit andes on eesmärgiks tekkiv jääk tootmises maksimaalselt ära kasutada või tootmisesse tagasi suunata pakkudes samal ajal tugevat müügisõnumit kolmandatele osapooltele (st. suurbrändidele). Teise näitena kirjeldas töö *Trash To Trend* (TTT) veebiplatvormi, mille eesmärgiks on pakkuda huvigruppide vahel kommunikatsiooniteenuseid, et anda võimalust jääke mitmekülgset väärtusahelas kasutada ilma, et olemasolevat globaalset infrastruktuuri oleks vaja olulisel määral ümber kohandada. Mõlemad näited toovad disaineri rolli tavalise väärtusahelaga võrreldes keskele kohale ning loovad potentsiaalselt üsna tugevat sotsiaalset, keskkonnaalast ning majanduslikku lisaväärtust. Kuna aga mõlemad algatused on veel arendusjärgus, ei ole tulemused veel täielikult vaadeldavad.

Magistritööst saab järeldada, et põhiliseks meetmeks, kuidas soodustada põhjaliku öko-innovatsiooniga tegelemist ja juurutamist, on tihe temaatiline koostöö tööstusharuga seotud huvigruppide hulgas ja neile tuge pakkuvate organisatsioonide vahel. Olgugi, et lihtsam on oodata avaliku sektori tõuget keskkonnateemadega tegeleda, on oluline nn. ennetav ja aktiivne hoiak, et ühiselt lahendada mitmeid probleeme, mis jäävad ühe

organisatsiooni tegevusvaldkonnast ja kompetentsidest väljapoole. Töö viimane alapeatükk kirjeldas Eesti erinevate olemasolevate organisatsioonide praeguseid ja võimalikke rolle öko-innovatsiooni toetamisel. Selle põhjal kirjeldati, milline võiks olla MTÜ Reuse tegevuse eesmärk ja ülesanded, et puuduvaid ülesandeid (vahendaja rolli) enda kanda võtta või koostöö läbi teisi organisatsioone toetada. Põhiliseks rolliks võiks olla öko-innovatsioonile keskenduvate uute väiksemate algatuste jaoks ühise katuse ja koostööplatvormi loomine, ühiste eesmärkidega seotud teenuste pakkumine tööstusharus ning huvigruppide vahelise kommunikatsiooni ja koostöö edendamine (nt. osaliselt TTT platvormi abil).

Magistritöö tõstis esile mitmed täiendavad teemad, mis tulevikus veel uurida tasuks. Näiteks oleks vajalik uurida, kuidas saaks avalikke statistiliselt vaadeldavaid mõõdikuid täiustada selliselt, et need võtaks arvesse kõiki kolme öko-innovatsiooni dimensiooni, ilma et täiendinnovatsiooni liialt üle ei tähtsustataks. Erinevaid töös käsitletud teemasid on võimalik ka mitmel muul moel avaliku poliitika arengu analüüsis rakendada. Ühe olulise kõrvalteemana kerkis töös pidevalt esile teadmiste loomise mehhanismid ning see, kuidas organisatsioon täpsemalt peaks põhjaliku öko-innovatsiooni eesmärgi oma strateegiasse ja eesmärkidesse juurutama (näiteks nn. nakatava juhtimismeetodi rakendamine tööstusharus on üks kontseptsioon, mida tasuks vaadelda). Praktilisema poole pealt on edaspidiseks uurimisteenaks see, kas välja pakutud mudel pikaajalises plaanis toimib ning on suuteline nii keskkonnaalaseid, sotsiaalseid kui ka majanduslikke huvisid võrdsel määral esindama. Ja viimaks on vajalik selgitada, kas sama SEE mudelit oleks võimalik üks-ühele rakendada ka teistes tööstusharudes või on vajalik mudeli mõningane kohandamine.

SEE mudel võiks pikas perspektiivis pakkuda raamistikku selgitamiseks, kuidas tööstus saab toimida põhimõttel, et pole olemas sellist asja nagu jääk - tööstus tegeleb vaid kasulike materjalide ringluse korraldamisega.

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Mina Ann Runnel (sünd. 19.05.1982)

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