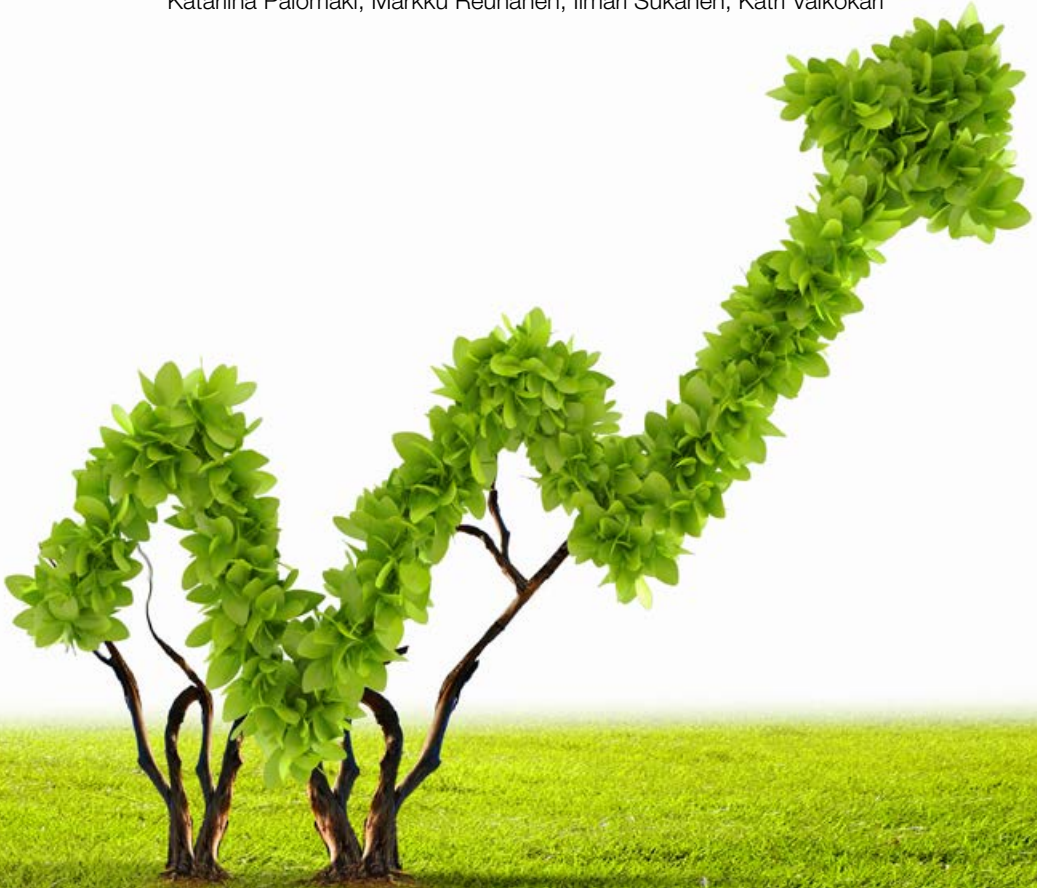





StraSus

Sustainable business – Case studies from Finnish forerunners

Pasi Valkokari, Nina Tura, Miia Martinsuo, Kenneth Dooley, Jyri Hanski, Jere Jännes, Jesse Kivilä,
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Sustainable business

– Case studies from Finnish forerunners

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SEARCH for sustainability and its role in managing business development activities

- WORLD
- EUROPE
- AMERICA
- ASIA
- AFRICA

“Strategic business models and governance for sustainable solutions”





Preface

There is a wide discussion on companies' search for sustainability and its role in managing business development activities. Different aspects of business development have been regarded as central in achieving sustainability in firms and networks. This publication presents key focus areas in sustainable business development and practical cases where different approaches to sustainability were created. The developed frameworks can be utilised in developing sustainable offerings and practices in the business of various companies and their business networks.

The research and development project called "Strategic business models and governance for sustainable solutions" has sought for new knowledge on how companies can take sustainability into consideration at the different phases of a solution's life cycle. The research work was conducted by VTT Technical Research Centre of Finland Ltd, Lappeenranta University of Technology, Tampere University of Technology and Aalto University. The development work was carried out in close co-operation with companies to form new practical knowledge regarding the development of sustainable business, in terms of strategic decision making, business development and innovation orchestration. New knowledge can be integrated into the solution development processes and refined into new services and business models throughout the solution lifecycle.

The authors wish to thank the StraSus companies - Ekokem, Fortum Power Solutions, Nokia, Solita and Vapo Clean Waters - and the steering group members for active cooperation during the project. The project was funded by Tekes Green Growth programme and participating organisations.

3.12.2015

AUTHORS

Tiivistelmä

Kestävä kehitys muuttaa yritysten ajattelutapaa ja yritysten välistä kilpailua. Luonnonvarojen niukuuden vuoksi yritysten on omien taloudellisten tavoitteidensa lisäksi huomioitava ympäristö- ja sosiaaliset tekijät liiketoiminnan tavoitteita asettaessa. Tämä julkaisu esittelee käytännön esimerkkejä, joissa on luotu erilaisia lähestymistapoja kestävän kehityksen mukaisen liiketoiminnan edistämiseksi. Esimerkkien kautta, julkaisu tarjoaa yritysten edustajille näkökulmia kestävien liiketoimintaratkaisujen johtamisesta, kehittämisestä ja innovoinnista.

Tämä julkaisu osoittaa, kuinka liiketoiminnan kestävän kehityksen mukaisella tiellä voidaan edetä seuraavien aihealuiden mukaisesti:

- 1) kestävän kehityksen mukaisen arvon ymmärtäminen**, huomioonottaen:
- 2) strateginen päätöksenteko**,
- 3) liiketoiminnan kehittäminen** ja
- 4) innovaatiotoiminnan orkestrointi**.

Julkaisun rakenne noudattaa samaa logiikkaa ja esittää käytännön tapausesimerkkejä näistä aihealueista. Julkaisussa esiteltäviä menetelmiä ja työkaluja sovellettiin ja edelleen kehitettiin yritysysteistyössä, johon osallistuivat Ekokem, Fortum Power Solutions, Nokia, Solita ja Vapo Clean Waters.

Tämä julkaisu yhdistää tärkeimmät tulokset työstä, joka toteutettiin "*Strategic business models and governance for sustainable solutions*" hankkeessa (StraSus). Hanke käynnistyi joulukuussa 2013 ja se jatkui helmikuuhun 2016 saakka. Tutkimustyöhön osallistuivat VTT, Lappeenrannan teknillinen yliopisto, Tampereen teknillinen yliopisto ja Aalto-yliopisto, ja tutkimus toteutettiin osana Tekesin Green Growth ohjelmaa.

Projekti tarjosi hyvän yleiskuvan kestävän liiketoiminnan kehittämisen vaatimuksiin monialaisen osaamisen kattavassa usean yrityksen ympäristössä. Koska StraSus lähestymistapa oli laaja, on joitakin kehitettyjä lähestymistapoja syytä edelleen jalostaa, jotta ne tarjoavat käytännön työkaluja yrityksille ja organisaatioille. StraSus työtä siis jatketaan ja uusien tutkimus- ja kehityshankkeiden valmistelu on käynnissä yhdessä toimijoiden kanssa, jotka ovat kiinnostuneita kestävän kehityksen mukaisen liiketoiminnan luomisen valmiuksiensa parantamisesta. Esimerkkejä uusista aiheista seuraavien vaiheiden tutkimukseen ovat mm:

- Kestävän kehityksen strategioiden toteuttaminen läpi ratkaisun elinkaaren
- Symbioottiset liiketoimintasuhteet teollisissa ekosysteemeissä
- Datasta viisauteen – kiertotalouden mahdollistavat lähestymistavat.



Executive Summary

The quest for sustainability has already transformed the competitive landscape and is changing the mindsets of companies. Since natural resources are scarce, actors doing business must take into account not just the economic goals, but they also need to address the environmental and social objectives in executing business. This publication presents the results of practical case studies where different approaches for sustainable business were created. The results offer an opportunity for different representatives of various companies to compare their own practices and learn from practical cases in sustainable business models and governance.

This publication shows the path towards sustainable business through the following themes:

- 1) understanding the value of sustainability**, and considering it in:
- 2) strategic decision making,**
- 3) business development** and
- 4) innovation orchestration.**

The structure of the publication follows the same logic and presents practical case examples in these topics. Tools and methods were applied and further developed within the case companies: Ekokem, Fortum Power Solutions, Nokia, Solita and Vapo Clean Waters.

This publication combines the main results of the work carried out within the “Strategic business models and governance for sustainable solutions” project (StraSus). The project started in December 2013 and it continued until February 2016. The research work was conducted by VTT, Lappeenranta University of Technology, Tampere University of Technology and Aalto University as a part of the Green Growth programme of Tekes. The project provided a good overview of the demands of sustainable business in a multi-disciplinary multi-company setting. Since StraSus had a broad scope, some of the developed approaches need to be further enhanced and refined to provide practical tools for practitioners (companies and organisations). The work of StraSus is therefore being continued. Case-specific projects are being considered to develop practical results for the needs of practitioners interested in improving their capabilities for sustainable business creation. Examples of new topics for the next steps of research include e.g.:

- Sustainability strategies implementation through the life cycle of the solution
- Symbiotic business relationships in industrial ecosystems
- From data to wisdom – approaches enabling circular business.

1. Introduction

Many companies have challenges in seeing the actual value of sustainability in their business. Identifying the overall value of sustainability is a highly complex task where multiple dimensions and stakeholders, each influenced by different factors, need to be accounted for. Seeing the value of sustainability is hampered by the ambiguity of sustainable development and confusion of terminology, data and methods of measurement. Links between corporate performance and sustainable value are not clear.



Due to the scarcity of natural resources, actors doing business must take into account not just the economic goals but also the need to meet environmental and social objectives in executing business. Thus, acknowledging that economic, environmental and social impacts occur at all life-cycle stages, reaching the whole value network down to the customer use. This suggests not only being able to manage internal operations of the organisation, but also ensuring that all the network members follow the same principles and norms that might have an impact on the sustainable solution delivery performance. The quest for sustainability is already starting to transform the competitive landscape, and is forcing companies to change the way they think. As sustainability is by nature a future oriented approach, smart companies start their journey towards sustainability from the future business opportunities instead of focusing on their current business approach¹.

This publication presents the results of the practical cases where different approaches were created and aims to show how these developed frameworks could be utilised in developing the sustainable offerings. This is done to offer an opportunity for different representatives of various companies to compare their own practices and learn from practical cases in sustainable business models and governance.

When business actors are empowered to change their thinking, sustainability becomes an essential part of their strategies, and it can be seen as a mother lode of innovations as well as a key driver for business development. In other words, sustainable business can be gained through the following themes (Figure 1):

- 1) understanding the value of sustainability**, and considering it in:
- 2) strategic decision making**,
- 3) business development** and
- 4) innovation orchestration.**

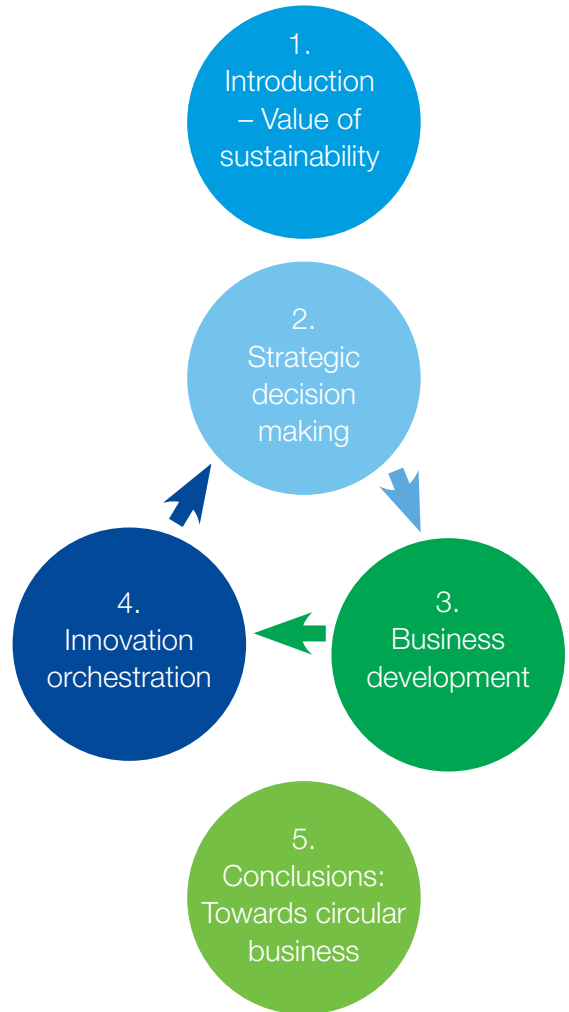


Figure 1. The key themes of the research.

The structure of the publication follows this logic and presents practical case examples from strategic decision making, business development and innovation orchestration towards sustainability in each of the three main chapters. We hope that it can support companies to change their thinking, to consider when they are able to compare their practices, and to learn from the practices of other companies within the same journey.

¹Nidumolu et al. 2007

1.1 CASES

Ekokem

Ekokem is a Finnish company providing comprehensive waste and energy management services. Their aim is to modify the current mentality of the consumer society towards a more recycling-oriented mindset (theme 1 & 2). In this ambitious challenge they seek to understand what sustainable value is (theme 1), how it is created (theme 2 & 3) and how they, as a company, can support companies in the creation of sustainable value (theme 3). The results of the study gave insight about Finnish companies' thoughts and perceptions on sustainability and strengthened Ekokem's understanding and view on their customers'

processes and needs related to sustainable operation and their vision about circular economy.

The collaboration with Ekokem started with a preliminary study and evolved to cover three cases, all of which were customers of Ekokem. The picture above states the progression of the case. First, a preliminary study was conducted that led to the identification of interesting topics and cases. Then, the main study with three customers of Ekokem was completed. Case-specific results were discussed, and finally, key conclusions from the cross-case analysis were reported.

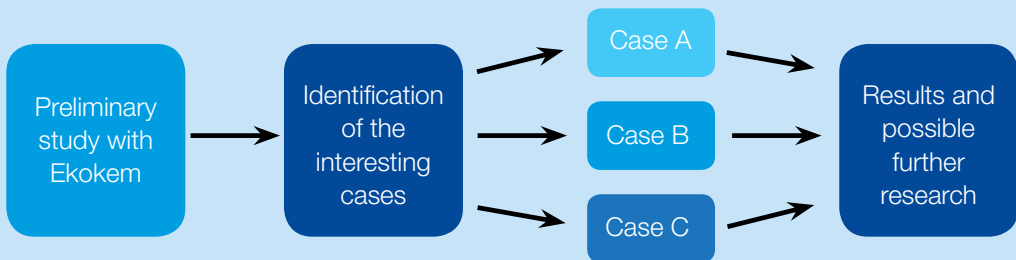


Figure 2. Study with Ekokem.

Fortum Power Solutions

Fortum is a energy company operating power plants, generating and selling electricity, heat and steam as well as providing other energy related solutions. They main operating areas include Nordic and Baltic countries, Poland and Russia. Fortum Power Solutions is a business area within Fortum offering wide scale of services from long-term full-scope operation and main-

tenance (O&M) solutions to highly specialised expert products and services.

In the Fortum case, the focus was especially on identifying the sustainability related value elements (theme 1) and finding out how to enhance the collaboration and business within different network actors under sustainability themes (themes 2 & 3). The case included five phases (figure 3):

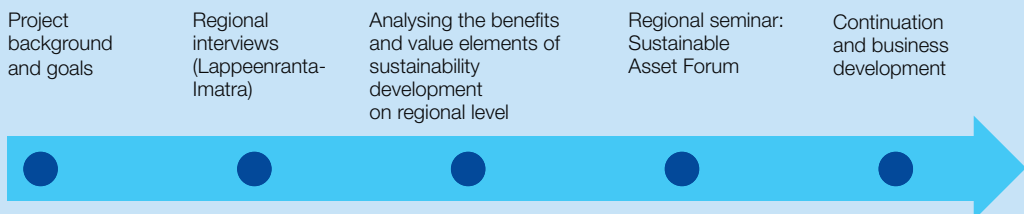


Figure 3. Phases in the Fortum Power Solutions case.

Nokia

Nokia is a leader in the fields of network infrastructure, location-based technologies and advanced technologies. The main goal for the company was to explore how sustainability could drive innovation in their products, services and processes (theme 4). The case focused on capturing and communicating the value that has been achieved through sustainability in Nokia's business operations in recent years. The direct business and environmental benefits of the past innovations have been recorded and communicated with the aim of inspiring a new generation of future innovations.

Two case studies were selected that demonstrate bold strategic decisions to reinvent a long standing organisational practice and to replace a long standing industry practice. These strategies together were the main contributors in delivering significant reductions in carbon emissions from 2011 to 2013. The case also identified future operational innovations that are inspired by the decision making processes of the past case studies.

Solita

Solita is a consultancy specialised in developing digital business and services for its public and private customers. The main products and services of Solita include information management and utilisation, analytics and supporting the planning process of their customers.

At the start of the project, Solita had a limited experience on sustainability, asset management services and the management of data that is collected during the life cycle of a product or

service. However, the company has technical expertise on creating and combining information systems, and analysing data. The aim of Solita case is twofold; Firstly, the goal is to understand what asset management and sustainability would mean for the company (theme 2). Secondly, the goal is also to find out what kind of asset management and sustainability based services and products the company could offer for its potential and existing customers (theme 3).

Vapo Clean Waters

Vapo is a bioenergy supplier and developer, and the world's leading peat industry company. The Vapo case concentrated on its Fuels business area, and especially on a new start-up of Vapo, "Clean Waters", that is the first Vapo Ventures start-up focusing on natural water treatment solutions. In the case, the main goal for the company was to develop the new service concept out of its know-how of natural water treatment (theme

3). The implementation and co-production of the services requires management and understanding of an extensive network of actors. The case work included several workshops with Vapo representatives, interviews with the key persons at Vapo and its stakeholders, conducting a customer questionnaire in collaboration with the company, and many other discussions and meetings

1.2 THE VALUE OF SUSTAINABILITY

Sustainability is seen as being central to future development among firms, nations, and the society as a whole. By promoting sustainability, companies aim to lower their environmental impacts, maintain or improve good social performance and create business benefits (including economic, social and environmental dimensions). Sustainable business development is not seen only as innovating greener products but also highlighting the importance of ensuring health and safety and developing an effective governance structure to take ideas into action.

Sustainability is a comprehensive concept and identifying the overall value of sustainability can be a pretty complex task. In order to see the overall value of sustainability, companies need to evaluate and demonstrate the value from all of sustainability aspects (i.e. economic, social and environmental) that have different influencing factors. One of the most commonly used definitions for sustainable value is made by Hart and Millstein (2003):

“... The global challenges associated with sustainability, viewed through the appropriate set of business lenses, can help to identify strategies and practices that contribute to a more sustainable world and, simultaneously, drive shareholder value: This we define as the creation of sustainable value for the firm.”

The core areas of sustainable business development are illustrated in Figure 4.

Actors on different levels are implementing a wide range of sustainability business practices and setting long-term goals and strategies. Sustainable development has several positive and negative impacts on a company's business. Sustainability can bring forth new business opportunities or customers and thus create possibilities for achieving competitive advantages. On the other hand, sustainability may also have negative effects and often this negative side of sustainability may be revealed to be underestimated and not well understood. For instance sustainable development often needs investments, involves risks and companies need to estimate, whether these extra costs are worth the benefits. Identifying whether the actual effects of a company's sustainability actions are positive or negative might be challenging as in many cases the actual monetary benefits is hard or even impossible to see. Due to the characteristics of sustainability, the main benefits for the company are often recognised only after a longer time period, which hampers the assessment of sustainable value.

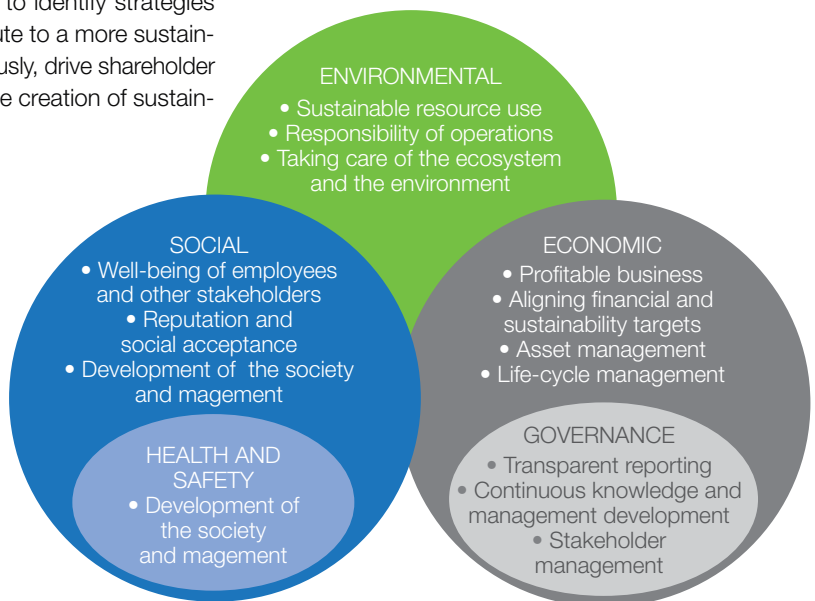


Figure 4. Value domains of sustainable business development.

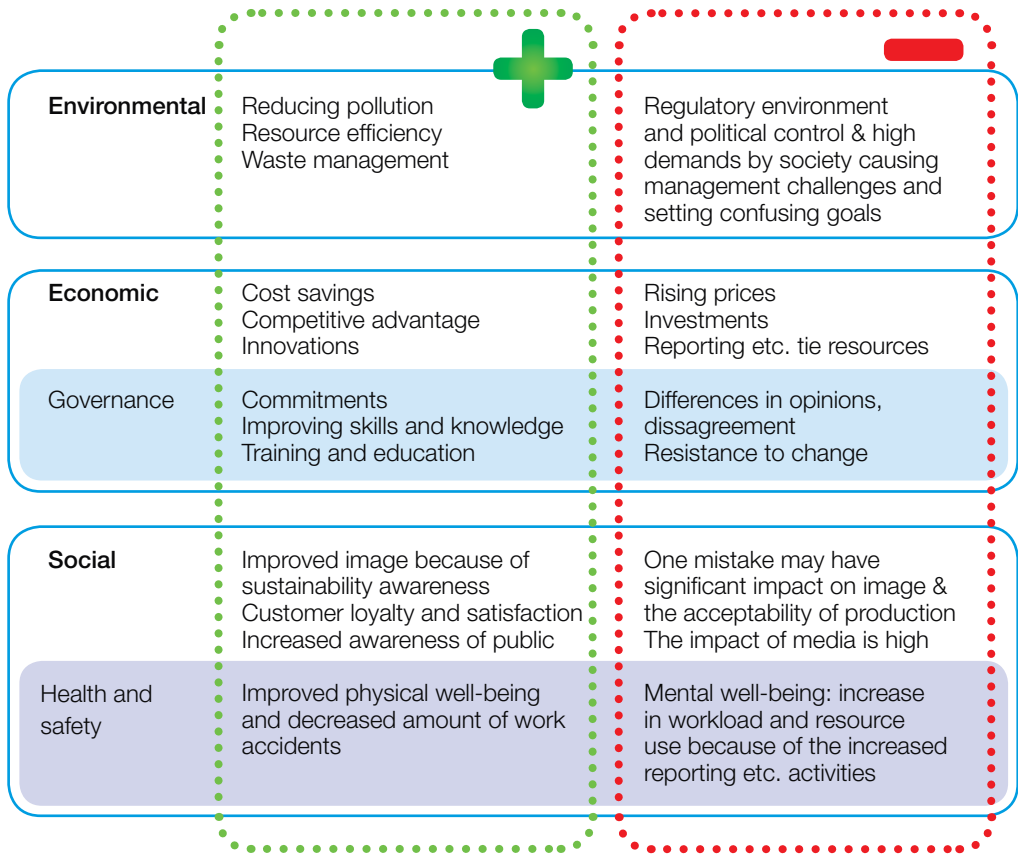


Figure 5. The impacts of sustainable business.²

In Figure 5 we illustrate the possible positive and negative effects of sustainability in different sustainability dimensions. From an environmental perspective, investing in sustainability has significant positive effects in terms of resource efficiency and reducing pollution. However as sustainability development motivations are often driven by external aspects (such as complying with the regulations and demands of authorities, and responding to the public concerns about the global development) conflicting demands may cause significant management challenges which also have an effect on company operations. From an economic aspect resource and operational efficiency may offer places for cost savings and gaining competitive advantage and improved governance practices increase the level of skills and knowledge inside the company.

On the other hand sustainability often requires investments that may result in rising prices. In addition, the company culture has a significant effect in successful sustainability business development, and problems in the culture may reflect as a negative atmosphere, and for instance the resistance to change. From social aspect for example sustainability efforts can increase or decrease the company image in the eyes of public or other stakeholders and the influence of media cannot be overlooked. Often sustainable development actions include improvements in health and safety practices offering several benefits. However sustainability is also seen to bring extra work (e.g. extra reporting activities) which may reflect as negative consequences in terms of employee well-being.

²Tervonen et al 2014

2. Strategic decision making

The resources and capabilities of companies are inexorably tied to sustainability issues and this poses a unique problem to management teams. Environmental and social sustainability influences each individual stage of the value chain from raw material use extraction, to the end of life phase and everything in between. Companies decide upon their future in constant interplay with their business and industry context. It is the ubiquity of sustainability that makes it such as important and challenging focus area.



Sustainability has been framed in strategic management as relating primarily to impact on the natural environment and the direct business case of this issue first rose to prominence during the win-win discussion in the mid-1990's. The win-win strategies of the 1990s are currently seen as the low hanging fruit of environmental management typified by reducing energy consumption and minimising waste. Today the best environmental management strategies aim to jointly consider all aspects of the whole production system and this systemic approach encourages companies to create solutions that consider long-term, global and environmental issues. This approach can be envisaged as being similar to lean management as it demands improvements in each element of the product system.

2.1 SUSTAINABLE BUSINESS AS PART OF STRATEGIC MANAGEMENT

The primary aim of this systemic approach to corporate sustainability is to optimise the sustainability performance of the entire corporate system. The benefits of environmental sustainability are described as including reductions in operating costs and long term risk, the enhancement of corporate image and attracting new eco-niche markets. Environmental risks posed by stresses on the natural environment relate to energy and fuel availability, material scarcity, water scarcity, population growth, ecosystem decline and food security. Increases in global industrial production

to meet the needs of an additional 3 billion middle-class consumers that are estimated to arrive in the global market in the two decades leading up to 2030 have raised interest in environmental risks that are associated with the natural environment. In addition, the business benefits of social sustainability can be delivered by creating and communicating a brand that strongly promotes democracy, diversity and equity and avoids corruption. By promoting these social sustainability values the company aims to attract investors, customers and new employees and to retain existing employees.

The main barriers to the systemic approach are a result of the knowledge transfer that is required in order to share information across the stages of the production system (see figure 6). However, it is expected that the barriers to this systemic approach are outweighed by the resultant significant improvement in financial and sustainability performance which is achieved by identifying solutions that make improvements in multiple stages of the value chain.

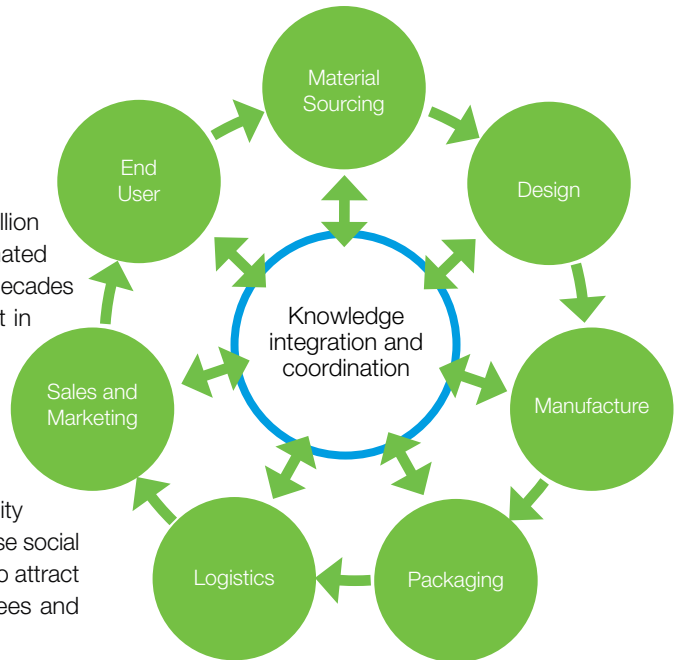


Figure 6. Knowledge integration and coordination across the whole value chain for the implementation of systemic innovations within a product system.

2.2 STRATEGY FOR SUSTAINABILITY

Strategy deals with the organisation's means to pursue competitive advantage in its operating environment, using the necessary resources. It is not only a future end state, but also the plan, path and pattern of activities taken to reach the desired end state. Very often, strategies are considered from the perspective of business value and the primary competitive alternatives, such as cost leadership, differentiation, focus, or customer closeness. Our interest in StraSus has dealt primarily with the strategy for sustainability, i.e., what end-states and competitive mechanisms organisations use, when they strive for business benefits through sustainable value. Sustainability

can actually be a driver for any of the competitive alternatives.

Industrial firms operate in highly dynamic contexts, and strategic choices require in-depth understanding and awareness of the business context. Customers are increasingly knowledgeable and demanding, and they may demand compliance with various environmental, social, quality and safety requirements. Competitors are very active and make their own moves both in terms of business and sustainability. Also, legal and regulatory requirements are constantly changing, thereby calling for companies' awareness of national and international regulations. Also the expectations of the broader public, labour organisations and local governments need to be taken into account, when considering strategies

for sustainability. StraSus results have revealed that companies are well aware of the contextual requirements. In addition to this the results show that the industry setting and dominant customer requirements as well as the regulatory context are central in deciding sustainability strategies (Figure 7).

In some strategies, sustainability is a necessity, even a “hygiene factor” that cannot really be neglected at all (lower left quadrant in the figure). In these cases, the customers, the market and the industry more broadly expect that all companies fill the required basic level of sustainability, and authorities place strict rules and laws to be followed by the actors. It is possible that in these kinds of contexts, companies implementing sustainability into their operations in a very cost-effective manner may succeed; but sustainability as such cannot necessarily become a differentiating factor among competitors.

If laws and regulations mainly guide and steer the sustainability issues in firms instead of forcing them or open up new opportunities, it is possible that some companies can utilise sustainability as a success factor in their strategies (lower right quadrant in the figure). This means that, under the conditions of the customers and industry requiring sustainability, some companies may be first movers or become more skilled in efficient sustainability programmes than others,

and they can build their image and sales argumentation upon their strengths in sustainability. This can lead to more innovative solutions among the actors in the industry, and consequent business success.

In the condition of a restraining legal and regulatory environment, it is possible that sustainability is not a key issue required by customers and the industry in general (upper left quadrant). However, it is possible that there is a niche of customers that see sustainability as something special and unique and are willing to pay for sustainable solutions. Thereby, sustainability may become a differentiator for certain firms, as compared to their competitors and the business environment, and they may utilise their sustainability capabilities to achieve business value.

Finally, in some cases there is a possibility that the legal environment is more enabling and the customers and industry are considering sustainability as a specialty (upper right quadrant). This could mean that there are other strategic options besides or in connection with sustainability, or sustainability might offer quite novel opportunities and become a source of competitive advantage, if handled successfully. In fact, finding a very special focus and customer closeness through sustainability strategies in such contexts may help build uniqueness into the firm’s business profile that cannot be reached through other means.

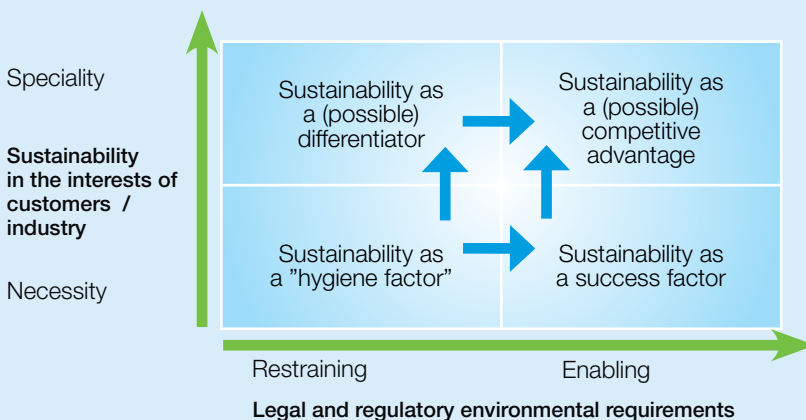


Figure 7. Summary of alternative strategies for sustainability.

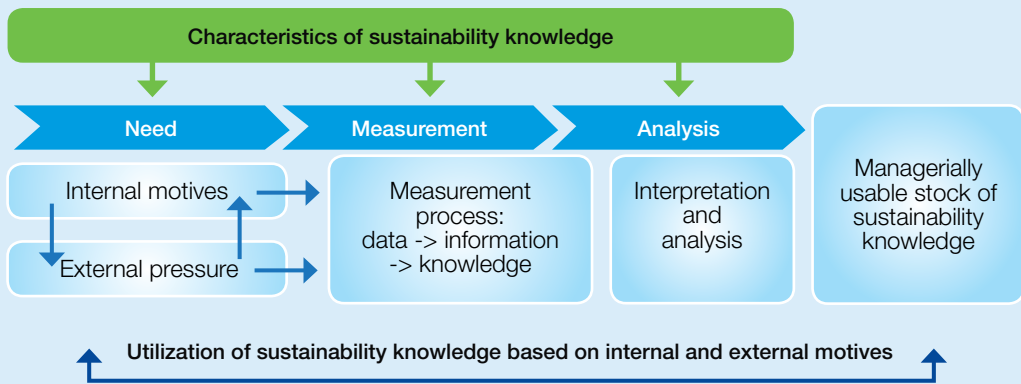


Figure 8. The process of sustainability knowledge utilisation.⁵

At best, sustainability is embedded into the firms' business strategies seamlessly. As sustainability knowledge in the firms is increasing, it is likely that separate sustainability strategies are needed in the beginning, to build momentum to the sustainability efforts at the company level and to raise awareness also more broadly in the business network.

2.3 UTILISING SUSTAINABILITY KNOWLEDGE

As mentioned in the previous chapter (see 2.1) achieving the business benefits of sustainability requires integration of knowledge and the creation of effective management and coordination practises which take into account the whole value chain. Knowledge transfer is required but even before, identification of the usable and valuable knowledge is needed.

Sustainability knowledge has unique characteristics (e.g. social robustness, recognition of system complexity and uncertainty, acknowledgement of multiple ways of knowing and the incorporation of normative and ethical premises) that hamper the identification and utilisation of

this knowledge^{3,4}. For example an effective use of natural resources is seen as a complex, important and urgent challenge and the related knowledge is distributed among the various actors in the world requiring collaboration across boundaries.

On a company level, sustainability is measured in various ways and companies gather sustainability related data from different sources. In the best cases information of this measurement guides managerial actions related to sustainability business development. However this requires proper knowledge analysis and utilisation activities. Figure 8 illustrates the process of sustainable knowledge utilisation from the need for sustainability knowledge into managerially usable data base of sustainability knowledge.

Many companies are struggling with the amount of measures and data, and there are several problems related to sustainability knowledge utilisation. As the activities of sustainability performance measurement are strongly driven by the stakeholders' interests and business ecosystem of the company, sustainability information is merely used in reporting activities required by different authorities. Much of the existing sustainability knowledge remains often unrecognised and unused.

³Clark 2007, ⁴Miller 2011, ⁵Tervonen & Ojanen 2015

CASE

Workshop of the challenges of sustainability knowledge utilisation

To identify the challenges of sustainability knowledge utilisation, we conducted a workshop with 16 different company representatives and knowledgeable experts of the issue. The workshop process consisted on three steps:

- 1) Introduction of the session objectives and the key concepts and problems
- 2) Identification of the managerial challenges and reasons for improper sustainability knowledge utilisation
- 3) Grouping and post analysis of the problems and challenges.

Based on the case, sustainability knowledge utilisation challenges are in many times faced on four levels:

Organisational (internal) factors <ul style="list-style-type: none">• level of expertise• attitudes• internal development and processes	Knowledge management <ul style="list-style-type: none">• management practices• methods and tools to gather, link, assess and analyze information	Sustainability measurement activities <ul style="list-style-type: none">• variety• importance• quality	Monitoring the business <ul style="list-style-type: none">• environment, stakeholders and change management
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------

Despite the fact that there may be challenges, the important thing is to communicate the clear link between the internal and external motives for sustainability measurement and the end part of sustainability knowledge utilisation process. Beating the challenges requires the creation of an open and flexible structure that encourages collaboration and communication inside and outside company boundaries. Choosing the scale of monitoring, data gathering and decision making is important. There is a need to create effective

ways to gather data but also to recognise information from different sources and understand the relationships and links between pieces of information. Measurement itself is certainly important, and the different dimensions of sustainability should be in balance. There should be a common understanding on the measurement objects, and a high degree of attention should be paid to the selection procedures of the right measures for the right objects. In addition, links to the strategy-based corporate measurement, like e.g. the

Balanced Scorecard, and management actions should be communicated. To cope with the multi-dimensionality of sustainable value, there should be a systematic, continuous effort to monitor the business environment and requirements of the stakeholders in order to be agile enough for change management. Increasing stakeholders' awareness on sustainability issues can help in enhancing knowledge transfer, achieving goals and transforming knowledge into action.

2.4 ASSET MANAGEMENT, SUSTAINABILITY AND STRATEGIC DECISION MAKING⁶

Production assets may have long life cycles and major changes occur in endogenous and exogenous factors during their life cycles. However, some dimensions of asset management (AM) decisions have been based more on intuition and visions in comparison to structured and well-tooled analysis⁷. In addition, there are several new issues that AM has to face i.e. sustainability, long-term perspective, overall risk exposure, interaction between built assets and natural environment, resilience, life cycle management, stakeholder demands and communication, information management and new types of governance arrangements^{8,9}.

Decisions on strategic AM are crucial from the perspective of improving the sustainability of companies. One of the means of improving the AM strategies and practices of companies, and thus their sustainability performance, is the new ISO 55000 series of AM standards¹⁰. The relationship between key terms of asset management is visualised in Figure 9. AM system directs, coordinates and controls AM activities. Formalised AM approach may, however, not cover all the AM activities.

For instance, the aspects such as leadership, culture and behavior may be managed using arrangements outside the AM system.

ISO 55000 series of standards gives guidelines for improving the AM strategies and sustainability. It emphasises the environmental, economic and social pillars of sustainability and the fulfilment of sustainability based organisational objectives. Additionally, it emphasises the role of stakeholders and their requirements and expectations. From the sustainability perspective, different stakeholders may have conflicting objectives for AM. Thus, the AM system should be transparent and consistent. The standard advises organisations to create a strategic AM plan which is consistent with organisational objectives and based on the characteristics and operational environment of the organisation. This plan sets criteria for AM decision-making.

In order to improve the strategic decision-making and sustainability of the asset management system in companies, the current level of the AM practices should be identified. The interview results presented in the next paragraphs present some of the best practices and examples found in Finnish companies.

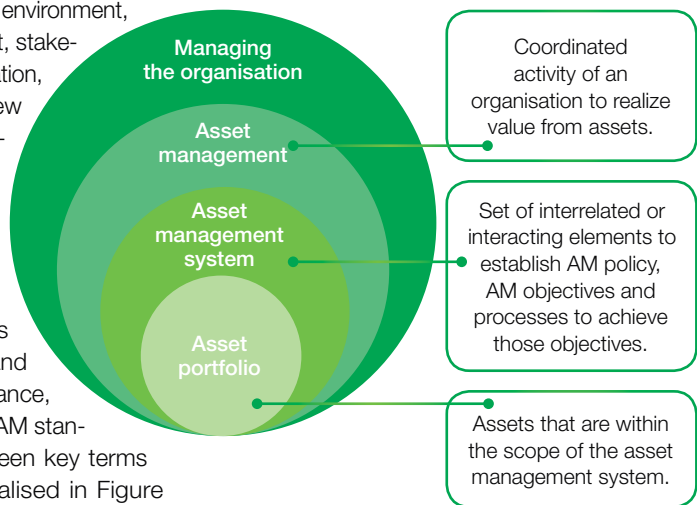


Figure 9. Relationship between the key terms of asset management¹¹.

⁶Hanski et al. 2015, ⁷Komonen et al. 2012, ⁸Brown et al. 2014, ⁹Liyanaage 2012

¹⁰ISO 55000-2 2014, ¹¹Adapted from ISO 55000 2014

Utilisation of asset based information

Companies gather and analyse data from their machinery and infrastructure and the analysis and utilisation of asset related information is considered important. The economic perspective of AM is seen crucial in decision-making, but also sustainability reporting, maintenance and operating information, value of assets and fault data are utilised. There are still several points of improvement in asset information management and information systems. The asset information is scattered in different systems, controlled by various agents and behind different organisational barriers. Companies, however, strive towards unified asset information management systems. Integrated approach to the management systems enables the use of existing systems (quality, environmental, safety, etc. systems) and, thus, reduces the need of developing new systems. This development enables more sustainable AM systems to be developed.

Sustainability and strategic AM

Decision-making is still somewhat based on intuition, expert opinion and experience and the asset based information is used mainly on an operational level. At the moment, AM strategies are not necessarily based on sustainability, even though they might increase the sustainability of the companies. Process development, energy and resource efficiency, capacity increase and cost savings are the most important drivers behind the AM activities. The state of the interviewed companies' AM strategies and processes varies from several processes and strategies to no specific strategies in place or at least no strategies that the interviewees are aware of. In addition, there are departmental variations in the AM strategies inside the companies.

There is an exchange of information with stakeholders, however the communication and long-term relationships with customers are emphasised. Stakeholders are also communicated

through sustainability reporting increasing the transparency of the operations of companies. The stakeholders mentioned include, for instance, government, society, suppliers and partners. Some companies also help their value network to utilise their asset based information better. The need of consistency is stressed in management and reporting.

Sustainability is visible in the strategies in the form of energy efficiency demands, emissions monitoring and in selection and procurement of machinery and materials. Supplier selection may also include sustainability criteria. Production and environmental goals set standards for AM. Sustainability can also be seen in the increased number of repairs and reduced number of replacements, and in new ways of inspections and acceptances. Moreover, often components are changed instead of replacing larger items such as equipment, modules, devices, etc.

Towards sustainable strategic AM

To demonstrate sustainability transparently, sustainability perspectives (environmental, social and economic) should be taken into account in the reporting and management of the company. The companies have recognised this and are striving towards a more sustainable future. AM strategies play a key role when improving a company's performance from the sustainability perspective. The sustainability of companies could be improved by using more AM based sustainability indicators, and using the asset information to support the decision-making more extensively. Emphasising sustainable development enables the companies to create new services and internally develop their processes and activities. Three proposals to improve the sustainability of the AM include (1) better linking the AM information to management systems, (2) predicting and visualising the development of the sustainability and AM indicators to create better decision support systems and (3) increasing transparency and the use of real time information in decision-making.

CASE

From maintenance and operation data to strategic decision support

The case company has a strong competence in creating and combining information systems, and analysing data. The company sees that the demand of more sustainable practices in their operations and their customers operations offers new business opportunities for them. There is, especially, a lot of potential in transforming data on asset operation and maintenance into information to support strategic decision-making. In addition, combining information from assets and various other sources may result in innovations that support the goal of a more sustainable future.

In the case, the researchers surveyed a large amount of sustainability and asset management related information (Global Reporting Initiative GRI, asset management, dependability, maintenance and performance indicator standards, etc.). The information and its relevancy to the services that could be offered by the company was discussed with the company representatives in several workshop sessions – at least one for each of the topic areas. The information provided in this stage is utilised as a basis of the ideation in the method described in chapter 3.4.



3. Business development

Rapid changes in the business environments and external pressure toward sustainability has raised the importance of considering sustainability issues as part of business development. A core issue is how can sustainable value be created, communicated and managed.



Today, sustainability has a substantial impact on a company's strategic decisions as well as research and business development activities. The levels of sustainability and sustainability practices vary significantly between organisations as well as industries and there is no exact way to execute sustainability.

3.1 SUSTAINABLE VALUE CREATION

Sustainable value creation is not limited to one specific function of a company. Instead, it must be acknowledged and supported throughout the organisation and viewed as an integral part of everything the company does. For example, at strategic level sustainable value creation might be realised by pursuing tighter collaboration with an external service provider. This might lead to the birth of industrial symbiosis which means

that the waste of one company becomes the raw material of another. Usually the industrial sites or parts of the processes from the companies taking part in the industrial symbiosis are also located close to each other. Strategic level actions also include overseeing own suppliers because in order to actually be sustainable, companies must have sustainable suppliers as well.

No function in a company can be held responsible for the sustainability of a whole company. All the functions within a company can make a difference and integration is needed and sustainability can be achieved through

cooperation inside the company and between companies. No one can do it all without external help. Collaboration with an external service provider might prove to be a way to identify new business possibilities and cost saving opportunities. Figure 10 summarises the possible issues fostering sustainable value creation. It must be remembered however, that the ways to create sustainable value are not limited to the ones presented here. Instead, they are offered as examples and starting points for more sustainable operations.

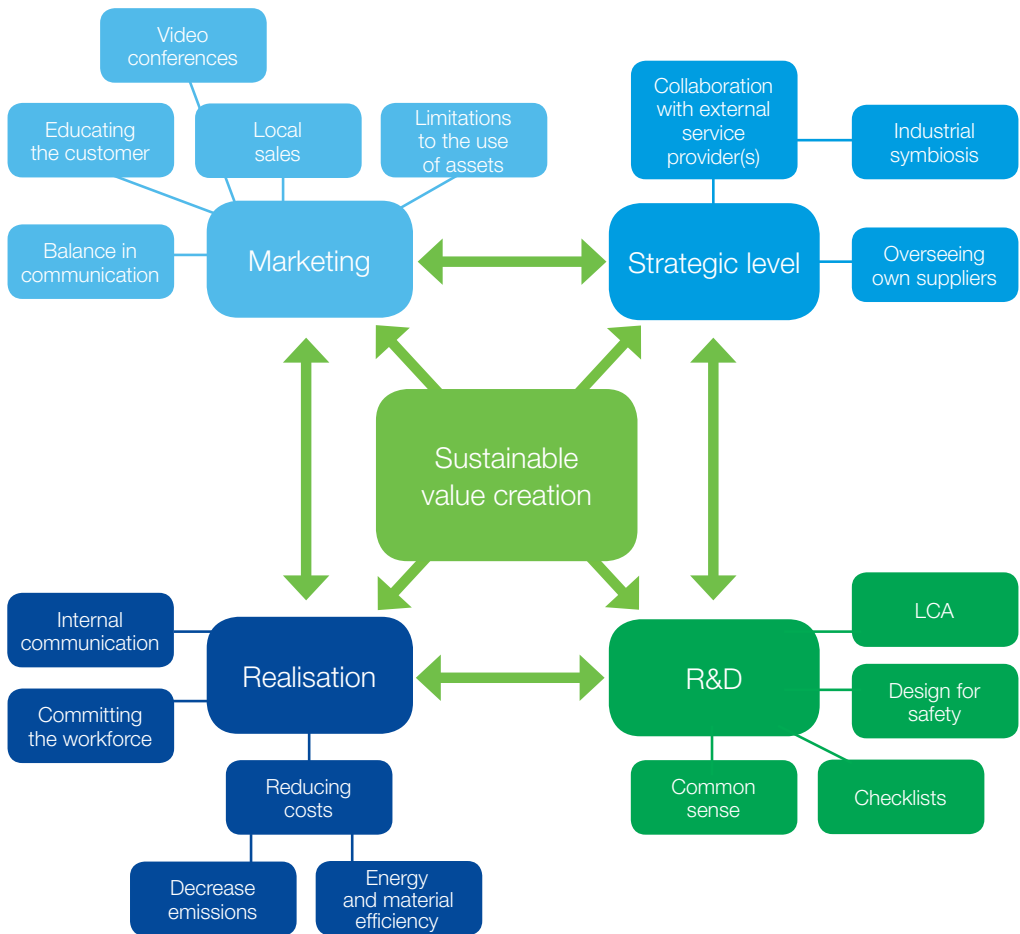


Figure 10. Sustainable value creation.

CASE

Internal sustainability practices

In R&D, sustainability may mean using different kinds of sustainability ensuring models or methods, such as Life-Cycle Assessment (LCA). LCA is a method through which companies can evaluate the life-cycle effects of their products. Sustainability might be evident in simple ideas and methods such as designing for safety or ensuring that there are no hazardous materials in a new product. Furthermore it might be as obvious as using common sense to avoid harmful effects on any stakeholders during or after the R&D processes.

In the realisation process, enhancing operations with sustainability is mostly about energy and material efficiency. When companies seek to reduce costs by cutting energy usage and decreasing the amount of wasted material, they end up saving natural resources as well. Of course the people working in production must not be forgotten. This means that safety and well-being issues must be taken care of. Committing the staff in the realisation process to continuous improvement may also lead to improved safety and quality. This might be done by giving the production workers permission to use a certain amount of time to come up with

improvement ideas. Flow of information is also of utmost importance and this can be ensured for instance by having a morning meeting every day, during which the employees are told the critical issues of the day.

In marketing, sustainability enhancing operation might mean, for instance setting limitations to the distances driven by the salesforce of the company. Limitations lead to more careful planning of sales trips and thus, to more effective usage of cars and decreased petrol usage. This also means fewer emissions. In order to save money, time and the energy of employees, a firm might try to organise as many video conferences instead of travelling as possible. Also local sales might enhance sustainability. Sometimes the customers have to be educated as they do not know about the health or environmental hazards of a given product or material. Communicating sustainability and sustainable operations is also important. However, bragging seldom pays off as companies that strongly state to be green will also then be more critically viewed by customers and other stakeholders. Companies must find a balance in sustainability communication.

CASE

The power of the focal company¹³



It can be noticed that the larger focal companies in particular, are in the position in which they can coordinate and control their suppliers, and expect them to adopt the same level of sustainability practices – relating to suppliers' safety measures, for example – that the company has itself. A focal company may for example introduce good practices and expect and oblige suppliers to introduce them too. This way, in time, higher standards spread and may eventually become common on the level of a whole industry. More generally, communicating company's commitment to sustainability may act as an example to other actors in the role of a forerunner and challenge them to do the same.

A company's position and power to affect others may depend also e.g. on the market and country, and in some markets a company that is a forerunner in its own country may be the one that is urged to develop its performance and practices.

3.2 COMMUNICATING THE VALUE OF SUSTAINABILITY

Sustainability development is hampered by the inadequate evaluation of sustainability actions value. Sustainability as multi-dimensional issue is prone to trade-offs in itself and in addition it competes for resources with other development objectives. In addition, realising the intended benefits of sustainability development projects is dependent on successfully communicating them to stakeholders and on shifting characteristics of the business environment (e.g. policy). The importance of communication in realising sustainability benefits is remarkable. However, many companies face uncertainty of how to present the sustainability actions and their value to the different stakeholders such as customers, regional operators, communities or media.

Sustainability development is hampered on two fronts:

1. Companies are unable to properly evaluate the genuine value of their sustainability actions' as there are no methods to account for opportunity costs and uncertainties.
2. Companies cannot fully benefit from those actions unless they find a trustworthy means of communicating their achievements effectively.

As sustainability is often driven by external pressure, this may lead companies to invest in sustainability actions with unsure or detrimental economic impact to their business. This not only creates uncertainties but also may reflect as opportunity costs when investing in sustainability excludes other alternative more productive investments. Identifying the value of sustainability is a hard task. Today many companies measure actions such as energy efficiency, emissions,

¹³Palomäki et al. 2015

cost-effectiveness and safety but also attempt to follow several management and qualitative indicators (especially as part of social responsibility). The amount of different measurements in companies is huge and there is lack of clarity with regard to which ones are the most informative, liable and important ones. Companies have large amounts of data but the analysing and utilisation activities are still under development. Many sustainability impacts involve also long-term and intangible characteristics that hamper

the estimation of their economic profitability. For example many social sustainability actions are hard to measure in numbers. In addition, sustainability investments usually involve high risks and other value decreasing trade-offs that may endanger their success and economical profitability causing even more uncertainties. There is no commonly used practice of how to evaluate opportunity costs and uncertainty of sustainability, which causes difficulties in the decision making and management of sustainability actions.

CASE

The future focus areas of sustainability value communication

In order to realise the benefits, it is critical to create good communication practices of sustainability and its value. In the future, it is important to pay attention and set the focus of sustainability value communication into following key areas:

Sustainability value measurement:

- Development of practices in evaluating sustainability costs and returns.
- The development of analysis and data utilisation activities.
- Clarifying the structure of measurement and evaluation actions.
- Measurement of social sustainability.
- Combining sustainability measurement & strategic management indicators.

Clarifying the definition of sustainability as part of business actions to avoid situational judgment of sustainability outcomes.

Seeking a sustainable balance between various dimensions requires careful management of divergent stakeholder interests and directional risks. This requires evaluating and accounting for opportunity costs.

Selecting situation-specifically the metrics and indicators

- from the chosen stakeholder perspective.
- based on the main purpose of the measurement.

Open, transparent communication and opening up firm boundaries.

Development of cooperative and open innovation capabilities to increase the level of innovation at systemic level.



3.3 SUSTAINABILITY MANAGEMENT PRACTICES IN NETWORKS

Industries are built of networks of complex and development-oriented relationships. To get a true understanding of the sustainability level of a company we need to consider its business environment with direct suppliers, other network actors and multiple stakeholders needs. When talking about business networks¹⁴ that aim for sustainability, it is natural that one of the forces bringing the network actors together is the sustainability objectives that the network actors share together.

When aiming for a whole network that acts in a sustainable way it can be noted that the operations and collaboration within it must be designed and managed as an integrated system in which network actors work together in order to achieve jointly set sustainability targets. Network

management practices can be distinguished into two main tasks:

- organising, which aims to identify the key actors and to define their roles and the network's operation model in order to integrate the value activities and operations,
- orchestrating, which aims to coordinate networked operations for shared (i.e. jointly discussed and negotiated) (sustainability) goals and ensure the commitment of involved actors¹⁵.

The following figure presents some sustainability management practices – especially ones highlighting the environmental perspective of sustainability – that companies can deploy in order to consider, control and influence their stakeholders to implement sustainability in their operations and business practices, and to develop collaboration with which the whole network can steer its operations towards becoming more sustainable. These sustainability management practices for networked operations include external operations

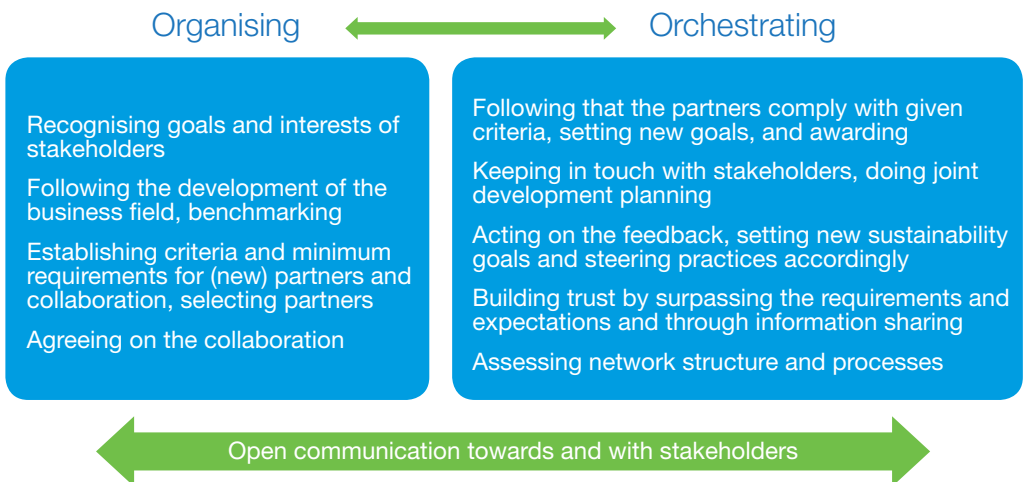


Figure 11. Sustainability management practices for networked operations.¹⁶

¹⁴Halinen & Törnroos 2005, ¹⁵Palomäki et al. 2015, ¹⁶Palomäki et al. 2015

that the focal company carries out in collaboration with its network actors.

In addition to the close partners of a company, e.g. suppliers, other stakeholders such as NGOs and competitors affect and are affected by the decisions of the company. Thus, the network perspective related to sustainability highlights considering stakeholders in a broader sense.

Collaboration in the key role

In order to do business that is sustainable, considering the values and interests of other actors in the networks, “traditional” governance is not

enough, but sustainability rather needs to be approached through collaboration and through jointly set goals, steps and practices. Being able to build constructive collaboration with stakeholders requires communication and knowledge sharing, openness and transparency. Attaining all of this calls for a change in managerial attitudes towards considering stakeholders in a broader sense. Giving and reacting on feedback and communication are important perspectives that need to be looked into more closely if companies want to improve their chances to become more sustainable as a company and as a network.

CASE

Collaboration with stakeholders¹⁷

Building up new kinds of collaboration and forming joint goals for sustainability – for example, to improve the state of the environment – together with a stakeholder group or various stakeholder groups is a way to improve the relationships with them. Companies may also develop their practices and create new goals and commitments for the sustainability on the basis of the feedback they collect from their stakeholders.

A company case presents an example for this: the company has invested in measuring the effects of its operations on the environment on an on-going basis, and also shares the data openly. The scale of the measurement is more extensive than is required by the authorities, so to this extent this is also a voluntary action by the company. The company sees that this is an important way to build trust between the company and its stakeholders, and to achieve a higher level of social acceptance for the business. The company also organises a yearly environmental seminar to which stakeholder representatives are invited. At the seminar, stakeholders have

an opportunity to give feedback and assess the business of the company, and the company is able to share information and add to the mutual understanding between the parties.

INTERACTION

MEASUREMENT

TRUST

CASE

Supplier network management practices

Suppliers form an important part of the competitiveness of companies, and thus controlling them and making certain requirements is seen to be a necessity – it is crucial that the whole supplier network is committed to the same principles and goals of sustainability.

Typically strategy-based criteria such as the supplier's sustainability goals, EHS (environmental, health and safety) issues and ethical principles are considered when a focal company is selecting a new supplier. For this, companies may use special check lists and also lists of already approved suppliers. In practice, many partners are selected through time and experience: knowing them through previous experience makes business easier to monitor and follow, and changing a supplier to a new one is often considered as a last option.

The collaboration with suppliers is managed through contracts that document the sustainability principles, e.g. specific environmental strategy and policy. Conditions are also set for the collaboration, and the performance of suppliers is

typically monitored, also statistically (e.g. EHS issues, work safety), they are audited, and can be obliged to report regularly. Companies collect feedback from their suppliers, and discuss these. Suppliers are given training, and they can be awarded for their good performance. If problems occur, the company engages in discussions, may suspend supplier's payments, or for example may plan a development programme or training depending on the case. Repetitive or serious problems such as failure to comply with safety regulations can lead to the termination of collaboration and removing the supplier from the list of approved suppliers.

Often a supplier is an object of decisions, and not actively involved in the decision making itself. Focal companies may have ready processes for the purposes of managing suppliers but not for the needs of collaborating either with them or with other stakeholder groups. It can be expected that shared practices for stakeholder involvement, collaboration and joint decision-making will become more common in the future.



3.4 THE FUTURE OF SUSTAINABLE BUSINESS ENVIRONMENT

In order to carry out successful decisions and management actions, it is important to be aware of the possible changes of the business environment. In the best cases, drivers can act as new possibilities to increase the business performance but in the worst cases it can hinder the companies' ability to operate. By being aware of the drivers of the sustainable business environment, managers can draw attention to the possibilities of future strategic directions and business opportunities. On the other hand, the early consideration of these drivers can help companies in avoiding the surprises that could in the worst case hamper remarkably company's business performance.

The future perceptions of sustainable business environment will influence on companies' long-term strategies and decision-making as a part of their business development and innovation processes. The benefits of developing sustainable innovations are usually not shown until in the long-run, which increases the significance of the prediction of the future. Companies need to react beforehand to the changes in

business environment in order to be the forerunners of sustainability in the future. Figure 12 summarises the drivers of sustainable business environments in the future.

By following these dynamic changes and observing emerging drivers of sustainable business environments, companies may create opportunities for creating several benefits in the future. For example different kinds of financial support and taxation policies for certain forms of energy may create new business opportunities and drive companies towards renewable energy resources. In addition the utilisation of a company's own internal resources more efficiently will create opportunities for developing new green products and services. In order to achieve the possible benefits, companies need to be aware also of the threats of external sustainable business environments. For instance, the unclear vistas of the future and the economic recession will create pressures on the companies and new regulations and legislative obligations required by authorities are seen as a risk among companies. By creating understanding of the characteristics of sustainable business environments and continuously monitoring and searching new drivers of sustainable business environments, companies may lower the level of the threats and turn them into opportunities of the future.



Drivers of sustainable business environment

- Social awareness of sustainable development
- Market pull, new needs and requirements
- Technology push, new technological solutions
- Green industry revolution
- Companies' internal resources
- Regulations, taxation, directives
- Cooperation and networks
- Forecast of the future

Figure 12. Key drivers of sustainable business environment for the future.¹⁸

CASE

Supporting ideation of new business concepts - Backpacket roadmap

The ideation of new business concepts starts with defining a common understanding of the current situation. Later, steps and actions for filling the gap between the state-of-the-art and future vision are defined.

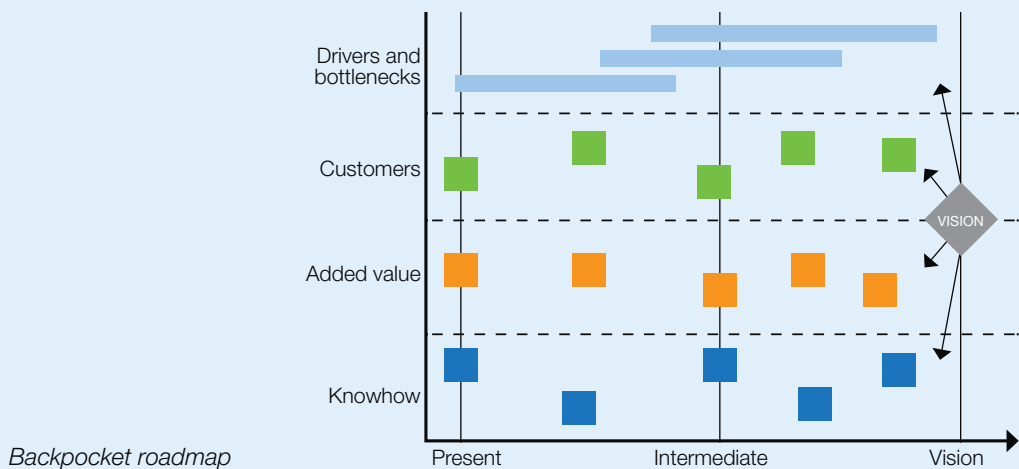
There are multiple different roadmap forms available. In the StraSus project case a Backpacket roadmap, developed at VTT, was used. Backpacket roadmap consists of three main stages; 1) Defining the object and time perspective, 2) Formulating the vision, and 3) Generating the content of the roadmap. The structure of Backpacket roadmap, as used in the case, is presented in Figure below.

The time perspective can vary, for example from one to 25 years, depending on the object; the shortest being used for rapidly evolving single technologies and longest for example for larger infrastructural entities, such as transport systems and stock of building.

The vision is a credible and wanted target state towards which the development is seen to be developing. In the Backpacket roadmap work the vision should include at least a description of the technical target state, but also information concerning e.g. products, services, actors, markets, drivers and bottlenecks can be added.

The process of generating content for the Backpacket roadmap starts by defining the state-of-the-art of the markets/customers, the existing technology or know-how, and the existing offering (products or solutions) through which the market needs and technology requirements are met. The drivers and bottlenecks are also defined. The roadmapping work then formulates the visions and goals, as well as the drivers and the bottlenecks, for a fixed number of years. Finally, intermediate step(s) required in order to meet the vision/goals are defined.

In the case Backpacket roadmap was used for the ideation of new sustainability related business concepts that could be further developed into products. Achieving a common understanding concerning both the state-of-the-art and the future vision between different compartments inside the company is crucial in every development project. Working and ideating together with a structured tool, in this case Backpacket roadmap, helps to achieve such a consensus. The feedback received from the company was encouraging. The Backpacket roadmap was seen as an efficient ideation tool, a common vision and development path for achieving it were outlined in one-day workshop.



4. Innovation orchestration

Business environments are facing rapid changes and (natural) environmental aspects in particular are showing the way. Staying competitive requires companies paying attention to the future trends and drivers of these dynamic green business environments.



The innovation drivers for the future of sustainable business can be split into two distinct categories which are low velocity and high velocity change. High velocity change is typically driven by technological change and by totally new product and process innovation. Radical innovations will establish new best practice designs and open up whole new markets and potential applications. These kinds of innovations create challenges for established firms as they destroy the usefulness of their existing capabilities in the same way that AirBnB has challenged the hotel industry and Uber has challenged the taxi industry. High velocity

change is often driven by companies who find themselves with a need to react to a changing business environment and thus they are often simple, experiential and unstable practices that rely on quickly created new knowledge and trial and error testing.

This section will predominately focus on low velocity change and consider the role of issues such as asset management, product and service development for existing dominant designs, end of life strategies and network alliances will have in the future of sustainable business.

CASE

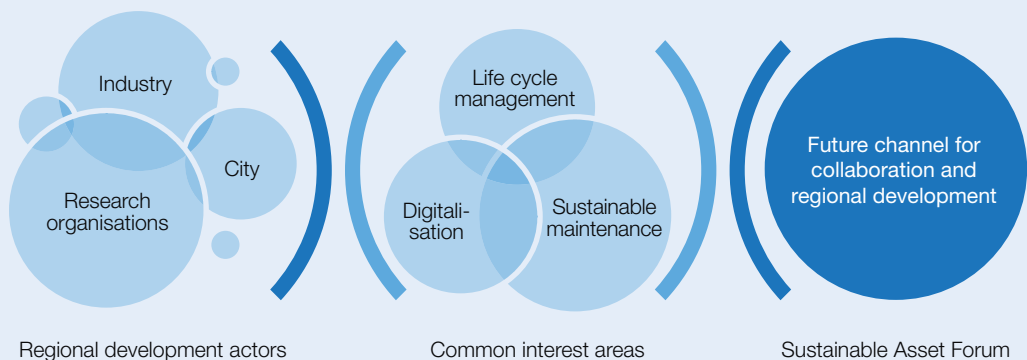
Collaboration with network actors for new sustainable business

The creation of regional innovation networks and joint investments can offer opportunities and benefits for different level network actors. The Fortum Power Solution case was built over the results of previous Fortum's projects in the Lappeenranta-Imatra region. In this regional area, sustainability is seen as one of the most significant topics for finding common development targets for regional network actors. For example utilisation of energy containing waste, renewable energy sources and sustainable constraining could offer significant and interesting areas for collaborative business development and innovation.

Increasing the effectiveness of sustainability innovation actions require cooperation & creation of relationships between regional network actors. From companies this requires a reform-mindset, ability to regenerate, the opening up of company boundaries, courage, trust and also including consumers for sustainability development. Involving sustainability into the development of regional innovation networks,

may bring forward many opportunities and benefits such as growth, specialisation (in company or regional level) and maintaining the vitality and competitiveness of the area.

The Fortum case included internal workshops and interviews with Fortum representatives and external interviews within regional (Lappeenranta-Imatra) energy intensive network actors. The results of the interviews worked as a basis for a regional seminar, "Mikä kestää". The aim of the seminar was to find concrete sources for collaboration based on common interests among network actors. Seminar was divided into two themes: **1) sustainable asset management and 2) digitalisation as an enhancing factor of sustainable business development.** The goal was in helping actors in creating new business and enhance the sustainability and productivity of the area. As the result of the seminar, the idea of "Sustainable Asset Forum" as a community including a collaborative platform for orchestrating the development activities of innovative sustainable solutions was launched.



CASE

Environmental impacts of the packaging material innovation

In 2011 Kraft replaced glass jars with a recyclable plastic equivalent in a number of their food product lines and the result was a container that was less expensive to produce, less prone to breakage, less environmentally harmful and was lighter and thus less expensive to transport. In one particular instance the resulting jar was 84% lighter and required 25% less vehicles for transportation. In this case the introduction of an alternative material resulted in improvements in multiple stages of the value chain and thus the new jar can be considered as a systemic innovation. The strategy of replacing glass with recyclable plastic reduced production costs and also reduced costs associated with logistics and waste due to fewer breakages. From an environmental point of view the new product produced less impact while still being recyclable and reduced emissions that are associated with logistics. A simple change resulted in a significant improvement in financial and environmental performance by leveraging complementarities in multiple stages of the value chain.



4.1 SYSTEMIC INNOVATION

Traditional innovation practices focus on areas such as product, process, sources of supply, new markets and organisational practices. Apart from the widest interpretations of organisational innovation, these focus areas have restricted discussion on innovation of the whole product system. System innovation will be discussed at the level of analysis of the product system, which encompasses the cradle-to-cradle of a product. A systems perspective exhaustively and holistically analyses the entire system. It is argued that this approach can create competitive advantage by identifying strategies that simultaneously result in financial and environmental performance improvement in multiple stages of the value chain. Autonomous innovations are those which can be pursued independently from other innovations. In contrast, the benefits of innovations that are fundamentally systemic can only be realised in conjunction with related complementary innovations. For example jet airplanes are a systemic innovation as the introduction of jet engines demanded that a change be made to the design of the air frames. The increased vibration caused by the engine required an increase in the airframe stress resistance. The means that the design of the jet engine and the air frame are complementary innovations and the introduction of the jet engine resulted in the jet airplane being a systemic innovation. Lean manufacturing is also a systemic innovation as it requires interrelated changes in areas such as product design and supplier management.

The introduction of a single innovation can result in a systemic innovation if it produces improvements in one or more areas of a system. Thus, systemic innovations can produce a change that is similar in magnitude to that which is produced by radical innovations; however, the resultant change is not radical as it enhances the capabilities of incumbent firms. In contrast to systemic innovations, radical innovations establish a new dominant design and open up whole new markets and potential applications.

A system can be viewed as consisting of interconnected components and thus the system is made up of linkages between the components and

the components themselves. As a consequence, successful innovation of product systems requires two types of knowledge. These are architectural knowledge which concerns the way in which components are integrated and linked together into a coherent whole and componential knowledge which concerns the core design principles and the way in which they are implemented in a particular. From the product system perspective the components represent each stage in the value chain and the links between the components represent the interactions between the stages. In Figure 6 (see chapter 2.1) the components are the value chain stages which include material sourcing, design, manufacture, packaging, logistics, sales and marketing and end user. Similarly the links between the stages represents the architectural links in the system.

4.2 VALUE CREATION IN SUSTAINABLE INNOVATION PROCESSES

Sustainability innovations can be seen as a tool to affect positively on the overall capital stock (economic, environmental, social) of a company. However these types of innovations include often high risk-rate and uncertainties in terms of market success and non-economic sustainability²⁰. Today the focus of sustainable innovations is moving more and more from the organisational and inter-organisational level (involving stakeholders in innovation networks) more on to societal level and changing the whole socio-technical systems. These types of innovations require successful diffusion in society: overcoming economic barriers, gaining user acceptance and also setting far-reaching approaches²¹.

In order to truly shape the business environment towards sustainability, we need more radical innovations with system level perspectives. The characteristics of radical as well systemic innovations influence significantly the formation, research and management of value based sustainability innovations. The goal of sustainable innovations is often changing on the level of the systems

²⁰Hansen et al. 2009, ²¹Boons et al. 2013

and shifting entire systems into more sustainable path, answering complex problems or gaining significant improvements in performance. These kinds of solutions require adoption and learning of new approaches and letting go of old ones thus having a magnitude that is similar to radical innovations. On the other hand systemic innovations are expected to have great sustainability potential and this is why sustainability innovations are increasingly systemic. Systemic innovations process across company boundaries and companies are increasingly dependent on external parties. This requires effective resource allocation, coordination of value networks, research collaboration and external venturing to create foresights and shape the business environment over time horizons. From sustainability innovation development perspective this means opening organisation innovation models.

The managerial problems of sustainability all come together to confound the innovation decision through the elements of opportunity costs and outcome uncertainties (see chapter 3.2). The figure 13 summarises the influences of these aspects on management of sustainability innovation processes.

Companies are forced to make investment decisions regarding sustainable innovations based on insufficient information. The essential problem in data collection and knowledge creation is the

objective assessment of different alternatives, in other words ability to evaluate opportunity costs of sustainable innovation. The more radical the nature of the innovation is, the more it encounters inertia in the business environment, displaces existing lines of business and business models, which are all difficult to account for. In sustainable innovations, uncertainty of the outcome of the innovations is increased as it is dependent on other system level characteristics and the actions of stakeholders. The systemic nature of these innovations is one of the main reasons why forming expectations of sustainability innovation outcomes is difficult. As companies have only limited power over the ecosystem their innovations are embedded in and depend on, the outcome uncertainty is greater.

The impact of sustainable innovations depends on the value creation. In sustainable innovations, the value requires attention from both economic and societal perspectives often at the network or system level. Communication capabilities have a significant effect on how much companies are actually able to capture out of the created value. Communication challenges cause difficulties to decision-making by increasing uncertainty regarding the extent of the realised outcome. Effective communication increases the actual impact and stakeholder commitment to sustainable innovations.

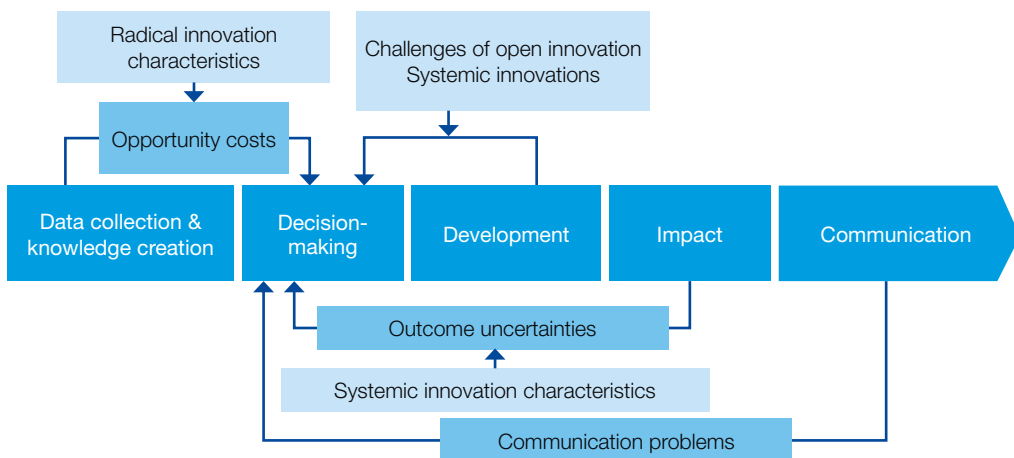


Figure 13. Challenges of sustainable decision-making in innovation processes²².

CASE

Overcoming organisational inertia

We studied the decision making processes of one company that had implemented a number of very successful innovations which were driven by organisational change. These innovations were of interest to the project as they were not driven by technological advancements and could have been implemented many years earlier. We were interested in uncovering what had stopped the innovations from occurring in the past and the triggers that caused them to finally be implemented.

One case concerned the method of logistics of the company's products. The company planned to reduce their carbon emissions related to logistics by eschewing air freight and by maximising the proportion of their products that were transported by land and sea. The result

of this initiative was a substantial reduction in emissions and costs however it also resulted in a longer lead time from order to delivery. In the past the company received a warning from its customer liaisons that the extended delivery time might impact on their sales and the innovation was not implemented. However, this was eventually overruled by management at a later date. When the initiative was implemented there was no negative feedback from the customers with regard to this change and it was seamlessly incorporated in to the company's practices. The customer companies have accepted the practice and some companies who order products with a very strict timeline are now willing to pay more for their products to be sent by air freight.



4.3 SUSTAINABILITY IN PRODUCT AND SERVICE DEVELOPMENT DECISION MAKING

Decision making in new product development projects deals with selecting the right projects to the product development portfolio, timing and scope of new product launch, and changes during the product development process. Organisational information processes are crucial in effective decision making for new product development. Managers may use various evaluation processes and decision criteria, when determining the feasibility, relevance and appeal of new product development projects.

Product development decisions should look at other than financial criteria, to implement the company's long-term strategies for sustainability (see chapter 2 about strategic decision making). Recently, sustainability has received some attention particularly at the level of single projects, and also at the level of project portfolios. Ecological and social issues, health and safety, societal influence, learning and capability development, and other non-financial decision premises are emerging as increasingly relevant topics in deciding on product development projects. As sustainability is "intangible", it can be more difficult to assess and measure than commercial, technical and financial criteria.



CASE

Sustainability-related decision making in new product development^{23,24}

Four different domains are recognised to be relevant to include sustainability into new product development decision making. Firstly, the decision making task and its complexity, information availability and instructions are quite important. Development process (or project model), other existing processes and their operational context were in a key role in task-related factors of sustainability decision making. Companies emphasise somewhat different issues in their project model, thereby structuring and supporting the task-related information processes differently.

Secondly, various decision maker-related factors such as expertise, team composition and incentives related to sustainability are seen as relevant. Particularly the different roles and incentives, and cooperation between business unit managers and environmental managers are issues to be solved.

Thirdly, attention should be paid to how the sustainability decisions are elicited. It deals with the way in which the opinions of the new product decision makers are elicited, including strategy as a key driver, and different types of analyses and evaluations needed for the decisions. The foremost elicitation criteria identified were the perceived cost-savings and efficiency potential - sustainability is mainly driven by financial and regulatory considerations.

Finally, different opinions need to be aggregated in new product evaluation effectively, clearly dealing with how new product development was organised and how well the internal information exchange is working. Figure 14 summarises the factors that are relevant to sustainability-oriented decision making in new product development.

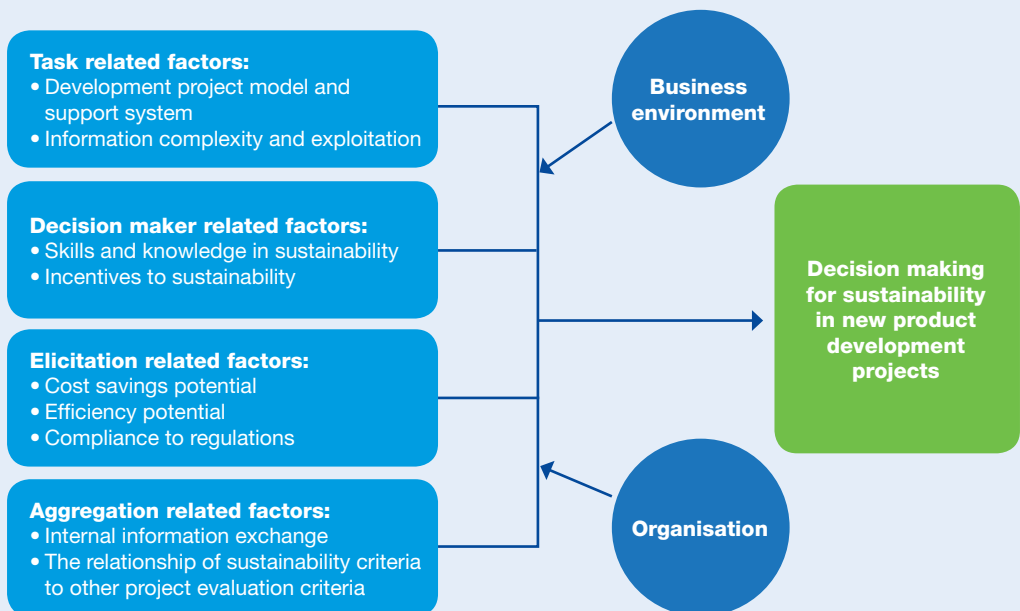


Figure 14. Factors relevant in sustainability-oriented decision making in NPD.

CASE

New service development²⁵

One of the cases looked into the development process of a knowledge-intensive service concept. The new business is based on the expertise that has been gained in the company's current business field, within which this expert service has been given in internal projects. During the project, the expertise was developed and productised in order to be offered as a service to external customers who have similar challenges. In the new service development process, under-

standing the network, the various stakeholders related to the service, and their perspectives and values was given a high level of importance. In order to break through to the market with the new service, the company needed to open up discussions with the stakeholder groups and explore the service and its benefits. This greater aim and need as a context, the case included several phases and viewpoints to the service development.



In this new service development process, the value perspectives and interests of stakeholders were explored specifically from the viewpoint of sustainable development, thus covering economic, environmental and social perspectives. Being able to develop responsible service business requires this kind of broader consideration of the business environment and of the stakeholder value. A multi-level approach – that incorporates also the analysis of other stakeholders and their values instead of customers only – is needed in order to achieve systemic change towards sustainable value-based business models within the networked business environment, and to find new business opportunities.

4.4 ALTERNATIVE PRODUCT END-OF-LIFE STRATEGIES

Sustainability brings a focus on design for end-of-life and post-use applications of the products. End-of-life strategy deals with the optimum end-of-life treatment for the product and its component materials. Companies have various options for minimising the environmental impacts of the product and its component materials, and at the same time they need to keep the costs low or even convert end-of-life

solutions into new profitable business. Many companies are increasingly concerned with the lifecycle cost of products and see lifecycle orientation as a driver for sustainability due to the legal requirements concerning environmental impact and the cost implications of alternative end-of-life treatments.

Defining end-of-life means particularly the design for the 'Five R's' of repair, reconditioning, reuse, recycling, and remanufacture. Table 1 summarises alternative end-of-life strategies for products²⁶.

Reuse	Reuse is a process where the product as a whole or its components or modules are used again without any repair or renovation operations other than cleaning. The reuse can be defined strictly to the purpose as product was originally designed or it can also include other purposes.
Service/Repair	Service is a strategy that aims to extend the usage stage of a product by repair or maintenance. Repair is a process of bringing damaged components back to a functional condition.
Reconditioning	Reconditioning restores the product functionally to as-new or almost as-new condition. This process can include methods such as resurfacing, repainting or sleeving.
Remanufacturing	Remanufacturing is a process where the products are brought back to "as new" condition, which requires disassembly, sorting, possibly also cleaning, inspection and repair, and re-assembly, with the result of the product becoming equal in performance to the original products. In remanufacturing, there is the possibility to improve the performance of the products by upgrading the original parts.
Recycling	Recycling is a process where materials are recovered without conserving any product structures, functionalities or product identity. This means returning the products to a raw material form which then can be used as raw material in the future manufacturing processes.
Disposal	Disposal consists of two alternatives, landfill and incineration. In landfilling products are sent to landfill as a solid waste, whereas in incineration the energy is restored from the product by burning them.

Table 1. Summary of alternative product end-of-life strategies.

²⁶Martinsuo, Sukanen & Kivilä 2015; Sukanen 2015

End-of-life strategies are broadly covered in electrical and electronic equipment business and various consumer product businesses, whereas business to business contexts are not as well covered, yet. Various tools and metrics have been developed to assist designers in environmental efforts, ranging from strategy categorisation tools, lifecycle scenarios and decision advisors to design tools, value chain analysis techniques, impact models, and so on. However, it has been noticed that such tools are not, yet, broadly nor effectively used in industries. It is possible that the context-specificity of such tools and techniques makes it difficult to share them across different contexts, or their complexity makes them cumbersome to use. It is also possible that companies do not, yet, have sufficient access to such data that is needed in sustainability-oriented measurements and assessments. As companies cooperate with others in their business networks, many tools and techniques suffer from the assumption of a single company view, where actually a network perspective would be needed.

4.5 PREPARING FOR THE END-OF-LIFE STRATEGIES

End-of-life strategies can offer new profitable options for different businesses by making it possible to take advantage of the value added to the product, its components and materials during the production process after the initial product's end-of-life. However, the preparing for the end-of-life strategies and options is a complex process which affects the organisation as a whole. The idea itself must have its place in the strategy of the company and be involved in the idea generation from the beginning. The end-of-life options have their role in the new product development and the manufacturing processes. The services offered must also support the circularity of the materials and components in the products. Marketing and sales also have their own part in the process by promoting the end-of-life options offered. By involving the whole organisation, its networks and customers can sustainable value be created with end-of-life strategies.

From practical point of view there are numerous ways in which the company can increase the reusability, remanufacturability and recyclability of the products. In figure 16, six important aspects of designing and preparing for end-of-life are presented.

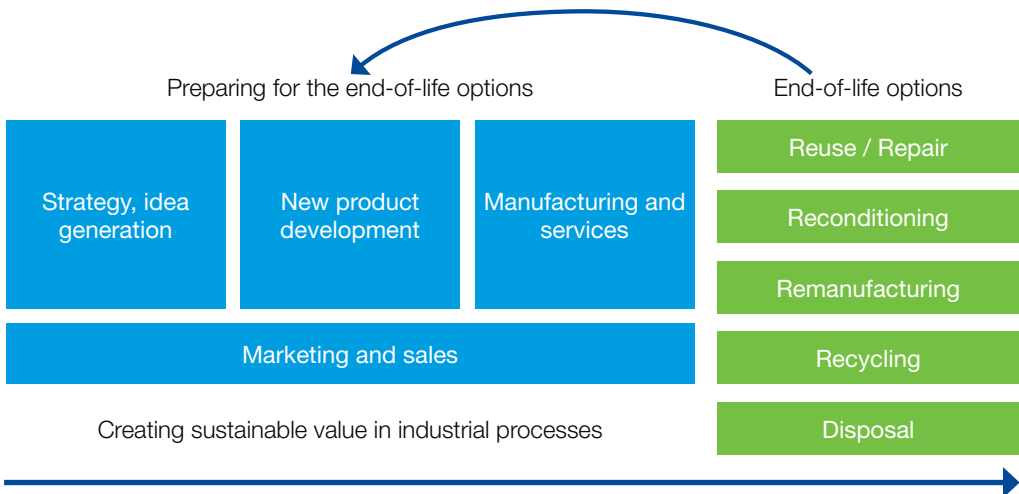


Figure 15. Preparing for the end-of-life options.

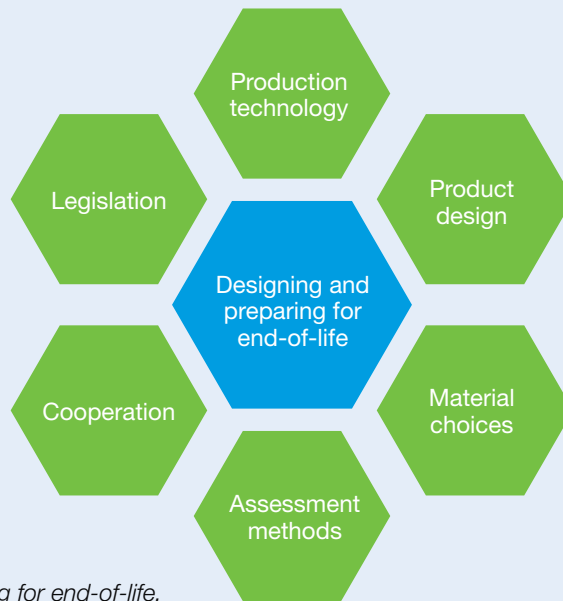


Figure 16. Designing for end-of-life.

CASE

Designing and preparing for end-of-life²⁷

The results in the study have showed that production techniques and technologies need to be suitable for the end-of-life alternatives. The production technologies need to be able to process recycled materials as well as produce products that can be utilised at their end-of-life. The products need to be designed in a way which supports the end-of-life aspects. This can mean design for longevity which supports the idea of longer lifespans and better reusability. Also modular design and design for disassembly are aspects which ease the repair and servicing of the products during their use stage as well as ease the disassembling of the products at their end-of-life for component and part reuse and for recycling. The material choices for products also need to support the end-of-life aspect. Products that consist of a low number of materials are easier to recycle than products that have a numerous of different materials in them. The materials also need to be chosen in a way that no hazardous materials are used.

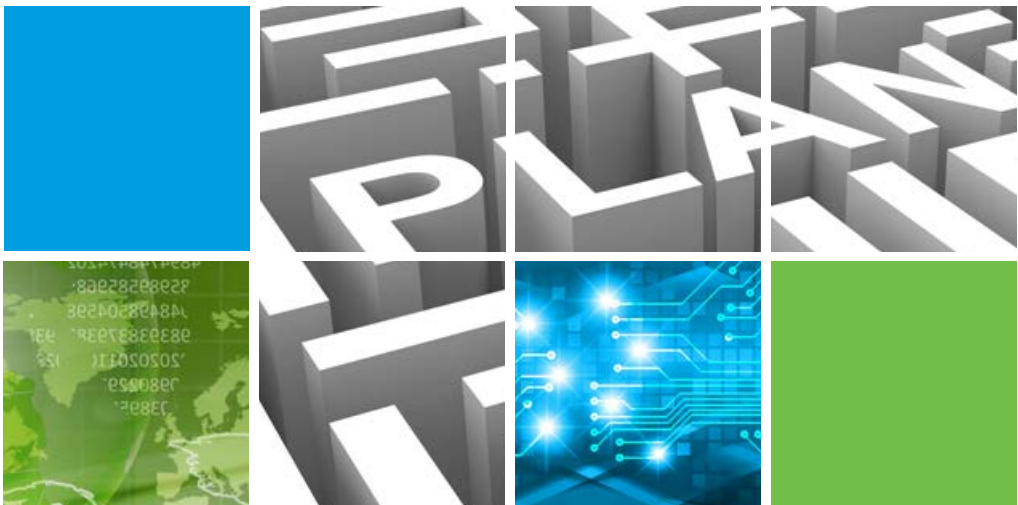
There are different tools and methods which can help companies in measuring, assessing and evaluating the end-of-life options. The problem, however, is finding a suitable one for the cause and utilising it properly. Cooperation is an important factor as end-of-life handling and processing is rarely among the core businesses of manufacturing firms. This means that the collecting and handling of end-of-life products is usually done by external service providers or governmental waste handling services. The customers need to be educated and encouraged to handle and sort their waste accordingly. It does not matter how well the products are designed for end-of-life if they never reach the appropriate channels for end-of-life handling. Lastly legislation is an effective way for encouraging and forcing companies to handle issues in a certain way and to take specific factors into consideration but can also act as a restrictor. Legislation can for example affect the use of waste and the selling of remanufactured products.

²⁷Sukanen 2015

5. Conclusions

A generic observation is that research and practice on innovation and business opportunities for sustainability are developing quickly in such areas as product-service systems, closed-loop business models and industrial ecology. Main principles within these areas are the change from a product-oriented to a service-oriented business strategies and from a linear model to circular business model operating in loops.

To conclude we first present an overview of the on-going transformation towards circular business and then propose the identified research topics supporting companies' transition towards service oriented circular business.



5.1 TOWARDS CIRCULAR BUSINESS

The recovery of the product, compared to old-fashioned disposal, could be an answer to environmental harm caused by the product's end of life disposal. Conducting a suitable R-strategy, in fact, reduces the demand for resources, such as energy and raw materials, and also provides the opportunity to create a profitable business. Therefore, sustainability and realisation cost characteristics are connected together²⁸.

The potential of closed-loop business has been estimated: if the approach was adopted by the EU, savings within a range of between 300 – 560 billion euros could be realised by 2035²⁹. However, practice is still far from a full execution of these concepts and there is still relatively limited understanding of how manufacturers, service providers, consumers and other stakeholders need to behave in order to realise successful business in these areas³⁰.

Moving towards circular business could be realised and new business models could be

identified by understanding the background of decision making of existing models and their related information and alignment inefficiencies that destroy value³¹. Also exploring the opportunities to improve asset tracking, include various types of returns along the product life cycle as well as to replace product ownership with creative service offerings are important for new businesses identification.

As an enabling technology, the internet of things, can keep track of valuable smart solutions and materials much more economically than earlier³². This could radically increase opportunities to implement different R strategies e.g. recovery. At the same time waste management technology is progressing quickly. Proper levels of asset tracking are required to maximise the value manufacturers, their customers, and/or third party providers can recover from products at the end of first and subsequent life. However, companies still struggle with the efficient integration of smart solutions into their business processes³³. Thus the business potentials of product life cycle data collecting, processing and waste traceability are not yet realised.

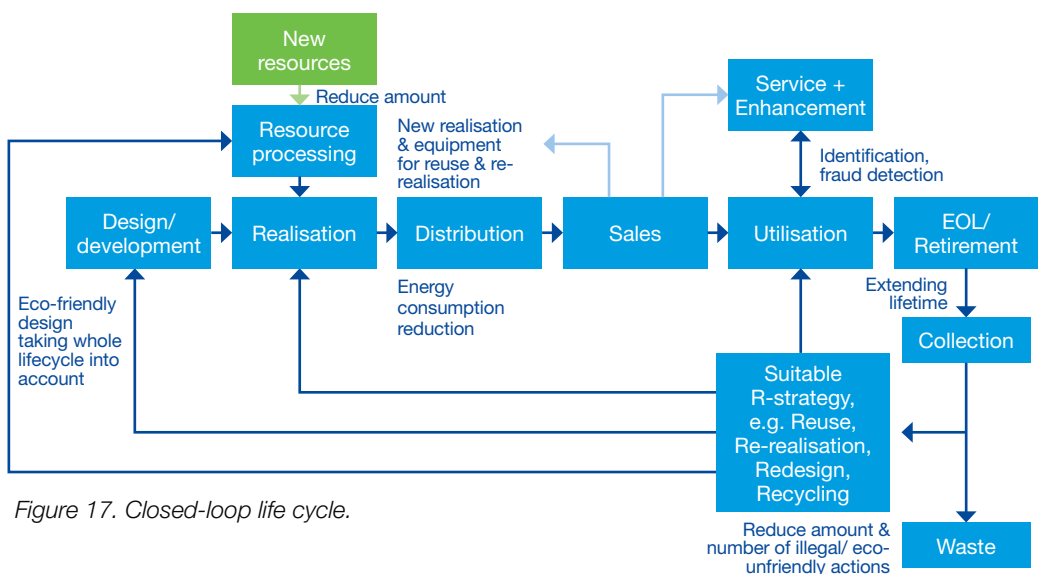


Figure 17. Closed-loop life cycle.

²⁸Gallo et al. 2012, ²⁹Ellen MacArthur Foundation 2012, according to Tennant, 2013, ³⁰Vladimirova 2014,

³¹Girotra and Netessine, 2013, ³²Ellen MacArthur Foundation 2015, ³³Schuh & Deindl, 2013

5.2 AVENUES FOR FORTHCOMING RESEARCH

StraSus research project has focused on business models and governance of sustainable solutions in a multi-disciplinary multi-company setting. Despite this rich context for research and learning, it is evident that many areas of sustainable business have not been covered sufficiently, yet.

Examples of new topics for the next steps of research include:

- **Implementation of sustainability strategies throughout the solution life cycle**
- **Symbiotic business relationships in industrial ecosystems**
- **From data to wisdom – approaches enabling circular business**

The implementation of sustainability strategies throughout the solution life cycle will concentrate not only on internal operations of the organisation but also networked operations. It will address sustainable value delivery and comparison of end-of-life alternatives.

Creation of symbiotic business relationships in industrial ecosystems requires collaboration, communication and coordination within complex networks of interdependent but independent actors/stakeholders. The challenge is to find the 'win-win-win' setting that balances between the self-interests of the involved actors and thereby influences and facilitates their actions to shape the ecosystem together.

From data to wisdom – approaches enabling circular business - will address the impacts of industrial digitalisation on corporate sustainability. It will identify efficient ways to implement smart solutions into their business processes improving life cycle wisdom management of solutions.



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Sustainable business

– Case studies from Finnish forerunners



There is a wide discussion on companies' search for sustainability, and on the role of sustainability in managing business development activities. Different aspects of business development have been regarded as central in achieving sustainability in firms and networks. This publication presents key focus areas in sustainable business development and practical cases where different approaches to sustainability were created. The developed frameworks can be utilised in developing sustainable offerings and practices in the businesses of various companies and their business networks.

This publication discusses the path towards sustainable business through the following themes:

- 1) understanding the value of sustainability,** and considering it in:
- 2) strategic decision making,**
- 3) business development** and
- 4) innovation orchestration.**

The structure of the publication follows the same logic and presents practical case examples under these topics. Tools and methods were applied and further developed with the case companies, which were Ekokem, Fortum Power Solutions, Nokia, Solita and Vapo Clean Waters.

This publication combines the main results of the work carried out within the "Strategic business models and governance for sustainable solutions" project (StraSus). The project started in December 2013 and it continued until February 2016. The research work was conducted by VTT Technical Research Centre of Finland Ltd, Lappeenranta University of Technology, Tampere University of Technology and Aalto University as a part of the Green Growth programme of Tekes.



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