CHALMERS

# SUSTAINABLE BUSINESS DEVELOPMENT

*Sverker Alänge and Mats Lundqvist (eds.)*

## Frameworks for **Idea Evaluation** and Cases of **Realized Ideas**

**Second Edition**

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# 1 INTRODUCTION

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This book is about developing sustainable businesses. The focus is on early stages – when a business is little more than an idea – and on innovation in an open environment, relatively unconstrained by organizational or other demands. Open innovation today is on many people's minds. However, literature on open innovation, sustainable business and idea development is still mostly aimed at the large corporation rather than towards a more genuinely open setting. Our setting is primarily the university, and especially the side of the university that nurtures new ideas to grow – sometimes into ventures, and sometimes into projects, but always with the intention of making an impact upon sustainable development – economic, ecological, and social development.

All sustainable development starts with an idea of wanting to make a difference. If this difference can be packaged into an offering that some customer pays for, then suddenly the idea is utilizing a whole market economy to make this difference. However, ideas not targeting paying customers normally also have to be packaged in ways that satisfy user or customer needs. Sustainable business development thus can be seen as a way of making the world a better place, not primarily by top-down intervention – through government agencies or programs – but through a more bottom-up process of trying to satisfy human and other needs, by promoting and offering new utilities: customer utilities, societal utilities and business utility (i.e. creating reasons for others to invest money in your idea).

Whether you are a practitioner, a student or a university employee, or engaging in your free time (i.e. being an engaged citizen) does not really matter. This book is written for anyone who believes in the power of the individual developing good ideas in networks, and who wishes to learn more about how to realize these ideas. The focus is on you – the idea developer, or if you like, the knowledge worker in the knowledge-economy – not on established firms, organizations, or financiers. After all, ideas especially in early stages depend upon the active engagement of individuals, regardless of where they are situated. If you are an employee, you might have larger initial resources to access but you would also have the duties and constraints of your organization to relate to. If you are acting in your free time, then you might not have the resources but you certainly have freedom to operate and to mobilize relevant networks. Most ideas depend upon a combination of individuals – some being more free but resource-constrained, and others representing structures and then also other levels of resources. This book is written to allow such an individual network-based open innovation perspective to flourish, pointing at opportunities, at useful tools and examples, and at the teamwork often necessary to release creative and accomplishing powers of the main resources of the new knowledge economy – ourselves and our nowadays global networks!

We expect the reader of this book to be a reflective doer, someone who learns while doing, and who likes to be inspired by others. The majority of the examples in the book are written by the doers themselves. As editors we have asked the authors to add reflections, and then we have also added some reflections of our own in the final chapter. We believe that good real-life examples have a never-ending ability to allow improved reflections and learning. We encourage you as a reader to discuss and debate issues and examples in this book. We will aspire to develop this version of the book into new versions and perhaps complement it with even more interactive means of communication – such as a website. We hope you share the ambitions we have about increasing knowledge and skills for sustainable business development. Please therefore give your constructive comments for us to improve any content.

The first part of the book focuses on frameworks and the second part on cases. We have tried to refer to the cases when appropriate as we introduce frameworks. The frameworks address sustainability, the challenges of so-called lock-ins, how to conduct early idea evaluation and development, utilizing group dynamics, and methods such as backcasting, scenario planning, LCA and patent analysis. The cases cover sustainable business development ventures, social entrepreneurship projects, and sustainable development and idea developments in established firm settings.

The 2nd edition of the book published in 2016 is nearly identical to the 2014 edition with the exception of Chapter 2: Sustainability in 2016, which has been updated to include the 2015 UN Climate Change Conference in Paris that saw a break-through in terms of all participating countries agreeing upon and signing the final document. This document, The Paris Accord, came into force in November 2016 after being ratified by a sufficient number of nations. In addition, the sections on 'business strategies for sustainability' and 'development of technology and markets for products that are environmental' have been updated in this chapter.

# PART I

# FRAMEWORKS

# 2 SUSTAINABILITY IN 2016

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This chapter derives our current understandings of the concept of Sustainability. Sustainability has only recently been clearly linked to business development. Its history dates back to the Sixties and is today largely affected by concerns about climate change. The aim of this chapter is to introduce you to the concept of Sustainability and give it sufficient background for you to subsequently explore the promises of sustainable business development.

## TOWARDS A FOCUS ON SUSTAINABILITY

In the first decades of the 21st Century it seems that a common understanding is evolving among scientists, industrialists and politicians about the need for the world to deeply consider sustainability. However, from this to potent political action on a global scale seems still to be a step to dream about, as indicated by the watered-down summit texts from the recent UN conferences on sustainability in Copenhagen 2009, Cancún 2010, Durban 2011, Doha 2012 and Warsaw 2013.

However, there are actions taken by individual companies both to act as a good citizen and increasingly also to develop 'green' business opportunities, there are customer groups creating new sustainable demand, and there are legal systems being modified (e.g. the use of energy-wasting traditional lamp-bulbs is being banned in the EU). But of course, there have been important steps taken by pioneers much earlier. And more recently the strength of the movements towards a sustainable perspective has been greatly reinforced by the fact that many strong opinion-builders in industry, among researchers, politicians and in media have joined. First, we will look back to some important input, starting in the 1960s and rapidly moving towards the end of the 1980s until now.

## WHAT HAS INFLUENCED PUTTING THE ISSUE OF SUSTAINABILITY ON THE AGENDA?

Rachel Carson's (1962) book '**Silent Spring'**, proposing that DDT could cause cancer in humans, made a strong impression on many individuals and started a debate concerning modern society's negative impact on nature. The realization arose that scientific/technological developments that had been seen as valuable for humanity also had negative impacts on humans, such as mercury to protect seeds and DDT to fight mosquitoes carrying malaria. She was not alone; there were others who actively discussed the future of the globe from a sustainability perspective, including Georg Borgström who in the 1950-60s pointed at the **Earth's biological limitations** (e.g. Borgström 1965). In 1973 the British economist E.F. Schumacher published an influential collection of essays called **Small Is Beautiful: Economics As If People Mattered**, which focused on decentralization and small-scale production as a way of satisfying both human and ecological needs.

The Club of Rome published in 1972 a book by a group of MIT researchers titled **The Limits to Growth** (Meadows et al. 1972). Based on a system dynamics model, the MIT researchers concluded that

> "If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, **the limits to growth** on this planet **will be reached** sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity." However, they also added that "**It is possible to alter these growth trends** and to **establish** a condition of **ecological and economic stability that is sustainable** far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential". (Abstract of The Limits to Growth, compiled by Eduard Pestel)

This book provided an important input into the debate about whether the modern economic model has a limit or not. The researchers' argument that in any closed system, such as the Earth, exponential growth is impossible without sooner or later collapsing, was supported by computer generated "stunning graphs, (of) what our fate was to be if we did not slow down" (Bishop 2006). The MIT team has since continued by publishing two more books providing additional data to support their argument of unsustainability, introducing the concept of **'overshoot'**, which means that we first exceed the limits, using up our resources in order to sustain growth, followed by collapse when there are no resources left, even to sustain on the previous levels (Meadows et al. 1992, 2002). In their most recent book they also utilize the 1990s concept '**ecological footprint'** (see Wackernagel & Rees, 1998) in order to make their point concerning overuse of resources by human civilization as compared to the carrying capacity of the planet. The ecological footprint is defined as the land (and water) area that would be required to support a defined human population and material standard indefinitely.

In 1972, on a Swedish initiative, the **first UN Conference on the Human Environment** was held in Stockholm. One major result was the Stockholm declaration with 26 common principles "to inspire and guide people of the world in the preservation and enhancement of the human environment" (UN 1972). Principle 1 stated that:

> "Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears

> a solemn responsibility to protect and improve the environment for present and future generations. In this respect, policies promoting or perpetuating apartheid, racial segregation, discrimination, colonial and other forms of oppression and foreign domination stand condemned and must be eliminated."

Another important principle was no. 21 that has become a basic legal principle for international cooperation concerning environmental issues crossing national borders:

> "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."

Other outcomes of this first UN conference were an action plan for continued international environmental cooperation and the establishment of the UNEP (United Nations Environment Program). However, although being an important early step, the impact on international cooperation concerning global environmental issues was limited in practice.

Hence, the starting point for the modern sustainability movement can be traced back to the more recent UN **Brundtland Commission's** (1987) report 'Our Common Future'. The following quote from the report, *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*, has been widely spread and has influenced the definition and direction of the sustainability movement. Another important statement in the report was that "*Humanity has the ability to make development sustainable".*

On a global scale the UN has been an organizing actor for other important landmarks in the development towards sustainability through a series of UN conferences.

- The **Rio Conference** in 1992 stated that *"Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature."* In connection with this conference, also the Agenda 21 was launched as an action program. While most program points were societal, there was also one section on improvement of industry, covering the "*improvement of production systems through technologies and processes that utilize resources more efficiently and at the same time produce less wastes"* However, it was also a short comment on the need for innovation and entrepreneurship: *"Similarly, facilitating and encouraging inventiveness, competitiveness and voluntary initiatives are necessary for stimulating more varied, efficient and effective options."* One program area suggested the support of 'Responsible Entrepreneurship', by encouraging the concept of stewardship in the management and utilization of natural resources by entrepreneurs, and by increasing the number of entrepreneurs engaged in enterprises that subscribe to and implement sustainable development policies. The rationale was that:

  > "Entrepreneurship is one of the most important driving forces for innovations, increasing market efficiencies and responding to challenges and opportunities. Small and medium-sized entrepreneurs, in particular, play a very important role in the social and economic development of a country. Often, they are the major means for rural development, increasing off-farm employment and providing the transitional means for improving the livelihoods of women. Responsible entrepreneurship can play a major role in improving the efficiency of resource use, reducing risks and hazards, minimizing wastes and safeguarding environmental qualities." (Agenda 21, 30.17)

- The **Kyoto Protocol** from 1997 provides a means for establishing environmental goals that individual countries can agree upon to follow. By November 2009 there were 189 countries that had ratified and followed the Kyoto protocol – although the world's major polluters, China and the USA, were not among them. The Kyoto protocol also introduced the Clean Development Mechanism (CDM) which stimulates sustainable development and emission reductions, by letting an industrialized country implement emission-reduction projects in developing countries and earn saleable certified emission reduction credits, each equivalent to one tonne of $CO_2$, which can be counted towards meeting the Kyoto targets. For example, a CDM project activity might involve a rural electrification project using solar panels.

- The **Johannesburg World Summit on Sustainable Development** in 2002 was one further step of developing the consciousness in the international community. The understanding of sustainable development was broadened and strengthened as a result of the Summit, particularly the important linkages between poverty, the environment and the use of natural resources. Governments agreed to and reaffirmed a wide range of concrete commitments and targets for action to achieve more effective implementation of sustainable development objectives. Energy and sanitation issues were critical elements of the negotiations and outcomes to a greater degree than in previous international meetings on sustainable development. One contribution to this conference from Chalmers was a paper by Christian Azar and John Holmberg analyzing what happens when a national economy gets richer. They found that some common sustainability-related issues are taken care of through self-organization in local communities, e.g. water and sanitation. Other sustainability issues, however, get worse when a community becomes better off, such as polluting the environment through increased CO2 emissions, due to a tendency to buy more and larger cars.

- The UN **'Intergovernmental Panel on Climate Change'** (IPCC) in 2007 was a major initiative to involve a very large number of scientists from many countries for the purpose of reviewing and assessing the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. Thousands of scientists contributed on a voluntary basis; one of them was Chalmers professor Christian Azar. IPCC published its very influential report on climate change in 2007 and was also rewarded with the Nobel Peace Prize that year. In this report it was made clear that human activities during the past 150 years have had major impact on climate change and estimations were made of future impact if no action is taken (see further below).

- In 2009 there were high hopes for a global agreement on limiting environmental impact during the UN **Climate Change Conference in Copenhagen** in December 2009. The immediate result was, however, very meagre as the world's two major polluters, China and the USA, were reluctant to put their signatures on a document and make major commitments.

- The UN **Climate Change Summit in Cancún 2010** aimed to reach an agreement on a global level. However, at the conference there was a clear divide between rich and poor countries and a threat that even countries who have signed the Kyoto Protocol would leave it, because some of the major polluters have still not signed the accord, such as China, India and the US. After considerable disagreement, the conference ended in a compromise agreement which makes the next step, the UN Climate Change Summit in Durban in 2011, even more challenging. However, for the first time, the Cancún Agreement commits both rich and developing nations to curbing greenhouse gas emissions. There is also an agreement on establishing a Green Climate Fund to provide financial aid to poorer countries for their contributions to remedy climate change.

- The UN **Climate Change Conference in Durban 2011** did not succeed to reach a global agreement on how to limit the impact on nature, but an agreement, the **Durban platform**, including **all countries** was reached to start **a process of developing a legally binding agreement**, which should be prepared by 2015 and is supposed to **take effect in 2020**. This means that the time-table to get all countries in the world involved in taking active measures has been postponed for 8 years, which according to Stern (2006) will substantially increase global costs to remedy climate effects. According to Rockström (2011) this delay will most probably result in a substantial increase in the Earth's global average temperature – instead of the Kyoto Protocol goal of a maximum increase of 2 degrees, this might result in somewhere between 3-4 degrees, which might have devastating effects on the global economy. One reason that no immediate step could be taken to include all countries in a developed version of the Kyoto Protocol was that the conference was characterized by a divide between the industrialized countries and the large rapidly industrializing countries. China, India and Brazil were of the opinion that the industrialized countries should limit their emissions immediately while they as industrializing countries should be allowed to increase their emissions in order to develop their economies further before they assume a more strict control of their emission increase. The Kyoto Protocol, which terminates in 2013, was further weakened by Canada making a decision to leave the agreement. However, until 2020 the EU countries keep their goal of lowering the $CO_2$ emissions by 20%. Another outcome of the conference was the launching of the **Green Climate Fund** to provide support to **developing countries** to limit or reduce their greenhouse gas emissions and to adapt to the impacts of climate change. The goal for the fund is to distribute US$ 100 billion per year.

- In the **2012** UN **Climate Change Conference in Doha** no agreement seemed possible. However, the delegates continued negotiating after the planned closure of the conference and an agreement was reached to **extend** the life of the **Kyoto Protocol**, which had been due to expire at the end of 2012, **until 2020**. The conference also **reified the 2011 Durban Platform**, i.e. the process of developing a successor the Kyoto Protocol. Another step forward was the 'Loss and Damage mechanism' that regulates richer nations' financial responsibility for damage in developing countries, caused by the richer nations' failure to reduce carbon emissions and thus contributing to climate change.

- The main contribution of the **2013** UN **Climate Change Conference in Warsaw** was a decision to establish an international branch (the Warsaw mechanism) to help poorer countries deal with **loss and damage** caused by extreme weather events and slow onset events such as rising sea levels (UN 2013). The conference was otherwise characterized by substantial disagreements between participants and difficulties in reaching agreements on how to proceed towards a global agreement scheduled for 2015 in Paris. The Warsaw conference concluded, by urging individual nations to take steps towards the climate goal of limiting the temperature increase to 2 degrees above the current levels and to bring their experiences and transparent plans to the table ahead of the planned Paris conference.

**Hurricane Katrina** in 2005 destroyed large parts of New Orleans and raised the awareness of climate change, not least because of intensive coverage on television. Other major natural catastrophes, e.g. the South Asian floods in 2007, also contributed to a growing awareness that the climate might have changed.

**Former vice president Al Gore's** 'An Inconvenient Truth: The planetary emergency of global warming and what we can do about it', published in 2006, also received considerable media coverage in combination with Gore's intensive touring the world to deliver his message. His work to raise the awareness of global warming provided him with the Nobel Peace Prize in 2007, shared with the UN IPCC.

In 2006 the **Stern Review on the Economics of Climate Change** was presented by the economist Nicholas Stern for the UK government. This became a very important document because it quantified the impact of climate change and it pointed at the economic rationale for changing now instead of in many years to come. According to Stern:

> ***There is still time to avoid the worst impacts of climate change, if we take strong action now.*** The scientific evidence is now overwhelming: climate change is a serious global threat, and it demands an urgent global response. … Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms. Using the results from formal economic models, the Review estimates that if we don't act, the **overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever.** If a wider range of risks and impacts is taken into account, the estimates of **damage could rise to 20% of GDP or more**. **In contrast, the costs of action** – reducing greenhouse gas emissions to avoid the worst impacts of climate change – **can be limited to around 1% of global GDP each year.**
>
> The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our actions now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes. … Because climate change is a global problem, the response to it must be international.
>
> ***The costs of stabilising the climate are significant but manageable; delay would be dangerous and much more costly.*** The risks of the worst impacts of climate change can be substantially reduced if greenhouse gas levels in the atmosphere can be stabilised between 450 and 550 ppm CO2 equivalent (CO2e). …This is a major challenge, but sustained long-term action can achieve it at costs that are low in comparison to the risks of inaction. Central estimates of the annual costs of achieving stabilisation between 500 and 550 ppm CO2e are around 1% of global GDP, if we start to take strong action now."

In June 2008 Nicholas Stern increased the estimate of cost to reduce the $CO_2$ to 2% of GDP to account for faster than expected climate change. Stern's quantifications supplemented earlier indicator-based argumentation and helped politicians to realize its importance by pointing directly to the effects on economic development.

So what were the major findings from the **UN (2007) 'Intergovernmental Panel on Climate Change' (IPCC)** that was published one year after the Stern Review and was the result of input from more than 1,000 scientists around the world?

### Observed changes in climate and their effects

**Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.**

**Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.** {1.2}

**Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 (Figure SPM.3).** {2.1}

Carbon dioxide ($CO_2$) is the most important anthropogenic GHG. Its annual emissions grew by about 80% between 1970 and 2004. The long-term trend of declining $CO_2$ emissions per unit of energy supplied reversed after 2000. {2.1}

**Global atmospheric concentrations of $CO_2$, methane ($CH_4$) and nitrous oxide ($N_2O$) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.** {2.2}

**Advances since the TAR** (Third Assessment Report) **show that discernible human influences extend beyond average temperature to other aspects of climate.** {2.4}

Human influences have: {2.4} *very likely* contributed to sea level rise during the latter half of the 20th century; *likely* contributed to changes in wind patterns, affecting extra-tropical storm tracks and temperature patterns; *likely* increased temperatures of extreme hot nights, cold nights and cold days; *more likely than not* increased risk of heat waves, areas affected by drought since the 1970s and frequency of heavy precipitation events.

**There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades.** {3.1}

The IPCC Special Report on Emissions Scenarios (SRES, 2000) projects an increase of global GHG emissions by 25 to 90% ($CO_2$-eq) between 2000 and 2030 (Figure SPM.5), with fossil fuels maintaining their dominant position in the global energy mix to 2030 and beyond. More recent scenarios without additional emissions mitigation are comparable in range. {3.1}

**Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century (Table SPM.1, Figure SPM.5).** {3.2.1}

**There is high confidence that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change.** {5.3}

**Risks to unique and threatened systems.** There is new and stronger evidence of observed impacts of climate change on unique and vulnerable systems (such as polar and high mountain communities and ecosystems), with increasing levels of adverse impacts as temperatures increase further. An increasing risk of species extinction and coral reef damage is projected with higher confidence than in the TAR as warming proceeds. There is *medium confidence* that approximately 20 to 30% of plant and animal species assessed so far are *likely* to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5°C over 1980-1999 levels. Confidence has

> increased that a 1 to 2°C increase in global mean temperature above 1990 levels (about 1.5 to 2.5°C above preindustrial) poses significant risks to many unique and threatened systems including many biodiversity hotspots. Corals are vulnerable to thermal stress and have low adaptive capacity. Increases in sea surface temperature of about 1 to 3°C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatisation by corals. Increasing vulnerability of indigenous communities in the Arctic and small island communities to warming is projected. {5.2}
>
> **Risks of extreme weather events.** Responses to some recent extreme events reveal higher levels of vulnerability than the TAR. There is now higher confidence in the projected increases in droughts, heat waves and floods, as well as their adverse impacts. {5.2}
>
> **Distribution of impacts and vulnerabilities.** There are sharp differences across regions and those in the weakest economic position are often the most vulnerable to climate change. There is increasing evidence of greater vulnerability of specific groups such as the poor and elderly not only in developing but also in developed countries. Moreover, there is increased evidence that low-latitude and less developed areas generally face greater risk, for example in dry areas and megadeltas. {5.2}
>
> *Aggregate impacts.* Compared to the TAR, initial net market-based benefits from climate change are projected to peak at a lower magnitude of warming, while damages would be higher for larger magnitudes of warming. The net costs of impacts of increased warming are projected to increase over time. {5.2}
>
> **Risks of large-scale singularities.** There is high confidence that global warming over many centuries would lead to a sea level rise contribution from thermal expansion alone that is projected to be much larger than observed over the 20th century, with loss of coastal area and associated impacts. There is better understanding than in the TAR that the risk of additional contributions to sea level rise from both the Greenland and possibly Antarctic ice sheets may be larger than projected by ice sheet models and could occur on century time scales. This is because ice dynamical processes seen in recent observations but not fully included in ice sheet models assessed in the AR4 could increase the rate of ice loss. {5.2}
>
> **Many impacts can be reduced, delayed or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts. {5.3, 5.4, 5.7}**
>
> **There is high agreement and much evidence that all stabilisation levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers.** {5.5}

Finally, the IPCC (2007) presents a relatively vague estimate of economic impact, but with estimates of impact on GDP in 2030 and 2050. The main significance of the IPCC (2007) was that the UN and policy makers all over the world now had a report where a large majority of influential scientists had participated and agreed upon climate impact. It also expressed the belief that "many impacts can be reduced, delayed or avoided by mitigation … to achieve lower stabilisation levels".

These reports and conferences were also further reinforced by **media**. In interviews conducted at Swedish large companies in 2004-2007, managers commented that they were aware of the Stern review (2006) and the IPCC (2007), but also that television programs such as the BBC Series "**Planet Earth**" (2006) had made a major impact on their view of sustainability.

In 2013-14, work groups of scientists within the **UN 'Intergovernmental Panel on Climate Change' (IPCC)** have published new data and new analyses of the world situation. Once again scientists have focused on establishing what they can agree upon with high confidence looking at the data from different disciplines and from all continents on Earth. IPCC (2013) to a large extent

confirmed the previous report's findings and added further details and confidence to the on-going process of climate change influenced by human activities.

> **Human influence on the climate system is clear**. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system (2-14).
>
> Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4 (IPCC 2007). It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. (10.3-10.6, 10.9)
>
> Cumulative emissions of $CO_2$ largely determine global mean surface warming by the late 21st century and beyond. Most aspects of climate change will persist for many centuries even if emissions of $CO_2$ are stopped. This represents a substantial multi-century climate change commitment created by past, present and future emissions of $CO_2$. (12.5)

One major difference in relation to the IPCC (2007) is that the IPCC (2014a) puts a major emphasis on management through adaptation (and mitigation) and that it focuses on risk in order to support decision-making in the context of climate change. It also stresses that people and societies may perceive or rank risks and potential benefits differently, given diverse values and goals. The earlier emphasis on providing firm climate data in order to establish rules and regulation on a global scale has, partly due to the meagre results of recent UN Climate Conferences, been replaced by a belief that national laws and regulation can be important steps forward. The importance of local actors, including companies in the private sector and NGOs, is also emphasized to a larger extent, in comparison to the earlier IPCC (2007).

The IPCC (2014a) summarizes that:

> Human interference with the climate system is occurring and climate change poses risks for human and natural systems. The assessment … evaluates how patterns of **risks and potential benefits** are shifting due to climate change. It considers how impacts and risks related to climate change can be reduced and **managed through adaptation and mitigation**. The report assesses needs, options, opportunities, constraints, resilience, limits, and other aspects associated with adaptation.

The IPCC (2014a) presents the following Principles for Effective Adaptation:

> **Adaptation is place and context specific, with no single approach for reducing risks appropriate across all settings** ***(high confidence).***
>
> **Adaptation planning and implementation can be enhanced through complementary actions across levels, from individuals to governments** ***(high confidence).*** National government can coordinate adaptation efforts of local and subnational governments … Local government and the private sector are increasingly recognized as critical to progress in adaptation, given their roles in scaling up adaptation of communities, households, and civil society and in managing risk information and financing *(medium evidence, high agreement).*
>
> **A first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability** ***(high confidence).***
>
> **Adaptation planning and implementation at all levels of governance are contingent on societal values, objectives, and risk perceptions** ***(high confidence).***
>
> **Decision support is most effective when it is sensitive to context and the diversity of decision types, decision processes, and constituencies** ***(robust evidence, high agreement).***
>
> **Existing and emerging economic instruments can foster adaptation by providing incentives for anticipating and reducing impacts** ***(medium confidence).***

> **Constraints can interact to impede adaptation planning and implementation** ***(high confidence).***
>
> **Poor planning, overemphasizing short-term outcomes, or failing to sufficiently anticipate consequences can result in maladaptation** ***(medium evidence, high agreement).***
>
> **Limited evidence indicates a gap between global adaptation needs and the funds available for adaptation** ***(medium confidence).***
>
> **Significant co-benefits, synergies, and tradeoffs exist between mitigation and adaptation and among different adaptation responses; interactions occur both within and across regions** ***(very high confidence).***

The IPCC (2014a) presents the key risks for each continent, the polar regions, small islands and the Ocean followed by adaptation issues & prospects. It also provides an estimate for risk & potential for adaptation for three time frames: present, near-term (2030-2040), and long-term (2080-2100) with two different estimates of temperature increase: 2 and 4 degrees. Here, long-term risk levels even with high level of adaptation seems to become critical if the temperature increases by 4 degrees: for Africa in terms of reduced crop productivity associated with heat and drought stress, for Asia in terms of increased risk of heat-related mortality, for Australasia in terms of composition and structure of coral reef systems, for North America in terms of wildfire-induced loss of ecosystem integrity, and for the Ocean a reduced biodiversity, fishery abundance and coastal protection.

The IPCC (2014b) focuses on mitigation which is defined as *"…the human intervention to reduce the sources or enhance the sinks of greenhouse gases"*. IPCC (2014b) assesses literature on the scientific, technological, environmental, economic and social aspects of mitigation of climate change. It also assesses mitigation options at different level of governance and in different economic sectors, and the societal implications of different mitigation policies, but does not recommend any particular option for mitigation.

> "The ultimate objective … is to achieve … stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

IPCC (2014b) point out that effective mitigation depends on various factors, including finding ways to deal with issues of justice and fairness, value judgements and ethical considerations, conflicting societal goals, risk and uncertainty:

> **Effective mitigation will not be achieved if individual agents advance their own interests independently.** … **Issues of equity, justice, and fairness arise with respect to mitigation and adaptation**. Countries' past and future contributions to the accumulation of GHGs in the atmosphere are different, and countries also face varying challenges and circumstances, and have different capacities to address mitigation and adaptation. The evidence suggests that outcomes seen as equitable can lead to more effective cooperation.
>
> **Many areas of climate policy making involve value judgements and ethical considerations.** … Social, economic and ethical analyses may be used to inform value judgements and may take into account values of various sorts, including human wellbeing, cultural values and non-human values.
>
> **Climate policy intersects with other societal goals** such as those related to human health, food security, biodiversity, local environmental quality, energy access, livelihoods, and equitable sustainable development, **creating the possibility of co-benefits or adverse side-effects.**

> **Climate policy may be informed by a consideration of a diverse array of risks and uncertainties, some of which are difficult to measure.** … **The design of climate policy is influenced by how individuals and organizations perceive risks and uncertainties and take them into account.** People often utilize simplified decision rules such as a preference for the status quo. Individuals and organizations differ in their degree of risk aversion and the relative importance placed on near-term versus long-term ramifications of specific actions.

However, IPCC (2014b) points out what will happen without any mitigation and what is needed in terms of changes in energy systems and land use in order to keep the temperature increase to less than 2°C, and also highlights the urgency of not delaying mitigation efforts:

> **Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist driven by growth in global population and economic activities. Baseline scenarios, those without additional mitigation, result in global mean surface temperature increases in 2100 from 3.7 to 4.8°C compared to pre-industrial levels.** *(high confidence)*
>
> **Mitigation scenarios in which it is likely that the temperature change caused by anthropogenic GHG emissions can be kept to less than 2°C relative to pre-industrial levels are characterized by atmospheric concentrations in 2100 of about 450 ppm CO2eq** *(high confidence).*
>
> **Scenarios reaching atmospheric concentration levels of about 450 ppm CO2eq by 2100 (consistent with a likely chance to keep temperature change below 2°C relative to pre-industrial levels) include substantial cuts in anthropogenic GHG emissions by mid-century through large-scale changes in energy systems and potentially land use** *(high confidence).*
>
> **Delaying mitigation efforts beyond those in place today through 2030 is estimated to substantially increase the difficulty of the transition to low longer-term emissions levels and narrow the range of options consistent with maintaining temperature change below 2°C relative to pre-industrial levels** *(high confidence).*

The IPCC (2014b) states that both efficiency enhancements and behavioral changes are key mitigation strategies. However, a comment is also made about the importance of technology policy as a complement to mitigation, i.e. to stimulate innovation through either publicly funded R&D or procurement. In line with IPCC (2014a) the report also emphasizes that the private sector can play an important role, adding that it also can take part in financing mitigation efforts.

> **Efficiency enhancements and behavioural changes, in order to reduce energy demand compared to baseline scenarios without compromising development, are a key mitigation strategy in scenarios reaching atmospheric CO2eq concentrations of about 450 or 500 ppm by 2100** *(robust evidence, high agreement).* Near-term reductions in energy demand are an important element of cost-effective mitigation strategies, provide more flexibility for reducing carbon intensity in the energy supply sector, hedge against related supply-side risks, avoid lock-in to carbon-intensive infrastructures, and are associated with important co-benefits.
>
> **Behaviour, lifestyle and culture have a considerable influence on energy use and associated emissions, with high mitigation potential in some sectors, in particular when complementing technological and structural change** *(medium evidence, medium agreement).* Emissions can be substantially lowered through changes in consumption patterns (e.g., mobility demand and mode, energy use in households, choice of longer-lasting products) and dietary change and reduction in food wastes. A number of options including monetary and non-monetary incentives as well as information measures may facilitate behavioural changes.
>
> **Technology policy complements other mitigation policies** (*high confidence*)**.** Technology policy includes technology-push (e.g., publicly funded R&D) and demand-pull (e.g., governmental procurement programmes).
>
> **In many countries, the private sector plays central roles in the processes that lead to emissions as well as to mitigation.** Within appropriate enabling environments, the private sector, along with the public sector, can play an important role in financing mitigation *(medium evidence, high agreement).*

The UN Climate Change Conference in Paris 7-12 December 2015 provided a break-through in terms of all 197 participating countries agreeing upon and signing (194 nations) the final document, The Paris Accord. This is the first time the largest $CO_2$ emitters, China and the USA, are behind an agreement that this time can be viewed as global. Article 2 of the Accord states that:

> 1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen **the global response** to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
>
> (a) Holding the increase in the global average temperature to **well below 2 °C** above pre-industrial levels and to pursue efforts to **limit the temperature increase to 1.5 °C** above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
>
> (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does **not threaten food production**;
>
> (c) Making **finance flows** consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.
>
> 2. This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of **different national circumstances**.

The Paris deal will however only come into force legally 30 days after it is ratified by at least 55 countries, which between them produce 55% of the total global greenhouse gas emissions (UN, 2015: Article 21, p. 31). This process of ratification takes considerable time.

Simultaneously the World is experiencing 14 consecutive months where meteorologists have recorded the hottest months on record, which means that 2016 is likely to hit temperatures 1.1C above pre-industrial levels. In addition, average temperatures worldwide are likely to increase more in the coming years as an effect of previous carbon emissions. This makes analysts warn that the target of keeping temperature rises below 2C is already in danger of being breached (BBC – 3 Sept. 2016).

Finally, a second important breakthrough for the Paris climate deal took place September 3, 2016 when the World's two largest polluters in terms of $CO_2$ emissions, China (20%) and the USA (17,9%) announced that they ratify the agreement – which means that it now is getting closer to become a valid agreement. Before China and the USA made their announcements, only 23 nations, many of them small island nations, had so far ratified the agreement and they accounted for just 1.1% of emissions (SVT - 3 Sept. 2016).

The following 25 countries had ratified the agreement by September 3, 2016: Bahamas, Bangladesh, Barbados, Belize, Cook Islands, Cameroon, China, North-Korea, Fiji, Grenada, Guyana, Maldives, Marshall Islands, Mauritius, Nauru, Norway, Palau, Peru, Samoa, Seychelles, Somalia, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and Grenadines, Tuvalu and the USA. Worth noticing is that among the nations that had ratified the agreement, there was only one European country - Norway.

On 5 October 2016, the threshold for the Paris Agreement was achieved, and it entered into force on 4 November 2016 (UN, 2016). A main contributor to reaching this threshold was India, the world's 3rd largest greenhouse emitter (4.5%), ratifying the Paris Agreement 2 October and setting the goal that at least 40% of its electricity will be generated by non-fossil sources by 2030 (BBC –

2 Oct. 2016). Then, the European Parliament approved the Paris Agreement 4 October with 610 votes in favor, 38 against and 31 abstentions (BBC – 4 Oct. 2016).

> The European Union declares that … it is competent to enter into international agreements, and to implement the obligations resulting therefrom, which contribute to the pursuit of the following objectives: - preserving, protecting and improving the quality of the environment; - protecting human health; - prudent and rational utilisation of natural resources; - promoting measures at international level to deal with regional and worldwide environmental problems, and in particular combating climate change …

By 23 December, 118 nations of the 194 signatories had ratified the agreement (UN, 2016). Put into perspective, although it has taken 10 months, the Paris Agreement has raced through the UN ratification process in double-quick time in comparison with the previous Kyoto Protocol that took 8 years – and still many important nations were missing (BBC – 4 Oct. 2016).

## BUSINESS STRATEGIES FOR SUSTAINABILITY

At least since the Brundtland Commission's (1987) report 'Our Common Future', the issue of sustainability has been on the public agenda, but not always on the corporate agendas. However, what industrial and service firms do 'matters' for sustainability. This can be observed in terms of the *direct* impact of their production processes, including raw materials' use and distribution/transportation of products, as well as the firms' *indirect* influence on the use and later destruction/recycling of their products in society. In addition, firms as actors in society impact the social domain including health, child labor and social equity.

Inspired by the Brundtland Commission, there have been several attempts to develop approaches to analyze the needs of, and to envision strategies towards, a future sustainable society. Several sustainability approaches have focused on the societal level, e.g. in the Netherlands where the sustainability demands for technological, cultural and structural changes in society were addressed from different stakeholder perspectives. However, in a paper looking back on 10 years of development, Vergragt (2001) commented that while the involvement of private companies in innovation processes is essential, the bulk of Dutch industrial companies is still in the earlier stages of development towards sustainability (i.e. primarily focusing on cleaning up production processes and not on eco-design of products and services).

Nonetheless, today there are examples from various countries of industrial firms taking corporate social responsibility and sustainability seriously. For example, based on an empirical study of Canadian firms in the oil, mining and forestry industries, Bansal (2005) found that the commitment to a sustainable development had increased over time, fuelled primarily by a greater concern for social equity. Recent natural disasters (e.g. Hurricane Katrina) have contributed to an increased general interest in global warming, in combination with specific efforts to influence the public domain. One such example is former vice president Al Gore's (2006) 'An Inconvenient Truth: The planetary emergency of global warming and what we can do about it', which has had considerable impact reaching many individuals and groups in several countries, through television, seminars and a book. This mass-media exposure has, according to Gore, a major purpose of influencing

politicians through the general public, but of course also managers in industrial firms develop new insights.

There were fewer approaches that directly addressed the need for corporations to develop strategies in line with the demands of a future sustainable society. The **Natural Step** was one such approach that from the early 1990s succeeded in having an impact on the way business firms develop their undertakings (Holmberg & Robert 2000, Nattrass & Altomare 1999). Holmberg (1998) outlines the steps for a **backcasting** approach to strategy development in business firms, based on system conditions for sustainability. Other researchers focused on **ecological auditing** as a way to develop sustainable businesses (e.g. Callenbach et al. 1993), or on **Corporate Social Responsibility** (e.g. Garriga & Melé 2004). Probably the most commonly used tool in order to estimate ecological impact is **Life Cycle Analysis (LCA)**, which in many companies has become a standard methodology used in connection with product development in order to identify ecological impact (e.g. Rex 2008). Alänge et al. (2016) compares two role models for integrating sustainability in product development, IKEA and SCA. They found that these two multinational companies, IKEA with input from the Natural Step and SCA a pioneer in making LCA a standard practice, followed very different routes towards sustainability during the time period 1990-2006. As sustainability can be successfully integrated into product development in different ways, there is thus no best practice by which to achieve more-sustainable behavior within all companies. The implication for practitioners is that it can still be a good strategy to learn from others successful approaches, but practices must be adapted to fit the logic of each firm's corporate culture and specific management system.

A major breakthrough in the academic business/strategy discipline took place in 2006 when the doyen of strategy research, Harvard Business School professor Michael Porter, received the 2006 McKinsey Award for the most significant HBR article during the year – an article in which he and his co-author Mark Kramer are arguing for companies to create competitive advantage by **integrating social and environmental issues into their core strategy**, i.e. making sustainability a natural part of strategy. They stated that NGOs, governments, and companies must stop thinking in terms of 'corporate social responsibility' and start thinking in terms of 'corporate social integration' in order to find shared values between society and corporations. To analyze this potential for shared value, Porter & Kramer (2006) developed a framework based on Porter's well-established strategy analysis tools: mapping the social impact of the 'value chain' and using the 'diamond framework' to analyze the social influences on competitiveness. Hence, to put these principles into practice, a company must integrate a social perspective into the core frameworks it already uses to understand competition and guide its business strategy. According to Porter & Kramer the essential test of CSR is not whether a cause is worthy, but whether it presents an opportunity to create shared value – that is, a meaningful benefit for society that is also valuable to the business.

However, there are also other strategy development tools that can be used, and which also to some extent have been used, to include sustainability issues in strategy development. Not least, the tools developed to cope with discontinuous or disruptive change can be useful, i.e. to help strategizing when there is a high degree of uncertainty concerning the conditions for the future. **System Dynamics** has been used to analyze complex interactions in the market and learning processes on

different system levels (de Geus 1988, 1996; Senge 1990). Another starting point has been to focus on disruptive technologies and observe the difficulty that previously successful firms have had when there is a major **technology shift** (Christensen 1997), and to develop tools and approaches for firms to analyze such shifts (Christensen and Raynor 2003). Because of the difficulty of knowing what the future has in store, one approach that has been advocated is to keep strategy alternatives open as long as possible by developing an understanding of the uncertainty and managing a **portfolio of real options** on the contingent elements of alternative optimal strategies (Raynor 2007).

**Scenario Planning** is an approach that has been relatively widely used by industrial firms, most notably in the oil industry (Schwartz 1991; de Geus 1996) in order to create pictures of plausible futures for decision-makers. There are several variants of scenario planning – the most common way is a deductive approach where four equally possible developments are outlined to form the basis for strategy processes (Van der Heijden 1996). Based on this understanding, a strategy which is working and **robust** under all four scenarios is developed. It has been argued that "robust strategies tend to result in mediocre, if acceptable, results under most circumstances and standout performance in none." (Raynor 2007, p.231.) However, scenarios should be seen as an input for **strategic conversation** which can both expand and focus the thinking of decision-makers in corporations, and the concept of equally possible developments and robustness has a role in this conversation. While primarily used for corporate strategy development, scenario planning has been used for several other applications and in creative combinations. For example, Carlsson-Kanyama et al. (2003) integrated the participative approach from scenario planning into a back-casting exercise in five European cities, i.e. for society's development (see further the section on Scenarios).

Recently a growing number of prominent researchers have repositioned themselves into addressing central issues connected with sustainability. Senge et al. (2008) point at the "Necessary Revolution: how individuals and organizations are working together to create a sustainable world". C.K. Prahalad and co-authors (Nidumolu et al. 2009) ask "Why sustainability is now the key driver of innovation" indicating that there is no alternative to sustainable development: "In the future, only companies that make sustainability a goal will achieve competitive advantage. That means rethinking business models, as well as products, technologies, and processes." They develop a 5-stage model of sustainability challenges, competences and opportunities starting from (1) viewing compliance as opportunity, (2) making value chains sustainable, (3) designing sustainable products and services, (4) developing new business models, and finally (5) creating next-practice platforms. They conclude their article by stating "That will happen only when executives recognize a simple truth: Sustainability = Innovation."

Porter & Reinhardt (2007, p. 22) further emphasize the direct link between climate change and business strategy: "Companies that persist in treating climate change solely as a corporate social responsibility issue, rather than a business problem, will risk the greatest consequences. …the effects of climate on companies' operations are now so tangible and certain that the issue is best addressed with the tools of the strategist, not the philanthropist."

## DEVELOPMENT OF TECHNOLOGY AND MARKETS FOR PRODUCTS THAT ARE ENVIRONMENTAL

Another clear indicator of a major change can be seen in the marketplace. Even in the traditionally conservative automobile industry a major change is occurring, where innovation has become central for business success. Toyota Prius III was no.1 in Japan, and Honda's hybrid was no.4 on the Japanese market in 2009. The 2010 Car of the Year in the US, Ford Fusion, is also available in a hybrid version, as well as in diesel versions. During the past years almost all manufacturers have launched cars consuming 4.5 liters per 100 km, and Volkswagen – which has been leading this development – is once again launching a diesel model that uses less than 3 liters per 100 km (they launched their first 3-liter diesel Polo in 1998, although with an advanced gearbox that has been a constant headache).

The startup company Tesla has taken the development of the electrical car and the needed infrastructure to a new level by realizing that the best way to develop its own business is to make sure the business ecosystem develops simultaneously. Tesla's mission is "to accelerate the advent of sustainable transport by bringing compelling mass market electrical cars to market as soon as possible" and in order to accomplish this mission Tesla has also invested in a battery-charging infrastructure and together with Panasonic in a large scale battery production unit, the Gigafactory. However, due to its focus on developing the ecosystem, Tesla made its patents available for other companies to use. Tesla also entered into agreements to share its technology with companies such as Mercedes and Toyota, in order to fulfill its vision of renewing the industry towards sustainable transportation (Steiber and Alänge, 2016 pp. 103,108, 136, 139). The incumbents in the car industry are now putting increasing resources on developing electrical alternatives to the traditional combustion engine.

The Chinese market has rapidly become the largest for electrical vehicles, beating North America and Europe as major selling markets, both in volume (400.000 in 2016) and in market share (1,4%). This means that China absorbs around half of the electric cars delivered in 2016 (Pontes 2016). The vast majority of these electrical cars are produced by 9 local Chinese manufacturers with Tesla supplying 3.4% of the 32.000 electrical cars sold in October 2016 on the Chinese market. The Chinese electrical car industry has witnessed an investment boom over the past few years with more than 200 startups. The industry is now in a process where winners among the startups will be selected by the Ministry of Industry and Information Technology while others will be shaken out (Bloomberg News, 29 Aug. 2016).

Sustainability is increasingly being used as a starting principle for innovation and development. Jeffrey Immelt, the CEO of GE, has made it very clear: whatever is being developed at GE is based on or stimulated by a sustainability vision. "At GE, we are taking a new approach to solving some of our customers' toughest environmental challenges. We call it ecomagination." (GE homepage.) GE is also changing the way it innovates in the world. "Rather than follow its historical path of developing high-end products and adapting them for emerging markets, GE is developing local technologies in these regions and then distributing them globally." (See Immelt et al. 2009.)

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# 3 DISMANTLING LOCK-INS AND TRAGEDIES OF THE COMMONS

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Most of us are affected by "thought models" that lock us into mindsets and behaviors that create inertia for change. We may remain for long periods of time in this state without any need for significant changes. But the lock-in can become a threat to the individual, the organization or the society that is locked-in when the context in which one "operates" changes faster than one can unlock. The inertia to change inhibits sufficiently rapid adaptation. From an evolutionary perspective, such inhibitions can be life-threatening. Many examples can be given where individuals, companies and societies die off because of inabilities to adapt caused by lock-ins in mental models unsuitable for the contextual changes they experience (cf. Diamond, 2006).

This lock-in effect may be one important explanation for why society, despite our knowledge regarding human-caused environmental degradation, climate change and the extinction rate of other life forms, seems so reluctant to do something about it.

It may also be one important explanation for why companies seem reluctant to change their product offerings despite the insight that those who do – in directions that solve the environmental challenges in ways appreciated and valued by their customers – will experience "one of the biggest business opportunities in the history of commerce" (Hart and Milstein, 1999:25).

Lock-in can appear at all three system levels of society: the individual level, the organizational level and the societal level. Each of these three levels' lock-ins pose threats and opportunities for the entrepreneur.

This article tries to dismantle these lock-ins and the tragedies of the commons that seem to be consequences of these lock-ins. The focus is the entrepreneur and it is discussed how the threats can be addressed and opportunities exploited in ways that will benefit the entrepreneur's business.

## LOCK-INS

What is a lock-in? In short, one can say that it is "an act or instance of becoming unalterable, unmovable or rigid" or a "commitment, binding or restriction"[1]. The use of the QWERTY keyboard is an almost global illustration of a lock-in. The QWERTY keyboard layout was originally designed to slow down the writing speed of users, so as to prevent the mechanical parts in the first typewriters from jamming with each other. The widespread production, habitual use and expectation of this keyboard layout makes it almost impossible to change despite what, these days, is its obviously inferior layout. The lock-in develops inertia for change.

Mostly, we are affected by contemporary "thought models" that lock us in – fashions, standards, social status attributes, perceptions of society, contemporary things worth striving for and so forth. Lock-ins are not new. Mankind has believed that the Earth is flat, that the Earth is in the centre of the universe, and that the sun orbits around the Earth. It has not been trivial to change these beliefs and thought models. Some, like Galileo Galilei, even got arrested when claiming that these thought models were wrong[2]. Lock-ins may occur on the individual, the organizational, and the societal level in any age.

## DEFINITIONS AND DELIMITATIONS

The following text in this chapter will elaborate on lock-ins and inertia to change, from an eco-environmental perspective and with the aim to build insights on how entrepreneurs can build eco-environmentally sustainable businesses and capitalize on eco-environmentally sustainable offerings. In order to pursue this aim, we need to understand some basic notions like *tragedy of the commons,* the notion of *good* and two dimensions of good, namely *private good* and *common good*. In addition, the notions of *externalization* and *internalization*, including their effects, must be explained.

## TRAGEDY OF THE COMMONS

[1] www.dictionary.com 2009-12-19 entering "lock-in"

[2] From http://en.wikipedia.org/wiki/Galileo_Galilei: Galileo's championing of Copernicanism was controversial within his lifetime, when a large majority of philosophers and astronomers still subscribed (at least outwardly) to the geocentric view that the Earth is at the centre of the universe. After 1610, when he began publicly supporting the heliocentric view, which placed the Sun at the center of the universe, he met with bitter opposition from some philosophers and clerics, and two of the latter eventually denounced him to the Roman Inquisition early in 1615. Although he was cleared of any offense at that time, the Catholic Church nevertheless condemned heliocentrism as "false and contrary to Scripture" in February 1616,[10] and Galileo was warned to abandon his support for it – which he promised to do. When he later defended his views in his most famous work, *Dialogue Concerning the Two Chief World Systems*, published in 1632, he was tried by the Inquisition, found "vehemently suspect of heresy," forced to recant, and spent the rest of his life under house arrest.

The tragedy of the commons (Hardin, 1968) is one element that contributes to understanding why consumers and industry, despite becoming aware that the current economic growth paradigm follows an unsustainable path, and despite having at least knowledge about mitigating technologies, seem reluctant to act and use it. Commons are shared "things" such as the seas, the air we breathe and initially also land. The simple logic behind the tragedy of the commons is that the whole benefit of using a common is personal while the consequence of overuse is shared among all users of that common. Hardin describes the result in his example of the herdsmen having private animals on a common pasture (Hardin, 1968:1244):

> Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

The tragedy thus is that in a collective, each individual tends to pursue his or her immediate best interest. When everyone does this, using a common, the consequence is ruin, which is not in everyone's best interest. The same principle is valid when using commons for disposal (Hardin 1968:1245):

> Here it is not a question of taking something out of the commons, but of putting something in—sewage, or chemical, radioactive, and heat wastes into water, noxious and dangerous fumes into the air, and distracting and unpleasant advertising signs into the line of sight. The calculations of utility are much the same as before. The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest," so long as we behave only as independent, rational, free-enterprisers.

Hence, while the world we live in has commons and there are difficulties in legislating temperance, the tragedy of the commons plays an important role in explaining why awareness of a problem may be high without translating into behavioral changes. It is worth noting that the tragedy of the commons is applicable not only to individuals, but also to companies and countries. No single entity in these three categories can be expected to show sacrificing temperance in the use of a free global common as long as the consequences are shared.

Hardin's generalization has been challenged. One hypothesis about environmental impact from growing affluence is that in the initial phase of the development of an economy, economic growth is preferred over environmental improvements – while in later phases, as citizens become more affluent, they change preferences towards environmental improvements. Such simultaneity of technology progress and change of preferences is argued to reduce the environmental impact. This is referred to as the Environmental Kuznets Curve hypothesis. The hypothesis is based on the relative measure of pollution per capita income. Several types of pollution seem to follow this hypothesis, but it has not proved applicable to all, for instance to municipal waste and carbon dioxide emissions, either in absolute measures or on a per capita level (Azar et al., 2002). Although many countries show improvements in relative reductions of $CO_2$ from GDP, absolute reductions have been much more difficult to obtain. The hypothesis is thus not very useful in regard to the impact of $CO_2$ and other greenhouse gases on climate.

Jared Diamond (2006) has described isolated societies that collapsed due to overuse, but also some local societies with self-organized Social-Ecological Systems[3] (SES) which worked for centuries. One of the two 2009 Nobel Prize laureates in economics, Elinor Ostrom, has for decades researched under what conditions the users of certain resource systems may self-organize in order to sustain them over time. Here are some claims regarding Social-Ecological Systems:

- All humanly used resources are embedded in complex social-ecological systems (SES)
- SES are composed of multiple subsystems and internal variables within these systems at multiple levels analogous to organisms composed of organs, organs of tissues, tissues of cells, cells of proteins etc.
- SESs are therefore complex systems
- Thus, we must learn how to dissect and harness complexity

## A FRAMEWORK FOR AVOIDING THE TRAGEDY

Ostrom uses Easter Island as an example of the importance of understanding the SES and its system dynamics. The resource system regenerated slowly on Easter Island while the population grew rapidly. Lack of understanding of the SES led to destruction of the resources (Ostrom, 2009). The Easter Island case is independently described also in *Collapse* (Diamond, 2006), and is a good illustration of how lock-ins actually may become life-threatening to the people locked in.

Ostrom suggests a general framework for analyzing sustainability of SES. She introduces a core subsystem, shown in Fig. 1 below (Ostrom 2009:420), from which she goes through a list of second-level variables that matter greatly as to whether a sustained SES may develop or not, such as (not the complete list):

- Size of the resource system
- Predictability of system dynamics
- Resource mobility (fish and water movements, possibly outside the resource system)
- Number of users
- Knowledge of the SES among users

[3] This is the notion used by Ostrom (2009) in Science, Vol. 325, 414-422.

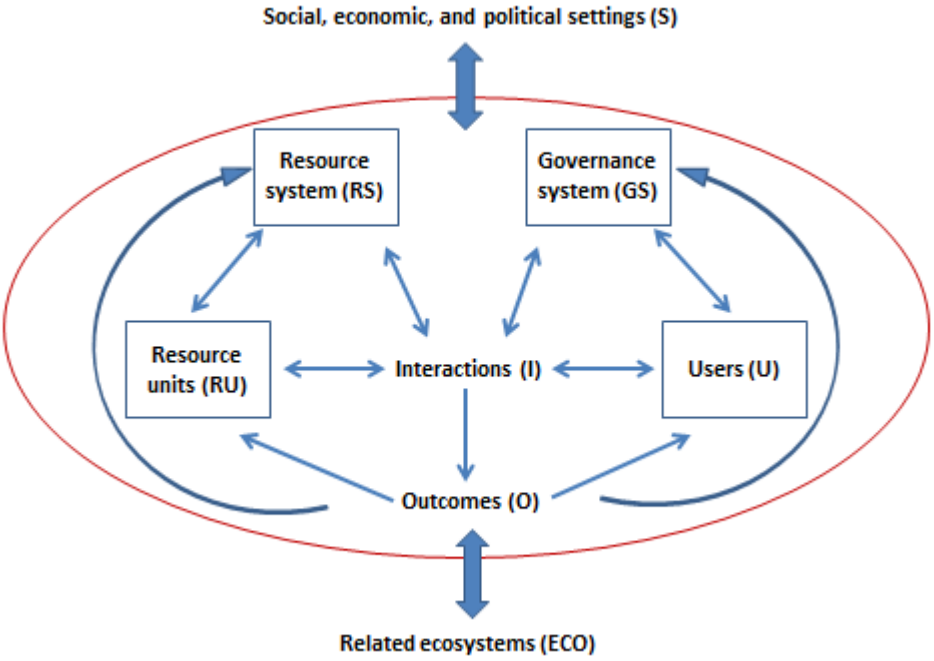



*Figure 1. The core subsystems in a framework for analyzing social-ecological systems. Source: Ostrom (2009)*

Creating a sustainable SES is not about not taking space in the ecosystem, which is inevitable. It is about not taking harmfully large amounts of space. The linear thinking and the notion of "efficiency" that come with our current paradigm do not seem to fit into a sustained ecosystem. Normally, we want to maximize the yield of something we want to "produce". To achieve that, we:

- remove everything else than what we want to grow = introducing a monoculture on that level
- kill everything that feeds on what we want to grow = introducing a monoculture on that higher level as well
- boost "productivity" with artificial fertilizer and irrigation, often an unsustainable way to produce
- expand geographically to meet "demand" = expanding the monoculture

Some effects:

- The extinction rate of species is about 100 times higher than pre-industrial level
- At the current rate, all rainforest will be gone before 2030
- A prediction is that it will take at least ten million years to restore – not meaning that extinct species will return, but that the diversity of species will be restored.

Conceptual thinking to avoid unsustainable business models was introduced with "The Natural Step" in the late 1980s, further refined by Holmberg et al. (cf. Holmberg, 1998). Three of the four principles relate to ecosustainability. Holmberg states (1998:33-34):

*In order for a society to be sustainable, nature's functions and diversity must not be systematically:*

1. *Subject to increasing concentrations of substances extracted from the earth's crust*
2. *Subject to increasing concentrations of substances produced by society*
3. *Impoverished by over-harvesting or other forms of ecosystem manipulation*

As seen, the linear thought model we currently use frequently clashes with these principles. The question is how to design a business model in line with the sustainability requirements yet producing "good" value as economically viable as an unsustainable business model.

## THE NOTION "GOOD" AND PRODUCTS' "PRIVATE GOOD"

The notion of "good" or value is far from a pure and objective utility maximization. One aspect is a product's perceived value for the paying customer – its perceived "private good". An illustrative and not so distant example of what is meant comes from the energy and petrochemical conglomerate Shell[4]. In the year 2000, Shell launched low-sulfur petrol under the name Pura, for a price premium of € 0.45 per liter. The marketing message was that it was a more eco-benign fuel. Pura came to account for only a few percent of Shell's petrol sales. Despite the disappointing market results, Shell continued, now together with Ferrari, and managed to further reduce the sulfur content. It was then re-launched under the name V-Power, with the message that the fuel was good for the engine and actively cleaned the intake valves. V-Power rapidly reached over 20% share of the sales. Both messages were equally true, but one focused on the common good and the other on the private good of the product delivery, resulting in a substantial difference in customer appreciation and market share.

A product may have more social meaning than its pure utility function. A car is a means to getting transported from A to B, but is also associated today with status, lifestyle, comfort, and other additional meanings beyond its pure utility function (e.g. Ahuvia, 2005; Belk, 1988; Dobers and Strannegård, 2005; Wattanasuwan, 2005). The status part is, among other things, reflected in engine power and torque, which affects the car's energy use and efficiency. From a $CO_2$ emission perspective, the status dimension of the car is in conflict with its eco-environmental performance. In comparison, a higher energy consumption of a refrigerator is not necessarily associated with more status, but can rather be seen as evidence of inferior technology and hence as carrying a lower status value. Different types of products thus carry different environmental challenges from a market perspective.

Another aspect of products in society is their dependence on other products and services. The usefulness of a car is highly dependent on an infrastructure of fueling stations that can provide the fuel the car runs on. Similarly, a refrigerator is expected to fit the voltage of the wall socket. Over time, a substantial inertia to change may develop in these networks of interdependent products and

[4] http://www.duurzaam-ondernemen.nl/index.html?http://www.duurzaam-ondernemen.nl/detail_press.phtml?act_id=5743&username=gast@duurzaam-ondernemen.nl&password=9999&publish=Y&username=gast@duurzaam-ondernemen.nl&password=9999&groups=DUO (accessed 2006-03-08) based on an article in The Netherlands Het Financieele Dagblad 2004-12-01.

services. Using the car as an example, changing fuel from fossil petrol or diesel to a renewable fuel may be easy for the car manufacturer, inconvenient for the consumer and very costly for the fuel provider. In comparison, more stand-alone products, like clothes, may be easier to change because of their higher relative independence.

The magnitude of required eco-environmental improvements will inevitably affect the current consumer meaning of products. An important competence among companies that intend to choose the sustainable route will thus be to redefine the consumers' meaning of products in directions that allow significant eco-environmental improvements in ways consumers will appreciate and interpret as being superior to the "old" alternatives. Currently there are not many eco-environmental illustrations to provide, while the more general theory on radical innovations in product meaning is developing rapidly (c.f. Dell'Era et al., 2010; Verganti, 2008). Companies like Kartell, Luceplan, Alessi and Apple seem to have developed a competence to redefine the meaning of products in ways that help them create new markets or uncontested market segments.

Thus, consumers' willingness to pay for eco-environmental improvements depends on factors that change *and can be changed*, such as the product's role and meaning, the infrastructure it is part of, and the perceived delivered value. Some changes can be made and appreciated more easily than others. Consumers' willingness to pay for eco-environmental improvements is affected by the products' social meaning, by the products' fit to the broader infrastructure of products and services, and by the products' perceived value. These factors are not static but may change over time. Companies, NGOs, media and governments may affect them, both consciously and unconsciously. This means that various product typologies carry different "greening" challenges and that these challenges may be consciously changed.

## "COMMON GOOD" AND ECO-ENVIRONMENTAL IMPROVEMENT

A reduced misuse, or reduced overuse of a common, can be expressed as either a greater common good or a lesser common bad. Eco-environmental issues are often about such misuse or overuse of various commons. $CO_2$ emission from combustion of fossil fuels is seen today as a common bad since it is an anthropogenic addition of $CO_2$ to the atmosphere that seems to cause unnatural and unwanted climate changes. Greening efforts that reduce the use of fossil fuels are seen as improving the common good or at least reducing the common bad. The notion of common good or common bad incorporates more than just eco-environmental issues, for instance traffic accidents and noise. Greening of industry is thus a subset of "common good".

Another reason for using the notion of common good instead of eco-environmental improvements is the established notion of "private good". The need for industry to focus on and improve the private good of its offerings in order to survive is more or less generally assimilated in the part of the world that runs market economies. When society's awareness about the negative consequences of consumption grows, this may affect the market rules for firms. A complementary "common good" dimension to the current market focus on private good may help organizations change their view of the market and find ways to innovate differently. In order for an organization to improve the common good of its product offerings, it must have knowledge about the issue of common

good, just as knowledge about the perceived good of private consumers is required to stay competitive in the marketplace of private goods.

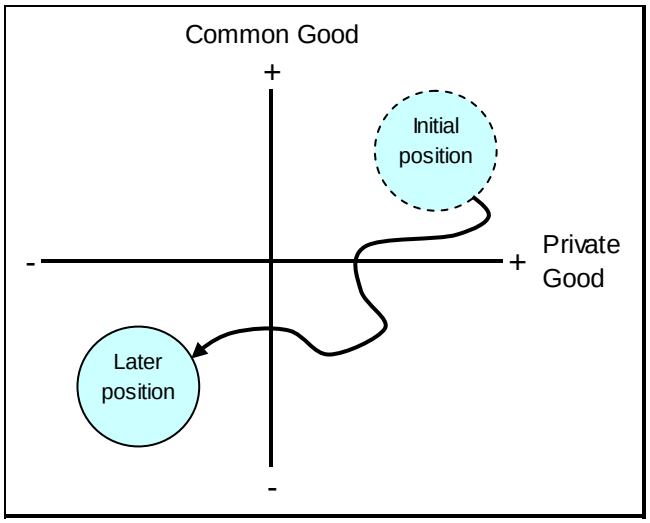



*Figure 2. Illustration of competitiveness for a non-changing firm. Source: Author*

The general competitive arena for product offerings is the right side of the vertical axis in the illustration above. Green innovations in general belong to the upper half of the above-depicted alternative market view. Successful green innovations belong to the upper right quadrant in that view. "Successful green innovations" are thus a subset of the more general "successful innovations" (the right half), while green innovations in general can also be uncompetitive (the upper left quadrant). The reason why a company's market proposition may move as in the illustration is that its competitive playground is not fixed and hence consumer preferences are not either. Henry Ford could not continue to sell "any color as long as it is black", and the industry producing CRT tubes for "fat TV" sets has seen their competitiveness vanish.

Since greening of industry is about improving commons while the tragedy of the commons is applicable, it seems appropriate to expect that more eco-benign product offerings also must provide personal value to the individual who pays, in order to become accepted, attractive and used. As has been described, this personal value can be added either within the current interpretation of product meaning or by innovating its meaning to something new.

## EXTERNALIZING AND INTERNALIZING COSTS

In the second quote from Hardin (1968) he stated: "The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them." What is described here is a situation where one (the rational man) has something he no longer wants to have (waste). When the rational man chooses to discard his waste into the common, it means he is *externalizing* the cost. If (or when) society's concern over the waste results in legislation that forces the rational man to take care of his waste and purify it at his own expense, it means the cost is *internalized*. Externalize/internalize is thus to be seen as moving the responsibility and associated cost of something (in this case waste) outside/inside the entity (individual, organization, country) that produced the waste.

Examples of internalizations of waste from road vehicles are NOx, VOC, HC and CO released from the vehicles' engines during combustion[5,6]. These are now regulated by governments which from time to time revise the maximum allowed levels. The internalization has carried several cost types and required legislation in order to happen.

## HOW LOCK-INS DEVELOP (THE KNOWLEDGE PERSPECTIVE)

One way to understand how lock-ins develop is by using a knowledge perspective. Knowledge can primarily be gained in two ways: through observations or through experiments. Entrepreneurs typically experiment with new market offers (private good) in the marketplace, while we mostly gain knowledge about eco-environmental issues (common bad) through observations. About 100 years ago an entrepreneur, Henry Ford, had a market success with a new technology – cars propelled by an internal combustion engine that runs on petrol.

When the market for automobiles started to grow, transport was an enabler of increased wealth through the expansion of markets for suppliers, products for consumers and the labor market for employers and employees. Personal mobility with the use of cars let people work and live at different locations. Leisure time became enriched. Relatives could easily meet. Since then, the average growth of the world motor vehicle population has been substantial. For more than fifty years, the annual average increase has been over 5% from about 50 million vehicles in 1946 to above 650 million in 1996 (Metz et al., 2001). Despite the historical growth, the future market for cars is estimated to be huge even if its relative position among the different mobility modes is believed to decline (Schafer and Victor, 2000). The private consumer, as well as society, has thus benefited from and enjoys increased mobility. And moreover, few want to be without it.

In the very beginning of the automotive era, there was an initial phase of competition between alternative technologies and the result was that the internal combustion engine (ICE) became preferred. Since then, the focus has been on developing and improving ICE-propelled cars (e.g. Hård and Jamison, 1997), resulting in technology development characterized by mainly incremental

[5] http://en.wikipedia.org/wiki/European_emission_standards
[6] http://www.airqualitynow.eu/pollution_home.php

innovations (e.g. Tushman and Anderson, 2004). The assumptions, concepts, values, and practices that follow, on the individual, the organizational and the institutional levels, form a paradigm – or a cultural pattern – within which, over time, these levels seem to have been trapped. The focus on ICE-propelled vehicles has taken place not only in industry but also in several other areas in society. A network of supporting services has developed and influenced, for instance, the educational system, the fuel infrastructure, service facilities, hotels, and so forth. Together these areas have formed a large technological system (e.g. Hughes, 1987) with considerable inertia to change. Consumers and society not only enjoy the benefits from cars but also become engaged in various forms in the development, production, homologation, distribution, sale, consumption, servicing, road infrastructure provision, fuel infrastructure provision, fuel supply, and end-of-life treatment of vehicles.

Society's knowledge about the negative externalities from consumption of auto-mobility was generally low when the industry emerged 100 years ago. Over the years, however, society has learnt about several negative externalities through observations. When, gradually, various effects of the accumulation of by-products from consumption of mobility became observable and consequences known, society, the business and the consumers came to realize that something must be done. Today, negative externalities from motor vehicles are a sincere global concern because of noise, accidents, congestion, toxic emissions, greenhouse gas emissions, hazardous waste and the like. The automotive industry has hitherto displayed difficulties in reducing or eliminating these negative externalities voluntarily. Alternative technologies are, like most existing technologies, often initially more expensive and less efficient and therefore may find it hard to successfully compete against the established ones (Kemp et al., 1998). Alternative technologies have to reasonably fit the established technological system to become accepted in the market (Hård and Jamison, 1997; Newton, 2002). Similarly, consumers in general show unwillingness to pay for improved environmental performance (Diekmann and Preisendörfer, 2003; Tyler et al., 1982). The situation is not necessarily an expression of bad morals, lack of knowledge or ignorance, but may to a greater extent be caused by inertia developed in the system over time that causes change to be perceived as tremendously difficult. Some suggest that governmental intervention is required to reduce these negative externalities (e.g. Norberg-Bohm, 1999; Porter and van der Linde, 1995), otherwise no change will occur. Others suggest that entrepreneurial abilities to "rethink" may be the way[7] to achieve the required transformative change.

## ONE CAN GENERALIZE THE EVOLUTION OF THE LOCK-IN SITUATION FROM THE ABOVE CASE:

First, there is a *knowledge problem*. To improve a common good or reduce a common bad requires knowledge about what it is that is good or bad. Such knowledge is not always readily available. Society tends to learn about these issues through observations, which means that the knowledge of what is bad is not available until a sufficient amount of what is bad has been produced and has had time to create an effect that can be observed. The time required from the initial production of

[7] http://www.ted.com/talks/johan_rockstrom_let_the_environment_guide_our_development.html viewed 2010-09-07

a potential "bad" until observations have been made and discussed in the scientific community so that knowledge can be claimed on the issue is often substantial. The time between initial production of the "bad" and validated knowledge that the "bad" really is bad can be several decades. In the automotive example, the bad may be NOx, HC, CO, VOC or $CO_2$ just to mention some emissions.

Secondly, there is a *lock-in problem*. While society unconsciously awaits knowledge on the issue, the production of the "bad" continues. Since it is a by-product from production of appreciated goods for paying consumers (in the automotive example it is torque from the engine), investments are made, production is scaled up, technology is chosen and becomes dominant, competitors establish themselves, customer preferences are formed, the market grows and the product establishes its role in society. Technology and organizations mirror each other more and more on both meso- and macro-levels in society. This whole development tends to create lock-in effects.

Thirdly, the *tragedy of the commons has developed* among actors trapped in the paradigm. The continuous striving for each and every firm in industry to stay competitive or improve competitiveness is shown by a continuous effort to deliver improved good to the paying customer. Initially, the production of "bad" is an unconscious but interdependent by-product from the produced private good. The unconsciousness can, at least partly, be explained by the initial general lack of knowledge on the issue in society. The interdependence between the produced private good and produced common bad creates reluctance against any voluntary reduction of the "bad" once it has been identified as being bad. The reason for this reluctance is the interdependence between the now identified "bad" and the long-established delivery of private good. Since the "bad" is common (for instance externalized through the car's tailpipe) and the good is private and there is competition in the marketplace, the tragedy of the commons rules among the producers. Every firm will pursue its own best interest, which means that if there is any cost associated with reduction of the common bad, no one will voluntarily reduce it. The tragedy of the commons also applies to consumers. If a reduction of the "bad" can only be made at a cost for the paying consumer, each individual in the collective of consumers sees limited reasons to make voluntary personal sacrifices. It also applies to many countries. As the industry grow and becomes an important contributor to GDP growth, a country seldom wants to lose the business to less environmentally stringent countries, especially not if externalities are global like $CO_2$. Our understanding of why the reluctance to change is significant increases by applying the view that products are physical embodiments of the organization's knowledge, and that the "bad" and the "good" often are co-produced in the product's technology[8]. Changing knowledge in an established organization like Ford or GM (including historical investments they have made in factories etc. because of the knowledge profile developed during the second phase above) is not done easily or quickly[9].

[8] An example: torque (good) and $CO_2$ (bad) are "by definition" co-produced in an internal combustion engine if the fuel contains carbon.

[9] For more information on the highly interesting concept "absorptive capacity", suggested starting points are:

Cohen, W. M. and Levinthal, D. A. 1990. Absorptive Capacity: A New Perspective On Learning And Innovation. *Administrative Science Quarterly* **35**: 128.

Zahra, S. A. and George, G. 2002. Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management. The Academy of Management Review* **27**: 185.

Organizations also develop path-dependences that affect their inertia to change.

Knowledge of how to reduce/remove the "bad" must then develop. Ostrom points out that we are dealing with complex systems where "ecological and social sciences have developed independently and do not combine easily" (Ostrom, 2009:419), i.e. the knowledge has not accumulated sufficiently regarding SES. Any alternative technology using resources and/or producing wastes of any kind may be the candidate for new, future eco-environmental problems if one does not ensure it is *truly* sustainable. Due to our limited understanding of SES's complex mesh of interrelations, it may be difficult to verify. One method to help develop more sustainable alternatives is Backcasting (Holmberg, 1998) which is described in Chapter 5. In the work to find solutions without any known "bad", important issues for the entrepreneur are what kind of knowledge and what combinations of knowledge will be required now and in the future, as well as whether the knowledge has to be within the organization or not – issues of accessibility and exclusivity of various types of knowledge. Grant suggests that the critical source of competitive advantage is access to knowledge and knowledge integration rather than knowledge itself (Grant, 1996).

## LOCK-INS AT THE THREE SYSTEM LEVELS

There are primarily three levels where lock-in effects can be observed in the system comprising society. These levels are the individual (the micro-level), the organizational (the meso-level) and the societal (the macro-level). Up to now, the main illustration of a lock-in effect has been on the organizational level, i.e. the meso-level. Lock-ins on the individual level and on the societal level will now be illustrated.

### MACRO-LEVEL LOCK IN

We will start with the macro-level, lock-in of the whole society:

One role of the government is to provide an unbiased market, preferably a "perfect market" i.e. a market where no single actor or set of actors is favored over others. A transaction between a buyer and a seller in a perfect market is supposed to involve only these two parties and ensure that any third party is unaffected. If any such side effect occurs, the government's role is to offset any such effect by using taxes or legislation – i.e. the market price for any merchandise is supposed to cover all its costs, both direct and indirect.

Let us take the tobacco market as an example. The collective of smokers needs more health care than average, because smoking negatively affects one's health. If tobacco is sold only at market price without any tax, third parties would be affected in terms of having to pay health-care tax also for the additional health care of smokers. The role of the government is therefore to put a tax on tobacco that covers the required additional health care of smokers. Only when the market price includes all direct and indirect costs can consumers make correct choices. When it comes to smoking and tobacco, many countries in the world have now realized the need for taxes in order to keep the tobacco market unsubsidized.

In 1998 in the USA, the price for gasoline at the pump was about $1 per gallon. An estimate if all indirect costs (such as anthropogenic greenhouse gases) were included pointed at a price of somewhere between $5.60 and $15.14 per gallon[10]. The difference is externalized from the seller and the buyer of gasoline to society and to coming generations. Such a huge difference between the "true" price and the experienced price may lead consumers to travel more, use less public transport, choose bigger cars, and prioritize acceleration and torque over fuel economy. The market is biased and it becomes impossible to compete with car technologies that at a more correct price may have become market successes.

The release of anthropogenic greenhouse gases is now known to contribute to climate change in cost-increasing ways. Not least the Stern report[11] shows that the cost of reducing these gases is significantly lower than the cost of doing nothing[12]. The use of fossil fuels release anthropogenic $CO_2$, which is a greenhouse gas. Society knows about it but almost nothing is done. In a world where the "market economy" is almost universally preached, the market for fossil fuels is indirectly subsidized in most countries. The lock-in of society in a "thought model" where we do not consider this indirect subsidy becomes evident in newspaper headlines like "Wind Power: Subsidies Are Nice, But Strong Winds Are Nicer"[13]. As long as we continue to indirectly subsidize the fuel sources that alternatives compete with, it will be quite difficult to judge whether these alternatives can compete without subsidies or not.

Then why is society locked-in on fossil fuels but not on tobacco? Consider the tremendous dependence on fossil energy in all parts of society compared to tobacco. The issue is perceived as much more delicate and includes many and powerful actors with considerable self-interest in fossil energy.

## A POTENTIAL DILEMMA WITH SUBSIDIES

A government normally tries to create subsidies that are "technology-neutral". However, from a pure knowledge perspective, a subsidy may affect entrepreneurs' and inventors' attention in certain directions. An illustration is the Swedish law that fuelling stations above a certain size must also offer at least one type of biofuel. Since a pump for biogas costs about ten times what a pump for ethanol costs, the effect is that ethanol is relatively easy to find for car drivers while biogas is not, unintentionally biasing the market in favor of ethanol over biogas. An alternative, although perhaps not so popular, would be to avoid promoting what one may believe is the future (for instance, we don't know the potential of inventions not yet made) and instead to punish what is known to be the problem, for instance by introducing or increasing a specific tax for that substance.

[10] http://www.icta.org/doc/Real%20Price%20of%20Gasoline.pdf
[11] http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm
[12] Relevant claims are found in the four pages in the section "Summary of conclusions". http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/media/3/2/Summary_of_Conclusions.pdf
[13] The Wall Street Journal blog March 2, 2009. http://blogs.wsj.com/environmentalcapital/2009/03/02/wind-power-subsidies-are-nice-but-strong-winds-are-nicer/

### A DISCUSSION ON A POSSIBLE SOLUTION OF THE MACRO-LEVEL LOCK IN

Most people do not like taxation because it reduces their disposable income. Can the indirectly subsidized market for fossil fuels be corrected without negatively affecting the disposable income of the collective of consumers? A NASA researcher, James Hansen, has suggested one solution to the dilemma, which he calls "carbon tax and 100% dividend"[14]. A carbon tax is put on the fossil source proportional to the carbon content. The tax income to the state is then paid out to all citizens on a per-capita basis. The effect will be that prices of all merchandise will better reflect the carbon content required for it to be produced and to reach the stores' shelves. The collective of consumers will retain its purchasing power since the total tax is paid out to them. A consumer with a high carbon footprint will, however, lose while one with a low carbon footprint will gain. Consumers will face more correct prices and the market will be less biased. Over time, consumption will most likely change to a lower carbon footprint because of the stronger relation between a product's price and the $CO_2$ emissions it causes.

### A MICRO-LEVEL LOCK IN

Lock-in on the individual level (micro-level, consumer level) emerges from the "defining power" of established technologies in (1) symbolic, (2) organizational and (3) behavioral structures (Hård and Jamison, 1997). In order to be considered by consumers, alternatives to established technological paradigms need to become socially embedded in these structures (Hård and Jamison, 1997; Newton, 2002). In addition, they should not challenge too many of these structures simultaneously (Chen, 2001). "An alternative technology seldom succeeds if it poses an alternative at all three levels" (Hård and Jamison, 1997:148). The product performance in these three structures constitutes its value perceived by the consumer, i.e., what the consumer considers "private good". This is true within an existing paradigm.

There is also an asymmetry in consumers' perception of gains versus losses, such that the perceived punishment of losing is greater than the joy of winning an equal amount of value (Kahneman and Tversky, 1979). One example is "the observed discrepancies between the amount of money people are willing to pay for a good and the compensation they demand to give it up" (Tversky and Kahneman, 1986). Outcomes are perceived as gains and losses rather than as states of wealth, that is, gains and losses refer to some kind of reference point (Kahneman and Tversky, 1979). Product alternatives to established technological paradigms may suffer significantly even from relatively small product attribute deteriorations. The potential for the firm to get paid also depends on the consumer's possibility to find a reference for comparison (Sjöberg, 2005) – i.e. without a reference, the chance of getting paid increases.

There are several "parallel" theories on how to decrease the impact of a reference for comparison. Some address the issue by approaches aiming at breaking loose from the existing paradigm, i.e. to

[14] http://www.columbia.edu/~jeh1/mailings/2008/20081229_Obama_revised.pdf page 5 and onwards.

create an uncontested market space. One is the *blue ocean strategy* (Kim & Mauborgne, 2005) approach while another is the *design-driven innovation* approach (Verganti, 2008). Others worth mentioning on the same theme are Christensen (1997) and Hamel and Prahalad (1994). While the authors proceed from quite different theoretical frameworks, they converge around the theme of (radical) innovation of product meaning for consumers. New product meaning can be created by you and/or by your customers.

Knowledge of consumer behavior on common good issues and on the product's social meaning may thus be important for organizations that want to voluntarily and profitably go green.

## A DISCUSSION ON A POSSIBLE SOLUTION OF THE MICRO-LEVEL LOCK-IN

Unlocking on the individual level is suggested to be done sequentially, i.e. not on all three levels simultaneously since it will challenge the perceived private value of the product too much.

Let us look at cars when illustrating the symbolic domain of a product's "value". A car has a very significant symbolic value. Chrome, leather, engine power, size, and even price are some car attributes that help the owner to shape his/her identity in society.

In the organizational structure there is, for instance, an infrastructure of fuelling stations for petrol and diesel and service stations with staff trained to repair and maintain cars with internal combustion engines.

Behavioral structures may contain expectations regarding load capacity, range on one tank of fuel, comfort, noise level, acceleration and so forth.

A more eco-benign car, possibly small in size, with a weak engine, running on a fuel not found at regular fuelling stations, may thus find it hard to successfully penetrate the market. Anyhow, this was a route first taken by at least two car manufacturers in their initial efforts to "go green" and they failed, not surprisingly (Williander, 2006). Here follows a brief excerpt from the comparison between two "green" offers – a methane-fuelled car vs. a hybrid car from that article:

> In the case of methane-fuelled vehicles, the consumer sees a range of cars where the bifuel or dedicated methane is an engine variant in a certain car model. The offer is hitherto based on the weakest engine, but at an additional cost of typically $4000 or more. The car will give the consumer either a range close to a traditional car, but then dedicated to only methane and possibly with reduced trunk space, or if a bifuel (means running on either of two fuels, methane or petrol) with a range roughly half of a traditional car for each of methane and petrol. After 23 years of methane-fuelled vehicle offers in the US, the infrastructure of stations providing methane fuel there is about 1600 unevenly distributed stations, where almost half of them are private, compared to more than 175 000 petrol stations. In Sweden one can find methane fuel stations unevenly spread in the southern part of the country.
>
> In Sweden and the US, most stations providing methane fuel only provide methane and not petrol, so a bifuel car has to be refuelled at two different locations. In addition, the fuel price difference in Sweden may result in an economic payoff first after more than 10 years of ownership for a normal household. The residual value in Sweden and the US has been lower than for similar petrol vehicles.

The price addition in a hybrid car is in the same range as for a bifuel vehicle. The reduction in fuel consumption roughly translates into the same fuel cost savings as when driving on methane in Sweden and the US (October 2003). The Prius brand exists only for the hybrid, which means a Prius owner is a hybrid owner and the reference price is obscured. The Prius can be seen as a bundling of common and private good into a unique product where it is impossible for the consumer to separate the two. The product proposition does not challenge any of the symbolic, behavioural or organizational dimensions of the existing dominant technology. No alternative fuel is required, and range cannot only be equalled but also potentially improved due to the car's higher energy efficiency. A unique body style, high-tech interior features combined with the hybrid technology marketed as high-tech create a symbolic value. In various ways, the consumer is continuously reminded that Prius represents leading edge technology, fuel savings and eco-environmental performance combined.

The difference in consumer acceptance of these two types of product offer, where the price addition and fuel savings are about the same, becomes obvious. Ford officially confirmed on 30 January 2004, that they would stop offering methane-fuelled vehicles in the US after the current 2004 model year. Volvo continues to sell some thousand bifuel vehicles annually, mostly to fleet operators while consumers' growing interest in the Toyota Prius II, launched outside Japan in 2004, prompted Toyota to decide in August 2004 to increase production by 50%, and in March 2005, 'the popular Prius gas-electric hybrid mid-size sedan recorded its best-ever overall sales month with 10 236 units, an increase of 160.9% over March 2004' in the US (noted in 2005).

## LOCK-IN ON THE MESO-LEVEL

Lock-in on the meso-level (i.e. among competitors) can be quite good for an unlocked entrepreneur. There are in fact several ways to "make competition irrelevant" (Kim and Mauborgne, 2005) by using a reconstructionist strategy that seeks to shape the environment (market) rather than a structuralist strategy that assumes the operating environment is given[15]. Innovations can be either competence-destroying or competence-enhancing for the established industry (Tushman and Anderson, 2004). By designing a "blue ocean" strategy, preferably based on competences not common among competition, small firms with limited resources may out-compete significantly larger and more resource-intensive firms, for the simple reason that competence is not easily changed.

[15] http://www.blueoceanstrategy.com/ . The reconstructionist view may create what is called a "blue ocean" indicating an uncontested market space. A structuralist view tends to stick to the current "red ocean" – the name suggesting that competition is "bloody".

## A DISCUSSION ON OPPORTUNITIES FROM THE MESO-LEVEL LOCK IN

Apple is one example of a firm that has repeatedly succeeded with "blue ocean strategies" and radical change of product meaning. In the established market of MP3 players, when firms competed with battery life and storage size, Apple unexpectedly entered the market and launched its ultra-slim rechargeable iPod with a unique and intuitive user interface. Combined with iTunes in the computer, one could easily manage one's music as well as buying more on the net – something lined with hurdles at that time[16]. By challenging the symbolic structure of the established market with its unique design and the behavioral structure with its intuitive interface and iTunes, Apple reduced consumers' perceived importance of battery life and storage space, attributes closely connected to the competence profile of the established MP3 manufacturers, and increased the importance of attributes more closely connected to the competence profile of Apple. After some time, Apple decided to enter the mobile phone market and launched its iPhone. By providing a mobile phone with a unique user interface, in this case a touch screen with many features combined with smoothly integrated third-party applications, they managed once again to make competition irrelevant.

If one can repeat the exploit of Apple with more eco-benign products from a firm with sufficient knowledge on how to build its business from an eco-sustainable business model, it will create "one of the biggest business opportunities in the history of commerce" (Hart and Milstein, 1999:25) for that firm. Referring to the car industry, which even today mainly continues to sell "a dream" (in terms of a lonely car on a curvy road without speed limits), an open question is what alternative meanings can be created with the reality that most of us experience, while developing through those alternative meanings a better mobility experience for customers and simultaneously an uncontested market space and increased profitability for the firm.


*The dream*

*Photo: Volvo Cars*


*Many people's reality*

*Photo: S. Alänge*

[16] Worth noting for entrepreneurs familiar with Geoffrey Moore's suggestions for how to "cross the chasm", this bundling of the iPod with iTunes made the offer more complete, which is precisely in line with Moore's suggestions on how to succeed with crossing. See Moore, G.A., 2002, Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers. ISBN 9780060517120

With the above pictures in mind, could Ford and Volvo have developed and marketed their methane-based offerings in more successful ways than trying to compete on "The dream" battlefield? And where did the Toyota Prius fit in?

## SUMMARY OF LOCK-IN:

In generalized terms, lock-in consists of three phases:

1) The "entrepreneurial" phase where focus is on the private good of a paying consumer and where some (consciously or unconsciously) unwanted by-products are externalized.
2) The growth phase where, under limited total knowledge, the private good is appreciated, the market and volume grow, investments are made and competition increases.
3) The "insights" phase where knowledge from complementary observations reveals unwanted consequences of the accumulated externalization of the co-produced by-products.

Lock-in can appear at all three system levels of society: the individual level, the organizational level and the societal level. Each of these three levels poses a threat and an opportunity for the entrepreneur. The question is:

## WHAT CAN A SMALL ECO-ENVIRONMENTALLY INTERESTED ENTREPRENEUR DO?

As said, lock-in can appear at all three system levels and each of them poses a threat and an opportunity for the entrepreneur. The three phases of a lock-in also indicate that any business, *for instance your own*, may become locked-in if by-products are co-produced, externalized and later on shown to be a burden for society. So one question is: Is your own business model sustainable? To answer that question, you need to understand the SES you operate in. Ostrom suggests that SES are complex, so you probably do not have sufficient knowledge on your own. Many entrepreneurs ensure they have access to knowledge in economics, brand development, patents, trademarks and other IP-issues, law etc. for good reasons – knowledge is needed to run a successful business. However, most company boards or management teams hitherto lack knowledge on eco-environmental issues or lack access to the right knowledge[17].With reference to Grant (1996), one recommendation is to *develop a knowledge strategy and knowledge network*. With that in place, you may use for instance Backcasting and your network's SES knowledge to check your business model "health".

[17] A good illustration of this is found in Amodeo, R. A., 2005, "Becoming Sustainable: Identity Dynamics within Transformational Culture Change at Interface, Inc.", Organization Development, Benedictine University, Lisle, where she describes the story of Interface Inc. and its founder Ray Anderson on their path towards a more sustainable business model.

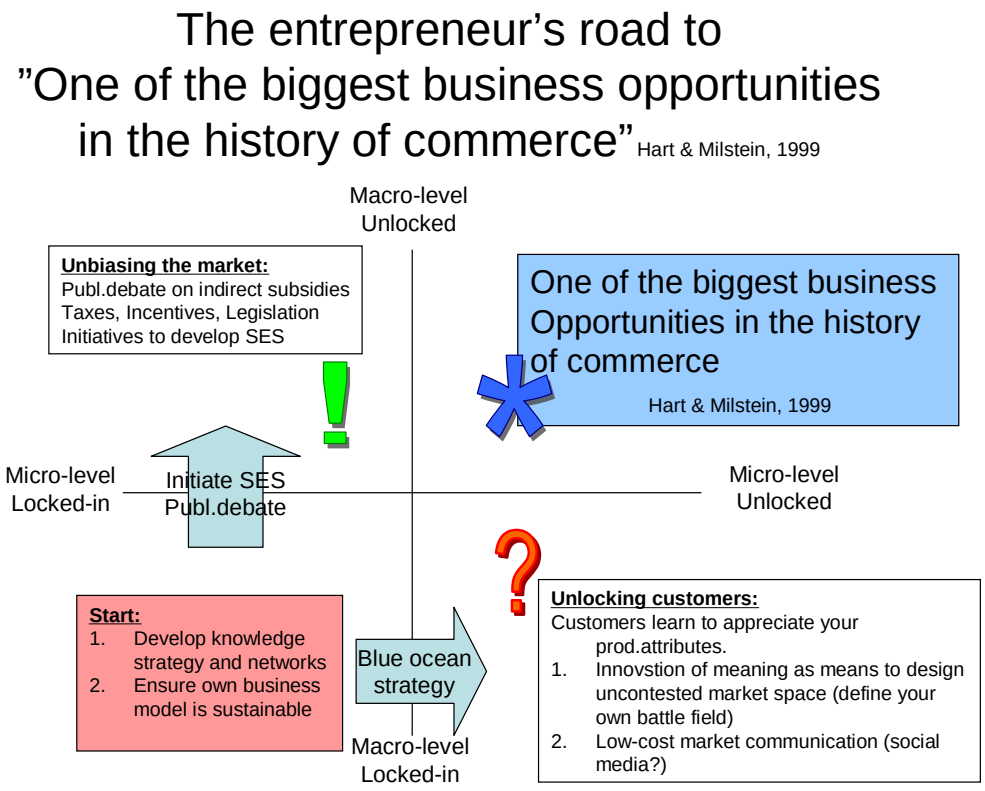
Is your market unbiased? Use your knowledge about lock-in situations and your knowledge network, and learn the conditions of your market. Is competition externalizing any costs? Can the accumulated cost be estimated? Is it a cost for contemporary society or coming generations? A recommendation is to learn your market from an eco-environmental point of view: *Identify any market biases and, on that basis, develop a debate plan and an SES initiation plan.* An encouraging conclusion from Axelrod and Cohen (2001) is that single actors may have disproportional effects in complex systems, for instance entrepreneurs like you. Hence, don't let the relative size of your business or "voice" discourage you regarding your chances to influence the market conditions. Make conditions work *for* you.

Some of the threats and opportunities for the eco-environmental entrepreneur from lock-ins of others may be listed as follows (see also the figure below):

Meso-level: Any inferior resource position an entrepreneur may experience against competition may be offset by a blue ocean strategy, possibly combined with a knowledge strategy based on Grant's suggestion that the critical source of competitive advantage is knowledge integration rather than knowledge itself. Given that the entrepreneur is not locked-in to the same mental "thought model" as the competition, the lock-in of competition is in fact a significant opportunity, especially if the lock-in has its roots in the competence profile of the firm since a change of competence profile carries a significant inertia.

Micro-level: Lock-ins of customers may constitute a threat and an opportunity. A significant problem may be the high cost of communicating with the market, as well as having sufficient knowledge and understanding of the symbolic, organizational and behavioral structures of the current market to develop a successful blue ocean of uncontested market space. Finding solutions to those issues (such as using "free of charge" social media and the like) may create significant opportunities, also for resource-weak companies when consumers starts unlocking at a speed higher than the competition can follow. Once again, a relevant knowledge strategy may help turn this into an opportunity.

Macro-level: A governmental lock-in that makes the market biased may be a considerable hindrance for the entrepreneur. A significant threat is often also the lobbying power of established business associations. One option is to actively engage in the contemporary public debate. It may often be relatively easy to get public attention when one's message is to speak for the improvement of the common good, pointing at how externalities from the established business create a common bad mainly to improve the private profit of that business. An important and potentially successful path for the entrepreneur is to take an active, if not leading, role in establishing a SES. This will be significantly easier if the entrepreneur has access to the required knowledge for suggesting SES criteria through a knowledge network with, for instance, academia.




## SOME FINAL REFLECTIONS

This chapter has had its focus on "greening of industry" – why it seems so difficult for some and what difficulties can be expected for those who decide to be among the first. The theories used have been developed by researchers not having eco-sustainability/"greening of industry" as a focus. Hence, the theories are more generally applicable than only to greening issues.

Greening may be seen as a subset of the more general issue of running a business without doing harm to any third party. The above theories and logics apply also to that more general topic. But in addition, the combining of the selected theories may help to guide any company that faces high competition, low profitability and low resources and hence needs to find a better business proposition and better conditions for that proposition.

If you take on the challenge of "going green", i.e. develop a sustainable business model for your firm, you will not only do good to society but in fact develop a competence and capability of how to be market-driving (instead of market-driven), which will ensure a lasting competitive advantage. So…go ahead!

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# 4 A PACKAGING APPROACH FOR EVALUATING IDEAS

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## INTRODUCTION

In this chapter an approach for idea evaluation is explored. Idea evaluation can be seen as the first stage in a sustainable business development process eventually resulting in solutions that are more sustainable – ecologically, socially and economically. Not all evaluated ideas become reality. However, the more the potentials of an idea are identified and expressed, the more likely it is for the idea to gain momentum and attract more resources. Our approach to idea evaluation differs from established theory in many ways. It combines characterization of future societal, customer and business utilities of an idea. It is not a full business plan committing stakeholders towards the execution of a business. It focuses on the creative packaging and communication of the idea in ways that enable future and often not yet identified stakeholders to be attracted to the idea, thereby hopefully helping to bring it forward.

We call our perspective the "packaging approach" to idea evaluation. Packaging ideas is seen as an activity of determining and communicating attributes around an idea relevant to various stakeholders as well as to society at large. Ideas can be seen as a package in both the "gift-wrapping" sense of the word – making ideas attractive – and the "parcel" sense of the word: giving ideas new destinations, inspiring new settings and people. Ultimately we believe that the knowledge economy is a place where well-packaged ideas mobilize new entrepreneurial mindsets in order to drive sustainable development.

A successful packaging of a new idea requires the ability to position an idea in a future attractive situation of use, while at the same time being very clear and realistic about the current state of the idea. This combined visionary and realistic packaging gives ideas the power to inspire towards long-term opportunities (visionary power) as well as lowering entrance barriers (through realistic descriptions and advice) for anyone aspiring to take the idea further. It is known from our innovation history that good ideas often take unexpected and parallel routes to success (see e.g. van de Ven et al., 2000). Making ideas well-packaged helps leverage this often non-linear, distributed and interactive stakeholder process around the nature of innovation processes.

In short, idea evaluation in our "packaging approach" results in a seven-page report and matched PowerPoint presentation. This format, of course, is not static. However, it is the pragmatic result of several years of idea evaluation practice in the Gothenburg innovation system. The format forces the evaluator to think through a clear disposition (package) of the idea evaluation and is sufficiently long (but not too long) for this package to attract the interest of new or existing stakeholders around an idea. We propose that an idea package address the following issues:

1. Describing the idea (functionality, novelty, freedom to operate, etc.)
2. Generating value visions around situations of use
3. Determining next steps in terms of further developments and financial needs

Before elaborating more in depth on these components of an idea evaluation, we first discuss different process perspectives and relate our approach to them.

## PROCESS PERSPECTIVES

When literature tries to put the process of early-stage business development into perspective, it either tends to depict a rather linear development process, or focuses on an integrative process resulting in a final product. Both linear and integrative process perspectives try to capture the whole journey to a commercialized product, and thus they deal only in a limited way with the early idea-stage.

### LINEAR PROCESS PERSPECTIVES

Linear processes often emphasize discrete steps such as research, development, manufacturing and marketing. Here, researchers are expected to focus on originality of discoveries and on new techniques. Developers focus on making it work. Manufacturers subsequently focus on how to produce it and marketers on how to sell the product. Linear models often miss out on the fact that ideas have their origin in the marketplace among customers and users, and that idea development can take place in interaction with customers (Von Hippel, 1988).

In the cases provided in this book, you hardly see any examples of linear models. The closest example might be NetClean with its focus on first the problem, then the product and finally the sales. However, in this case as in all the other cases, you still have a very clear focus not only on technology or research results from the beginning, but also on utilities – whether for customers, society or the company.

In conclusion, linear models mostly indicate how ideas sometimes evolve in and between established organizations – from one unit to the other – and, thus, are not very useful as an ideal model of how ideas should be developed. Hence, such linear sequences should not be seen as the most effective or efficient way to develop an idea. On the contrary, linear models can be seen as a description of the often long journey ideas need to travel (and persevere) through different organizational cultures in order to eventually become realized.

## INTEGRATIVE PROCESS PERSPECTIVES

Integrative product development models include a range of literature concerned with efficient and effective product development in increasingly competitive and fast-changing environments (see e.g. Wheelwright and Clark, 1992). They are called integrative process perspectives since they emphasize the complex task of integrating different subtasks into a distinct whole – a new product. Integrative models have been spread since the Eighties. They were a reaction to linear models being seen as too inefficient, and they had their origin primarily in attempts to understand the competitiveness of the Japanese consumer industry of the time. Integrative product development models focus on getting an often complex and investment-heavy product on the market in due time and with the right quality and costs.

As indicated in Table 1, product development is something distinctively different from commercializing new technology. A core distinguishing factor is that new ideas based upon technologies initially are much more open-ended and undefined as regards end-market use, whereas product development processes normally have an established product-user-situation as an outset when specifying and bringing together (integrating) parts and subsystems of a new product.

| Characteristic | Product development | Technology commercialization |
|---|---|---|
| **Object to be commercialized** | Singular design | Multifaceted capability |
| **Start of commercialization (and time scale)** | Product conception (1-5 years) | As soon as a potentially valuable concept is proposed (10-20 years) |
| **Stakeholders** | Customers as end-users | Several whose mix and interest evolve with the technology |
| **Nature of demand** | Targeted segment | Derived from products |
| **Competition** | Other products for same function | Against other technologies for same product or function |
| **Marketing Challenge** | Unique selling proposition of finished product | Exploitation of whatever the technology can achieve at the point in time |
| **Timing** | End-user market opportunity | The time line of competing inventors, adopters and resource providers |
| **Opportunity for value creation and appropriation** | Revenue from making and selling products | Product sales and/or collateral benefits over life of technology |

*Table 1. Differences between product development and technology commercialization according to Jolly (1997, p.xvi).*

## OVERLAPPING STAGE-MODEL

Jolly (1997) provides a synthesis between a linear and an integrative process perspective into what he calls an Overlapping Stage Model for Technology Commercialization (see Figure 1). This model is still linear in the sense that stages are carried out sequentially. However, it is also integrative in the sense that each stage applies a holistic business-oriented reasoning, resulting in stage-relevant verification that helps bridge into the next stage by satisfying and mobilizing new stakeholders. The

first bridge thus focuses on mobilizing interest and endorsement, sufficient to incubate the idea into the next integrative result: a demonstration. Subsequent bridges are around mobilizing market constituents and finally around mobilizing for delivery.

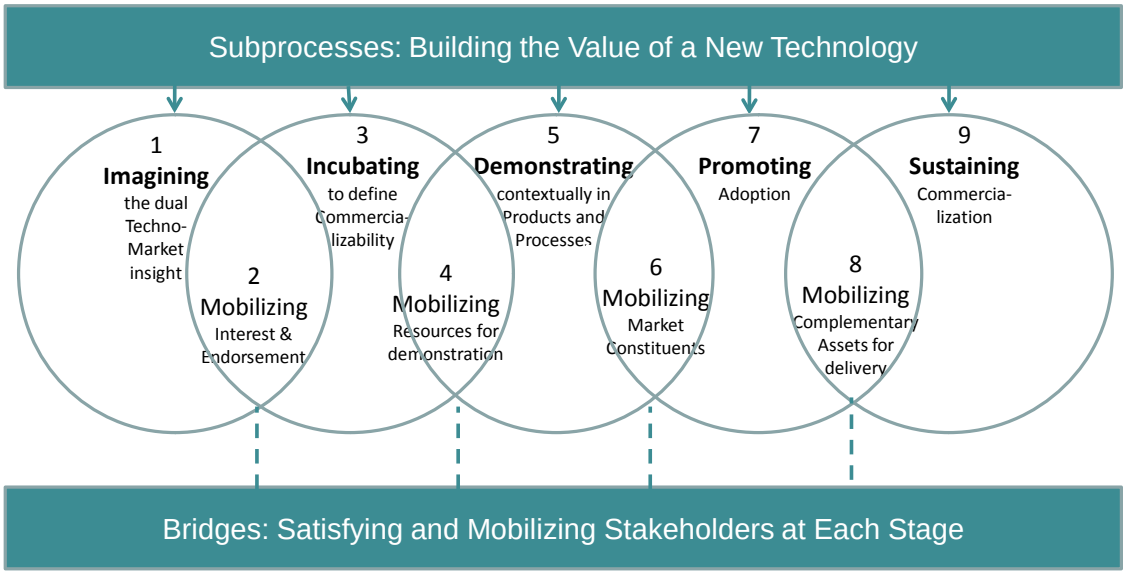


*Figure 1. Jolly's overlapping stage-model in which the current approach to early-stage business development fits with the first stage. Source: Jolly (1997, p.4)*

According to Jolly, new technological ideas can be challenging to commercialize for many reasons, and there are activities which typically can go wrong such as: the linking of technology discovery to a market opportunity, having the technology endorsed early, incubating the technology sufficiently to understand its true potential, mobilizing resources for verification, demonstrating the technology for the context in which it is to be used, mobilizing the market constituents for gaining market acceptance, promoting the final product(s), choosing the appropriate business formula (model) and sustaining commercialization to realize value from the technology (life cycle management) (Jolly, 1997 p.2). Figure 1 provides an overview of the different sub-processes and bridging activities needed in order to bring a technology to successful commercialization.

## OUR PACKAGING APPROACH

Our packaging approach focuses on early-stage idea evaluation and idea growth. It expands upon the first step of Jolly's (1997) overlapping stage-model for technology commercialization (see Figure 1). However, our approach is suited not only for technological ideas but for all types of early-stage ideas to which some kind of positive utility – societal, customer or business utility – can be attributed (Lundqvist, 2009). Sometimes the embryo of a promising idea comes from a technological opportunity. Other times an idea originates from an understanding of a need.

Regardless of origin, the first important step for any idea according to our approach is to develop it into a dual techno-market insight.

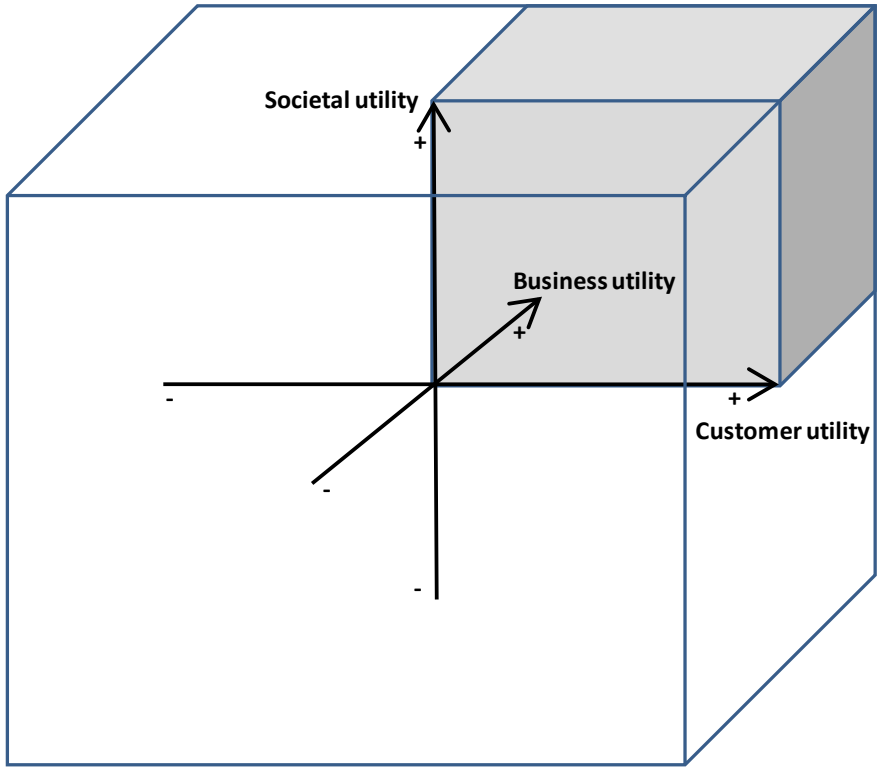


*Figure 2. Three types of positive utilities of ideas should be striven for (see Lundqvist, 2009).*

'Imagining the dual techno-market insight' – Jolly's labeling of the first stage – builds upon an insight that dates back to Koestler's famous book "The Act of Creation" (1964). Critical in the packaging of new ideas is the creative combination of technical and market reasoning, in all possible creative ways. One-sided reasoning, either technical or market-oriented, is rarely enough. The beauty of techno-market insights is that they are acts of creation – combining dimensions from a world of technical functionalities and a world of utilities – into something often unexpectedly new.

Once a promising techno-market insight is formulated, then a more analytical process starts: breaking down, testing and refining what the idea is about. Doing this helps in accomplishing Jolly's first bridge – 'Mobilizing interest and endorsement' – which is needed to go into a stage of 'Incubation'. Our approach to idea packaging ends with the generation of an 'idea evaluation report' that hopefully enables such mobilization.

In many of the cases in this book, you will be able to learn more about the early idea evaluation stage as well as about later business development stages. For instance, Ecoera is a good example of how the act of Imagining can evolve from agro-pellets into a whole platform of doing carbon sequestration (i.e. reducing $CO_2$ levels in the atmosphere) while also producing better food, sustainable energy and taking care of agricultural waste. It also shows a non-linear process going back and forth between different stages in an iterative way. Cefibra gives the reader a good example

of how to secure endorsements and mobilize resources. Vehco and Netclean are examples of ideas having walked all the way to a sustainable commercialization, generating revenues and sales growth. These cases help us put our early-stage approach in perspective and sensitize our ability to anticipate and prepare for challenges in later stages. Subsequently this chapter will focus on our packaging approach for early-stage idea evaluation.

## THE IDEA EVALUATION REPORT

A way to describe our packaging approach is to start with the end-result – the package. As already indicated, our experience is that a useful idea evaluation is a seven-page report and a complementary PowerPoint presentation. The report consists of four major sections.

1. **A Summary**, primarily framing the essence of the idea and its potential future value in terms as attractive as possible (thereby inviting the reader to read further).
2. **An Idea description**, capturing the idea and its setting (including a technical description, and a novelty and freedom to operate (FTO) analysis and idea provider presentation).
3. **Value visions** for specified situations of use, generated through scenarios and identification of customer, societal and business utilities for relevant situations.
4. **Next steps**, indicating market potential and how it can be analyzed further, any needs of further development and verification, and crude financial estimations.

Two general remarks on the idea evaluation process are worthy of comment, before attending to each component of the report depicted in Text Box 1. First, the report is not necessarily indicative of the order in which you do the idea evaluation work. The moment you have only a crude sense of the idea, you should probably start working on the different components in parallel. The more you allow yourself to generate hypotheses and state assumptions, the faster you will make progress as these hypotheses are either substantiated or replaced by better ones. Secondly, when you get an idea presented to you (assuming that it is not your own), it is very easy to initially become judgmental rather than explorative and curious. We therefore encourage idea evaluators to be humble and open-minded towards all types of ideas. Even if, for instance, novelty turns out not to be as high as the idea provider thought, it normally does not prevent you from generating value visions or indicating development steps. So, although we have chosen to call the process an "idea evaluation" (since this expression is more established), we really would like you to think of it as "idea appreciation" and "idea growth".

**Text box 1.** A typical **Table of contents** for an idea evaluation

1. **Summary** (0.5 page)
2. **Idea description** (1-3 pages)
    a. Technical/functional description
    b. Idea providers – backgrounds and interests
    c. Novelty
    d. Freedom to operate (FTO) analysis
3. **Value visions** (1-4 pages)
    a. Identifying and prioritizing situations of use
    b. Temporal analysis for prioritized situation(s) of use
    c. Customer utilities for prioritized use
    d. Societal utilities for prioritized use
    e. Business utilities including indicative business model
    f. Market quantification
4. **Next steps** (1-3 pages)
    a. Further verification and development of idea
    b. Competence requirements
    c. Risk analysis
    d. Financial estimates
5. **Appendices**
    a. Log book (who did what when)
    b. Other important data

## THE SUMMARY

The section normally written last – the Summary – is the most important part of the report. As regards idea evaluations, the main purpose is to create a more attractive package, allowing the idea to mobilize new interest and endorsement. The Summary should therefore focus on capturing the essence of the idea in as illustrative and communicative terms possible. Therefore, do not hesitate to sell the idea through simplification, use of metaphor or other rhetorical means. You have the rest of the report to explain all complexities and worries, so the Summary can and should prioritize the essence and the strength of the idea. That said, a few sentences in the end of the Summary indicating other major findings of the report is of course adequate in most of the cases. A Summary for a seven-page idea evaluation is normally around half a page long and should not be more than a page.

## THE IDEA DESCRIPTION

The section describing the idea contains a short illustrative description of the original idea and of the idea providers. Depending upon how technical the idea is, the section also includes a more or less elaborate analysis of novelty and freedom to operate (FTO).

### TECHNICAL/FUNCTIONAL DESCRIPTION

Assuming that the Summary has given the essence of the idea, the Technical/Functional Description subsection gives a more systematic account of the initial idea, using illustrations and tables if helpful. Regardless of whether the initial idea is technical or not, a description focusing on functionalities is often a relevant part. "Functionalities" is the language of designers and engineers rather than of customers and users, and is a language concerned with describing performances in qualitative and – if possible – even in quantitative terms. Having isolated more or less unique functionalities of an idea is also helpful in order to identify potential user needs and customer utilities, accounted for in the subsequent section.

Often technical ideas need descriptions other than only in functional terms. Depending upon how obvious the idea is, how complex it is, and how little verified it is, a technical description can be anything from a very short explanation to elaborate drawings and listing of subsystems, their status and functionalities. One way to develop an initial idea is through using a database[18] of 1400 examples of biomimic design solutions. It can be used to inspire stakeholders around the idea to see new opportunities and perhaps look beyond initial obvious technical understanding of the idea. Do not be afraid of trying to grasp your technology in different terms. Ultimately it is your technological insight and imagination that constitute half of any techno-market insight upon which 'value visions' will be constructed. Of course, to the extent that the idea has unique functionalities or performs established functionalities in new and better ways, you may have sufficient novelty to be able to apply for patent protection.

Ideas that do not initially include a technical solution need to be dealt with somewhat differently. Such ideas can be a service idea or an idea about a specific need. In these cases the starting point of the idea evaluation is different, first focusing on situations of use (dealt with in the next section). Based upon a more thorough and systematized description of what value is created, the idea evaluation can then start identifying critical assets describable as technologies or at least "techniques" that are critical for the provision of that value. Once this is done, the structure of the idea evaluation section proposed here should be relatively adequate. However, since technologies or techniques in these cases are not the starting point, you might want to add a paragraph about how the determination of your techniques was done, and perhaps also add a table where your choice is compared with alternative ways of producing a utility.

[18] Biomimicry Institute – www.AskNature.org

### NOVELTY AND FTO

A whole chapter in this book – chapter 7 – is dedicated to the use of patent information to determine patentability (including novelty) and freedom to operate (FTO). Here we therefore focus explaining why novelty and FTO are critical to examine in early idea evaluation. Determining the novelty of any idea – even one not close to being patentable – is critical for subsequent choice of business strategy. Often early ideas appear more novel than they are, and often only a few hours of searching the web with fresh eyes offer valuable inputs, upon which a more realistic strategy can be built. Identifying competing solutions nurtures creativity and gives you something to relate to. Thus, contrary to the first gut reaction – "this idea is dead since it is obviously not new" – a more appropriate reaction should be "how can we learn and adapt our idea based upon this knowledge?" So, in our packaging approach, novelty search is a valuable tool for development and adaptation and not only a critical step to determining patentability.

FTO analysis in many ways complements the novelty search. When using the patent system for a novelty search you also analyze FTO. However, FTO also depends upon an exercise where any claims by anyone upon the idea (friends, employers, partners, financiers, etc.) are clarified and acted upon. We call this activity 'degunkification' (Petrusson 2004, p. 161). Ideas are often 'gunky' and initially they may seem hopeless to develop further. However, just as in the case of many novelty searches, a closer examination of where ideas are gunky can also reveal opportunities to proceed, at least regarding where negotiation needs to occur for FTO to be established.

In the idea evaluation report, this first part of describing the ideas as well as determining any novelty and FTO should be seen as an act of communication rather than giving a full account. Focus on making descriptions as clear as possible. Also include a listing of key actors around the idea, their interests and background. Often it is a big advantage to communicate with the support of tables and pictures. Any details of the technology and its potential can be put in an appendix.

## GENERATING VALUE VISIONS FOR SPECIFIED SITUATIONS OF USE

When you are in the early idea evaluation stage, the generation of value visions should be a highly creative and iterative process. Failing to be creative here can mean missing out on a huge opportunity, since many ideas can have multiple situations of use, all normally also allowing flexibilities around what business model to build. However, being creative is not only about new techno-market insights depicting new situations of use. Creativity is also needed to become as concrete as possible, at least regarding one chosen situation of use. Concreteness with, for instance, customer utilities and a business model normally requires multiple iterations of hypothesis testing: generating assumptions and then finding ways to question these assumptions, which in turn generates new assumptions.

This section is designed to help you generate value visions indicating the overall potential of the idea, as well as becoming as concrete as possible regarding at least one prioritized situation of use.

The concept of value vision in our approach encompasses two challenging paradoxes: the generate-select paradox and the endogenous-exogenous paradox. The generate-select paradox has to do with the time-constraint put on the process of idea evaluation and captures the difficulty of both thinking broadly and creatively about situations of use, while also becoming concrete enough regarding at least one situation. This paradox needs to be resolved case-by-case with the sometimes unpleasant decision to select just one area of use in order to focus. The section is structured around the more generative side of finding areas of use and creating scenarios in the initial paragraphs, and ends with concepts more adequate for one or at most two concretizations.

Borrowing language from biology, the endogenous-exogenous duality captures the need both to think "from within" a solution (endogenously) while taking the external for granted, and in parallel also to recognize external (exogenous) factors and how they can change. The proposed starting point for generating value visions – finding situations of use – helps bridge the paradox in allowing you to capture something both endogenously (the "use" where a solution addresses a need) and exogenously (the "situation" which can be seen as determined primarily by external factors). After that, an exogenous analysis is recommended in the form of temporal analysis, allowing creative analysis of different types of future situations. Subsequently, the temporal analysis and three paragraphs focusing on different types of utility then signify a more endogenous – from within – construction of the idea in use, given a certain selected environment. The section rounds up again with a more exogenous analysis, in which the market potential is indicated for the prioritized situation of use.

## IDENTIFYING SITUATIONS OF USE

"Use", "User" and "Utility" are a key concept to elaborate in an idea evaluation. "Use" is a broader word – being both a noun and a verb – and is suitable as a starting point along with the relatively flexible word "situation". The expression "situation of use" should help you think creatively about how, where and for whom an idea can be applied – and put into use. Once such situations of use are established, the step towards the more business-oriented translation of a use into "utility" or "utilities" is closer at hand.

The concept of utility is central in several disciplines including economics, sociology, law and psychology, and can easily become challenging and complex. Consider, for instance, the question of whether a human need comes from within (endogenous understanding) or through societal norms that we more or less implicitly adapt to (exogenous understanding). Traditional business development, building upon assumptions from marketing, finance and management literature, focuses on established situations of use and thus on well-known customer demands and market segments. Here you have established transactions, and well-known consumers and user behaviors – i.e. you have a clear and exogenous understanding of utility. Although there is nothing wrong with looking at established behaviors, it will normally not do the job for our type of idea evaluation. As we learn from e.g. the Vehco, NetClean and Ecoera cases in this book, an entrepreneurial venture can actually create new demands and establish new transactions. In doing so, it also creates new economic value, not just replacing an established offering with an incrementally better one. Hence, for many reasons, we need to apply a wider concept of utility while still being pragmatic

and practical (and in most cases economical) about what to achieve. In broadly searching for situations of use, we hopefully also do a better job finding unconventional applications of our idea.

## TEMPORAL ANALYSIS: SCENARIO PLANNING, BACKCASTING AND PREDICTIONS

By temporal analysis we mean any attempt to "look into" the future. For idea evaluations such analysis normally requires different techniques depending upon time scale among other things. We normally think of temporal analysis in terms of extrapolating a present into the future. Such techniques are often used in market analysis but have diminishing value the more innovative the idea is or the longer one want to predict the future. For idea evaluations we therefore propose temporal analysis techniques that are more suitable for long-term analysis and for more innovative ideas, namely scenario planning, backcasting and prediction through web-based tools.

Scenario planning is a very powerful tool deserving a separate treatment in this book – Chapter 6. Put into the context of idea evaluation, it can either be used prior to selecting one or a few situations of use, or be fruitful as an instrument for one selected area of use. The latter – doing scenarios for one chosen situation – is normally recommended. However, often the scenario planning exercise itself helps generate new situations of use, as external factors are manipulated and the idea with its intended use is put in a new light. One of the advantages of scenario planning is thus its creative generative power and the fact that it opens up new paths.

Backcasting, just like scenario planning, help us break with our default "here and now" understanding of the future. Backcasting, which is treated in Chapter 5, "place us" in a desirable sustainable future as a starting point. Backcasting and scenario planning opens up our minds and prepares us for alternative futures. These techniques thus have stronger potential in identifying and qualifying different situations of use than traditional extrapolating techniques, given the current rate of change in many societal sectors. For instance, the quick depreciation of the value of large fuel-consuming cars (SUVs, etc.) after Gore's film "An inconvenient truth" (see Chapter 2) would have been more easily anticipated through scenario techniques than through more linear extrapolating techniques.

The Internet offers opportunities for a new set of predictive temporal analysis. One such tool is patent databases (see Chapter 7) which can offer strong indications of how "hot" an area might become in a more distant future. Another way of using the Internet is simply to identify and evaluate what different key stakeholders are expressing about an area. Such prediction power increases the more systematically the web can be searched. The new Gothenburg startup Recorded Future offers such a systematic predictive tool[19].

[19] Big Data for the Future – Unlocking the Predictive Power of the Web (Truvé, 2011, Recorded Future AB)

## CUSTOMER UTILITY

Customer utility is almost always a key issue to explore in idea evaluations. A customer perspective is relevant in most cases where a user of some product or service has a choice of using it or not, or has a choice between different offerings. Even if the customer is not paying for the service or product, he or she still needs to be addressed in terms of what are the relevant customer utilities. Studies of, for instance, environmental cars (Williander, 2006) indicate that customers are happy to buy more environmentally sound cars (having higher societal utility) just as long as customer utilities (convenience, design, costs of use) are not worse than alternative solutions. This might sound cynical, but in the case of our packaging approach it leads us to single out ideas that end up in the "positive cube" depicted in Figure 2. In other words, why bother to develop ideas that cannot have positive customer, societal and business utilities? If you are situated in an industry with negative societal utility, then it is understandable that new products have negative but still improved societal utility – i.e. being outside "the positive cube". However, if you are investing voluntary time in new ideas, why settle for that?

There are several ways to categorize customers: as paying customers, end customers, customers as a system of users, purchasers, decision-makers (a purchasing system), etc. Of course, the way you want to make your specific categorization of "the customer" depends upon the idea and your prioritized situation of use. However, as a rule of thumb, starting with any user who has some kind of expressible need is normally fruitful. Once such a customer is identified, a second question is what are the utilities desired by this customer. The third question concerns how and by whom the use of the offered utilities will be paid for. Once these questions are answered, the listing of specific utilities becomes a powerful tool, in order to make comparisons with other competing solutions, to determine how strong your chosen technology or technique is, etc.

Many situations of use are, at least partly, not paid for by users/customers. These include infrastructure, healthcare and schools as well as dealing with safety, security and environmental concerns. Thus, for much of the economy, customer utilities are not a direct economic concern for the user, other than in indirect ways (through affecting public opinion, influencing democratic elections, etc.). Nevertheless, for these situations of use, customer utilities are still relevant to carefully address. For instance, even if you consume healthcare for free you still want to apply a customer (patient) perspective upon the service given. In some cases, however, the "customer and user perspective" falls short and instead societal utilities exist only together with what we can call a citizen perspective. E.g. we are not normally customers for investments in the environment, into safety and security, etc.; these societal utilities we tend to appreciate more as citizens (and by being taxpayers and voters).

We often have developed countries in mind when analyzing customer utilities, but increasingly we are learning that large economic potentials for new ideas are often at the bottom of the pyramid (BOP), i.e. among the most poor. Prahalad's (2006) insight about BOP in his breakthrough book helps us to see and search for customer utility in new ways, as indicated in text box 2.

**Text box 2. The Bottom Of the Pyramid (BOP).**

The Bottom Of the Pyramid (BOP) market includes 4 billion potential customers having a purchasing power of less than $1500 a year. BOP markets can be approached by questioning the following dominant assumptions (Prahalad, 2006):

1. There is money at the BOP although the main assumption is that the poor have no purchasing power. For instance the countries of China, India, Brazil, Russia, Indonesia, Turkey, South Africa and Thailand are home to about 3 billion people representing 70% of the developing world population. The purchasing power of these nations is larger than that of Japan, Germany, France, U.K. and Italy combined.
2. Contrary to common belief, BOP markets are not always difficult to access. For instance 23 cities in developing countries have dense populations above 10 million residents allowing intense distribution opportunities.
3. The poor are not only brand-conscious, they are also extremely value-conscious by necessity.
4. BOP markets are connected and rapidly exploiting the benefits of information networks.
5. Contrary to popular belief, the BOP customer accepts advanced technology readily.

Market development imperatives on BOP markets are the following (Prahalad, 2006, pp. 16-21):

1. Create a capacity to consume. Avoid providing products and services free of charge since that might be difficult to sustain and to scale. Focus on principles of affordability, access and availability.
2. When the poor become consumers they also acquire the dignity of attention and choices previously reserved for the middle-class and rich.
3. Private sector firms approaching the BOP market must focus on building trust between themselves and consumers in order to bridge an historical gap of mistrust from both sides.

The following twelve principles of innovation on BOP markets are proposed by Prahalad (2006, pp. 25-46):

1. Focus not only on price but on creating a new price-performance envelope.
2. Blend old and new technologies into hybrid solutions.
3. Solutions should be scalable and transportable across countries, cultures and languages.
4. All innovations must focus on conserving resources: recycle as well as eliminate and reduce waste.
5. Product functionality is crucial. Marginal changes to products developed for rich economies will rarely do.
6. Process innovations are as important as product innovation, since the presence of a logistic infrastructure cannot be assumed.
7. De-skilling work is critical. Product and services need to take into account the skill levels, poor infrastructure, and difficulty of access for service in remote areas.
8. Educating customers on product usage is essential, often through creative approaches such as video mounted on trucks and low-cost theatrical productions.
9. Products must be robust and work in hostile environments.
10. Understanding variety in terms of language, skill levels, familiarity with function, etc., in often heterogeneous consumer populations is indispensable.
11. Innovate in methods of distribution.
12. Product developers should focus on the product platform in order to embrace sometimes rapid changes on BOP markets.

## SOCIETAL UTILITY

Societal utility can be determined by analyzing ideas from the perspective of how they help make the world a better place. It is then not only the chosen situation of use that should be considered, but also the whole life-cycle, including also production and potential recycling. Societal utility can sometimes be expressed in monetary terms, such as reduced healthcare costs. Doing so normally

is a good exercise and also has strong communicative value when used properly. However, we also need to be careful about giving the impression that only the measurable or the economic effects are important. In many types of social entrepreneurship – see chapter on this and the case of Dem Collective – it is really a variety of effects aspired for: changing the behavior of an established business, of a local community, of engaged citizens, or viewed as corporate social responsibility (CSR) activities (see also chapter about CSR at IKEA).

Societal utility at its core involves values about society that we hope will stick to others and eventually to something institutionalized into structures (like a social security system, environmental protection system, etc.). They all begin with ideas and, in the example of the car safety-belt invented by Volvo in the Sixties, it ended up being a commercial product (with customer and business utilities) as well as increasingly shared values about safety (a societal utility) that have spread around the globe. As we learn from the chapter about Vehco, societal utility of saving fuel in truck driving is easier to achieve than driving more safely, and in this case primarily because of the cost pressure within this industry. However, that did not imply that there were no ways to influence the customers of truck companies – the general public or companies with CSR policies – to ask for safer transports, now that we know there are Vehco technologies to provide them. Such opinions can then eventually have an impact also on cost-driven or conservative industries.

Societal utilities, although specific from case to case, can be identified by using theories about sustainability, lock-ins and backcasting (see Chapters 2, 3 and 5). Deriving specific societal utilities based upon the four system conditions in the backcasting methodology (chapter 5) is normally worthy of an attempt especially to determine the ecological sustainability of an idea. These principles help you operative within planetary boundaries, being aware of future constrained resource conditions. An important aspect to this is to avoid business models based upon sales of consumables to drive profits or the reliance upon rare elements.

Determining any impact on social sustainability normally requires other types of reasoning, not least about how different stakeholders – users, producers, communities – are affected by the use or production, etc.

## BUSINESS UTILITY AND BUSINESS MODELS

Business utility is linked to the development of a viable investment opportunity. This third form of utility addresses the economic sustainability of an idea in a situation of use. This utility is important to consider when you want to sustain a diffusion of an idea beyond your own and others' private or social engagement. A key point in most business plans is to differentiate between investment needs (how to reach a certain future state) and how much value this future state has compared to the current value of an idea or venture. A return of investment (ROI) calculation wants the investment to be less than the increase of the value, including also a substantial risk factor. The discounted cash flow analysis is a way of quantitatively estimating such business utility including a risk. However, it is of course inherently difficult to make accurate assumptions and predictions about such business utility in early stages. Therefore, a reasonable achievement in this stage is to generate an indicative business model.

Business models, generally speaking, are ways to describe how value is created and captured (Lindgren and Sundelin, 2010). There are different business model frameworks offered today. Some focus more on the internal activities behind producing a value proposition. Others place more emphasis on external relationships and especially on transactions with customer, suppliers and partners. In the cases of this book you get different examples of business models. An indicative business model for your idea evaluation might combine some internal activities with some key external actors, in order to indicate some kind of realistic economic sustainable business, in which the original idea is a part. A key transaction to discuss in any indicative business model is of course the value proposition towards the target customer. Developing an indicative business model will also help you make any financial predictions.

## MARKET QUANTIFICATION

Indicating a market potential and a competitive landscape normally adds a lot of attractiveness to the idea evaluation. Market potential is a highly flexible construct, as indicated in Figure 3, which describes different levels of inclusiveness in the pharmaceutical industry. As long as you are clear about what you mean by market potential, you can choose to make estimates about the following:

1. Overall potential (i.e. future sold units) of a business area in which your solution is just one of many different solutions. I.e. how wide do you draw the circle around "your market"?
2. What growth will you anticipate for you chosen market and how will you argue for it? Through analogies, extrapolations, scenarios, good reasoning, or combinations?
3. For a specific need, should you include everyone with the need, only those with the need translated into a demand, or only those able to pay for the supply?
4. National, regional or global market?
5. Should you indicate market potential for your future use of an idea only (i.e. market share), or an overall potential?
6. What measure of market potential do you choose: sold units/services, sales, after-sales, etc.?

Being in an early uncertain stage, where no one yet has invested money and uncertainty is high, an idea evaluation can normally answer the questions above by emphasizing opportunity while remaining trustworthy. Hence, emphasis on taking a larger measure (global, overall market, high expectations of growth) rather than a smaller one (regional market, only our future product, only customers who currently can pay, etc.) is normally wise in order to increase attractiveness of the idea packaging, as long as the argumentation is clear and the assumptions made are reasonable.

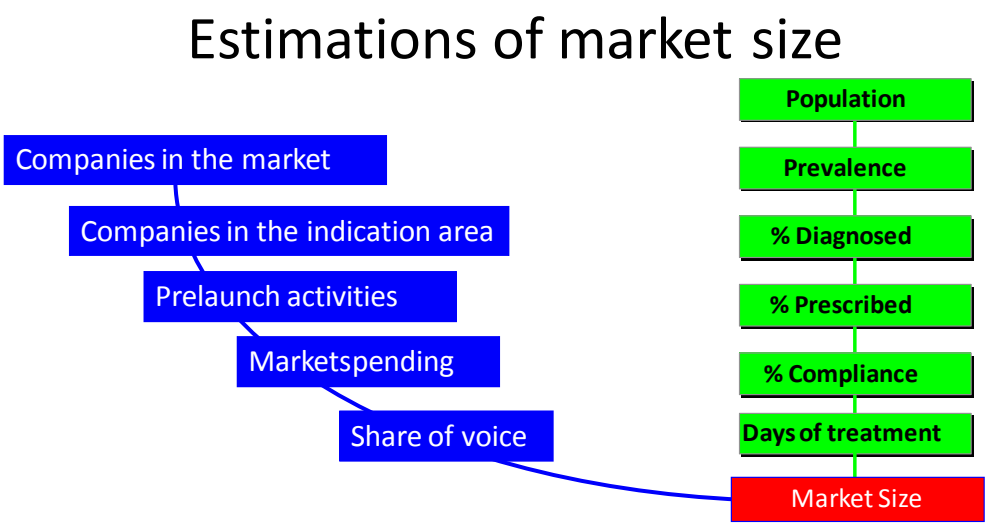


*Figure 3. Factors in pharma industry to relate to when specifying market size (adaptation of slide by Boo Edgar)*

## NEXT STEPS

The last part of the idea evaluation report is written to give the idea some "momentum" forward. "Next steps" is used as a heading to help you and the reader to focus on what can be done in the near future, and avoid making too extensive plans around later stages that normally are unpredictable at this stage anyhow. The next steps that often are relevant to focus on concern further verification of the market, further verification and development of the idea, competence requirements, risk analysis and financial estimates.

### FURTHER VERIFICATION OF THE MARKET

A huge area often worthy of further verification concerns the market and how it will be reached. Depending upon the chosen situation of use, the initial questions to ask might differ. Apart from verifying any market potential discussed above, another key question is to determine a realistic rate of diffusion – which in turn requires careful selection of target market, target segment and target customer. All these choices normally are worthy of further verification, which can be done in multiple ways: through secondary data on the Internet and elsewhere, through market surveys on the Internet, through interviews, clinics, close acquaintance with customer, etc. Yet other ideas depend upon macroeconomic developments such as changes in legislation or international agreements. Such issues might also be worthy of further investigation, apart from the above and any further substantiation of the value visions depicted in the previous section.

### FURTHER VERIFICATION AND DEVELOPMENT OF THE IDEA

Verification is increasingly a term used to describe specific further development and testing of an idea. Verification plans can serve as means for applying for government grants or other funds. If granted such financing, you can then conduct critical development work in order to prove the value

or reduce the risk of an idea. Verification plans should therefore take the idea into a more proven state. Think about what you would like to have confirmed in order to believe more in the idea. Think about yourself as an investor. What would you like to know in the next one to two steps in order to appreciate a claimed value of the idea or a reduced risk in securing the value? Verification plans ultimately are written for potential future stakeholders, i.e. actors who will engage in the idea. It may thus differ how much these actors value risk reduction and/or the assurance of technological functionalities, but most likely all these factors are more or less important. An idea evaluation should at least give indications of such next steps of developments in order to inspire others to take action.

## COMPETENCE REQUIREMENTS

Attracting the right competences is often critical. Normally, good ideas are surrounded by competent persons. However, for the idea to evolve, very often new competences are required. It is often difficult to determine these competences, especially for idea providers who have carried an idea for a long time. Your role as an idea evaluator therefore needs to be to indicate some key competences you find important to attract to take the idea a few steps further.

A good starting point for specifying new competence is the chosen situation of use. Normally you can quickly specify a competence just by reflecting upon what persons might have experience of such a situation. Another point of departure is the business model. What are the components depicted in the model, and what competences should you attract to build those components? A third source is from a so called Concept-Knowledge (C-K) mapping[20], where you can identify the knowledge required to support a newfound concept. All this said, the main competence needed in an early stage has to do with the further development and verification of the idea. Thus, depending upon your identified verification needs as regards both securing the future market and developing the solution, you should be able to propose needs for competences.

Competences are not the same as hiring personnel. In early-stage business development, a lot of valuable work is done either pro bono or by persons hoping to gain a future share of a venture. Around universities there is also an invaluable network of alumni who are willing to offer advice and contacts. Hence, specify what you really want in terms of competences and leave it to subsequent idea developers to try to attract the best expertise possible as well as engaged developers.

## RISK ANALYSIS

The risk analysis is typically an exercise done at the end of the idea evaluation. At this stage you would normally be positively surprised about how much experience you have gained around the idea. Displaying parts of these experiences in a structured risk analysis table is therefore often very valuable.

[20] Shai et al. (2009)

The concept of risk is more complex than you might first consider. For instance, is a risk objective or subjective? And how much can risks actually be managed, especially if you consider (exogenous) changes in the environment? For the purpose of an idea evaluation, the risk analysis can be simplified into trying to answer the following questions in a way not overly pessimistic or optimistic:

1. What are the main risks regarding market and solution?
2. What is the likelihood of a specific risk happening – low, medium or high?
3. What is the negative impact of a specific risk – low, medium or high?
4. What measures can you carry out to – as much as possible – prevent a specific risk?

When answering the above questions for the packaged report, you normally end up bundling risks together into 3-7 categories. A reason you do such bundling, is to enable for any reader and future stakeholder to actually gain confidence in the idea. By packaging the ideas in a confidence-building way, without of course disguising any relevant information, then you enable any future stakeholder to become attracted to the idea. The packaging approach, as stated initially in this chapter, is ultimately about enabling good ideas to gain momentum. Risk analysis can therefore be seen as part of a "rhetoric" where the Summary captures the interest, the subsequent chapters adds information and detail, while the Next Steps and especially the risk analysis enables readers to gain confidence and increase willingness to engage.

### FINANCIAL ESTIMATES

Idea evaluations that include financial estimates normally increase attractiveness and help build confidence. However, unlike for instance a risk analysis, this type of "financial confidence" easily just invokes a false confidence, given the early stage of the idea and unpredictability of most factors. Anyhow, sometimes it can be useful to add a product calculus based upon reasonable assumptions around component costs as well as a future price. Also, when a business model can be made fairly concrete, then rough estimations of future cash flows (discounted or not) can be made. Be very clear about what assumptions you make, and try to make your assumptions moderate. However, often financial estimates are avoided in these early stage idea evaluations for the reasons stated above.

## PACKAGING FOR COMMUNICATION

Finally, the perhaps most important component in our approach – the packaging – will be discussed. So far we have dealt with important components of an idea evaluation. Critical in our approach is to take control over your idea presentations and package them from the perspective of the receiver, not the messenger. In short, we want receivers to (1) **get a grip**, i.e. to quickly get a first comprehensive image and understanding of the idea and its potential, (2) be able to **substantiate** that image with facts and arguments covering aspects of the idea that a reader typically would have questions about, and (3) present **next steps** in order to indicate where efforts are needed as well as to build confidence.

Planting the **main "image" of the idea (1)** is the focus of an Abstract/Summary as well as a PowerPoint presentation. As already stated, do not underestimate the power of images, analogies, metaphors, stories, etc., when capturing the essence of an idea. Such descriptions are normally very powerful and, of course, also risky to use if they lead the thoughts in a wrong direction. As discussed and exemplified more in the chapter "Frame the Claim", an initial labeling of an idea, such as using the word "embryonic" about stem cells, can have tremendous effects on subsequent developments – for good and for bad. Nevertheless, try to find forceful idea-descriptions. Look at the communication provided in some of the cases in this book – about technologies, products, etc. – and you will hopefully find some inspiration.

The **substantiation part (2)** of a report is where you create credibility, trust and realism in the idea. This part is mainly written for persons who give the idea a deeper interest. It is also the part where you have most degrees of freedom to arrange your description. Normally the reader is not another technological expert in the same area as the idea provider. When writing, you should rather think of receivers who might have complementary competence to add to the idea. You should also emphasize credibility as if you had a journalist or an investor digging into the idea. Always be aware of the way you use references as well[21]. Be realistic about risks and challenges; more so here than in the first part where making a clear mark in the head of the receiver is the prime interest.

Finally, the idea evaluation and presentation should involve at least a page about **next steps (3)**. Avoid depicting a full action plan or business plan. Instead, outline what you would do if you had this or that resource at hand, to take the idea one or two substantial steps further. In this section, you can also add any financial estimates for any preliminary cash flow or investment need. Note, however, that these estimates are generally more applicable for ideas closer to a market introduction. In any way, financial estimates are needed if the receiver of the idea evaluation report is an investor.

With these three parts – the substantiation part being the most flexible – you have done what one can expect for an early-stage idea evaluation. Most likely you have acted under secrecy, and it is now up to those owning the idea to take further steps. Apart from that, you can expect, having done a good job, that the idea from now on is more easily expressed by those concerned with it, in turn creating leverage and a bigger likelihood of progress and development. Now dare to let go of the idea. Adding value to the ideas of others is perhaps one of the best ways also to make you both useful and attractive in the knowledge economy. If you do a good job, people will come back and ask you for more! Then the snowball continues to roll, and value is created.

[21] Guidance for making references can be found on http://kib.ki.se/vetartikel/player.html and on http://www.ub.gu.se/ref/Refero/1intro.php, both in Swedish or a guide in English http://education.exeter.ac.uk/dll/studyskills/harvard_referencing.htm.

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# 5 BACKCASTING – WHAT IS A SUSTAINABLE FUTURE AND HOW DO WE REACH IT?

*Sverker Alänge and John Holmberg, Chalmers*

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*John is Professor of Physical Resource Theory and holds the UNESCO Chair in Education for Sustainable Development. He is also Vice President of Chalmers University of Technology with responsibility for Sustainable Development, which is the driving force for the whole university. John laid the foundation for a backcasting approach based on the four system conditions in his Ph.D. dissertation in 1995, and has since been very active in influencing policy makers including the UN and industrial corporations in their development of sustainable strategies. His research is focused on reducing complexity in order to make it possible for organizations and policy makers to act.*

This chapter is about ways of defining sustainability in an actionable way, in order to innovate and change the way products and services are being developed. The starting point is the four system conditions for sustainability developed by Holmberg (1995) and the Natural Step (a non-governmental organization). The second part of the chapter proceeds to introduce one particular proven way to introduce sustainable strategies in organizations, the 'backcasting approach' (Holmberg 1998; Holmberg & Robèrt 2000). The chapter ends by suggesting a combined backcasting/scenario planning approach (Alänge et al. 2007).

## DEFINING SUSTAINABILITY

There are many definitions of sustainability, but a common starting point is the Brundtland Commission's report 'Our Common Future' which defined sustainable development in the following way (UN Brundtland Commission 1987, chapter II):

> "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
>
> "At a minimum, sustainable development must not endanger the natural systems that support life on Earth: the atmosphere, the waters, the soils, and the living beings."

This broad definition has inspired many followers, both policy makers and academicians. When it comes to the company world, the question is how to make the sustainability concept useful for decision-making and action. There have been many attempts, more or less successful, to understand and act in a sustainable way.

There are some areas which are relatively easy to grasp, e.g. that it is no good to let dangerous by-products from production out directly into nature or into the sewage system. Sometimes sustainability is focused only on environmentally friendly products. Usually however, sustainability is seen as a multidimensional concept of supporting life on earth, which entails more than using environmentally friendly technologies and products to achieve economic growth (Sotoudeh 2005).

Many times, decisions need to be made concerning new products where it can be extremely hard to analyze any possible negative impact, especially if these impacts would show up sometime in the future and perhaps only if linked to some other changes in the environment. This means that the complexity sometimes is too large for companies to grasp the full picture, or the data or the knowledge needed may simply not yet exist. This refers to the 'dilemma of deciding under ignorance' which was discussed by Croy (1996).

> "In 1908 changes in the design and use of the automobile were easily implemented, but accurate prediction of its eventual social consequences was impossible. It was not possible to anticipate future problems with air pollution, lead in gasoline, non-renewable resources, social dynamics, etc.
>
> Today the undesired effects of automobiles use are easily determined, but change is difficult to implement" (Croy 1996 in Sotoudeh 2005).

Researchers have followed two tracks in order to deal with this complexity of sustainability. One way has been to try to list all substances and practices that were considered non-sustainable, and advise companies to avoid what was listed. Of course, this will work like a list of doping substances; it will omit the ones that were not yet known when the list was made. Furthermore, a list mainly contains individual components, while we realize that sustainability is a complex concept where one component is linked to several others and negative effects may only occur in combination with other factors. Even if only renewable resources are considered, there is a complexity because "…most renewable resources are part of a complex and interlinked ecosystem, and maximum sustainable yield must be defined after taking into account system-wide effects of exploitation." (UN Brundtland Commission 1987.) Hence, an alternative approach followed is to try to reduce the complexity and develop general principles which can be used to guide decision-making.

This is the case for the approach of defining what is sustainable, developed by Holmberg and Robèrt (Holmberg 1995, 1998; Holmberg & Robèrt 2000). The starting point is to identify what scientists can agree upon regarding sustainability and use this as a common base for the analysis, instead of including all those issues where they disagree. This led to the formulation of four non over-lapping basic principles for sustainability, which are being used as a non-prescriptive starting point for systems thinking about sustainability.

## THE FOUR SYSTEM CONDITIONS

The starting point for identifying system conditions is the observation that humans can destroy the functions and biodiversity of the ecosphere by a systematic increase in concentration of matter that is net-introduced into the ecosphere from the outside (Earth's crust or Space), or a systematic increase in concentration of matter that is produced within the ecosphere, or a systematic physical deterioration within the ecosphere by over-harvesting or some other form of ecosystem manipulation which is not reversible (Holmberg & Robért 2000).

The *ecosphere* is that part of the Earth which directly or indirectly maintains its structure and flow using the energy (ordered energy, available work) flow from the 'sun/space battery'. With this definition the ecosphere contains the *biosphere*, the *atmosphere* (including the protective stratospheric ozone layer), the *hydrosphere* (water) and the *pedosphere* (the free layers of soil above the bedrock).

The *lithosphere* is the rest of the Earth, i.e. its core, mantle and crust. Processes in the lithosphere are primarily driven by radioactive decay of its heavy elements. The formation and concentration of minerals in the lithosphere are so slow that these resources, as viewed by society, can be considered as finite stocks.

There is a natural flow from the lithosphere to the ecosphere through volcanoes and through weathering processes, and there are reverse flows through sedimentation. However, compared to the turnover within the ecosphere, the exchange of energy and matter between the ecosphere and the lithosphere is often much smaller.

The above observations led to the formulation of the system conditions phrased as not allowing the destruction of the ecosphere, by adding a negation to the above principles for destruction. Hence, in order for a society to be sustainable, nature's functions and diversity **cannot** be subject to:

1. Systematically increasing concentrations of substances extracted from the Earth's crust
2. Systematically increasing concentrations of substances produced by society
3. Systematic impoverishment by over-harvesting or other forms of ecosystem manipulation

The first three system conditions provide a framework for ecological sustainability. In addition, a fourth system condition was added which is a principle for the distribution of society's resources. This system condition links directly back to the sustainability definition in UN Brundtland (1987):

4. Resources are used fairly and efficiently in order to meet basic human needs worldwide.

The Four System Conditions can be used in different ways:

- Provide input for strategy processes, e.g. through a backcasting exercise with the leaders of an organization accepting the principles for a sustainable society and envisioning their own organization's role in such society. The system conditions can serve as a guide to ask the 'right' questions and to reduce the perceived complexity, which can contribute to avoiding investments in dead-ends (Holmberg 1998).

- Can contribute to a shared mental model, facilitate communication, trigger creativity and make individual efforts align in a coordinated and effective way.

    - "…when humans become aware of problems, and perceive them from a shared systems perspective, we often have an ability to turn them into challenges and to find possibilities and creative solutions." (Holmberg & Robert 2000, p. 293)

- Can be used to guide specific tools for sustainable development, such as LCA, ecological footprint, or environmental management systems (e.g. Robèrt 2000; Robèrt et al. 2002).

- Can support individuals' decision-making in their daily work. For example, in the early concept development phase of product development, the system conditions can assist individual product development engineers selecting alternatives that do not systematically increase the number of new substances in the ecosphere. If the concept alternatives also are in line with the other three system conditions, then all concept alternatives could be sustainable from the start (Alänge et al. 2007).

## BACKCASTING

The most common way that the system conditions for sustainability have been introduced into organizations is through a backcasting approach (Holmberg 1998), which has also been the approach communicated and used by the Natural Step (Nattrass & Altomare 1999). Through backcasting, organizations have a possibility to analyze their own position in relation to the demands of a future sustainable society and to develop strategies of how to move forward in line with sustainability demands.

The backcasting approach has also been shown to bring advantages for innovation, as the backcasting exercise supports managers in thinking 'out-of-the-box' and in avoiding lock-ins. One early example of this was when Electrolux succeeded in taking one step ahead of all competitors and launching the first CFE-free refrigerators and freezers, after having used backcasting to analyze its products and technologies in a sustainability perspective (Holmberg 1998).

Backcasting is normally done in four steps:

1. **What is a future sustainable society?**
   - ⇨ The first step is to define and agree upon the criteria for sustainability and then use them as a framework for the following steps
   - ⇨ Development of a vision of a future sustainable society, within the framework for sustainability
   - ⇨ The company elaborates on the implications of the principles for its specific company context – 'makes the principles its own' – through a discussion of sustainability
2. **The company describes its current situation in relation to the criteria for sustainability**
   - ⇨ Mission, markets, products, environmental impact, human resources, etc.
3. **The company develops a future vision**
   - ⇨ within the agreed framework for sustainability
   - ⇨ based on its knowledge about the company and the market, etc.
4. **Strategies are developed towards the company's future vision**
   - ⇨ Development of a plan of goals and activities to move in the direction of the vision – including follow-up and reflection
   - ⇨ Here, a possibility exists to use scenario planning technique in order to develop robust strategies in relation to some dimensions that are important but unpredictable

## SYSTEM CONDITIONS FOR SUSTAINABILITY IN COMBINATION WITH SCENARIO PLANNING

It is possible to use the four system conditions for sustainability (Holmberg 1995) as the guiding frame for strategy development in combination with a scenario planning process in order to make the strategy robust (Alänge et al. 2007). The four system conditions are timeless in the sense that they are applicable both in a very long-term perspective and as a guiding principle for decision-making today. The scenario planning process adds an increased awareness of the multitude of factors that could possibly affect a company's development during a selected time period, usually 10-15 years (see Figure 1).

The strength of the system-conditions approach is that instead of providing restrictions in terms of absolute numbers, e.g. for pollution by specific substances, it provides guidelines in a relative and system-related sense. Hence, the first three system conditions provide guidelines concerning ecological sustainability through their focus on the potentially damaging effect of *systematic increases* of substances or *systematic degradation* of the environment. This includes a systematic increase of

substances extracted from the lithosphere, a systematic increase of new substances created by society and a systematic degradation by physical means of the resource base, including the biodiversity. Hence, these three system conditions provide a set of guidelines within which companies' and other societal actors' activities must be incorporated in order to be sustainable. Based on these guidelines, a fourth (and first-order) principle for the society's internal turnover of resources has been formulated, i.e. that resources should be used *fairly and efficiently* in order to meet basic human needs worldwide (Holmberg & Robért 2000, p.298).

The system conditions' focus on 'systematic increases' means that they can be used as an input for decision-making concerning very specific decisions, such as what material to select for a new product, or for more general strategy questions, such as what markets to target and how. Although the decisions may concern activities today and in the near future, the system conditions ensure that these decisions are made in the more long-term context of a sustainable society.

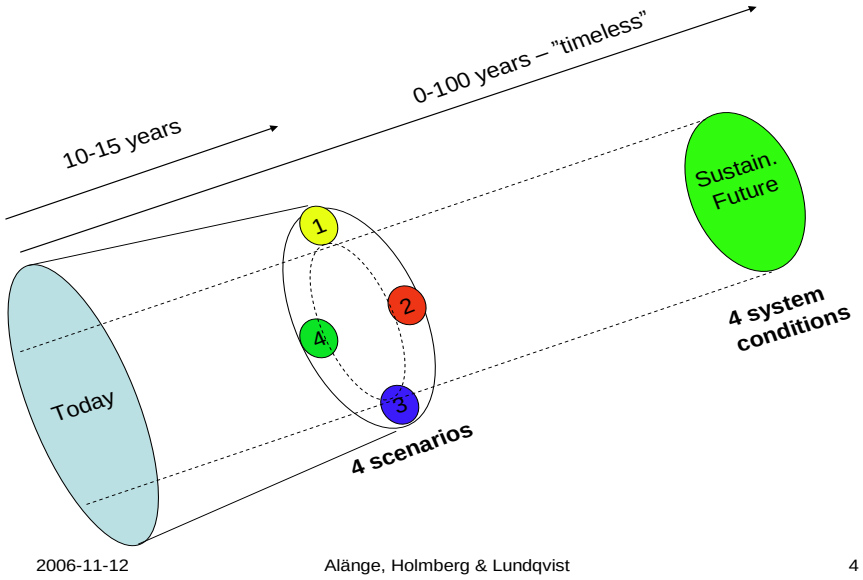


*Figure 1: The relationship between the four system conditions and scenario planning*

However, while the system conditions provide the frame needed for development towards a sustainable future, they do not directly provide guidance for all factors that could possibly influence a firm's development towards a sustainable future. The scenario planning can be seen as a complementary process aimed both at considering identifiable trends and at exposing less clear and more uncertain factors (critical factors) which may have a considerable impact on a firm's development as well as on its survival (Van der Heijden 1996).

The two (or three) most important mutually independent critical factors are being selected as a basis for generating scenarios. First, possible future developments (reasonable end values) along these dimensions (critical factors) are being generated. Second, these critical factors are being used as axes for a matrix, where four (several) equally possible futures or scenarios can be described. If the relevant critical factors have been identified, these four scenarios can provide vivid pictures of equally probable future developments that cover an area of possible developments. (See Figure 1.)

The circled area in the middle indicates equally possible developments, and the scenarios 1-4 are points describing this area. The scenarios' function is to expand the basis for decision-making to include important but uncertain factors which often remain hidden in traditional strategy processes. The aim is to create a robust strategy which makes it possible for a firm to succeed within "the circled area", regardless of which development will occur in reality. By thinking through and discussing possible developments, there is also a possibility to create "early warning systems" along the alternative development paths, which can provide essential input for modifying the strategy selected.

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# 6 SCENARIO PLANNING – THE FUTURE NOW

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*Boo is Associate Professor at the Sahlgrenska Academy, University of Gothenburg. He is also the Director of the Gothenburg International Bioscience Business School, GIBBS, which is a joint initiative by Chalmers University of Technology, University of Gothenburg and the Sahlgrenska Academy, and was created in close collaboration with the regional health care organization and biotech/pharmaceutical companies. Boo's professional experience and career development span several areas within the pharmaceutical industry and life science area, including clinical pharmacology and clinical research, project management, R&D Strategy Development and leading a discovery and research company. Previously, his main area of research was in the field of pharmaceutical development, but he now focuses on the innovative power of biomedical research. Among other things, he is conducting research into how the ability to embrace new ideas and entrepreneurship is influenced by attitudes, management and education. At the moment he's involved in three EU projects covering these areas but also including the introduction of emerging innovations in regenerative medicine in Europe. Boo is also an entrepreneur. Altogether he has been involved in more than a dozen start-ups, and in his role within the entrepreneurship schools at Chalmers and University of Gothenburg, he has supported around 25 venture creations. He is active in the boards of several young start-ups.*

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> *"[Scenario planning] is a powerful tool that tests the mind, challenges belief, stretches the spirit, and at its best creates new sources of hope. People who take naturally to scenario thinking are lifelong learners; they believe that the world is continually changing and are forever seeking insight from new places, making new connections, and innovating new solutions."* – *Scearce et al.*[1]

## SUMMARY

A new project idea, irrespective of origin and organizations, will always need to react and adapt to the operating environment in order to survive. However, the most successful organizations will predict the future with intelligent insight, enabling them to change proactively to maintain competitive advantage.

Traditional planning techniques use predictions, forecasts and projections, but they may not be able to cope with 'disruptive' changes in the environment. A more powerful approach is scenario planning, which can be seen as a rediscovery of the original entrepreneurial power of creative

foresight in the context of accelerated change, greater complexity and genuine uncertainty. In practical terms, this involves thinking, unconstrained by the present, to consider plausible future options. It is about making choices today with an understanding of how they might turn out tomorrow.

This chapter reviews the process tools available for scenario planning. The key steps are as follows.

1. Identify the focal issue or decision.
2. Identify the key forces in the environment.
3. What are the driving forces?
4. Identify and rank factors by importance and uncertainty.
5. Select and build the scenario stories.
6. Flesh out the scenario details and their implications.
7. What will be the leading indicators and signposts?
8. Communicate and represent the scenarios to the contributors.

In conclusion, it would without doubt be helpful to have insight into the future. Scenario planning is a robust method for taking the guesswork out of the equation as far as possible while retaining the ability to consider a variety of plausible eventualities. This approach is therefore particularly useful when considering the longer term and/or situations in which unexpected changes may disrupt previous trends.

## INTRODUCTION

If you could become a time traveler, what would you do? If others were aware that you could travel through time, just imagine their interest and the questions they would ask.

- How would you learn about the future and what would you do with that knowledge?
- Should you take the opportunity to gain financially from knowing the result of the next horse race, football game, lottery or Nobel Prize awards?

Although not used in this way in H.G. Wells' book *The time machine*,[2] which was written in 1895, more recent books, plays and movies based on this theme have included individual and corporate gain as part of the plot. Would you be happier if you knew the future? Would your planning improve in all essentials?

### DEFINITION OF SCENARIO PLANNING

The uncertainty we face globally results from the interaction of many forces: technological, scientific, cultural, social, political, human, economic and environmental.[3,4] Substantial resources have been applied and various methods have been developed, such as the Delphi method, without noticeable improvement in our insight into the future. But another method deserves closer inspection. This method – now known as scenario planning – was first developed with a focus on

military needs, but was later applied to the business environment at Royal Dutch/Shell by Kahn and Weiner.[5] The term 'scenario planning' was coined somewhat later by the RAND Corporation.[4]

Scenario planning is the process of creating several varied but plausible views (scenarios) of the future and then examining these in depth. It considers the uncertainties and driving forces that may impact on the future. This allows a company to anticipate possible futures, stimulating both review of current corporate strategies and thought about novel strategies.

Pierre Wack, one of the originators of scenario planning as it is commonly used today, described it as a discipline for encouraging creative and entrepreneurial thinking and action "in contexts of change, complexity, and uncertainty".[2]

Scenarios describe futures that *could* be, rather than futures that *will* be.[6,7] They are alternative, dynamic 'stories' that capture key ingredients of our uncertainty about the future; they are plausible but not necessarily 'likely'. These stories are used to try to improve our understanding of the world and its behavior. The relationship between different factors contributing to the creation of such stories was analyzed and described by the *WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT (WBCSD)*, with input from a number of global companies.[8] The group presented the relationship shown in Figure 1.

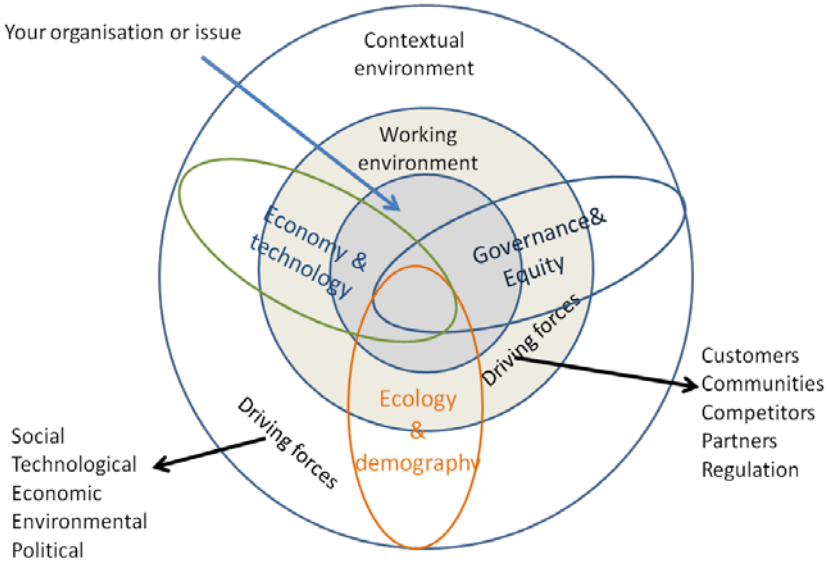



***Figure 1****. Different factors contribute and are driving forces (see further below) for the development of our views of the future. Adapted from World Business Council for Sustainable Development.*[8]

Traditional strategic planning takes one or two of these factors into consideration. This suffices when levels of uncertainty are low and levels of control high. However, scenario planning can have advantages when there are high levels of uncertainty and poor control.

The Global Business Network *What if?* report quotes science fiction writer Bruce Sterling:[1,9]

> *"Futurism is an art of re-perception. It means recognizing that life will change, must change, and has changed, and it suggests how and why. It shows that old perceptions have lost their validity, while new ones are possible."*

Scenario planning strives to achieve these new perceptions and therefore to equip individuals and organizations to perform well in times of change.

## PLANNING METHODS

In this section, we discuss various practical planning tools, including scenario planning and some traditional methods, such as regression analysis. Some of these methods are simplistic, others more complicated. Backcasting is an important part of the planning process and is discussed in Chapter 5.[10]

In relation to sustainable business, we will consider:

- regression analysis, based on predictions, forecasts and projections
- scenario planning, including disruptive techniques.

Figure 2 indicates the circumstances in which the different methods are most appropriate.

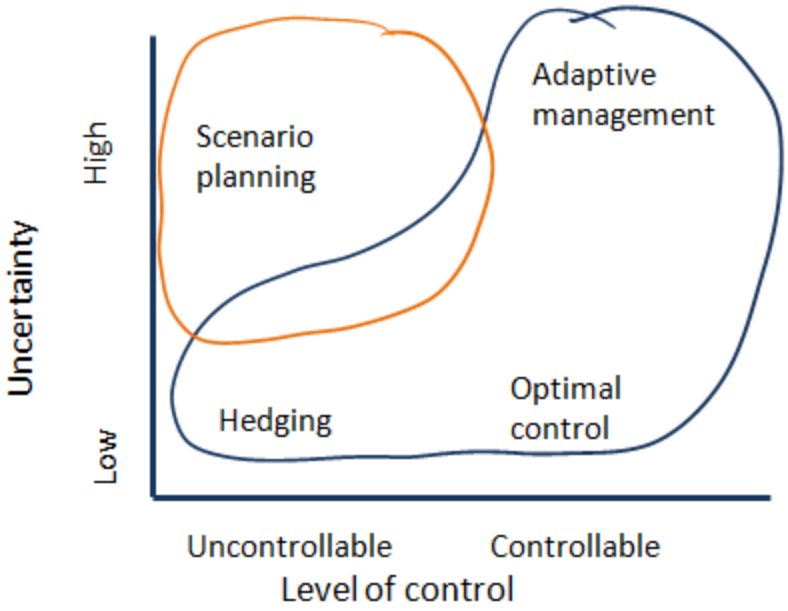



***Figure 2.*** *Regression analysis (blue) provides good predictions in some circumstances, but when uncertainty is high and the level of control is poor, scenario planning is more useful. Adapted from Peterson et al. (2003)*[11]

## THE MORE LIKELY FUTURE

Traditional planning methods seek to identify the 'more likely' future. Societal perceptions, personal beliefs and a lot of structured knowledge (facts) all contribute to provide a best 'guesstimate' of the future, but the major underlying assumption is that things will go on in roughly the same way as they did before.

## PREDICTIONS

A prediction presents the likely future at a specified time, based on specified assumptions. It is conditional on how things currently are, and is based on particular beliefs about the drivers. It is often determined from measured probability distributions of model parameters, and assumes that the measured probability of the chosen model itself is correct.[12] A prediction is therefore understood to be the best possible estimate of future conditions under specified assumptions. The less sensitive the prediction is to the quality of the drivers, the better.[5,13]

Scientists understand that predictions are conditional probabilistic statements; non-scientists often understand them as things that will happen no matter what they do.[4,5,13,14]

## FORECASTS

Forecasts, in contrast to predictions, are the best estimates from a given model or the expressed thoughts of one or several individuals. Both of these, forecasts and predictions, are closely tied to optimal decision-making.[8,15] This could also be described as follows: if we do this, that will happen (e.g. if we support this decision about production, the market share will increase). Optimal decision-making or adaptive management is thought to maximize the expected net benefits or minimize expected net losses, where the expectation is integrated over a specified time horizon. Optimal control and hedging represent active and passive approaches to optimal decision-making.[16]

## REGRESSION ANALYSIS

Regression analysis is usually based on historical data on sales performance, development history, and perceived need in the present and in the future, with the help of reports (often industry-driven) and mathematical models derived from historical analysis of the data sets. Linear or non-linear regression analysis is then used to extrapolate into the future. Known competitors (on a company or product level) will complicate the analysis, because they could behave differently depending on the circumstances, such as the nature of the threat and their financial performance.

The more concrete the data available to feed into the model, the better the forecasts and predictions will be. This enables companies to assess which strategy appears to be optimal and provides

guidance on timing and amount of investment in resources. However, the work process is similar to that used in scenario planning, as may be seen later in this chapter.

### LACK OF RESPONSIVENESS

The risk with this kind of planning is that it does not move beyond the tangible and quantifiable issues that management usually considers, and can therefore lack responsiveness. It may be more difficult for management to adapt, anticipate, recognize and respond proactively, particularly if there are large changes.

## THE POSSIBLE FUTURE

Uncertainty can be confusing and demoralizing, but it can also inspire action because the future is not already determined. The future is being created by the plans and actions of people.

Scenario planning stresses that there are uncertainties that are not controllable by the people making the decisions, and focuses on plausible (and not necessarily likely) stories. This is a different approach from forecasting or predicting, both of which focus on the more likely situation.

Scenario planning is ideal when:

1. you are dealing with a strategic issue
2. the proposed solution is unclear
3. there is no clear solution to the issue (disruptive innovations should be sought)
4. you are working in an uncertain environment
5. the organization is open to change and dialogue
6. you have support for a process
7. you can attract the necessary resources.

Among the tools that a manager can use for strategic planning, scenario planning stands out. It has already been used to:[4]

1. spot and utilize disruptive political changes (Eastern Bloc)
2. develop service business models (Electrolux, SKF)
3. anticipate the 1973 energy crisis (Royal Dutch/Shell)
4. identify future needs in biotechnology (WBSCD)
5. create new product ideas and new business opportunities (General Electric)
6. develop sustainable energy (WBCSD)
7. formulate business proposals for non-profit organizations (Global Business Network)
8. investigate the impact of disruptive innovation on businesses (IT industries)
9. develop capabilities and education for the future (Price Waterhouse Coopers).

The use of scenario planning is increasing – and will continue to grow – because it is a proven technique for developing understanding and managing uncertainty (see Case study). It is a challenging approach, but one that promotes greater insight, innovation and adaptability. Scenario planning is also a learning tool and an instrument for sharpening strategic thinking. The scenarios help us to understand the logic of developments, and to clarify the driving forces and key players, as well as our own potential to influence.[17]

**Case study**

In his 'progress with strategy' videos (www.gsk.com/investors/presentations_webcasts.htm) Andrew Witty, CEO of GSK, credits scenario planning for his changing approach to the business since his appointment only 18 months ago. In response to GSK's reliance on prescription products, and to increasing health technology assessment making market access more difficult in the traditional markets, Witty has altered the strategic direction of GSK to:

- move away from selling 'little white pills' and towards vaccines and biologicals
- reduce its focus on the USA, Japan and the top five European markets and increase its focus on emerging markets such as Brazil, Russia, China, Mexico and the Middle East
- disinvest where the margins are no longer favorable
- redeploy assets to the emerging markets
- focus more on consumer-accessible products
- concentrate on products protected by intellectual property rights
- increase efficiency and drive down costs.

By identifying basic trends and uncertainties, a team – rather than an individual – can develop a story line for a series of scenarios that may overcome the flaws in usual planning and decision-making, namely over-confidence and tunnel vision.[12,18] Table 1 summarizes the differences between scenarios, forecasts and predictions.

| Scenarios | Forecasts | Predictions |
|---|---|---|
| Plausible futures | Probable futures | Based on past performance |
| Based on uncertainty | Based on greater levels of certainty | Based on political pressure/lobbying |
| Illustrate risks | Hide risks | Well hidden risks |
| Qualitative or quantitative | Quantitative | Quantitative and pressured |
| Used rarely | Used daily | Every day |
| Strong for a medium- to long-term perspective and when there are uncertainties | Strong for a short-term perspective and when there is a low degree of uncertainty | Strong for short-term and where there are strong political pressures |

*Table 1. Summary of differences between scenarios, forecasts and predictions. Adapted from Lindgren and Bandhold (2003)[17]*

## DISRUPTIVE INNOVATIONS

Disruptive innovations are changes that improve a product or service in ways that the market did not expect. For example, the introduction of Losec/Prilosec led to a seismic change in the management of peptic ulcers that traditional models had not predicted.[19] Another example relates to β-blockers, which were contraindicated in patients with heart failure until the findings of a major study by a group in Gothenburg were reported.[20] The investigators achieved significant results using a lower dose than was used prior to the study and in a different kind of formulation.

With MinuteClinics (www.minuteclinics.com), the innovation is provision of low-cost, walk-in clinics in high-traffic areas such as drugstores and shopping malls. They have proved successful and can be considered to be an example of disruptive innovation.

Christensen has outlined three categories of disruptive ideas:

- innovations that are financially unattractive to the major stakeholders
- innovations that are financially attractive to the major stakeholders
- innovations that are unattainable to the major stakeholders because the technology or capital requirements are simply beyond their reach.

Scenario planning can be useful in exploring possible outcomes of disruptive innovations. However, as Lindgren and Bandhold have pointed out, there are also other reasons for using scenario planning (Figure 3).[17]

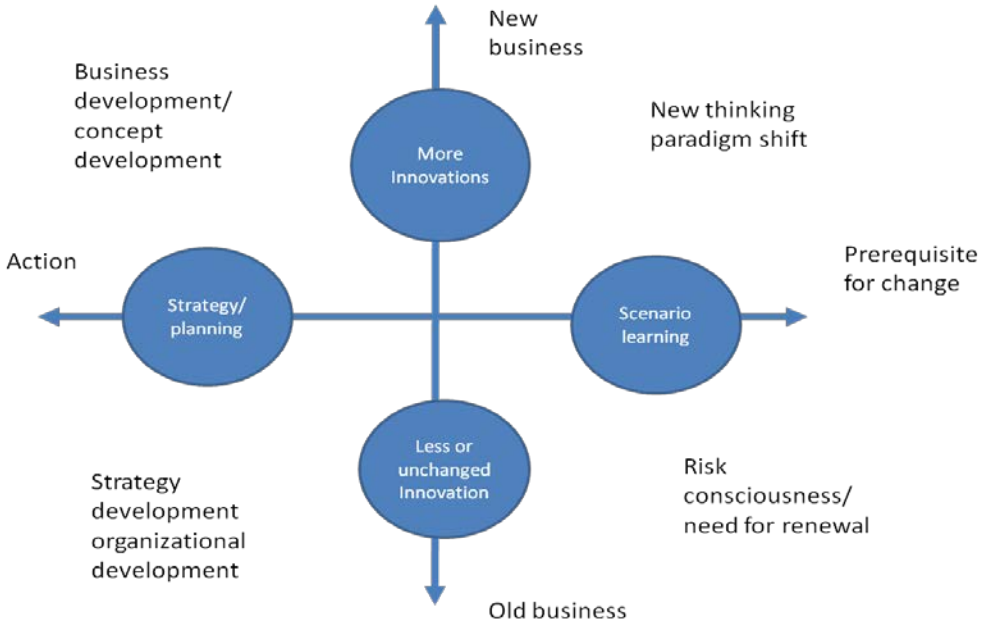



*Figure 3. Scenario planning can be used for many purposes. Adapted from Scearce D., Fulton K (2004)[1]*

## A PROPOSED PROCESS

There are a number of different approaches to scenario planning, but most of them are derived from the original work carried out within Royal Dutch/Shell and research undertaken by the RAND Corporation. The method and approaches differ owing to variation in the aim of the planning. Many use a six- to nine-step approach, and typical steps have been summarized in the Appendix (based on Schwartz, Ringland, Schoemaker, Peterson and Scearce et al.). If there are major differences in the views held about some factors by the experts involved, these can be treated as uncertainties.

A simple stepwise approach to running a scenario planning workshop is as follows.

1. Define the issue.
2. Identify and involve the major stakeholders.
3. Define what the future will look like.
4. What will be the main forces impacting on 3? Create a list.
5. Rank and combine the forces in 4.
6. Tabulate the forces by rank, number and predictability.
7. Using post-it notes, map out the forces on a white board.
8. Re-group the post-it notes together by potential scenario and trend (predictability and importance).
9. Select the most important key uncertainties and plot them on a scenario matrix.
10. Sense-check internally with the group for plausibility (re-do, if necessary).
11. Script the scenarios into a storyline and present internally.
12. Act on the scenario analysis.

## IN SUM: RUNNING A SCENARIO PLANNING WORKSHOP

1. Define the issue you want to understand in terms of time, scope and decision variables. Such issues should encompass social, technological, economic, environmental and political domains. They may include legal, medical or scientific issues.

2. Identify the major stakeholders or players who have an interest in the issue. Identify the underlying assumptions, gather the available facts and decide whom to interview.
   a. Seek out a cross-section of interviewees who represent diverse, provocative and dominant perspectives. Be sure to include key decision-makers and a cross-section of stakeholders. In most cases, interviews with astute people outside of your organization (such as customers, thought leaders and partners) can provide important insights.
   b. Conduct the interviews.
   c. Analyze the interviews, looking for patterns and points of similarity or difference. Are there any common or conflicting assumptions? Any major differences?
   d. Formulate your conclusions and share them.
3. Articulate the 'official future'.

a. Identify the assumptions.
b. Research appropriate sources.
c. Analyze your data.
d. Share the future with the internal stakeholders.
e. Test the official future.
f. Identify key questions.
g. Agree which elements of the model have a high level of certainty.

5. Identify and study the **main** forces in the official future that are shaping the issues defined in step 1.

6. Create a master list of forces (F) that could change the industry (topic) in the next 10 years (trends).

7. How important is a particular force (in relation to the others) in shaping the future of the industry (topic) (rank and combine)?

8. Compile a table by giving each force a number and then including a sentence in the second column of the table to describe that force. Rank the forces (with 1 as the highest ranking), score the importance on a scale of 1–5, and score the predictability on a scale of 1–5.

| Number | Force* | Rank† | Importance (score 1–5)‡ | Predictability (score 1–5)§ (uncertainty/certainty) |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 to 100 | | | | |

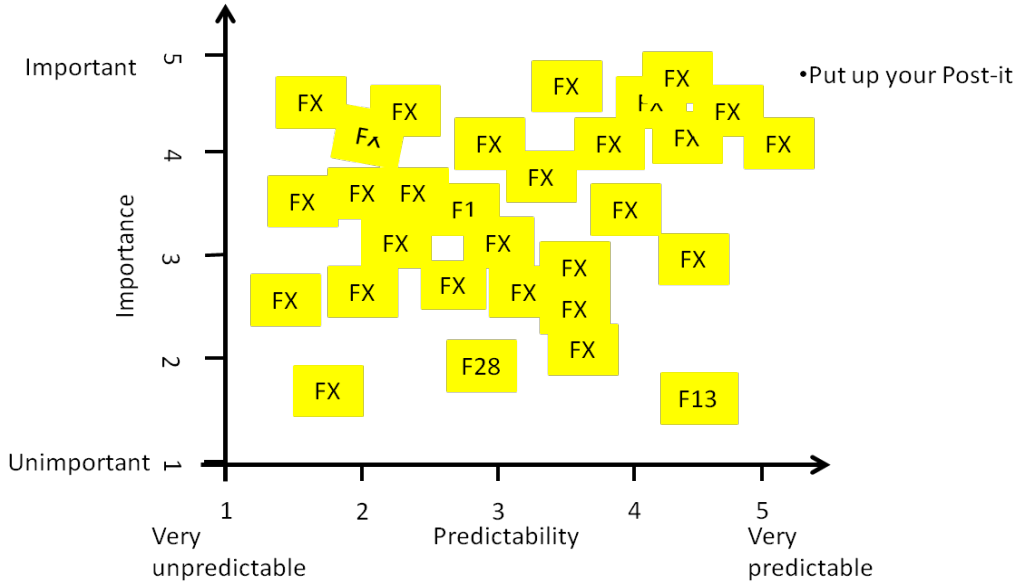
*The forces should be related to the issue.

†Where 1 is the highest ranking.

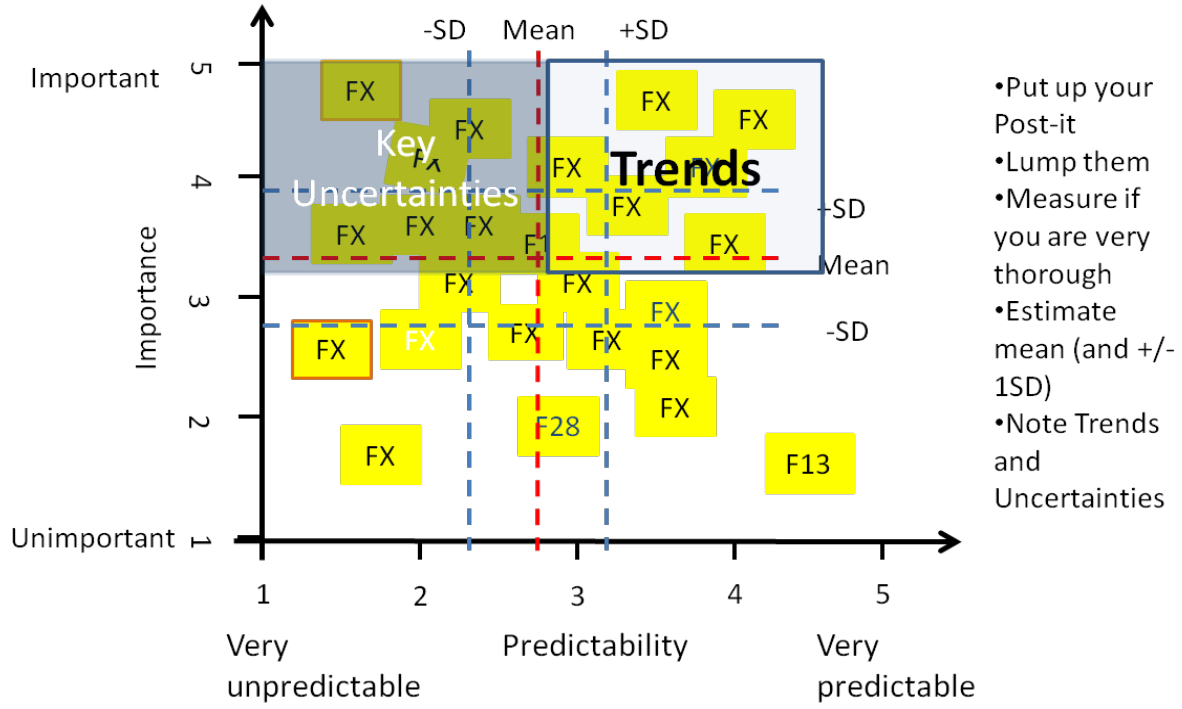
‡Where 5 is the most important.

§Where 5 is the most predictable.

9. On a white board, draw two axes as below. Transfer the number of each force to a Post-it note and place these notes on the graph according to the scores in the fourth and fifth columns of your table.



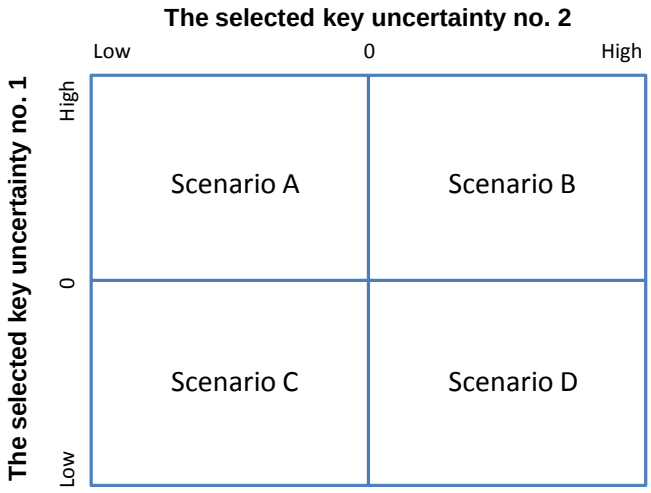

10. Note the potential scenarios by circling them, rearrange the Post-it notes if necessary, measure and draw the average line to divide the four squares. Identify the trends (very predictable and important forces) and the key uncertainties.



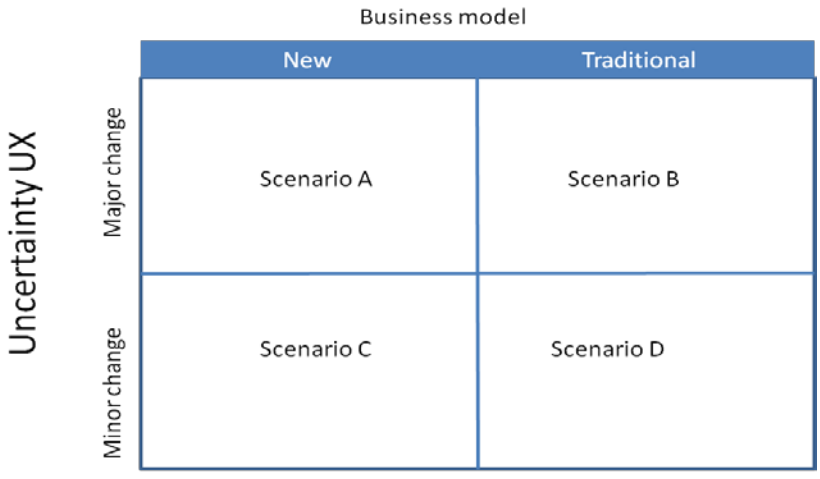

11. Identify trends or predetermined elements that affect the main forces (e.g. the greying of the world; use drawings to explain).
12. Identify key uncertainties (forces deemed important whose outcomes are not very predictable) from the list of 3. (Ask, assume, three is a good number)
13. Select the two most important key uncertainties.

a. Draw a table of key uncertainties. Reformulate the description of the forces as a question.
b. Draw a table of trends.

14. Plot the most important uncertainties on a scenario matrix in an appropriate way depending on your issue (see the principle figure below with 2 selected key uncertainties, which can have different unpredictable outcomes, here indicated as low and high. From the outcome combinations it is possible to create 4 different equally plausible scenarios A-D). Identify a set of scenarios that is considered to be relevant to your area.




The second figure shows an example where one of the critical uncertainties is the business model, and the other is uncertainty UX entailing either minor or major change.




Assess the internal consistency and plausibility of the initial scenarios. There should be internal consistency – if there is not, put these aside and create new scenarios so that you have a wide range of outcomes.

a. Are the main future trends all mutually consistent?

   b. Can the outcomes postulated for the key uncertainties co-exist?
   c. Are the presumed actions of stakeholders compatible with their interests?

15. Assess the revised scenarios in terms of how the key stakeholders might behave.

16. Carry out additional research, re-examine the consistencies, and portray each of the scenarios in an influence diagram.

17. Construct a story to describe the scenarios.

18. Re-do and re-assess, and present.

19. Act!

You are ready. Welcome to the future!

**Thanks to:**

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## Useful links

www.juergendaum.com/news/09_08_2001.htm (Royal Dutch/Shell case study).

www.ibm.com/services/us/gbs/bus/html/bcs_strategyplanning.html (Enterprise of the future. Global CEO Study 2008. Analyzes and gives case studies across 10 industry sectors including life sciences.

http://www.iftf.org/ (Institute for the Future)

http://www.altfutures-afa.com/about.asp (Alternative Futures Associates)

www.gsk.com/investors/presentations_webcasts.htm (Andrew Witty's 'progress with strategy' videos)

| Steps proposed by: | | | | |
|---|---|---|---|---|
| **Schwartz[21]** | **Ringland[4]** | **Schoemaker[22]** | **Peterson[11]** | **Scearce *et al.*[1]** |
| Identify the focal issue or decision | Define the question, conduct interviews, use seven questions (page 87 of reference 4) | Define the issues to be understood. Make sure that the scope is broader than the industry (question).<br><br>Identify the main stakeholders | Examine the future in light of a specific question. Separate the relevant aspects of the future that are knowable from those that are unknowable | Do as many interviews as time allows. This is essential to capture the underlying assumptions |
| Identify the key forces<br>(in the environment) | Collect external data, identify the forces, and list the sources | Study the main forces that could shape the future | The forces (focal issues) should emerge from the planning process | Identify the focal issues |
| Identify the driving forces | Which factors change radically under paradigm shifts | The forces should cover the social, technological, economic, environmental and political domains | The focal issues should be used to assess the system. Uncertainties will emerge during discussion and will inform scenario development | The driving forces are the critical uncertainties |
| Rank by importance and uncertainty | Develop a list of relevant factors and categorize them as trends or uncertainties or factors where there are major questions.<br><br>Uncertainty may relate to:<br>• the degree of influence/ power<br>• social values<br>• consumer behavior<br>• the shape of global trade<br><br>Major uncertainties include:<br>• regulation/ de-regulation<br>• community values/ individualism<br>• innovation/ technophobia | Identify trends or predetermined elements that will affect the issues or forces. Identify the key uncertainties. Do a matrix that shows a correlation between the uncertainties.<br><br>Select the two most important uncertainties. [See next section 'Running a scenario planning workshop'] | Identify the alternatives as the system may evolve.<br><br>A set of alternatives can be defined by choosing two or three uncertain or uncontrollable driving forces<br><br>The alternatives should imaginatively but plausibly push the boundaries of commonplace assumptions about the future. This set of alternatives provides a framework around which scenarios can be constructed | Separate the official future from the alternatives |

| | | | | |
|---|---|---|---|---|
| | • open cultures and trading/ closed and restricted world trade | | | |
| Selecting the scenario logics by grouping the issues/key drivers | Group the ideas, and build and populate with a story line, including the main driving forces and uncertainties of each scenario | Assess the internal consistency and plausibility. Questions to ask:<br>• are the main future trends mutually consistent?<br>• can the uncertainties all co-exist?<br>• are the actions of the stakeholders compatible with interests? | A set of scenarios should usefully expand and challenge current thinking about the system. The appropriate number of scenarios is generally considered to be three or four | Synthesize and combine the driving forces according to: the degree of importance for the focal issue, the degree of uncertainty surrounding those forces |
| Flesh out the scenarios | Name the scenarios and use 'the elevator pitch' | Assess the revised scenarios in relation to the stakeholder's behavior | Convert the key alternative scenarios into dynamic stories by adding a credible series of external forces and players' responses. Each story should track the key indicators | Publish or publicly discuss the scenario |
| What are the implications of the key trends and uncertainties | Walk through the scenarios and try to describe them | Re-examine the internal consistencies of the learning scenarios. Use feedback loops | Simulations may be used to test the likelihood of each scenario | Prepare narratives (be aware that these are time-consuming to write and to read) |
| Identify the leading indicators and signposts | Identify descriptors for the different scenarios that will differentiate them. Should report the focal issue | Reassess the uncertainties and all the steps | Each scenario should have a name and be tested for consistency and plausibility | |
| Communicate the scenarios | Involve the interviewees, feedback via PowerPoint, text etc. and outline a process for the future | Present the final scenario using PowerPoint etc. | Scenario planning that involves stakeholders can provide a forum for policy creation and evaluation. Should be communicated | Act on the scenarios, to inform and inspire action |

# 7 THE LIFE CYCLE PERSPECTIVE - A WIDER ENVIRONMENTAL PERSPECTIVE ON PRODUCTS AND SERVICES

*Henrikke Baumann, Chalmers and Erasmus University*

*Henrikke Baumann, Associate Professor, works at Environmental Systems Analysis at Chalmers University of Technology. She has been active researching and teaching LCA methodology, practices of LCA and LCM since 1991. She also serves on the board of the National Swedish LCA centre. Presently, she shares her time between Chalmers and Erasmus University Rotterdam, where she is a Marie Curie visiting fellow in order to build up an international academic network for researchers on sustainable product chains.*

## INTRODUCTION – LIFE CYCLE LOGIC

The complexity of the environmental challenge to society demands that we deal with many interrelated problems rather than solve one problem in one place at a time. The life cycle logic offers a systems perspective that allow us to deal with the environmental consequences of an entire product chain, from resource extraction to waste management (see figure 1). Since a life cycle study covers an entire product chain, it can provide interesting insights into the often globalized nature of production and consumption systems.

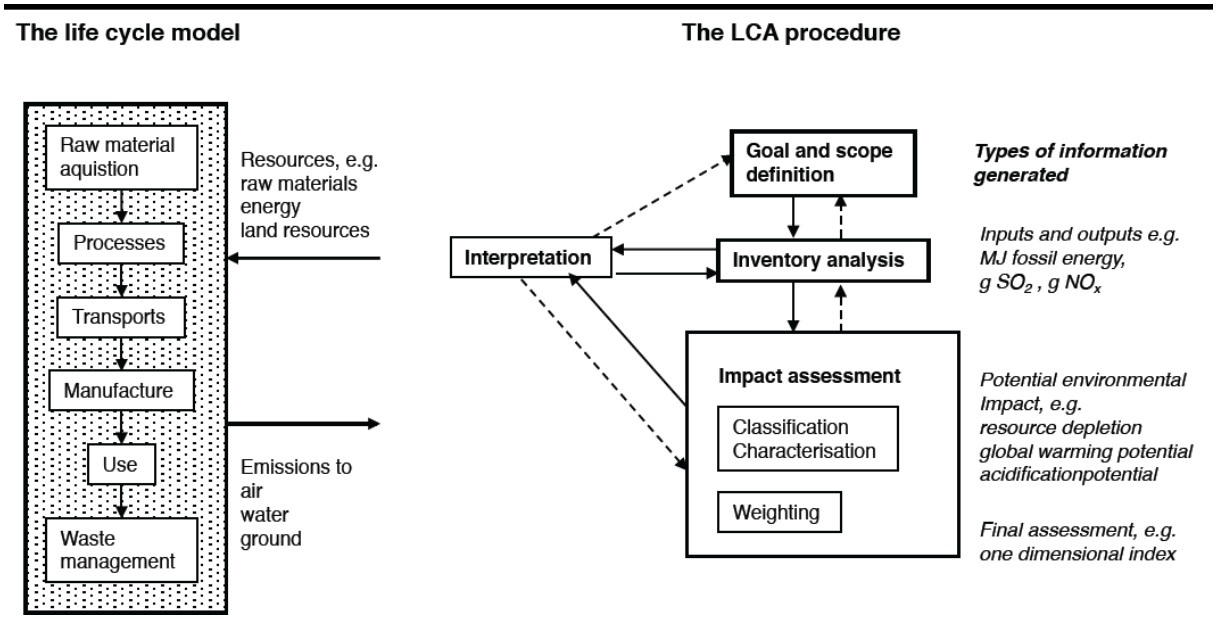


*Figure 1. LCA is defined both through the model of the product system (left) and through the procedure for carrying it out (right). The dashed arrows indicate an iterative work process. An extensive and formal description of the procedure (only!) is found in the ISO14040 standard. Source: Baumann and Tillman (2004) "The Hitch Hiker's Guide to LCA"*

The first LCA studies were carried out in the late 1960s and early 1970s, but it was not until the 1990s that LCA started to come into more widespread use. By now, LCA has been applied to nearly all sectors of business and society. Life cycle terminology has over time become quite developed. Depending on the context and the application, one speaks of life cycle thinking (LCT) when it comes as a general philosophical framework, life cycle assessment (LCA) when more or less formal analysis is made and life cycle management (LCM) when the philosophy guides management processes in companies and product chains. The naming of the 'life cycle' principle goes back to when studies sometimes were called cradle-to-grave studies, with raw material extraction as the cradle and waste management as the grave. More recent and popularized variations of this are, for example, well-to-wheel for environmental analyses of cars and farm-to-fork for food studies. Unilever, for example, expresses its commitment to sustainable chocolate in Magnum ice creams going from bean-to-bite. Cradle-to-grave, cradle-to-gate, and gate-to-gate are further terms — these indicate a partial life cycle study and the extent to which a product system has been modelled in an LCA, from raw materials extraction to waste management, to the factory gate, or between factory gates, respectively.

The explicit focus on product systems in LCA and LCT has attracted much interest for life cycle approaches to product development and ecodesign (Baumann, Boons & Bragd 2002). There are both simple descriptive approaches, and those that use LCT in a prescriptive way. For example, the cradle-to-cradle design model is an expression of life cycle design that aims for zero waste product systems (McDonough and Braungart 2002). Figure 2 collects a number of more-or-less life cycle-based ecodesign tools that can be used in product development. Also policy-makers use LCA and LCT in multiple ways, but the main purpose is to guide policy development away from point-source control towards product-oriented policy making. Many ecolabelling schemes are based on LCT and LCA. Carbon foot printing is basically an LCA that only looks at climate change, and excludes acidification, toxicity, biodiversity change, etc. Extended producer responsibility and take-back schemes are two additional policy concepts based in LCT. Extended producer responsibility prescribes that each company or a consortium of companies is responsible for the environmental costs of their products through the end of the products' life cycles, and that producers should take back product after use for responsible recycling and waste management. The packaging industry and the automotive industry are two sectors where the extended producer responsibility has led to industry wide recycling organization and end-of-life management. The application of LCT to policy making is somewhat problematic: the global nature of business has many of its product flows outside the reach of national policy-makers. This gives much freedom to the exploration and application of the life cycle principle in business. Throughout the history of LCA, LCT and LCM, industry has provided the impulse to much of the methodological development. This is perhaps counter-intuitive, since environmental issues are often seen as the responsibility of policy-makers.

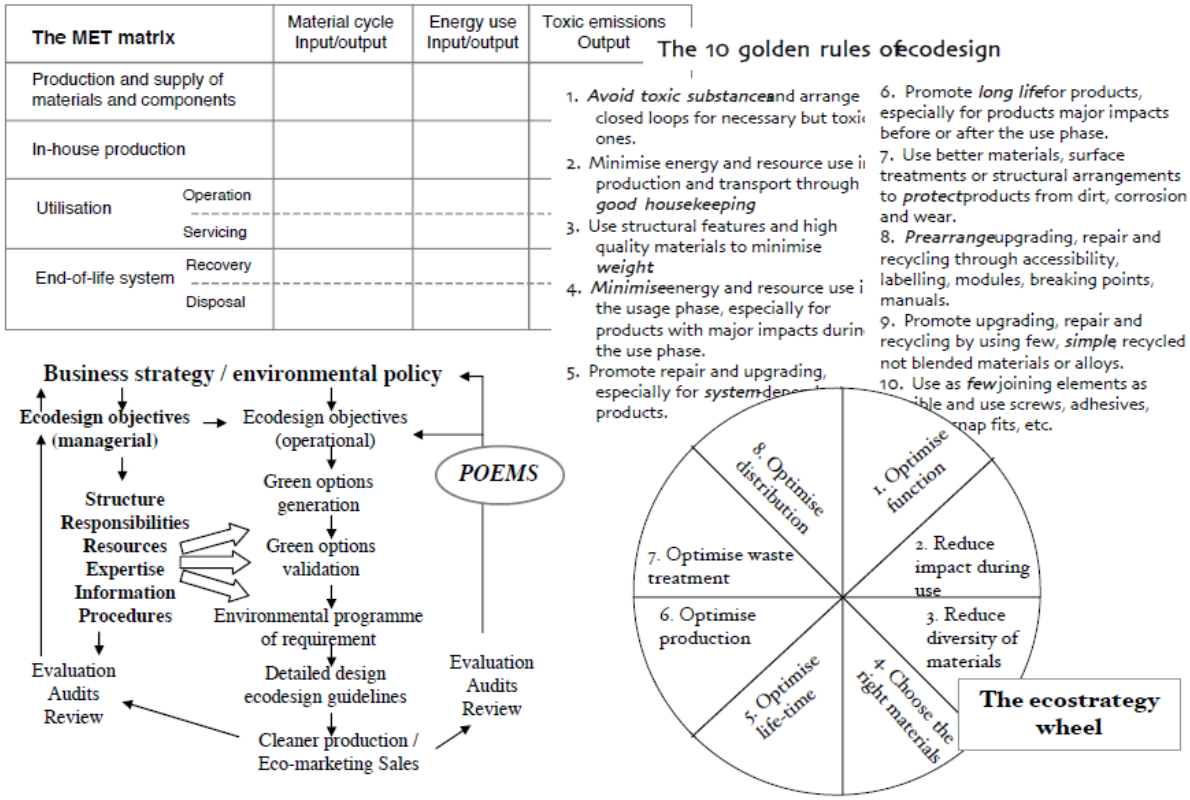


*Figure 2. Four ecodesign tools for product development with some built-in life cycle thinking. With the 'MET matrix' (Material-Energy-Toxic emissions), the environmental impact is estimated and described. The rule-based tools only prescribe a number of rules to follow, e.g. the '10 golden rules' and those of the 'ecostrategy wheel'. With 'POEMS' (product-oriented environmental management system), a guide to when and where in the process of product development the environmental should be made. Source: Baumann and Tillman (2004)*

## LIFE CYCLE THINKING AND LIFE CYCLE ANALYSIS — TWO ENDS OF A SPECTRUM

LCA is quite an ambitious tool, so to say, since it covers all steps in the product system and all environmental issues, not only climate change! This means that a lot of information and data is needed for an LCA. Although there are those who like the detective work of finding data for a full LCA, such thorough work is not always feasible nor even necessary. Sometimes, application of the mere cradle-to-grave philosophy on product and service systems, i.e. doing some life cycle thinking around what material flows are associated to a product or a service can be sufficient. Life cycle studies are therefore done with different degree of detail: qualitative and partly quantitative, 'full and complete'. Simplified LCA, screening LCA, qualitative LCA and life cycle thinking are other terms that are also used.

LCA is principally a methodology for comparing equivalent product systems, although a stand-alone LCA comparison is also possible. In a stand-alone LCA, researchers compare different parts of one product system. Because comparison is made, it is necessary to abide to a set of 'rules' for the comparison to be fair and equal. These rules basically concern the functional unit, the system

boundaries, type of data and type of environmental impact assessment. Even if a simplified and qualitative life cycle study is made, it is important for a comparison to be fair and equal. Also, identification of how these basic rules have been followed help in the critical reading of published LCA reports.

In all types of LCAs, the comparison is made by relating the environmental impact to a unit that expresses the function of the product system. For example, beverage-packaging systems can be compared on the environmental impact per liter of packaged drink. The unit of comparison is called the functional unit, and its definition is essential for the comparison to be fair. At the end of this chapter is an exercise about defining functional units for various product systems.

The quality of a comparison also depends on the system boundary definition, e.g. deciding whether or not to include the production of capital equipment. There is also a tricky situation when, for example, a production unit delivers more than one type of function (see figure 3), and the LCA only is interested in one of them—this requires a decision on how to divide the environmental impacts between the functions. If one decides to partition the environmental impacts, one makes an allocation. The alternative is to add production of the extra functions to the other product system in the comparison. This is called system expansion (see figure 4).

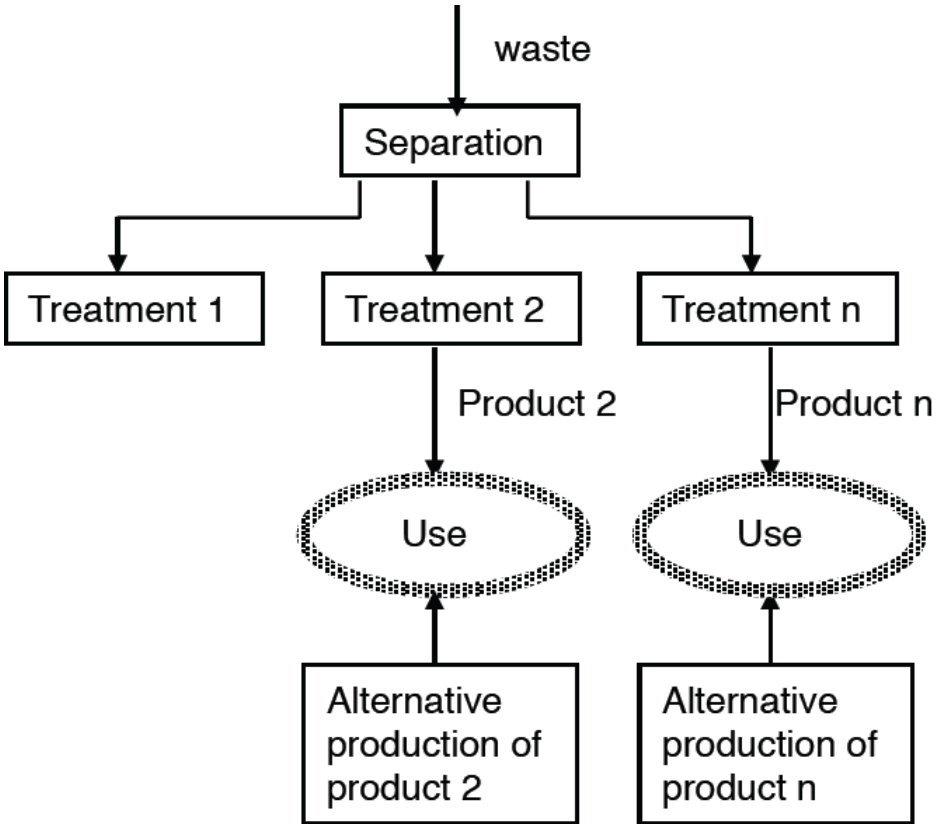


*Figure 3. Two cases of multiple functions from a production step. Allocation, which means dividing the emissions among the different products of the production step, is one way of singling out the product desired for the comparison. Source: Baumann and Tillman (2004)*

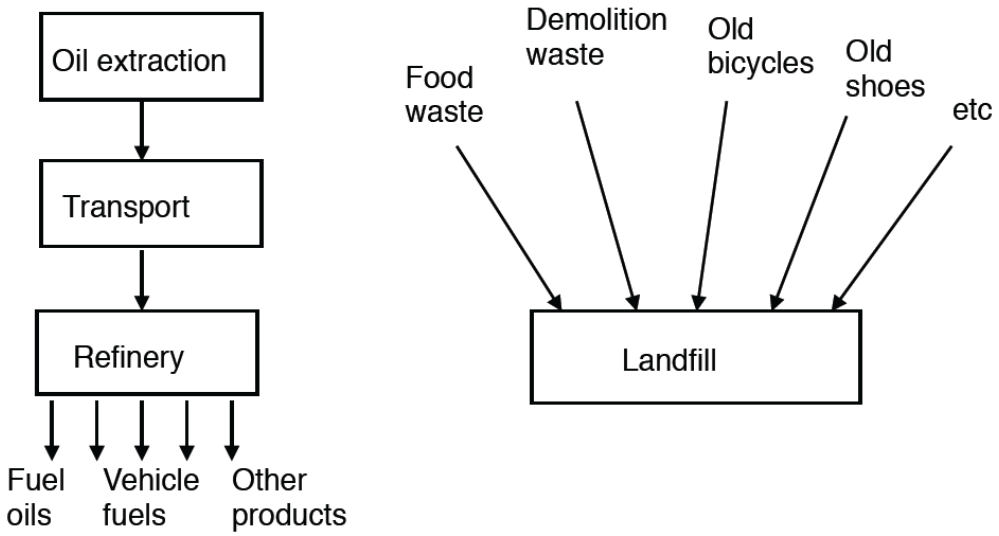


*Figure 4. System expansion is another way of dealing with a multifunctional production step. System expansion means that one adds the production of the extra products to the compared system (hence, system expansion), so that both systems in the comparison deliver the same number and type of functions. Source: Baumann and Tillman (2004)*

The type of data is also of great importance in a comparison. Using average and old data for one product system, and recent and site-specific data for the other product system, does not make an easy comparison. Finally, how the assessment of environmental impacts is made is central to a comparison, especially if simplified impact assessment is carried out. For example, only looking at greenhouse gases when comparing, for example, plastic carrier bags and paper carrier bags provides an unequal comparison. The fossil oil-based plastic bag will come with greenhouse gas emissions, whereas all the emissions to water coming from the production of the wood-based paper bag will not show in the comparison. Furthermore, impact assessment can be made at different levels: at the levels of emissions, at the levels of environmental problems, or at a overall level where the different environmental problems/emissions have been weighted together in some relative and subjective manner (see figure 5). To complicate things further, there are of course several alternative impact assessment methods one can use in an LCA. The different weighting methods are based on different principles when measuring up the relative importance of the different environmental emissions/problems. For example, the EcoIndicator method is based on how a panel judged the different problems; the EPS method is based on the willingness-to-pay for avoiding the problems; environmental theme method is based on distance-to-target, i.e. the distance to fulfillment of environmental policies and targets.

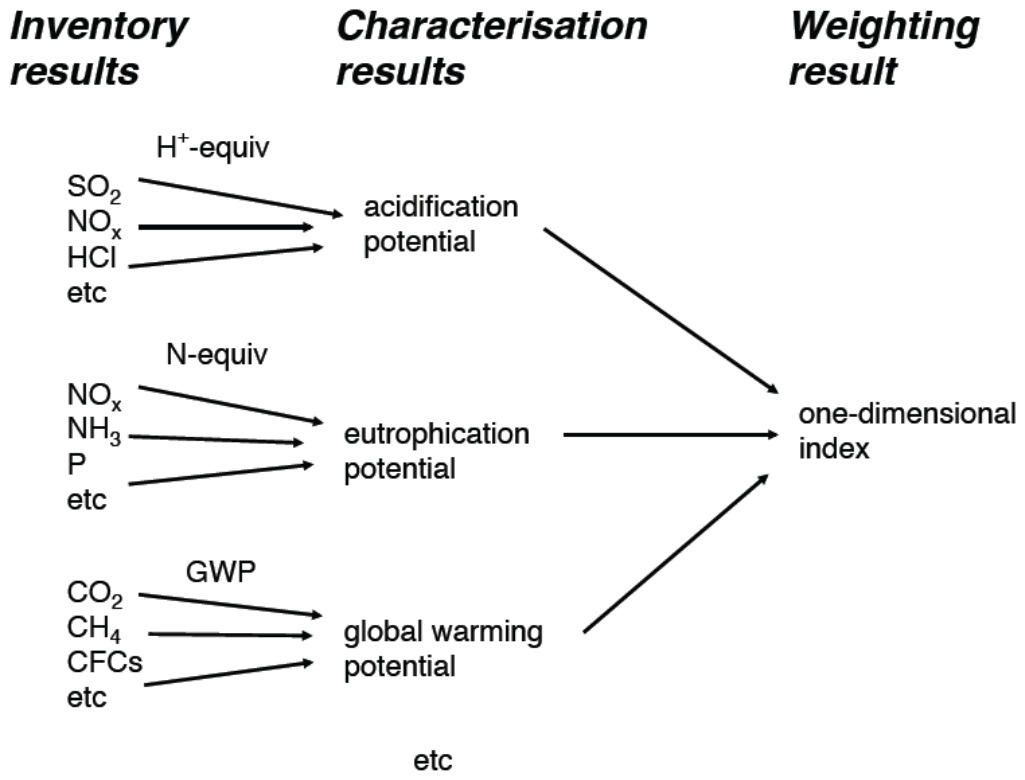


*Figure 5. Results of an LCA can be presented as a list of emissions (inventory results), or emissions grouped and added together using equivalents as environmental problems (characterization results), or as a single number representing the overall, total environmental impact (weighted results). Source: Baumann and Tillman (2004)*

## AREAS OF APPLICATION

Product design and development have been major areas of LCA application since the beginning. Many other areas of applications have been identified over the years, but the use of LCA in product development is probably most common. Early on, many worked for the idea of the 'five-minutes LCA' that any product developer could perform with simple LCA software and databases. Since then, more diversified ways of using LCA in product design have developed. Some are very simplified LCAs while others are more complex approaches depending on for what stage of the design process they are intended.

Ecodesign tools come in many sorts and kinds as complements to ordinary design tools. They fall into two broad categories: creativity tools and analytic tools (Lewis & Gertsakis 2001). Brainstorming is an example of a well-known creativity technique, but there are also tools that specifically support the generation of environmentally-oriented product ideas and concepts. For example the '10 Golden Ecodesign Rules' and the 'ecostrategy wheel' (in figure 2) can be used to generate environmental options during brainstorming. The many generated product ideas and concepts then need to be evaluated. This is where the analytical tools come in. There are many ecodesign tools of the analytical kind. A simple analytical tool intended for assessment in the earlier stages of product development is the MET matrix, also in figure 2. "Ordinary" quantitative LCA is

typically used for analytical purposes but there are also life cycle approaches that support creative processes.

The problem of using "ordinary" quantitative LCA in product development is the shortage of data and the lack of concrete designs to evaluate during the early design stages. Towards the later phases the problem becomes another: there is seldom enough time for doing LCA studies. LCA is nevertheless a useful concept since it brings a comprehensive environmental perspective to ecodesign that enables identification of environmental trade-offs such as material minimisation versus durability. Figure 6 presents a limited overview of life cycle approaches and their intended use during product development. The figure shows that there are many variations in how and when LCT and LCA can be used.

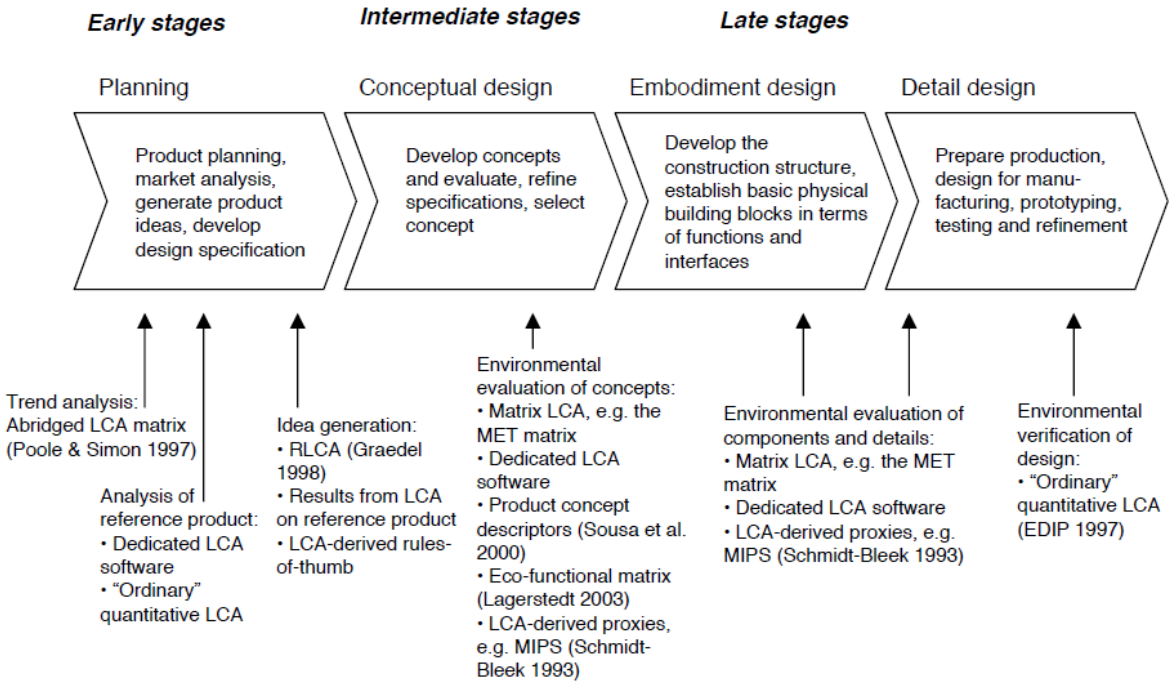


*Figure 6. Different LC-based approaches and tools for different stages in the product development process. Source: Baumann and Tillman (2004)*

Some of the LC-based approaches in figure 6, especially those for the early stages, are described in the following.

## TREND ANALYSIS

During product planning, trends in design can be analysed and evaluated. Poole & Simon (1997) suggest the use of an abridged LCA matrix, with which the trends towards, for example, increasing miniaturisation and more cloud solutions are assessed in a comparative way. The matrix is filled with statements about positive and negative effects of the studied design trend together with cautionary notes, such as "miniaturisation of electronic product may complicate disassembly and recycling" (Poole & Simon 1997).

## IDEA GENERATION

One approach suggested by Graedel (1998) is reverse LCA (RLCA), which focuses on the functional unit in order to explore and analyze the needs that a product is designed to fulfill. The term reverse refers to the fact that the needs and functions are examined in detail before any product design is characterised. In normal LCA, one evaluates a (conceptual) product, whereas with RLCA one begins with the environmental characteristics of an ideal product and works backward to determine the physical design that would best satisfy those characteristics. What makes RLCA a creativity tool is the focus on needs rather than on a product, which encourages creative systems thinking and supports identification of opportunities for innovation.

Another creativity approach is the use of LCA studies of reference products as inputs to brainstorming sessions early on during product development. This can not only contribute to the generation of product ideas and concepts. Such inputs can also support more general environmental learning in the designers (Bakker 1995). Well presented LCAs of well chosen reference products and/or product systems provide the designers with comprehensive nuanced knowledge of the factors that determine the environmental properties of the products they work with. The LCA study of a reference product can be obtained either by having an LCA study carried out on a chosen reference product, or by going to the library (or the internet) to find a report of an LCA study of a related product. The general learnings from such LCAs may provide critical knowledge about environmental strengths and weaknesses of the reference product system, knowledge that in turn may influence the designers' mental frame of reference so that they apply the new learnings "intuitively" in the design process. When results of several LCAs on the same reference product are very similar, it is possible to derive LCA-based design rules for that category of product. The general learning from careful reading of LCA studies may contribute more fundamentally to environmental product design than the rote application of evaluation tools.

## ENVIRONMENTAL EVALUATION OF CONCEPTS

The MET matrix (Brezet & van Hemel 1997) is a good representative of life-cycle-oriented matrices for the evaluation of product concepts. It was developed as a simple method for designers to systematically describe the environmental properties of a product. It covers the main life cycle stages and environmental impacts in a simplified way (see figure 2). Many companies and organisations make their own version of the MET matrix, especially if they want a greater or lesser degree of detail - knowing that there are two main approaches to filling such a matrix with information. The first is to describe the environmental impact of a product in absolute terms, for example short descriptive statements about materials used, recyclability, major environmental impacts, etc, complemented by some quantitative information on the amount of materials used, energy content of materials, etc. The quantitative information can be given in absolute numbers or on a scale, e.g. from 1 to 5 where 1 indicates a low amount or impact and 5 a large amount or impact. There will then be a descriptive matrix for each product, which provides a basis for the environmental ranking of them. The second approach consists of making comparative assessments, in relative terms, between for example the new product and the existing product or between competing alternative designs directly in the matrix. In that case, the differences between the reference product and the alternatives can be expressed on a simple scale ranging from better to worse or with qualitative statements. The main advantage of matrix LCA is that it is efficient, both in terms of time and resources (Graedel 1998; Lewis & Gertsakis 2001). It can be carried out

by existing staff. However, since the results are based on the designer's existing knowledge, it is recommended to have some co-operation with environmental experts, at least to begin with (IVF 2000).

If one decides to attempt "ordinary" quantitative LCA, there is today open source software that comes with a database with some basic data. Before attempting such calculations, it is wise to know what the product system looks like — if it is fairly simple or very complex with lots of materials, components and recycling loops. Search for OpenLCA on the internet! This could be worthwhile for conducting a simple LCA of a reference product in the case when no relevant reports can be found.

## IN A NUTSHELL AND FURTHER READING

Reading of LCA reports can be a good way to learn about different product and service systems. Knowing the basic logics of LCA comparison allows you to read LCA reports with a critical eye and determine the credibility, relevance and validity of the results in relation to your project. To get further into LCA methodology, the ISO standard is not recommended reading — it is overly technical and partly contradictive. Recommended reading about LCA methodology and application is found in the Hitch Hiker's Guide to LCA (Baumann and Tillman 2004) and on the Life cycle thinking and assessment website of the European Commission (http://lct.jrc.ec.europa.eu). Another worthwhile book about the environmental issues of various materials is "Sustainable Materials: With both eyes open", by Julian Allwood — a book can be downloaded from the internet.

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## FUNCTIONAL UNIT EXERCISE

The functional unit is central in any LCA. It is a measure related to the function that the studied systems have in common. In addition to that, it is also a basis for the calculations. For this reason, the functional unit needs to be quantitatively defined. A careful definition of the functional unit is important for all LCA studies, particularly where comparisons are involved. Furthermore, thinking about what the function really is can be a starting point in a new product development process — what other solutions can deliver the same type of function?

Define the functional unit for the following products/services. It may help to list different versions of the studied product (for example, buses, bicycles, etc in the case of people transportation). In some cases, you may come up with more than one functional unit depending on the number of properties/qualities of the product you want to specify.

- Mineral water packaging

- Bread

- Newspapers

## READING AN LCA REPORT

Find an (a couple of) LCA report(s) about a product/service similar to that in your project. What can be learnt from those reports?

1/ what type of LCA study was done? degree of detail, number of product alternatives, definition of functional unit, illustration of product flows, environmental information and data, age of data, type of results, credibility of results…

2/ what environmental findings are relevant? major environmental problems, location of major environmental problems (problematic processes, geographic location...), critical issues (governance, technical, economic, social) for total environmental impact. Can general environmental conclusions be drawn about the studied product systems?

## SOLUTIONS TO FUNCTIONAL UNIT EXERCISE

**Mineral water packaging**, for example in glass bottles, PET bottles, aluminium cans, steel cans: per litre in a particular size of packaging, for example 33/50 cl servings or for 1,5 l servings.

Alternative conceptual solutions: What about soda fountains? Soda streams? Powders to mix with water?

**Bread**, for example industrial factory bread, local bakery bread, home baked bread: per loaf, or per kcal, or per normal daily serving. Qualitative aspects such as taste, smell, etc. has to be considered in parallel.

Alternatives to bread: more müesli? other carbohydrates?

**Newspapers**, for example paper journals, e-journals: per person-reading and day

Alternative conceptual solutions: Personalised news (without those sections you're not interested in).

# 8 PATENTABILITY AND FREEDOM TO OPERATE – A PRACTICAL GUIDE FOR EARLY STAGES IDEAS

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## INTRODUCTION TO PATENT ANALYSIS FOR EARLY-STAGE VERIFICATION

The path to successful value creation in an early-stage setting is based on three different parameters. First, the technology must have some kind of value-creating potential – that is, the functionality of the technology must be translated and implemented so as to provide a utility for a customer. Second, the technology itself has to work. Usually this is of considerable risk and uncertainty for early-stage technologies. Finally, the project and its owners have to appropriate the gains of the project – this means that the value generated from the technology has to be captured by the investors and developers of the project[22]. Depending on industry characteristics, different control means can be applied in various ways to ensure appropriation of generated value[23]. One such tool that is particularly important for early-stage projects is the patenting instrument. In contrast to large firms, early-stage projects have very limited market power and control few complementary assets[24]. At the same time, early-stage projects are often developed in collaboration with large actors or other research organizations where the patents, in combination with agreements, are crucial means for clarifying the control, ownership and the rules[25]. Any serious evaluation of the value-creating potential of an early-stage technology should therefore include an analysis of the current and potential patent position of the project.

As illustrated in Table 1, the patent position of a project can be analyzed from a number of different perspectives. For example, a central issue to clarify would be what claims have been made, or could

[22] Day G, Schoemaker P. Wharton on Managing Emerging Technologies. Wiley; 2004.
[23] Cohen W, Nelson R, Walsh J. Protecting their intellectual assets: Appropriability conditions and why U.S. manufacturing firms patent (or not). NBER Working Paper Series 7552 (2001)
[24] Levin R, Klevorick A, Nelson T, Winter S. Appropriating the returns from industrial R&D. Brookings Papers on Economic Activity 3 (1987) 783-831.
[25] Petrusson U. Intellectual Property & Entrepreneurship: Creating Wealth in an Intellectual Value Chain. Center for Intellectual Property Studies; 2005.

possibly be made, on the patents within the project[26]. A patent ownership analysis is usually a particular challenge in early-stage projects where the technology is being developed by several inventors associated with different institutions and contracts. Another aspect to analyze would be the current and potential control position of the project itself. That is, how effective can the patent position be in enabling the project owners and inventors both to control the development and to appropriate the gains from the technology? A third patent-based control issue to evaluate is the claims made by other actors, by mapping existing patent claims. By going through these three steps, the analyst will understand important opportunities and risks in going forward.

| Patent-based control issues for early-stage verification | Analysis tools | |
|---|---|---|
| Clarifying patent ownership | • Title claim analysis<br>• Background/foreground analysis | |
| Development of a patent-based control position to ensure appropriation | • Intellectual Asset analysis<br>• **Patentability search**<br>• Patent due diligence | Scope of the article |
| Patent infringement risk | • Intellectual Asset analysis<br>• **Freedom to operate (FTO) search**<br>• Claim chart analysis | |

Table 1: Overview of patent-based control issues and related analysis tools.

The purpose of the article is to provide the analyst with practical patent search methods for gathering relevant patent documents in order to perform some of the steps outlined in the table above. More specifically, the text will address how to gather patent documents for patentability and FTO searches.

- **Patentability searches** are conducted to gather all relevant prior art in order to understand the different patenting opportunities – mainly in relation to the novelty, non-obviousness and utility criteria[27]. It is important to note that patentability searches are not limited to patent documentation. Any relevant material made public, either in patent documents or in other formats, could have an impact on the patentability of a technology. This guide is only limited to patentability search among other patent documents.
- **FTO searches** focuses on what other patents claim in order to see (1) if the project infringes other patents, (2) if the project is expected to infringe other patents in the future, or (3) if patents in the project are covered by other patents.

Title claim, background/foreground analysis, patent due diligence and claim chart analysis are thus outside the scope of the article, but should still be considered to be important steps in the early-stage project verification.

[26] Ibid.
[27] Bainbridge P. Intellectual property – Seventh Edition. Pearson Longman; 2009.

## THE GENERAL SEARCH PROCESS

Even though there are differences between a patentability and FTO search, the general methodology of the search is the same. The methodology presented in Fig. 1 can be used for patentability as well as FTO searches. The process consists of seven different steps, where the analyst first defines the subject matter in a way suitable to the purpose of the search. The definition of the subject matter is then converted in steps 2, 3 and 4 into an input, including different search strings, for the search engine. After the search is performed in step 5, the results are evaluated in relation to the subject matter and the purpose of the analysis. Finally the results are usually put together and presented in a report. As is illustrated in Fig. 1, the process should be seen as a learning process where the results retrieved through the searches will be iteratively used to re-define the scope until the analyst feels satisfied with the final results.

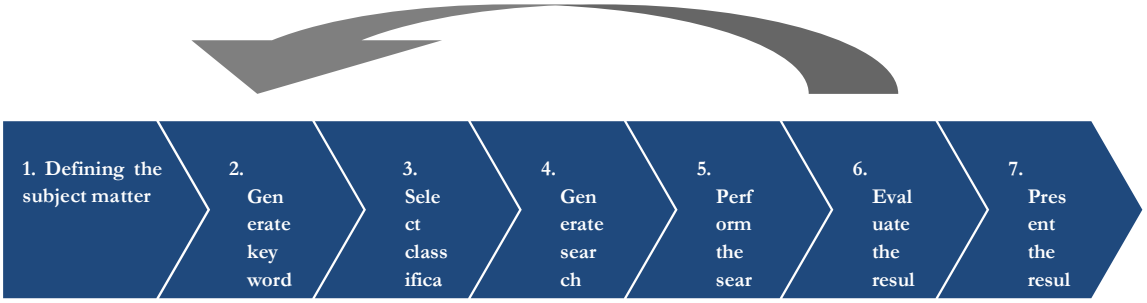


*Fig 1: The general search process.*

The process incorporates three different concepts to determine a set of relevant patents: keywords, classifications and citation search. The keyword concept is the primary search method in this article, where the analyst applies words, logical operators, truncation limiters and proximity operators into a search string that generates a corresponding result. All patents are classified into different hierarchical classification systems based on the kind of technology that the patent is describing. By limiting the search to a particular set of classes, the domain of patents is narrowed and non-relevant documents can be filtered out. It is furthermore helpful to use the fact that patents are citing similar literature. When relevant documents have been found, the citations can used to find other patents of relevance for your search.

### STEP 1: DEFINING THE SUBJECT MATTER

The differences in defining the subject matter in patentability and FTO searches are illustrated in Table 2. The subject matter in patentability searches is usually rather clearly defined and based on the technology that is being analyzed. In contrast, a good FTO search for early-stage verification should not only take into consideration the current technology, but should also assist in further development efforts. This makes the FTO search broader and the description of the subject matter fuzzier, particularly in the early-stage setting.

| Search purpose | Defining the subject matter |
|---|---|
| Patentability search | • The subject matter is defined based on the technology that is being considered for patenting. |
| Freedom to operate search | • The subject matter is defined as the developed technology or the technology that could be developed. |

*Table 2: Defining the subject matter in patentability and FTO searches.*

The patent searching book "Patent Searching: Tools and Techniques"[28] suggests a process of asking three different questions to define the subject matter:

- What problem does the invention solve (utility)?
- What is the invention (structure)?
- What does the invention do (functionality)?

The purpose of asking these three different questions is to capture the subject matter from different angles. There may for example be many functional ways to solve a particular problem. On the other hand, one functional solution could equally well solve several problems. If the words in the keyword search were formulated by using only one angle, there is a significant risk that the analyst will miss important documents. By answering these questions the analyst will be able to extract words that can be used in the keyword search. Table 3 provides an example of how you can answer the three different questions for an improved heat pump solution[29].

| Subject matter questions | Heat pump answers |
|---|---|
| What problem does the invention solve? | **Heat pumps** are not **effective** at **low** outdoor **temperatures**, and should have a **low manufacturing cost** and high degree of **reliability**. |
| What is the invention? | A **liquid ring, a shaft, housing, a compressor.** |
| What does the invention do? | Cooling through the **Carnot process**. Achieved by passing the cooling medium from the condensation stage to the evaporation stage through **a return system**. Applies a **liquid ring** in a **rotating motion**. |

*Table 3: Defining the subject matter from three perspectives.*

[28] Hunt D, Nguyen L, Rodgers M. Patent Searching: Tools and techniques. John Wiley & Sons, Inc.; 2007.
[29] Patent number: US006024988A

By highlighting a few central words it is possible to pick out what captures the essence of the subject matter. These words will then form the basis for the generated keywords that are used in the search.

### STEP 2: GENERATE KEYWORDS

The next step is to generate the actual keywords from the highlighted words. By creating a list of synonyms for the highlighted words, it is possible that the analyst will reduce the risk of missing important documents. In the heat pump example, the word "coldness" could for example be used instead of "low temperature". A good starting point for synonyms is obviously an online synonyms database. For more advanced technology an expert could be consulted. It is again important to note the learning and iterative dimension of the search – the gathered results will give the analyst new input on the words that are used to describe the technology.

### STEP 3: SELECT CLASSIFICATION AREAS

An effective way to narrow down the search is to specify a number of classes. All patents are classified into some kind of classification system. The most common are the International Patent Classification (IPC), the European Classification (ECLA) which builds on IPC, and the United States Patent Classification (USPC). While there are some differences between the systems, the general principle is the same – technology areas are hierarchically broken down into sub-classes that are in turn further broken down into sub-classes[30]. The logic behind the breakdown structure of the classification systems is not always consistent. Sometimes a class is defined in terms of the use; in other cases the patents are categorized based on their structure, their use or the functionality[31]. It is furthermore helpful to know that patents are in many cases not classified correctly – especially in very specific sub-classes. The analyst should therefore be careful and not overly confident when he or she uses the classification systems, even though they are a very good place to start[32]. Relevant classes can be found in three different ways:

- Search or browse the classification system.
- Review a set of patent documents and pick out their classifications. If one or two documents have been identified, it could be helpful to follow their citations and find additional relevant classes.
- Consult a patent examiner at a patent office.

[30] Adams S. Comparing the IPC and the US classification systems for the patent searcher. World Patent. Information 23 (2001) 15-23.
[31] Falasco L. Bases of the United States Patent Classification. World Patent Information 24 (2002) 31-33.
[32] Adams S. Comparing the IPC and the US classification systems for the patent searcher. World Patent. Information 23 (2001) 15-23.

## STEP 4: GENERATE SEARCH STRINGS

After the subject matter has been defined, keywords have been generated and appropriate classes are chosen, the search strings should be constructed. To construct the search strings, four different text search operators are used:

| Operators | Examples |
|---|---|
| Boolean operators (e.g. AND, OR, NOT) | "Heat AND Pump" returns all documents that contain heat and pump |
| Proximity operators (e.g. ADJ,NEAR,WITH,SAME) | "Heat ADJ Pump" returns all documents where heat and pump are in the specific order next to each other.<br>"Heat ADJ3 Pump" returns all documents where heat and pump are within three words from each other. |
| Truncation limiters (e.g. $,*) | "heat*" returns documents with heat and any unlimited number of characters after heat.<br>"heat*3" returns documents with heat and any three characters after heat. |
| Parenthesis (e.g. ()) | "(((liquid ADJ ring) OR (rotary ADJ vane)) ADJ pump)" returns documents where "liquid ring" or "rotary vane" is followed by pump. |

The analyst should again consider the synonyms as well as the words in plural. It is in many cases equally important to get documents where pump is included as well as, for example, pumps. In this case pump* should be included. This result would, however, also include pumpkin or pumpernickel. Pump*1 may thus be an appropriate choice. The words used for different text search operators can be different depending on search engine – the help section should always be examined before using a new search engine.

Searches can very easily become too broad, whereupon many documents are included that are not relevant. It is also rather easy to get too narrow results so that important documents are missed. Different people advocate different approaches to this problem. One suggestion is to start broadly and narrow down by adding new keywords. Even though this is a fairly intuitive approach, it can easily skew the results with too many unsystematically added words. Another approach is to start narrowly and broaden the search from there[33]. A third approach is to utilize the three different angles – utility, structure and function – as described above. By starting broadly in one category

[33] Nijhof E. Subject analysis and search strategies – Has the searcher become the bottleneck in the search process? World Patent Information 29 (2007) 20-25.

you can narrow down the search from the perspective of the other categories. This is the preferred method, as you effectively cover the technology area from different perspectives.

## STEP 5: PERFORM THE SEARCH

Most search engines provide different means of limiting the search. The most important limitation in relation to patentability and FTO searches is of course the date. While FTO searches are only concerned with active patents, a 25-year date limit is appropriate[34]. Patentability searches are, in contrast, only concerned with prior art. Any prior art published is therefore relevant and there should not be any time limit to the search. The differences between an FTO search and a patentability search should also be considered when deciding where to search in the patent document. Three points can be made about where to search:

- The abstract provides a short summary of the claims. In many cases the claims may be amended but the abstract is not. Searching in the abstract can be helpful if the objective is to gather patents that claim a particular technology.
- The description part of the patent can in theory contain almost any text. In many patents, this section is quite long and includes description of technology that is not necessarily claimed in the patent. Since the objective in the patentability search is to identify all relevant prior art, the description is obviously of interest. In the case of a FTO search, you are primarily interested in what is actually claimed. While a search in the description part of the document can generate important documents, the analyst performing an FTO search should be more concerned with searching in the claims.
- The claims are obviously central for the FTO search – in some cases it may be appropriate to search only in the claims.

## STEP 6: EVALUATE THE RESULTS

The sixth step in the general search process is to evaluate the retrieved documents. The evaluation of the results is usually done rather intuitively by a good searcher. The key to scanning quickly through documents and identifying the ones that are relevant is to focus on the key subject features of the invention. By understanding what is truly unique in the subject matter, it is possible to determine rather rapidly whether a document is relevant or not. If the retrieved patent document is close to the core subject features, a deeper reading should be performed.

In the case of patentability search, the analyst should have a fairly good idea of the unique subject features and why they are novel. The purpose of the freedom to operate search is, of course, to find patents that "read on" the subject matter – which means that only active patents are considered and the analyst should have a strong focus on the claims. One way to quickly relate found

[34] Some patents are prolonged and valid for more than the standard 20 years.

documents to the subject matter is to create a matrix checklist, as illustrated in the example in Table 4.

| | pulp located at the first roll | a head box | distribution of pulp through liquid tunnels | heating of pulp on second roll |
|---|---|---|---|---|
| US 6,323,311 | X | | X | |
| EP 198825B1 | X | X | | X |

Table 4: Checklist matrix of patents in relation to subject features.

As noted earlier, the evaluation of the results should not only be made in relation to the subject features. The analyst should also, through the reading of the documents, learn more about the technology area and in many cases go back and perform new searches. It is also important to know that a freedom to operate search requires a fairly advanced level of understanding of the patent law. In the case of early-stage verification, the analysis could be performed by somebody with moderate understanding of the technology and the law. In later stages professionals should be contacted.

## STEP 7: PRESENT THE RESULTS

Finally, the analyst should present the results in an easy-to-assess format. While it is outside the scope of this article to present a complete reporting format, a few suggestions can be made.

- Try to re-use and possibly expand on the suggested format presented in Table 4. It is possible to be even more specific and include details about the found documents. See text box 1 for suggestions.
- It is very important to always include how you performed the search. This is not only limited to the process itself, but also refers to the search-related parameters such as:
  - Search strings
  - Classifications
  - Databases
  - Contacted experts.
- Try to avoid lengthy discussions and copy/paste text from the documents you refer to. Be concise but still content-heavy.

## Example: FTO table

| Documents | Comments | Subject features |
|---|---|---|
| US 6,323,311<br>✓ | The document provides a similar overall method but lacks crucial distinguishing features and the integration of an axial-flow compressor. | 1✘ (claim 2)<br>2<br>3✘ (claim 10-12)<br>4 |
| EP 198825B1<br>✘ | Document presenting a very similar solution and should be carefully considered before going forward. | 1✘ (claim 1-4)<br>2✘ (claim 5)<br>3<br>4✘ (claim 10) |

**Subject features**

1. A method for treatment of cellulose pulp where the pulp is located at the first roll.
2. A method of using a head box for distributing the cellulose pulp in the form of a uniform layer.
3. The placement of a rotor in the central unit for deflocculating the pulp.
4. A method of using an axial-flow compressor in the pulp treatment process.

*Text box 1: An example of a reporting format.*

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# 9 FRAMING THE CLAIM

*Boo Edgar, Chalmers and University of Gothenburg*

*Boo is Associate Professor at the Sahlgrenska Academy, University of Gothenburg. He is also the Director of the Gothenburg International Bioscience Business School, GIBBS, which is a joint initiative by Chalmers University of Technology, University of Gothenburg and the Sahlgrenska Academy, and was created in close collaboration with the regional health care organization and biotech/pharmaceutical companies. Boo's professional experiences and career development span several areas within the pharmaceutical industry and life science area, including clinical pharmacology and clinical research, project management, R&D Strategy Development and leading a discovery and research company. Previously, his main area of research was in the field of pharmaceutical development, but he now focuses on the innovative power of biomedical research. Among other things, he is conducting research into how the ability to embrace new ideas and entrepreneurship is influenced by attitudes, management and education. At the moment he's involved in three EU projects covering these areas but also including the introduction of emerging innovations in regenerative medicine in Europe. Boo is also an entrepreneur. Altogether he has been involved in more than a dozen start-ups, and in his role within the entrepreneurship schools at Chalmers and University of Gothenburg, he has supported around 25 venture creations. He is active in the boards of several young start-ups.*

> *Scientists and engineers can change the world, but first they need to get over their "serious marketing problem." Larry Page, Co-founder of Google, 2007.*

## CHAPTER LEARNING IN SUMMARY

- The ability to communicate and the actual communication of a technology are essential in supporting further development.
- The important role of the media and public communication
- Public opinion about more controversial issues in science and technology is therefore essential.
- Scientists and policy makers assume that increased public understanding of the issue will lead to increased support for the issue or for the technology.
- The public, however, by nature abounds in individuals and groups that rely on information coming from multiple sources, including other scientists.
- In several areas such as gene-modified crops, stem cells, nanotechnology and climate change, the impact of public communication and framing your claims is evident.
- Framing the communication is an unavoidable reality of the communication process in these issues.
- We don't know how the public uses the media to form opinions about science-related topics, but we have to.

- Avoid words and scientific language that may be disruptive in themselves.
- It is the researcher or the spokesperson (and the journalist) that is responsible for how the public takes in scientific results.
- For a new idea there is consequently a need to inform the public and policy makers about:
- The main research results
- How to follow the ongoing developments
- How the public can form its own opinion on the basis of sound, science-based facts and data
- The impact and realism of the results
- You have to think through how you "frame the claim". The more disruptive, the more planning!

## INTRODUCTION

Less than a dozen years ago the first human embryonic stem cell line was established[2], with a flow of researchers around the world joining the research and establishing or trying to establish their own stem cell "line". From sources, the researchers developed pluripotent stem cell lines, which are capable of renewing themselves for long periods and giving rise to many types of human cells or tissues. (See 'Further reading' below for scientific references.) The summary of the science of stem cells during 2001 was collected in a report by NIH[3].

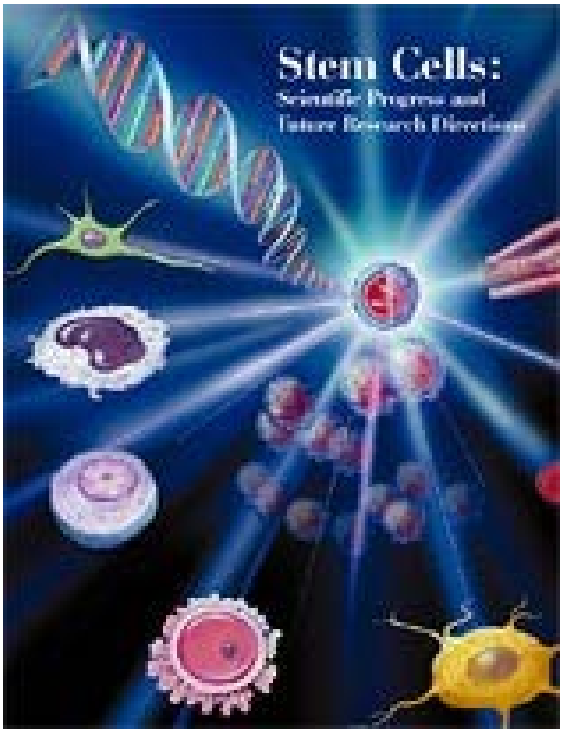


*Figure 1: The most read and available information on stem cells in 2001[3].*

After the first publication in 1998, media, policy makers as well as scientists created a hype of what could be delivered from and achieved with these stem cells[4]. Frost&Sullivan[5], Boston Consulting Group[6,7] and other market-research-oriented companies joined in the presentation of future market

prospects. Not only would all diseases be curable instead of treatable – bad ligaments could be changed, hearts renewed, memory restored, progressive disorders stopped, new medications needed could be developed on human cells instead of using animals, and so on.

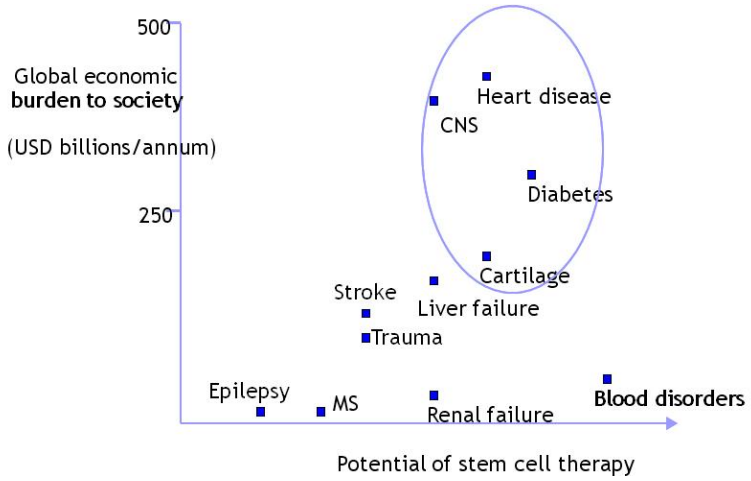


*Figure 2. The market in 2001 for diseases that could be treated by stem cells*[7].

During the same time period in the US, anti-abortion groups, conservatives and the Roman Catholic Church objected on moral grounds against using stem cells extracted from embryos – even those at fertility clinics that might otherwise be discarded. Some went even further: the National Conference of Catholic Bishops and other critics denounced this distinction as sophistry. In the process of obtaining embryonic stem cells, they claimed, scientists destroy the embryos, thus killing human life[3]. The choice of the scientifically correct term 'embryonic', therefore, was totally wrong, not only from a communication perspective but also for a fair description of, in most places, fertilized eggs that could not be used to produce life[8].

While the debate in the US was quite controversial, the discussions in Europe and elsewhere in the world were calmer. The European Commission started its work of understanding what it would be able to support[8].

In Sweden, the Invest in Sweden Agency developed a brochure named Stem Cells to market the potential for investments here[6,7]. In the UK, Singapore, South Korea and Japan as well as Sweden, steps were taken to support stem cell research based on fertilized eggs. Sweden had a law already in place that allowed research on human fertilized eggs, provided that it received approval from an ethics committee [8].

In August 2001 President Bush proposed a way out of the moral dilemma. The pressure was too hard to totally ban federal support to stem cell research while satisfying Catholic and other groups[9]. The US minister for health, Tommy Thompson[9], delegated to the National Institute of Health (NIH) the responsibility to arrange federal support for research on the available stem cells lines. There were strict rules for these lines: they must have started before the 9th of August and all be in

a blastocyst stage. In total there were more than 60 (actually 72 in the end) stem cell lines available at 10 universities[9] in the world. The more stem cell lines, the better the research, was the mantra.

Nineteen stem cell lines originated in Gothenburg, making Sahlgrenska research groups into major players[10]. An interview published on August 29 on the first page of New York Times really put Gothenburg on the map, reporting among other things the following: "In a tiny room in Sweden the university's scientists are cautious about the statement by the American government that they have 19 cell lines. They say they have 3 established ones, 4 that are being studied and described, and 12 that are still in early stages." [10]

"The goal is to get cells to grow on mediums from no animal sources," Dr. Semb said. Since mouse embryonic cells already can, he said, it is theoretically possible[10]. Dr. Henrik Semb was and is one of the researchers behind the first stem lines in Sweden and the differentiation of such cells to beta cells, a possibility for treatment of diabetes. Swedish media covered the stories, but it was more or less a US discussion[11, 12].

The September 11th attack took all communications on stem cells and their possibilities away from public media, although the work, research and scientific results, and product development and successes continued. Hearings in the US senate were cancelled, and it took close to eight years before the ban in the US for federal support was lifted, in March 2009[12]. Finally in the summer of 2009 NIH published the guidelines for potential federal support for future research in the field[13]. In Europe the Commission has continued to support the research[8].

To change the view of the general public, policy makers and politicians in the US towards a positive attitude took a long time. Meanwhile, a significant amount of knowledge was gathered. The knowledge in summary may be reviewed and read in 2009 World Stem Cell Report[14].

Early hopes had been attached to potentially early deliverables in mostly therapeutic solutions. These had failed, which affected the public media situation negatively. Add a few fundamentally negative mindsets, and public opinion can turn against this kind of research. In the meantime, however, the research continued especially outside the US, The insights about the future benefits grew stronger, with substantial results and know-how created. The legal and regulatory system is still lagging behind and it will take some time to become updated globally, due to the education and learning needed about what is possible to do. Still, today this change is happening.

## CELLARTIS™

In 2001, during this interesting time, a university spin-out venture was formed by several researchers for *in vitro* fertilization, development biology, clinical areas and business developers. Already from the start, the company focused on the commercial applications of human stem cells derived from fertilized eggs. In collaboration between Cellartis, and the Universities in Göteborg and Uppsala, the first approvals from the ethics review boards were achieved and the first fertilized eggs were donated. From these a number of cell lines and potential cell lines were established early

in 2001. In the start-up process, several ethical discussions and handling processes took place, where the platform for the university as well as the company research was elaborated[5].

In the business plan presented in September 2001, the market opportunity was described in the following way[15]:

> *To be the leading source for defined human stem cells for advanced research and the world leader in development and of stem cell based therapies.*

And the research was described thus:

> *"Stem cells represent the most recent phase of the biotechnology revolution in medicine. Knowledge of how adult stem cells maintain and repair different aged, diseased or damaged tissues throughout the life of an individual, together with the development of technologies for the manipulation of the growth and differentiation of stem cells, will enable these cells to be used as a potentially unlimited biological resource for:*
>
> *cell-based discovery tools for drug screening and toxicology*
>
> *cell-based basic research and discovery tools*
>
> *cell-based therapies for regenerative medicines and for tissue engineering."*

Today Cellartis[16] is a well-positioned company with the single largest production of undifferentiated and some differentiated stem cells (see Figure 3).


*Figure 3: Major products available today from Cellartis[16]*

The company today presents itself as follows:

> Cellartis AB is a Swedish/British biotechnology company focused on human embryonic stem (hES) cells and technology for drug discovery research, toxicity testing and regenerative medicine. The company is the world's largest single source of ethically derived hES cell lines and has developed more than 30 ethically derived cell lines. The main business objective of Cellartis is to develop hepatocytes and cardiomyocytes from the proprietary stem cells for use as tools in drug discovery.

The company's strategy is to accelerate product development by working in partnership with academia and industry towards advanced stem cell products and technologies. Cellartis was founded in 2001 and is located in state-of-art facilities in Göteborg, Sweden and in Dundee, UK. The laboratories are prepared to meet the EU guidelines for current Good Manufacturing Practice (cGMP)

In the news one may follow the intentions for regenerative medicines mostly within diabetes but also in other areas.

## REFLECTION AROUND THE DEVELOPMENTS

It took 8 years to arrive at useful products and there is still some work before we will be able to see the benefit of regenerative medicine based on embryonic stem cells. There are therapies in trials with different cell types – mostly adult cells from other parts of the body, mesenchymal cells for the heart. There are also studies in late planning with embryonic-based oligodendrocytes, in acute spine accidents. The regulatory agencies in both Europe and the US have guidelines for Advanced Therapies[17] that will direct potential new uses.

Could the progress of such bright potential for embryonic stem cells and therapeutic cloning have been faster if the communication to the public and thereby opinion had been different? Will we see more rapid development now that federal funding can be used again in the US? The eight years have been utilized to actually be able to mass-produce cell cultures, which was not possible in 2001. The stem cell colonies in 2001 were still handled by hand. Nowadays robots are used[16]. Where has Europe gone during this time? The potential advantages that Europe had in 2001-2002 have been more or less lost. However, one might say that some perspectives in setting up a new technology in 2001 were not present. The IP area during these years has become even more complicated, which calls for an open platform principle in the therapeutic research going forward[18,19,20]. Could a common European perspective[8] have changed the opportunity for patients with Parkinson, diabetes and heart infarcts earlier than will be the case? Can framing the claim guidelines utilized today change the willingness to fund the prospects, added on to the question of need?

## FRAMING THE CLAIM

There is a growing recognition that effective communication about a scientific issue, a new technology, and disruptive ideas requires initiatives that sponsor dialogue, trust, relationships, and public participation across a diversity of social settings and media platforms. In 2001 this was not present. There was not even a common plan within the stem cell community. No learning from the Gene Modified Crops debates a few years earlier was considered. In the companies involved, neither the perspective nor the potential for framing existed – partly due to the discussion of *in vitro* fertilization which had taken place 15 years earlier – or the understanding that an accepted term, 'embryonic', could be understood in the wrong way. The communication did not take place between researchers and policymakers or to the general public. There were some references to the ongoing debate, but that was all.

The Swedish government at that time did not respond[21] to the information that the Sahlgrenska Academy at the University of Gothenburg was in discussion with the ministry of health in the US – unthinkable today?

Framing is unavoidable in communications. It is a reality of the communication process, especially when applied to public affairs and policy. Audiences not only rely on frames to make sense of and discuss an issue; journalists and other communication experts use frames to craft interesting and appealing news reports; policy makers apply frames to define policy options and reach decisions; and experts employ frames to simplify technical details and make them persuasive. Politicians rely on frames to be able to respond to questions.

Nowadays there is no such thing as unframed information, and the most successful communicators are adept at framing, whether using frames intentionally or intuitively. All over the world, in National Science Boards, scientists enjoy an almost unrivaled level of public trust and respect. Admiration for science and scientists is also reflected in a 2009 survey by the Pew Research Center for People & the Press. According to this survey, 84% of Americans agree that science is having a mostly positive effect on society, with this strong agreement relatively consistent across every major demographic, political, and religious segment, including 74% of respondents who scored in the lower third on quiz-like questions measuring science knowledge[22, 23].

Thus, one should always plan for good communication and a possibility to change people's minds. Facts don't speak for themselves. But start by dividing the information into different parts. The following approach, adapted from Nisbet, was published in The Scientist in 2007[24] and later in the American Journal of Botany[25].

| **Available frames** | **Explanation** |
|---|---|
| Social progress | Improving quality of life, or solutions to problems. Alternative interpretation as harmony with nature instead of mastery, or as "sustainability". |

| | |
|---|---|
| Economic development/competitiveness | Economic investment, market benefits or risks; local, national, or global competitiveness |
| Scientific/technical uncertainty | A matter of expert understanding; what is known vs. unknown; either invokes or undermines expert consensus; calls on the authority of "sound science" or peer review |
| Morality/ethics | Right or wrong; respecting or crossing limits, thresholds or boundaries; research performed in the public good or serving private interests; a matter of ownership, control, and/or patenting of research, or responsible use or abuse of science in decision-making, "politicization" |
| Pandora's Box / Frankenstein's Monster / runaway science | Call for precaution in the face of possible impacts or catastrophes, out of control, Frankenstein's monster, or fatalism – i.e. action is futile, the path is chosen, there is no turning back |
| Third way/alternative path | This is a possible compromise position, a middle way between conflicting / polarized views or options |
| Conflict/strategy | This is a game among elites; who's ahead or behind in a winning debate, battle of personalities. Will not likely be won. |

*Table 1: Potential frames to use in communication (adapted from 25)*

If the planning had been there and a framing of the message had been utilized for different groups, the debate on stem cells and its outcome could have been different. For instance, how can religion affect the awareness of stem cells? In another study by Nisbet, the acceptance of stem cell research among highly religious people was more than 60% lower than by the non-religious[26]. How can one utilize this knowledge and plan for communication?

The process could be as follows:

1. Plan
2. Continue the research and acquire the learning
3. Stay on the message and show tenacity
4. Focus on the editors, not the journalists
5. Use words carefully
6. Think in terms of local news
7. Facilitate unplanned meetings
8. Increase the use of networks

With important questions – not only stem cells, but also others such as climate solutions – the lessons are important, so the failures are not repeated again. Religious individuals are everywhere, but there are different religions. For a new idea it is therefore necessary to inform the public and policy makers about

1. the main research results
2. how to follow the ongoing developments

so that they can form their own opinions on the basis of sound, science-based facts and data, and can understand the impact and realism of the results.

You have to make a plan. The more disruptive ideas – the more planning!

**Useful links**

A short-cut into the science: http://isscr.org/public/gladstoneVideo.html

The international society for stem cell research information http://www.isscr.org/public/index.htm

http://www.gu.se/media/digitalamedier/program/samtalmed Discussion on stem cells in the brain with Peter Eriksson

Everything that you want to know and perhaps a bit more: http://stemcells.nih.gov/

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# 10 TEAM DYNAMICS FOR SUSTAINABLE BUSINESS DEVELOPMENT

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Research shows that team diversity can lead to creative development (Hambrick and Mason, 1984) and a higher level of performance (Williams and O'Reilly, 1998). Differentiating opinions, knowledge and background allow for a thorough ventilation of alternatives, particularly in non-routine, novel, and undefined issues. However, variables in a person's background (stemming in part from series of individual strategic choices) not only affect the generation of alternative ideas – they can also lead to conflicts. While team members with different and even conflicting perspectives stimulate discussion about alternative approaches and solutions to an issue, the way in which the team manages these discussions can lead to ideas 'outside the box' or to breakdown of team function. Facilitating discussions where opinions differ is challenging: if achieved, a team can develop a process that allows sustainable development of ideas, built through discussion, analysis and reasoning (Okhuysen and Bechky, 2009).

This chapter will outline some of the constructive and destructive dynamics that conflict can stimulate within teams. We will build from practical examples to explore approaches for sustainability within team function. Individuals within a team can learn to clarify and legitimize their perspective in order to convince others in the team, while at the same time the team can establish processes that allow for pluralism – acceptance and co-existence of multiple ideas and beliefs. A process that allows for exploration of multiple ideas, discussion, and argumentation supporting various perspectives can strengthen team decisions and proposals towards external actors.

## USING CONFLICT

Conflict is often something that we try to avoid. When working in teams, conflict can make us feel uncomfortable, tired, frustrated, judged, unmotivated, and angry, among other things. Conflicts typically fall into two main categories – relationship conflicts and task conflicts. Relationship

conflicts result from differences in personality and value or belief systems[35]. Our belief and value systems, impacting our attitudes and behavior, stem from a long development period, related to the family and social environments in which we grow up. Our beliefs and values are often deep-rooted and thus not easily changed. Often, it is not immediately apparent if conflicts are arising from different perspectives that are task-associated, or if there are underlying belief systems that are being called into question. A first step in dealing with conflict, and using conflict, is to be able to differentiate between issues that are task-related and issues that are value-related.

In this section, we will focus on task conflicts – conflicts that can arise from the content of the task or the process through which the task can be completed (Weingart & Jehn, 2009). We utilize conflict as a point of stimulus – an indication that there are multiple ways to look upon the issue at hand, about which different individuals have strong points of view. Differentiating points of view can be based on facts, data, opinions and assumptions (content) or logistics and delegation (process). The first step towards working through differences is awareness. When exploring the commercial potential of early-stage innovations, there are some common points of departure. Let's call these the 3 C's: Context, Communication and Cloudiness.

## CONTEXT – SETTING DEFINITIONS

When presented with a business idea, often the first task is to establish a goal or objective. But the question 'what is our purpose?' quickly leads to many other questions: in which environment, with what resources, time frame, cost, etc.? Establishing a goal requires discussion of the context in which that goal is placed. Many questions need to be asked and explored in order to establish a bounded working condition and a plan of action. Questions deal not only with what the idea will be shaped into, but how the work will be carried out. Depending on our learning styles and philosophies, we may have different ways of approaching the work process. Should the focus be on the first step towards success, or rather on understanding the ultimate result and working backwards? One team member may be focused on how to start a process, while another wants to understand what the team is to achieve and, based upon that, how the team should divide work – the typical doer vs. planner. Conflict can arise either when questions are left unanswered (and arise later on) or when individuals have strong opinions regarding how the questions ought to be answered. In both cases, communication becomes crucial, particularly in order to determine whether a strong opinion is based on previous data (e.g. when a certain process for approaching information gathering has been successfully used before) or is grounded in a person's belief structure (e.g. when it is important to the person that information is gathered in an ethical manner).

[35] For further investigation into understanding behavior and emotion, see the literature by Edwin Locke, Albert Bandura, Icek Ajzen and others.

## COMMUNICATION – HOW AND WHY DEFINITIONS ARE ESTABLISHED

When evaluating an idea, information is presented and prioritized in many different ways. Many times, conflict arises due not to the subject matter, but to the way in which the subject is defined or organized. Facts, data and opinions are presented through one interpretation of one team member, and taken in through another interpretation by another team member. Sometimes those interpretations are relatively aligned, but sometimes team members have very different understandings about what is meant by a particular word or phrase. The different understandings can be pushed further from one another when it is assumed that the meaning is 'crystal-clear'. Discussing an issue can quickly turn into defending a point without realizing it. It is important to remember that one or another opinion is not wrong, it is just different – and to discuss why.

## CLOUDINESS – BASING DECISIONS ON IMPERFECT INFORMATION

For many, developing a business means finding answers to questions, and knowing that the solution proposed is the 'right one'. This is particularly challenging when operating in an environment of uncertain and divergent information. What do you believe and why, and when is there enough information to be able to move forward? One way in which team members handle uncertainty is to span from opinions to belief and value systems, which can introduce relationship conflict. Awareness of how the team deals with uncertainty, and attempts to establish boundaries and definitions, can be important starting points for managing discussions.

A situation common to Master programs involving real-world project work is balancing educational needs and project needs while maintaining a sense of fairness for different individuals involved: I will call this example 1. Student A is motivated to work in the project in order to gain experiential learning. This student does not care what grade the group receives, but instead wants to make a good impression on the different external actors involved in the project. Student B is also motivated by a learning environment in which theories can be directly applied and tested, but is equally driven by achieving high grades. Student C is taking part in the project work because the Master program will be a valuable addition to the resumé and illustrates quality and prestige. Based on their interests and motivating factors, the three students approach project and educational work with different points of view. Student A will work day and night to fulfill customer needs, and is not interested in understanding how a theory is being applied in a real-world context if it does not give immediate and visible benefit to the project. It is important for this student to control decisions that will impact the project's ability to communicate to customers and receive financing, and will thus prioritize meetings and time for applications above lectures or group discussions. Student C also wants to make a good impression, and be seen as intellectually competent by both external actors and educators. This student acts strategically based on the situation at hand. Student B is most concerned with understanding why theories and models are applicable to the real-world situations of the project, in order to be able to adapt and adjust knowledge developed in the education later on in the real world. Their different interests and motivations towards balancing project and educational activities affect how the students approach various tasks. None of their approaches are 'wrong', but they may be different enough to cause conflicts.

Some teams do not 'argue' or 'have conflicts' but still are challenged by misunderstanding and can benefit from increased communication: I will call this example 2. A team of three students, two of whom are Swedish students and one is an international student, work together on a business development project. For several months, the team has functioned well, agreeing upon how to divide work among them, with each student eventually having a specific role around a designated area – finances, marketing and technology. However, the two Swedish students start to notice that the international student is increasingly quiet and seems disengaged, often working independently from home. The two Swedish students are both frustrated about the lack of motivation of their teammate, but also feel they have so many activities to manage that they push forward. Near the end of the project period, the team meets with a coach. During their meeting, the topic of work load and work efficiency is discussed. Through this discussion, one of the Swedish students openly questions the international student about the observed lack of engagement and perceived lack of motivation. The international student starts to explain that the role given was not a motivating role, but the student accepted it because the other two teammates were so enthusiastic about their roles and felt that they could develop their strengths. The international student felt that the remaining role was not an area in which the student was especially competent, and this student found it difficult to produce good work. However, the student did not raise the issue with the group because the student perceived that the other two enjoyed their positions and that discussion would require time that could be utilized in different activities for the project. Thus the international student decided to do the best job possible until the end of the project period. The two Swedish students started to reflect back on the different dialogues of the past few months and realized that they also had not taken the time to discuss roles or motivation for the roles, and had just assumed that everything was okay. They reflected upon being so focused towards their own activities that they did not recognize the international student's slow loss of motivation over the period. The members started to talk through all the assumptions they had made and listen to each other's interpretations of different meetings they had, and realized that they had drawn different conclusions from the same situation because they had not fully understood the perspective of other individuals in the group.

Both examples illustrate the importance of the three C's. The students in the teams needed to ask questions of one another, such as 'what is important', 'when and how often should norms be discussed and revised', 'what is good enough', and 'how is each person motivated', in order to further understand the different perspectives of each individual. Then the team members can utilize this information to allocate roles and responsibilities so that each individual is motivated, recognizing where trade-offs between one option and another may need to be made. Using the framework of the three C's often requires investments of time – not just to discuss, but to clarify different points of view, and to verify points of view periodically through the life of the team. The teams utilize communication of their understanding (interpretation of something uncertain) within a context in order to educate the other individuals in the team about their way of seeing things. Example 1 illustrates how different goals impact motivation. The team can then explore different options for approaching activities of the project in a way which fulfills the motivation of each individual, or which will require managing different trade-offs. Example 2 shows how the existing context that each individual brings, for example a cultural perspective, can shape how different contributions are valued/appreciated: what is done to understand these differences? Differentiating

between individuals and their culture, their educational background, and items that 'define' them is extremely difficult. The three C's can be used as a framework to investigate and potentially identify differences and understand why differences might exist. In Example 2, the team could have communicated a basis for assigning the roles – the competences of the individual (i.e. the outgoing, extroverted individual is responsible for customer relationships), the educational background (i.e. the individual with economics education is responsible for finance), the interest area (i.e. an individual with a background in technology wants to learn more about finance, so is motivated to work in that role rather than a technology-responsible role), etc., and discussed this in relation to the context of the project – a limited amount of time to get things accomplished, a learning environment that will at one point transition into a business or market environment, etc. – and the trade-offs that need to be made relative to individual interest, motivation and the collective needs of the team and the project based on the context.

After using the three C's to help identify differences, our next step is to determine how to deal with the differentiating points of view. But before we start, it is important to take a little side step and discuss our tendencies to avoid conflict. It is quite common when working in a team, particularly when we know that there is a definitive time period for the work, to choose not to express and/or argue for our positions. Sometimes this is due to time constraints. Other times, it is because there is no established leader or hierarchy in the team and we want to ensure a smooth process (cooperation). Awareness of how our engagement can impact the process and outcome of the team activity is important, but sometimes not engaging can be more detrimental than the alternative (Okhuysen and Bechky, 2009). A team can invest time in the beginning of the work process to establish common norms that will guide how the team collectively wants members to contribute, including providing space and time for open discussions, but also determining how to summarize or conclude these discussions if decisions need to be made.

Using group norms as an established framework for team discussions, the following approaches can be used to investigate different points of view. Investigation can provide additional understanding about the perspectives presented that can lead to better-informed decisions and recognition of the contributions of team members.

## SETTING AND EXPLAINING DEFINITIONS

Making assumptions from the start, when working with persons with different backgrounds, experiences, etc., can lead to different individuals in a team thinking and working along divergent paths – this is the fundamental problem of conflicting assumptions (Shani and Lau, 2005). Establishing definitions and clarifying assumptions at the outset can help to put everyone into a common context. Even the very first discussion of what the task is requires clarification within the group. Taking the time to discuss assumptions and interpretations can provide insight into where there are natural alignments of 'fact' and 'opinion' and where there are divergent views. Taking note of the similarities and differences in the collective attributes of the team can be important to remember when engaged in discussions later on in the team process. Remembering that individuals think about certain meanings in different ways can allow team members to shape communication

differently through asking for clarification and exploring how someone else understands something.

## ADVOCACY AND INQUIRY

A particular method for investigating meaning is called 'advocacy and inquiry'[36]. Advocacy means presenting support for a particular idea in a way that can convince the other party. Effective advocacy involves understanding the position of the person(s) being spoken to and providing them with the information they require so that they are satisfied. Inquiry is asking questions that draw out critical information which can be vital in providing understanding and transforming a discussion. Advocacy and inquiry can be utilized together to 'dig beneath the surface' when an apparent conflict has emerged. Both build upon taking a 'learning' perspective: being curious and wanting to know more about the other person(s)' point of view.

## STRENGTH-BASED FOCUS

There are often multiple paths that a team can take to fulfill a task. Understanding the strengths that exist within the team and how they can be utilized should help the team determine the best processes for achieving the task in a way in which team members feel comfortable – as they are building upon existing competences – and appreciated for the contribution they bring to the task performed (Okhuysen and Bechky, 2009). Building on strengths can also help the team make choices when faced with uncertainty.

## CREATING WIN-WIN SITUATIONS

Different perspectives can quickly transition into defending different positions, where a discussion turns into a negotiation with a winner and a loser. Instead, a team can choose to expand the perspective to see how many of the ideas and opinions can be collectively incorporated into a decision, creating a situation in which everyone 'wins' (Thompson, 2001). Getting to a 'win-win' situation builds upon some of the approaches already mentioned, including understanding and clarifying definitions and assumptions as well as inquiring after their interests and advocating why a certain perspective could be good for everyone. Active listening and openness to all choices available help to objectify the issues at hand, positioning the team as partners collaborating in finding a solution.

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# PART II

# CASES

# 11 REDUCING THE CARBON FOOTPRINT WITH BETTER CROP YIELDS – THE ECOERA BIOSFAIR™ PLATFORM

*David Andersson, Ecoera*

*David has a background in bioscience, agriculture and a degree from GIBBS – Göteborg International Bioscience Business School. Apart from being the lead entrepreneur behind Ecoera, a venture from Chalmers School of Entrepreneurship (CSE), David is also engaged politically on the national and international level focusing on environmental policy, as well as being an associated lecturer, coach and idea recruiter at GIBBS and CSE.*

## INTRODUCTION

The first idea for what is now the company Ecoera was simply: mix biomass and environmentally friendly additives to form a renewable pellet fuel for heat production. This demanded a technology transfer from Chalmers University of Technology, where the Department for Inorganic Environmental Chemistry was engaged to channel knowledge and research results towards implementation in a biofuel production system – the BIOAGRO Energy production facility. This facility has been a joint initiative where Ecoera is one of the technology providers and project management members.

However, during the process of implementing and working with agricultural residues, Ecoera discovered a new opportunity to elevate the potential of using agricultural residues. Since the biomass residues (husks, shell, low-grade seeds, straw, etc.) are easily decomposed in biological systems, they do not stabilize $CO_2$ for more than a year or so. The new Ecoera Biosfair™ platform transforms the biomass pellets into the stabilized carbon form called biochar. This biochar can then be retained in agricultural soils and provide for a fourfold benefit: (1) removing CO2 from the atmosphere for up to 1000 years, (2) reducing waste and methane emissions, (3) providing biogas energy, (4) enhancing soil quality and improving crop yield (see Figure 2). Linked to the platform, Ecoera developed a new carbon offset product for the carbon emissions market, allowing $CO_2$-concerned actors to pay for an erased carbon footprint.

The development around leveraging the initial idea into the biochar realm has put Ecoera in the front edge of an emerging field of not only neutralizing the carbon footprint but actually diminishing it. Ecoera today is the first company in the world that has created sales with this new type of $CO_2$ reduction technology – stabilizing biomass carbon into biochar while also generating renewable syngas (a form of biogas) as well as soil enhancement. These first steps on a journey towards economic, environmental and social sustainability are described here – the Ecoera story so far.

## BACKGROUND: REFINING THE ORIGINAL IDEA

The initial idea of producing pellets from agricultural residues came from an EU project called BIOAGRO in which the bioenergy consultant ÄFAB, the seed company Skånefrö, and the combustion technology producer HOTAB all have been involved since 2006. The project aimed at creating a prime pellet fuel from agricultural residues – such as husks, shells and straw from crop and seed production. Usable pellets based upon these residues were something unique. Pellets normally are made from sawdust – a raw material of declining supply and increasing demand.

The basic concept was essentially to put together the optimal formula for a biomass fuel pellet used to replace oil for heating. The formula would, among other things, optimize the combustion performance and flue gas acidity and also make the ash returnable to the field as a fertilizer. This is a concept still in the Ecoera arsenal, but more would spring from this initial idea.

# THE ORIGINAL IDEA: AGROPELLETS PRODUCTION FROM CERTAIN TYPES OF AGRICULTURAL RESIDUES

## SHORT TECHNICAL DESCRIPTION

In a nutshell, the original pellet idea was to develop a renewable fuel from agricultural residues. These residues such as husks, shells and straw are generally hard to combust in pellet furnaces. The idea was to take environmentally safe additives and combine them with the residues in specified recipes or "agropellet formulas" for a standardized pellet fuel compatible with furnaces and marketable as a commodity.

## THE PEOPLE BEHIND THE IDEA AND THEIR INTERESTS

The people behind the idea were a seed production company and a bioenergy expert. They wanted the agropellet formulas and additives to be found and integrated in a large biomass energy facility called the BIOAGRO Energy system. This was originally an EU LIFE program project. The following describes the involved competences:

- Sven-Olof Bernhoff, project manager of the BIOAGRO facility. He is managing the seed company Skånefrö.
- Bengt-Erik Löfgren, CEO of ÄFAB, a cleantech consultant highlighted by the US Embassy in Sweden. He has a vast network within the bioenergy industry.
- Folke Günther – One of the most prominent Swedish researchers in the field of biochar carbon management.
- Fredrik Carlman – Fredrik has experience in investment management as well as working with renewable energy industry in Russia.

- David Andersson – farming background, molecular biologist and bio-entrepreneur. Has been working in small startups and larger corporations.

### NOVELTY AND FREEDOM TO OPERATE

The novelty was in some respects not clarified as the project started. It was an idea that had been implemented on a lab-scale in the U.S. before. The novelty was the use of seed residues for fuel pellet production too, since this was a rather unknown territory due to severe combustion problems with the biomass firing.

No patents were involved in the project. There were patents specifying a creation of a pellet from agricultural biomass, but this is a weak patent that is virtually impossible to enforce. Therefore, we assumed that we had a window to work in.

## FUTURE USE

### SOCIETAL UTILITY AND CUSTOMER UTILITY

The societal utility is strong, as the current situation with global warming and increasing oil prices is getting worse by the day. The technology – the pellet formulas combined with the BIOAGRO facility – allows the customer to "upgrade" biomass waste into a pelletized fuel. Through the developed technology, the customer has an opportunity to convert agricultural residues into a pelletized fuel and sell it on the market. The typical customer for the Ecoera pellet formulas is a seed and biomass by-product producing company, like a rice, seed or grain producer, generating a large stream of non-food biomass. The companies in this segment are generally cooperatives of farmers or of seed producers selling high-quality seeds for agriculture. An example is the Polish market, where seed producers will be forced by a newly introduced law to utilize their biomass residue and not – as currently – put it in landfills (where it rots and produces methane, a greenhouse gas 23 times more potent than carbon dioxide). By letting them build a BIOAGRO facility based upon an Ecoera Bioagropellet license, they would leverage their residues into fuel.

## VALUE PROPOSITION (TO WHOM, FOR WHAT AND HOW?

The customers are seed companies and larger farming units generating large streams of biomass residues from seed cleaning and harvest, respectively. The industry-scale farms, generating large amounts of straw, have a suitable biomass residue source. The seed companies screen the seeds and thereby generate a stream of biomass residues, usually burned or landfilled, the latter generating methane emissions and handling costs.

Currently the biomass residues incur a 650 SEK/ton cost for the seed production company. Ecoera's pellet formulas are included as a license in a larger agroenergy facility – the BIOAGRO ENERGY facility. By mixing biomass and additives using the Ecoera formulas, this facility is converting residues into a fuel with 1500 SEK/ton revenue.

The company implementing a so-called BIOAGRO ENERGY facility (see Figure 1) would also enjoy a reduced dependence on fossil fuel. After leaving the BIOAGRO ENERGY facility, the fuel is sold to utilities such as power plants, airports, or municipal buildings who can use agropellets to lower their energy costs due to high wood-pellet prices.

## MARKET POTENTIAL INCLUDING A ROUGH BUSINESS MODEL AND PRODUCT CALCULUS

There are around 16 billion tons of agro-biomass residues worldwide, representing a potential 24 billion SEK market. Today, only 1 percent[37] of this biomass is converted into useful energy. In the case where a larger company is handling bulk amounts of these residues, there is a business opportunity to turn the residues to revenues (see image at lower right). The fuel is being marketed at 1500 SEK per ton, significantly lower than wood pellets, but with a 10% lower energy content. The current business model allows Ecoera to charge 10 SEK license fee per ton for pellet fuel produced, based on the proprietary formula database of 52 optimized biomass-and-additive mixes.

## THE PROCESS

The process began by linking up additional R&D capacity. This was done through hiring a person to work with the specific agropellet formulas. In parallel, the Department of Inorganic Environmental Chemistry at Chalmers University of Technology was connected to the project, setting up master thesis work together with the Ecoera in-house R&D staff, to analyze and determine the power of certain additives for the agropellet fuels. This development directly enabled the development at the EU-funded project "BIOAGRO" which, together with Ecoera, physically implemented the knowledge in the shape of a large agropellet production facility. The work got a boost through the Region Västra Götaland funding a 1.2 MSEK project with 50% grant financing

[37] A potential renewable energy resource development and utilization of biomass energy – United Nations Food and Agricultural Organization.

as well as an Innovationsbron Fokus Verifiering grant, which funded the in-house research at Ecoera and salaries for developers and a scientist.

### FURTHER VERIFICATION AS WELL AS TECHNICAL AND PRODUCT DEVELOPMENT

Today the agropellets are produced successfully in the BIOAGRO Energy facility. This has been accomplished through the "BIOAGRO" EU project resulting in the current BIOAGRO facility among other things. The EU project has had technology challenges, but due to an exceptional project manager, Sven-Olof Bernhoff, and a Project Management Team, the facility has now been built. The project has attracted over 1000 visitors from 48 nations and has, according to the EU Commission Monitor Team, already been endorsed as a "Best EU LIFE Environment project".

*Figure 1. The BIOAGRO production facility from the inside. Pellet production to the right, and the BIOAGRO 1250kW BIOAGROFIRE pellet furnace to the right.*

## COMPETENCE REQUIREMENTS AND POTENTIAL COLLABORATIONS

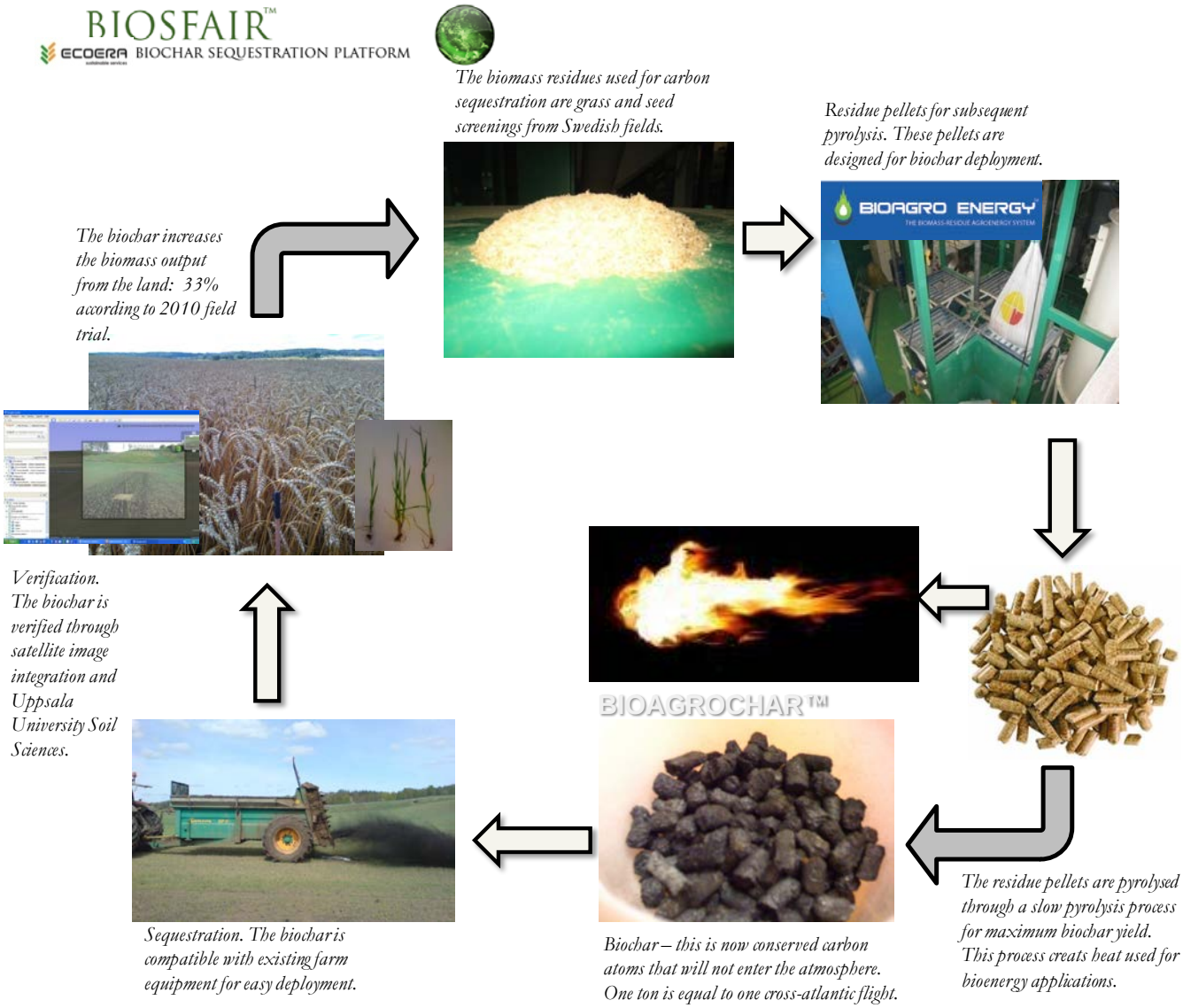
The further work with agro pellets will demand a sales department to locate and engage accounts for selling BIOAGRO system solutions, including the Ecoera pellet formulas. This will be done through the company BIOAGRO Energy Österlen AB that was formed in January 2010. Ecoera has an exclusive agreement with this company for selling BIOAGRO Energy facilities including the database with pellet formulas. There has already been interest from all over the world, thereby showing the need for this type of solution for handling biomass residues and generating a renewable energy source.

However, all these developments are only the beginning. The above work led to a next step in the development of an even more sustainable solution. This occurred when one of the idea providers showed a new opportunity, called biochar carbon sequestration. This opportunity was at first rejected due to lack of knowledge, but as we analyzed it further, we realized that this was a larger and potentially a more radical technological opportunity.

## THE BIOCHAR OPPORTUNITY

So what is biochar? The concept of biochar includes a pyrolysis step of the agropellets generated at the BIOAGRO facility, thereby producing syngas and biological charcoal (biochar). The syngas is a valuable and energy-rich gas comparable to biogas. It has a range of uses: it can be used for heat or biofuel production.

*Figure 2: The biochar commercialisation platform – Ecoera Biosfair™*




The biochar (biologically active charcoal) is simply returned to the fields as a *soil enhancer*. Studies have shown that biochar enhances the soil fertility and has been shown to double the crop yield.

The biochar soil applications made in Sweden, by Ecoera, showed a 33% harvest increase on dry sandy soil.

The biochar (image at left) is not consumed by the plants. Instead it *serves as a catalyst* in the soil for microbial processes and also keeps nutrients more readily available to the plants. The biochar carbon has stability in soil for over 1000 years. In comparison: if you plant a tree, it will lock away carbon dioxide for 65 years.

In essence, this means the biochar has a great benefit for agriculture and the climate, as this technology provides a method of *decreasing atmospheric* $CO_2$. It thereby constitutes an easily quantifiable way of removing $CO_2$, thereby enabling a market for a new type of carbon offsets. This carbon offset market was our new target.

As illustrated in Figure 2, biochar from agricultural waste is physically locking away carbon dioxide and is the only technology that enables us to take invisible carbon dioxide out of the atmosphere, transform it into black lumps of pure carbon and, by applying it into the soil, prevent it from going back into the atmosphere. It gives a whole array of benefits for agriculture and biomass waste management. Calculations have been made regarding continuous addition of biochar to soil, and it was estimated that the biomass residues stemming from a field can be converted to biochar and added every year for 150 years until saturation[38]. In Sweden, it is possible to make the nation net negative in carbon emissions by applying biochar on one-third of the agricultural soils available[39]. The global potential for carbon removal using sustainable biomass utilization methods is calculated to be taking care of 12% of global emissions[40]. In Sweden, the amount of carbon dioxide equivalents sequestered in one-third of the agricultural soils has a potential of removing the Swedish carbon footprint, making the country net negative in carbon dioxide emissions, whilst improving the soils.

An important part of building the platform is shaping the market for the carbon sequestration offset demand side. Ecoera identified three test customers for this new carbon offsetting method. They sold this service and so sequestered – plowed down biochar in soil – in Swedish farmland. The initial price tag for the carbon sequestration offset is currently higher than for other mainstream carbon offset products. However, the price will go down when the other effects from the Ecoera BIOSFAIR™ platform are quantified and accounted for. The biochar-enhanced soils have also shown increased fertility in the trial results, where the yield increase was 15% per added

[38] The amount of biochar added during the 150 years will make the soil reach the carbon levels of the fertile Terra Preta soils in the Amazon. Source: Folke Günther.
[39] The total agricultural soil area in Sweden is 3,500,000 hectares. The per capita emissions are 11 tonnes including imports (http://www.carbonfootprintofnations.com/content/ranking/) with 9 million population. The land area can absorb 30 tonnes of biochar per hectare. 1 tonne of biochar = 3 tonnes of CO2 eq. There is a potential of sequestering 315 million tonnes CO2 per year, which is roughly three times the carbon footprint of Sweden.
[40] Sustainable biochar to mitigate global climate change – Woolf, Lehmann, Joseph et al., Nature Communications.

kg of biochar to the soil compared to a 1 kg baseline up to 3 kg, making the full increase 33%. (See first trial results below.)

The current customers for the biochar carbon offset service are frequent business fliers. Organizations purchasing the biochar offsets can thereby become "carbon-reductive", not only carbon-neutral. This can become an attractive new policy – to become carbon-reductive – for many progressive organizations to communicate. When the platform is built in full scale, we project a price for carbon-reductive offset at the level of SEK 500 per metric tonne. Compared to alternatives – mainly paying for planting of trees – the BIOSFAIR™ offering is on the same price level. The difference is, of course, that a carbon footprint is reduced for a much longer time – beyond 1000 years – thus marking a trend break in dealing with global warming: a permanent reduction of $CO_2$.

## MAIN LEARNING FROM THE CASE

### CHALLENGE 1: "REVERSE TECH TRANSFER"

The first challenge was to do what we call "reverse tech transfer" – an innovation project stemming from business – and then to approach the university to engage it in a new research project. To identify the right department and set up the intellectual property ownership structure can take time. However, in this case it was relatively easy to accomplish, since the project was within the Chalmers School of Entrepreneurship and therefore good connections already existed.

### CHALLENGE 2: RUNNING EU PROJECTS THAT DEVELOP A NEW BUSINESS

The second challenge was to balance the research and development in an EU project with actual business development. The BIOAGRO project was funded by the LIFE Programme, an EU Commission funding instrument for the environment. Generally, projects in this program are international in character. The projects are usually international, research-driven with strong public-private partnerships where small to medium enterprises (SME) and other companies and municipalities collaborate with universities. The EU project partners – and an additional idea provider – engaged Chalmers School of Entrepreneurship (CSE) with the idea of creating a CSE project for the purpose of commercializing research and development for new fuel "Bioagropellets" in collaboration with the EU project BIOAGRO. During the CSE project year, it was possible to attract soft money for this development, but to receive further development grants the CSE-project "Ecoera" was incorporated as Ecoera AB in 2006. As a result, in part, Ecoera was a project partner and in part Ecoera was a sole company with its own interests. This created the challenge of commercialization of the Ecoera pellet formula's IPRs, as one of the rules within the LIFE Environment program included the blocking of commercializing the results before the finalization of the project. In the case of the BIOAGRO project, the finalization date was the 30th of November 2009. During this time, Ecoera invoiced the EU project management, and also started to build and innovate in the new field of biochar.

## CHALLENGE 3: ESTABLISHING A NEW CARBON OFFSET BUSINESS MODEL

After completing the agropellet formula development and integration into the BIOAGRO ENERGY facility, the next step was to get into the new area of biochar and, using the gained strengths and network assets, to create a platform for atmospheric carbon dioxide removal. One of the main challenges for this is to communicate the concept of being able to remove $CO_2$ from the air. Until the worldwide breakthrough of biochar[41], the paradigm was and to a very large extent still is – about emissions reductions only. Sequestration – actual removal – of $CO_2$ has yet to reach the global consciousness. However, our work to disseminate the concept was built around actually doing it – to prove that it works and to set an example.

The assets were the exclusive access to the BIOAGRO Energy facility for the specialized biomass residue pellets as biochar raw material and exclusive access to low-cost pyrolysis equipment for biochar production from a Swedish inventor. In addition to this, we established contact with the leading Swedish biochar R&D team. The challenge has been to open up the mainstream public to the fact that we need to have negative net emissions to counterbalance the $CO_2$ emissions that we have today. The world can only stand 2 degrees of increase in global average temperature. To have this, we need a 350 ppm $CO_2$ level in the atmosphere. To reach this level, many developed nations even need to have negative net emissions by 2050. This can only be accomplished by removing $CO_2$ already present in the atmosphere – hence the biochar type of solutions is needed.

Ecoera, however, succeeded in establishing the world's first commercial transaction coupled with a new type of emission right. This was done for three customers, among them the BioBusiness Alliance of Minnesota. By collaborating and nurturing a strong network within the biochar research and technology industry, many benefits have been created, such as the Biochar Offsets group to create a worldwide standard for biochar offsets.

All in all, Ecoera is now producing biochar and starting to create a market for this new carbon offset product and the market for using biochar as a soil enhancement. All this started by mixing biomass and putting it on fire…

[41] http://www.time.com/time/magazine/article/0,9171,1864279,00.html

http://www.economist.com/research/articlesBySubject/PrinterFriendly.cfm?story_id=14302001

## CHALLENGE 4: COMPLEXITY IN VALUE CHAIN OF THE ECOERA BIOSFAIR™ PLATFORM

The business case for biochar application is a challenge to accomplish, partly due to the "tragedy of the commons" (see Chapter 3) and the associated challenge of who should build the actual platform and not just benefit from parts of it. Should the platform be built by entrepreneurs, or by established business actors? Most likely the platform requires a collaboration among these actors, but who should then coordinate the collaboration? Ecoera, so far, has taken on a coordinating role, but this is not self-evident since Ecoera easily can be accused of having its own self-interests in the process.

The platform offers four specific types of economic value to different stakeholders, each requiring its business model: (1) biomass waste handing cost reduction, (2) syngas heat utilization, (3) climate compensation and (4) biochar as soil amendment. Ecoera now has "proof of principle" for each of these values while also indicating business models. Now the different models need "proof of concept" while being tied together into the Biosfair platform. Ecoera in combination with the BIOAGRO Energy system aim is the first company to connect the four sources of revenue into a platform with the following components.

Added in total, we can show that by implementing the Ecoera Biosfair platform, each tonne of ingoing biomass residues is valued[42] to the following rough numbers.

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[42] In short, the opportunities and challenges are the following:

1. Residue reduction: the current biomass residues (husks, shells straw) are handled at a cost of SEK 650 per tonne. This is now being reduced to zero as the biomass is being utilized. However, the current value of bioagropellets is SEK 1500 tonne.
2. The syngas is now used for heating purposes, currently drying biomass to upgrade it in turn to a better bioenergy source. This heat energy can be sold at SEK 7200/MWh, the average price per MWh in Sweden for district heating. With a 50% energy output compared to ordinary combustion, every tonne of bioagro pellets generates 2.2 MWh, thereby adding up to a heating revenue of SEK 1584 per tonne biomass[42]. The cost for 1 tonne-per-day production can be accounted to SEK 1,000,000 including labor with an interest cost at SEK 50,000 per year, thereby making the biochar cost SEK 166 per tonne. This equals SEK 55 per tonne of ingoing bioagropellets.
3. The current climate compensation revenue is SEK 1500 per tonne $CO_2$. Since one tonne biomass results in 0.33 tonnes of biochar carbon and biochar carbon is chemically equivalent to $CO_2$ by a factor 3.67, one can generally account for 1 tonne of biomass = 1 tonne of $CO_2$. From scaling up the system, Ecoera accounts for a climate compensation price for the carbon offset at a price tag of SEK 500/tonne $CO_2$, hence each tonne biomass equals SEK 500 in offset revenue.
4. Being sold as a soil amendment, the biochar can exert an increase in crop output. The current data from the Ecoera Bioagrochar formula R54 shows a crop yield increase of 33% when keeping the fertilizer application rate constant. Therefore, the soil amendment value can roughly be calculated to be equivalent to an approx. 20% reduction in fertilizer cost per hectare. Or one can assume a revenue increase for the farmer at a value of SEK 1800 per hectare[42] and year. Since the soil amendment is stable in the soil, it can be calculated as an investment over a ten-year period, thereby adding up to 18000 per 30 tons per hectare at a cost of SEK 600/tonne biochar in investment. This equals a biochar value of SEK 200 per tonne bioagropellet substrate at a pyrolysis conversion of 33% biomass to biochar.

| Revenue source | SEK/tonne biomass |
|---|---|
| Residue reduction | 650 |
| District heating | 1584 |
| Carbon offset | 500 |
| Biochar equivalent | 200 |
| Total revenue | 2884 |
| Cost bioagropellets | 1500 |
| Pyrolysis cost | 55 |
| Value per tonne | 1379 |

It is concluded that the basic system is profitable when making these calculations. However, the physical implementation is the main hurdle, not to mention the policy issues regarding a price for carbon emission and emission reduction, As this text is written, the United Nations has not agreed to a global emissions target. (N.B.: the numbers above give a snapshot of the current situation and are to be adapted for case assignments if needed.)

## THE LEARNING: THE NETWORK IS THE ULTIMATE INTELLECTUAL ASSET AND STRONGER THAN THE ORIGINAL IDEA

Without the network of researchers, business leaders and enablers, Ecoera would not have been able to reach its current level. Just prior to incorporating the venture, Ecoera was approached by WWF – the World Wide Fund for Nature. They finally selected us to be one of 12 Climate Entrepreneurs, thereby opening a larger network and leverage of the brand. Our core idea, technology and method were acknowledged by a jury consisting of professors, politicians and business leaders to be one of the innovations to shuttle our society into a low-carbon future. Through this we got introduced to conferences and were able to do promotion at fairs in the US. After a while our current idea provider approached us with a new possibility to explore – the Biosfair platform. The first concept and platform for producing pellets from agricultural residues was now developed and extended. After a long time of "pruning" we therefore ended up with a network and a range of technologies, assets and resources spanning an entire – and foremost, a new – value chain.

As a personal reflection I think the main mission for true sustainable business development is to link up and create offerings for currently hard-to-quantify assets, creating advantages such as increased air quality, cleaner oceans, healthier soils and biodiversity. In essence: put a true value on these ecosystem services provided by nature. For our entire industrial age, these assets have been used and abused, creating the tragedy of the commons. But this has to change. These assets will be the main parts of future corporate balance sheets. Society and economy will get there. We are on our way.

# 12 DEVELOPING MORE SUSTAINABLE MATERIALS – CEFIBRA BIOCOMPOSITES

*Thomas Bräck, re8 Bioplastics*

*Thomas has a background in Industrial Engineering and Management from Chalmers University of Technology as well as a degree from Chalmers School of Entrepreneurship (CSE). Today Thomas runs re8 Bioplastics, a company developing the technologies Cefibra and Posibla, both stemmed from CSE-projects.*

This chapter describes how a more sustainable materials technology combining natural fibers with plastics is turned into a business concept, called Cefibra, and the learning gained during the process.

## THE IDEA

### SHORT TECHNICAL DESCRIPTION

The initial innovation stems from research at Chalmers University of Technology. The research included both composite and polymeric materials with focus on cellulose fibers. This resulted in a new method for producing a composite material based on polypropylene and cellulose fibers. In this method previous problems with clustered fibers, uneven quality and expensive large-scale production had been overcome. Thus, the new method opened up for a new type of composite which has not been possible to produce on a large scale before.

### THE PEOPLE BEHIND THE IDEA AND THEIR INTERESTS

The idea provider was professor Antal Boldizar at the division for Polymeric Materials. Antal Boldizar led the research conducted by a doctoral student. He saw a potential in the results and discussed with the other parties within the research project, including industrial parties, whether they had any interest in the new technology. They did not. Therefore, he contacted Chalmers School of Entrepreneurship in order to evaluate whether the technology could be commercialized and provide societal utility.

### NOVELTY

The technology constitutes a method to create high-performing biocomposites using long thin fibers from nature. Other attempts to use natural fibers to reinforce plastics had resulted in clustered fibers that decreased the quality and performance of the end product and gave expensive large-scale production. By combining knowledge from different industries with new research, this new method had overcome the previous problems.

### FREEDOM TO OPERATE

A novelty search showed that there are many actors that have tried to solve this problem and used different fibers. However, our method was unique and the performance and quality of the end product were extraordinary. We were neither excluded from using the material component nor able to exclude someone else from using the different components. Therefore, we could file a method patent, not a product patent. A product patent would in this case be stronger, protecting the composition as such, whereas a method patent only protects the method. In our case the method is the invention; our method gives exceptional performance of the end product, and therefore we still have quite strong protection.

## FUTURE USE

### SOCIETAL UTILITY AND CUSTOMER UTILITY

Reducing the dependence on oil will result in benefits both environmentally for society and economically for the plastic industry. Cefibra not only reduces the dependence on oil due to less use of oil-based plastics; it also gives new material properties resulting in new types of products and gives the opportunity to recycle a high-performance composite, which normally is not easily done.

The material could be used in plastic converting such as injection molding and extrusion processes. This means that the material could be used in many applications and industries ranging from furniture and sport equipment to automotive and industrial applications etc. The material can reduce fossil-based plastics and at the same time improve properties such as stiffness, strength and weight.

### VALUE PROPOSITION

Cefibra can offer the plastic converters a very beneficial alternative to existing material in a wide range of product applications. The cellulose fibers' high strength opens up for less consumption of plastic as well as new product design and longer lifetimes.

The material can be provided in granulate form and directed towards semi- and full-product manufacturers as well as large industrial actors and their contractors. The material can be produced

partly on a license basis and partly in-house. The target price will be within the range of materials with similar properties, such as polystyrene and glass-fiber-reinforced polypropylene between 12-16 SEK/kg.

### MARKET POTENTIAL

The plastic market is huge, and ever more biocomposite materials, i.e. natural-fiber-reinforced plastics, have been introduced in order to decrease the amount of oil-based plastics used or to increase the mechanical properties. One example of this is wood plastic composite, which is a market opener for Cefibra. This material uses milled spill products from the wood industry to fill plastics. This market has increased by 300% in the last decade and during 2007 it had a size of 2 billion SEK in Europe.

The first targeted product was chosen to be cloth hangers. Cefibra would sell granules to a plastic converter that creates the hangers for a company that distributes them to the cloth industry.

## THE PROCESS

### OUR APPROACH TO COMMERCIALIZE THE TECHNOLOGY

We started by approaching different actors in the plastic industry in order to get an understanding of the market. By discussing with potential customers and partners we found that the material had many benefits compared to glass-fiber-reinforced plastics. We also found that there was a great demand for materials like this within the plastic converters. The potential customers were open to helping us, answering our questions and testing material.

In an early stage we realized that we needed to get more experienced people into the team. Therefore, we focused on establishing a board by discussing with individuals in our personal network and identifying suitable persons within the plastic industry. Our search resulted in an entrepreneur that had life-long experience in the plastic industry and a technical manager at one of the biggest players in the Swedish plastic industry. The discussions within different actors have also resulted in many partners and potential customers. One example is that we have started a partnership with Södra Skogsägarna to jointly develop a process of using their pulp fibers to create biocomposites.

Parallel to this, we continued to develop and verify the technology. This was done by conducting our own tests at Chalmers combined with testing together with consultants and firms in the plastic industry. Results in the technical development affected what we could do with the material and how the business model would look. So did the ability to protect the technology with IPR, where we started with a licensing model and now have a model including an in-house production line.

The potential customers we talked to gave a positive response and were really interested in the material. Therefore, we thought that if we just could show the material properties, the customers would buy the material. However, after some tests at a larger scale we realized that the material was not perfect yet. We then realized that we needed to get one specific product to focus development on, and which included partners that would help us reach the market. By coincidence we tried the material in a floorball blade process, and the injection molder, Fristad Plast, was impressed with the result. We had found our focus product! The product owner, X3M, liked it and let elite players such as Nicklas Jihde try it; they loved the stiff material. Unfortunately, the product owner decided to place the manufacturing of the floorball blades in China and our control of the development and the results would disappear.

We then came in contact with another injection molder, Hammarplast, who wanted to find a material to use in their new storage box. This box had a new design that needed higher performance of the material than the pure plastics that they used today. They did not want to use glass fiber because it could not be recycled, it tears on manufacturing equipment, and it has a risk of splintering. Here we had obvious customer benefits; the injection molder owned the product and had a good reputation, and would be a good first customer. Therefore, we changed focus product.

**The storage box was not obvious from the beginning; how would your process of finding the "right" application look like?**

As regards financing, we discussed with different companies that had gone through the same process, and received recommendations regarding who they had been in contact with and what they had done in order to succeed in attracting funding. After that, we investigated which programs we could apply for at institutions such as VINNOVA, Innovationsbron and ALMI, and created applications which we then discussed with the institutions and our predecessors before submission.

## FURTHER VERIFICATION AS WELL AS TECHNICAL AND PRODUCT DEVELOPMENT – YEAR 2009-2010

We received verification funding from VINNOVA in 2009 to industrialize the technology. Therefore, we are now doing tests together with machine engineers and conducting tests together with customers. We also attracted some of the large players such Volvo Trucks, Lego, IKEA, SAAB Automotive etc. that wanted to do tests with the material, and now we need to stimulate these big customers by doing these initial injection molding tests – in parallel with focusing on the storage box together with Hammarplast.

## LEARNING FROM THE CASE

## CHALLENGE 1: WE ARE NOT THE EXPERTS – HOW COULD WE BUILD KNOWLEDGE WITH SMALL RESOURCES?

In order to commercialize a new technology we needed to be humble and learn from others and the industry, as well as from experimenting with the technology. We gained a good understanding of the technology by being the actor actually conducting the tests in the lab and discussing the technology with scientists, customers and partners.

We also realized the importance of building an experienced board and discussing with all kinds of people, especially potential customers. By opening up and showing that we were willing to learn, the customers also opened up and helped us by telling us what they wanted from us. We were welcomed because we were young entrepreneurs with a lot of drive and enthusiasm, coming from Chalmers and representing new technologies with a green profile and high performance, which they realized would be interesting for them in the industry.

Our experienced board gave us credibility, good advice and fast answers to questions related to the industry, and opened up doors to customers and partners. Once we had access to customers and partners, we were able to test the material at their facilities. All of these steps are invaluable for a start-up.

***Lesson number one: Get your fingers dirty, learn the technology and connect with people in open-minded ways!***

## CHALLENGE 2: HOW COULD WE OBTAIN FINANCING FOR RISKY INNOVATIONS?

One constraining factor is of course finances. In early stages, the risk is normally too big for venture capitalists. However, there is often sufficient funding from governmental institutions that support start-ups. The supply is larger if the start-up is conducting research and perhaps associated with a current trend – e.g. Cleantech. We used predecessors, i.e. other start-ups that had been successful, and discussed with them and looked at their applications in order to find their strengths and use best practice. We then looked at the overviews of the programs suitable for our projects and created applications.

We could also add that one success breeds another; if you have managed to get funding from one actor, this could be used in order to gain and illustrate credibility towards the next level. The innovation system is progressive, rewarding actors that reach successive milestones.

***Lesson number two: Learn from others to communicate value towards different actors to receive soft funding.***

## CHALLENGE 3: THE CUSTOMERS ARE INTERESTED, BUT ARE NOT WILLING TO BUY – HOW COULD WE PROCEED?

We started with a broad view of who our customers were. We also drew much interest from many potential customers. However, we did not get anyone that was willing to pay for the material. I like to compare this with crossing the chasm[43] (see Figure 1). The great interest indicated that they were innovators who were interested in the technology. The step of moving to a business includes in most cases a need to cross the chasm. We had a vast interest but no one really interested in investing money in order for us to reach the market. We needed to find a focus product and partners that could help us verify the concept with the given product. This product should then, like a bowling alley, make a breakthrough and result in other products being introduced on the market. When we are in the next phase, the tornado, it becomes important to focus on the injection molders and extruders in order to rapidly increase the market shares. In the tornado the focus is, according to the theory, to sell as much as possible because it is in this phase that the share of the market is determined. We focused on the injection molders at an early stage, with the consequence that we became diffuse and allocated our limited resources in different directions.

However, I believe it was right to initially shoot in different directions in order to learn the customer benefit and to find the focus product first. I also believe that it was important to be able to shift the focus product if needed. Perhaps we will change the focus product once again before we reach the market.

*Lesson number 3: Find your focus product and go for it*

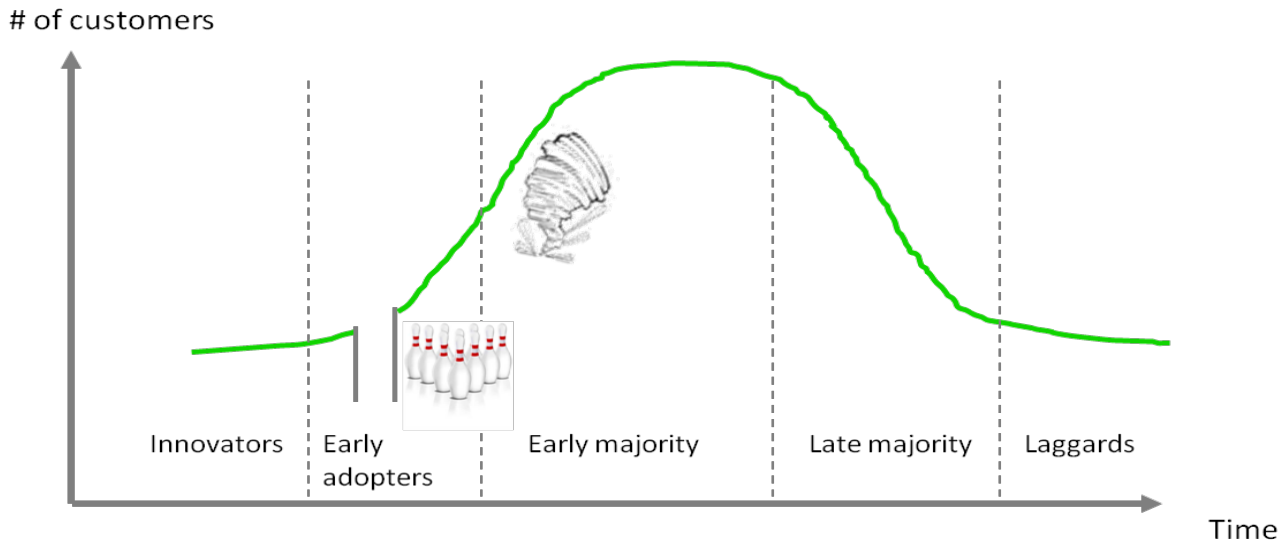



*Figure 1. The adoption cycle of innovation according to Moore including "the Chasm" (Moore, 1997)*

## CHALLENGE 4: HOW COULD THE STAKEHOLDERS BE ALIGNED?

[43] Moore, Geoffrey, 2002, *Crossing the Chasm*, Harper Paperbacks.

We were really successful in attracting the right people. However, we realized that much time at our board meetings went outside the agenda, discussing larger visionary questions. We also realized that it had been a hard time creating the business plan and explaining the future path. We attributed this problem to the lack of a deeper discussion involving the shareholders and the board regarding what we wanted the company to become in the future and how we intended to get there.

As an alumnus from Chalmers School of Entrepreneurship I attended a course in appreciative leadership, and in parallel also was introduced to the concept of backcasting by Mats Williander at Connect Väst. Together we combined the strength-based thinking from the course with a backcasting method and created a workshop, led by Mats, for the board. We let the board find the strength in our company today, visualize a sustainable future and where we wanted to be in that future, and combine our strengths into a path forward. The workshop resulted in the involved stakeholders gaining a joint picture of where we wanted to be in the future, and we also had created a vision that to a large extent emphasized sustainability. Furthermore, the workshop also made it easier for me to communicate to other actors regarding our future plans.

*Lesson number 4: Align the stakeholders for sustainability by using appreciative inquiry building upon strengths as well as on backcasting methodology.*

## FINAL REFLECTION

The Cefibra case shows that a business is built on a number of lessons and iterations, but looking at the big picture it resembles a well-thought-out straight line. Probably the same goes for bigger companies; it all depends on the zooming level. Reviewing the history of successful companies like Google, IKEA and others might well at first reveal a straight line, but when going into details it would consist of several iterations.

# 13 SUSTAINABILITY THROUGH ECONOMIC INCENTIVES – VEHCO IT SOLUTIONS FOR TRUCK TRANSPORTS

*Martin Lackeus, Chalmers and University of Gothenburg, fm Vehco*

*Martin is one of the founders of the company Vehco, started at Chalmers School of Entrepreneurship, and was the CEO of the company for many years. Vehco today has 60 employees and is growing steadily. Martin is now at Chalmers pursuing a PhD in the area of entrepreneurship education, while also managing the project G4E – Gothenburg for Entrepreneurs – a collaboration between Chalmers and University of Gothenburg.*

In this chapter we will look at a company that has created quite substantial value for society. The solutions offered by Vehco save both the environment and many lives by changing the driving behaviour of truck drivers into a more environmentally friendly and secure way. We will examine the rules of the market, which are not always focused on value for society, but instead concentrate mainly on economic value and profit maximization. If we learn to understand the powerful and sometimes merciless dynamics of the market better, we can increase our capability to shape products and offerings that give value to society and to shareholders at the same time. The Vehco example illustrates this quite well.

With this example we will learn more about a product which is good for society, but which would not have existed for very long if it had not been for the fact that it is supported by a powerful return on investment calculus for the paying customer. Many products and services can claim to do good for society, but if no one is willing to pay a little something in conjunction with them, they will not stay on the market for long. Neither will they become widespread, since the supplying company will go bankrupt before that would happen. We will also learn that the return of investment doesn't have to be in real money coming back to the paying customer – it can be in the form of increased quality of life for him or others he cares for. But if the customer is in fact getting more money back than he needs to invest, it certainly speeds things up, as we will see.

## INTRODUCING VEHCO

Vehco is a Gothenburg-based company that develops and sells IT solutions for the transportation industry. The clients are located throughout Sweden. The company has around 40 employees engaged in sales, customer support and product development, and has offices in Gothenburg, Stockholm and Aarhus. Vehco's product Co-Driver is the Nordic market's leading solution for

vehicle tracking and communication between the offices and trucks, and is used by trucking companies to work more efficiently and with greater profitability. With the help of Co-Driver, clients achieve for example:

- Reduced fuel consumption by between 6 and 12%.
- Simpler and cheaper communications between office and drivers.
- Better overview of the fleet thanks to positioning.

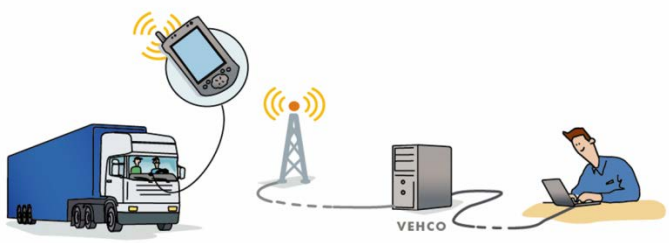
Competitive benefits of Co-Driver are many - the solution works on all truck brands, and cost savings are proven by many reference customers. Moreover, drivers like to use Co-Driver since it is very easy to use. Competitors to Vehco include truck manufacturers Volvo, Scania, Nordic IT companies Locus and Pocket Mobile, and Belgian Fleet Management specialist Transics.

## HISTORY OF VEHCO

Vehco was founded in January 2001 when Anders Tingström came with his business idea to Chalmers School of Entrepreneurship. The starting team consisted of Anders Tingström and three students at the school – Martin Lackéus, Mattias Hedlund and Magnus Gunnergård. In 2001, deep surveys were made of the requirements that really needed to be met for a computer solution in a truck to be successful. Technical development of product Co-Driver was initiated shortly thereafter. In August 2002 Co-Driver was launched on the Swedish market, in conjunction with the exhibition Truck 2002 at Elmia Trade Fair of Engineering, and shortly thereafter the first installations at customers were made. The following years witnessed a commercial breakthrough for Vehco, in the form of a multitude of new customers.

## THE PRODUCT AND THE MARKET NEED

Co-Driver is a product for efficient information flow between staff in the office and the trucks on the field. In the truck Co-Driver consists of a standard Internet-connected handheld computer that is both an aid to the driver and an automatic collector of operational information. In the office Co-Driver consists of a PC program where you can send, receive and analyze various types of information to and from trucks.




The reason why mobile computers in trucks have become increasingly common is that there is an opportunity for substantial savings in administration, communications and fuel. The haulage industry is fiercely competitive, and the long-term survival of truck operators is dependent on their capability to continually increase their efficiency. Common features include positioning, order processing and messages. More recently, the use of monitoring fuel consumption, digital timesheets and Internet in the truck has become increasingly important. All this can be done with Co-Driver, which today is the Nordic market's leading solution for vehicle tracking and communications.

## SERVICES IN CO-DRIVER TODAY

The need for information flow varies widely between different types of truck operators. Therefore, Vehco has developed a wide range of services to choose from. Each customer is unique, and will choose the services that are the most important for its type of business. The business model includes a possibility to choose only a subset of services, and thereby lower the initial and running cost of the solution. The services in Co-Driver are described in figure A.


*Figure 1. Economic value of Co-Driver for customers*

An installation of Co-Driver costs approximately SEK 25,000 plus monthly fees of approximately SEK 300 per month and truck. This cost is often paid back in around 1 year for the customer. The biggest cost saving is in the area of improved driving economy. But the other services can also be highly beneficial, and many customers have already invested in Co-Driver without even ordering services that save fuel at all. The calculation below is an example of how much money can be saved per year and truck with Co-Driver, in a typical customer case. In this case, the Co-Driver investment is reimbursed in approximately 9 months, since the total savings per year amounts to SEK 37,000 distributed on the following components:

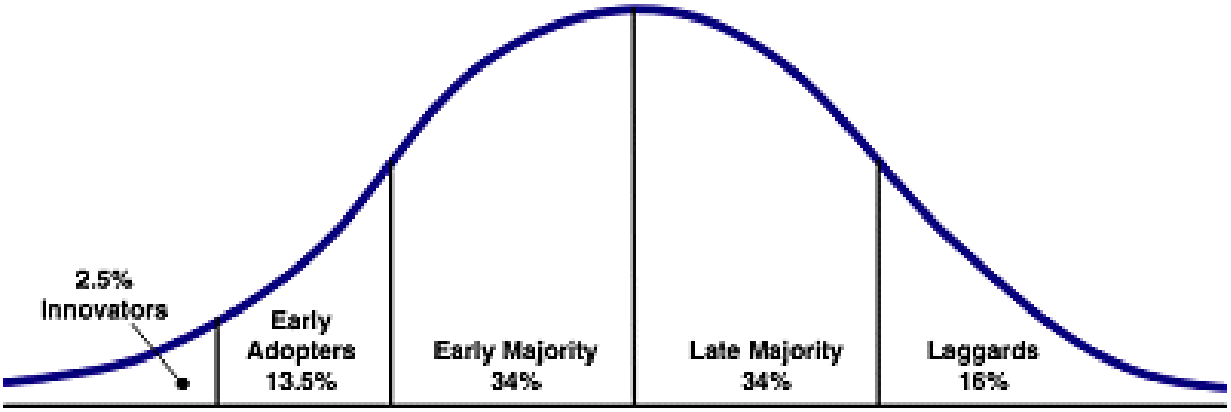
- **Reduced fuel consumption** – 4% of fuel costs for a truck running 120,000 km per year equals SEK 17,000 per year and truck. This reduction tends to be between 6 and 12%, so 4% is a conservative estimate.
- **Less overtime** – 1% reduced cost for salary for a usual customer equals SEK 6,200 per year. Even a small efficiency gain quickly becomes quite a lot of money here.
- **Lower administration** – 5% less administration equals SEK 6,700 per year and truck. Many haulage companies have a very heavy administrative burden with a lot of paperwork, so this is a conservative estimate.
- **Cheaper communication** – SEK 150 per month in saved costs equals SEK 1,800 per year and truck. Achieved by messaging and positioning.
- **Efficient transport management** – 5% of administrative costs equals SEK 6,700 per year and truck. The task of managing many trucks is a lot more efficient with help of computers.

Every truck company, however, is unique, and therefore Vehco usually makes a customized savings calculation for each customer.

## VALUE OF CO-DRIVER FOR SOCIETY

The value of Co-Driver for society is mainly on the environmental level, but also slightly in the area of traffic safety. As more and more transportation companies in the Nordic region have started using this type of technology to save fuel and optimize their transportation activities, more and more goods are transported with less use of fuel. And since fuel is becoming increasingly expensive, systems like Co-Driver every year become more and more a vital part of every transportation company's tools for doing business. And when many transportation companies start saving substantial amounts of fuel and therefore money, their competitors have to follow the trend in order to stay competitive on the market.

The product adoption of Co-Driver on the market has followed the product adoption curve; see the figure below. First it was the early innovators that agreed to try out Co-Driver, just because of the excitement of new technology. Then the early adopters followed, looking at the potential effects that could be achieved. When the fuel savings became obvious for the early adopters, the early majority joined and also succeeded in saving fuel. This changed the rules on the market, since the transportation companies now had to use the new technology to keep up with the competition. Solutions such as Co-Driver are necessary today for transportation companies to stay on the market and win new contracts from their customers. And the gain for society in environmental aspects is of course substantial.




The situation on a European level is strikingly different, however. Saving fuel is not nearly as common in other parts of Europe as it is in Sweden. Vehco as a company has played an important role in at least one unique respect on the Nordic market. Looking at countries outside of Sweden, it is obvious that the fuel-saving capabilities of similar solutions are not nearly as developed as in Sweden. And this fact is not explained by different fuel costs; these are about the same in the whole of Europe. It is also interesting to see that fuel saving is not nearly as prioritized by customers in other countries in Europe as it is by customers in Sweden. The reason for this situation is that on many European markets there has not been a focus on fuel savings, since there has not been a company similar to Vehco talking about the possibilities and showing the market that it actually works. Hence, it is not only what is technologically possible that explains the market characteristics – it is equally important what technology and functionality the leading companies in the various markets are promoting and refining.

The European leader in this specific technology field is Transics. They have not at all based their growth as a company on fuel-saving functionality, but have instead used the customers' need for controlling the drivers' activities as a means to raise the demand for truck computers. And in Sweden, this has led to their losing most potential customers to competitors offering more developed fuel-saving technology, such as Vehco.

Innovative companies pursuing new technologies and new ways to use technology thus seem to be able to create important value for society. However, it is not until the effects become obvious that the majority of the market adopts the new technology. And being able to show a strong economic calculation substantially speeds up the adoption among the early and late majority customers. The early majority customers care mainly about economic effects, and the late majority customers care mainly about keeping up with the competition. The laggards either go out of business or manage to stay in business by other unusual means.

The conclusion is that if you want to do something very good for society with your product, you need to have a very good calculation for the paying customer.

## IDENTIFYING THE KEY TO UNLOCKING THE MARKET

As described above, Sweden is one of the few places in the world where fuel savings using mobile technology are obvious and a requisite for a transportation company to be on the market. We will now look deeper into the breakthrough moment when Vehco unlocked the key to this rewarding use of mobile technology.

When Vehco started as a company, the basic idea put forward by Anders Tingström was quite simple and straightforward – "What good can we do for customers by using the operational data in a vehicle's electronic system?" With this approach it soon became the primary focus of the venturing company to start looking at how to obtain fuel savings, and identifying what customer types would benefit the most from fuel savings. Even though cars, boats and other vehicles all can save fuel, the most interesting customer segment soon was identified as trucks and transport companies.

The continued research into the matter revealed that there were already solutions on the market, but these had not yet become widely spread and in use. One of the main suppliers was Volvo, who had pioneered the area of computer-equipped trucks already in the early 1990s. But market research showed that installed systems were not used by the drivers in the intended way, for various reasons. The idea of equipping trucks with mobile computers seemed compelling in theory, but reality was a different story.

The Vehco founders found many reasons why mobile technology could fail in trucks, and made a thorough list of all contradictory requirements that had to be met by a solution in order to reach a high market penetration. These requirements were then put into the context of the theory pioneered by Geoffrey A. Moore in the book "Crossing the Chasm – Marketing and Selling High-Tech Products to Mainstream Customers" (2002). The market for mobile computers in trucks was not yet a mature market – in fact it was a very immature market with only the most innovative customers willing to try new solutions emerging on the market.

It became clear that there was a need for what in the theory of Moore is called "A Compelling Reason to Buy" – i.e. one very important advantage of a solution, which would make it obvious for the customer that a purchase was necessary and beneficial, and that it also was worth the effort to implement the solution which had proven to be time-consuming in the implementation and needed the attention of the managers of the customer's organization.

The compelling reason to buy was identified by using a simple Return of Investment calculation. Looking at the costs of a typical customer, and looking at the benefits that the new technology could bring, the most profitable aspect of the solution was the fuel-saving capability. And that became the main focus of the founders – the key to unlocking the market.

## MAKING THE KEY WORK IN REALITY

The idea of saving fuel was not new to the market at this time. Many transport companies had tried educating the drivers in Eco-Driving, thus trying to save fuel. And the method was showing great results in the short term, but the results never lasted more than a month or two. Soon drivers started to get back to their old habits of driving that were less economical. But it was now clear that the key to achieving long-term fuel savings was to find a way to change the long-term driving behavior of the drivers.

After a few years of developing Co-Driver, there were quite a few trucks that were equipped with a mobile computer measuring the fuel consumption. The trucks usually were owned by innovative customers that really wanted to be among the first to adopt new technology. But the results still were not as convincing as we had hoped, because it was not easy to go from knowing how much fuel had been used to changing the amount of fuel that was used. Knowing the cost didn't automatically give you a lower cost, but it was a good starting point.

The breakthrough came when a customer asked Vehco to do an analysis of two trucks that were in theory equal, but in practice had very different fuel consumptions – one very lean and the other very costly for the owner. One of the founders of Vehco, Magnus Gunnergård, dug himself down in operational data coming from the two trucks for weeks and weeks, trying to find meaningful patterns in the driving behaviour of the different drivers. And the effort paid off – he found the explanation in that the top speeds used by the more economical drivers were lower than the top speeds used by the less economical drivers. The conclusion for Vehco was to encourage its customers to tell the drivers not to drive faster than 80 km/h. And the amount of time drivers spent driving faster than 80 km/h was measured by the Co-Driver product, communicated to the manager, and then posted on the wall in the lunch room for the drivers. This had an immense and long-lasting effect on driving behaviour, thus making the fuel saving effect sustainable. And many drivers really appreciated this new way of being able to show their boss that they did a great job driving economically. After all, how interesting is it to make the extra effort if no one pays attention to it?

Afterwards, this might all seem trivial. Today it is well known that maintaining a lower top speed saves fuel. But the key to unlocking the market was to build a technological system that made it possible to encourage drivers to actually follow this fundamental rule within the Eco-Driving theory. And more parameters have also been added to the product, measuring many aspects of economical driving and communicating the results to the drivers in a transparent way. Also many functions outside of economical driving have been added to the Co-Driver product, since most customers demand what in Moore's theories is called "A Whole Product", meaning that you have to solve all the customer's needs within the specific field with one solution, in order to get the majority of mainstream customers to buy your product.

## NON-MONETARY RETURN ON INVESTMENT

The fact that the return on the investment in Co-Driver was delivered in the form of substantially lower costs for the paying customer helped the product to quickly reach a wide user base. Indeed, when Vehco added services focusing on traffic safety that were highly beneficial for society but not at all beneficial economically, it became obvious that these services were not at all interesting for the customers – not even considering that these services had the potential to save many lives for people in society. Of course many customers said that these services were highly interesting, but ironically they never went forward and placed their order. Their interest in these services seems to have been quite politically motivated. Not many people want to be caught openly not caring about human lives.

The services within traffic safety were built on the same basic principle as the services for saving fuel. Follow-up of driving behavior was done by using mobile technology, and then presenting the results to the drivers in the same way as with the fuel-saving methodology. Each driver could see exactly how safely he had been driving, and compare it to his colleagues. It was even done in the same way as the fuel-saving service, by tracking the driving speed. However, it is not economically beneficial to drive at 30 km/h past a school, so the value for society was much greater than the economic value for the transportation company.

The conclusion is that money has proved to be a much more powerful driving force than societal benefits, even if societal benefits are large in terms of saving human lives. It seems that the benefits for society are not in focus for customers that are working in fiercely competitive environments; instead the focus lies on economic benefits for themselves and their shareholders. This is not difficult to understand when looking at each individual company from a strict business perspective. And some of Vehco's customers have regularly pointed this out through the years, saying:

*"How am I supposed to invest money in quality and traffic safety when my customers keep choosing the cheapest supplier, not taking into account other values than money?"*

Each and every company acting on a highly competitive market is forced by market laws to optimize its profit. Spending money on products and services that do not contribute to the profit will therefore lead to the opposite – loss. And in the long run a business can and should not exist without being able to deliver profits. A business cannot pay its bills with proven societal benefits. And a business cannot deliver societal benefits without someone paying for it.

There is, however, hope in this case too, because there is a group of customers that are not as profit-maximizing as the transportation companies, and that is the end users – the consumers. The day when the consumers start demanding products that have been transported in a safe manner, these demands will transfer across the entire value chain. If the end users, for example milk buyers, will demand not only environmentally friendly milk, but also traffic-friendly milk, this will force milk producers to act upon new customer demands. Their action will be in the form of new demands when buying transport services, and only companies using mobile technology following up on traffic safety will be eligible to deliver the desired transportation services. But this is still in the future, even in Sweden. Vehco has reported signs on the market that this will actually be possible – there are customers further down in the value chain that have started looking at traffic

safety in this way. But the order has not yet been placed. A success story about someone owing their life to Co-Driver technology would probably do wonders in the consumer end, but that is not a story that can be easily told yet – it is difficult to know what accidents never happened and why they didn't happen.

A conclusion that can be drawn from this example is that it is certainly possible to get customers to pay for non-monetary return on investment. It is, however, much more difficult than getting them to pay for monetary return on investment, and it probably involves some trend-setting activities among consumers. Under all circumstances a supplier always has to make sure that there is some kind of return on the investment obtained for the paying customer, monetary or not. Otherwise the business is not long-term economically sustainable. And if there is not a paying customer at all, the business is probably not even short-term economically sustainable.

## FINAL REFLECTION

To summarize, the solution to Vehco's challenge was as much psychological and economic as it was technological. And what the preceding actors on the market had forgotten to take into account was how the technology was actually received in the reality of everyday users, and how it affected or did not affect their everyday life and economy. Ultimately, technology must be used to significantly improve the situation of real end users, preferably their economic situation. Not until an emerging company really makes a sustainable impact on people's lives and/or wallets will it be a sustainable company.

# 14 MAKING A PROFITABLE SOCIAL BUSINESS – NETCLEAN TECHNOLOGIES

*Christian Sjöberg, NetClean Technologies*

*Christian Sjöberg is one of the founders of the company NetClean Technologies and has also been the CEO of the company since its founding in 2004. Christian has a background in computer science and Chalmers School of Entrepreneurship and has studied computer science at the Technische Universität in Munchen. NetClean was named by Deloitte as the fastest-growing technology company of 2008 and Christian was nominated by Ernst & Young of Sweden as the Entrepreneur of the Year in 2010.*

## THE COMPANY NETCLEAN TECHNOLOGIES

In this chapter I will give you a history of how we built the company NetClean Technologies, what mistakes we have made and what we learned on our way. I will share some of the challenges we have and reflect upon our way and other ways to deal with them.

NetClean Technologies is a Swedish company that develops technical solutions to support every aspect of the protection of children on the Internet. The company has a close cooperation with several non-profit organizations, for example the World Childhood Foundation, ECPAT, BRIS and Internet Watch Foundation.

Using a NetClean product is a way of integrating social responsibility with successful operations. Making the decision to take a stand against child abuse demonstrates that an organization strongly supports widely established values. This is similar to complying with environmental standards and working for sustainable development. Apart from the system blocking suspected child-pornographic materials, the most important effect of deploying NetClean is that the organization is helping to protect children. Before describing the entrepreneurial journey of NetClean, let me first describe our products.

### NETCLEAN PROACTIVE

NetClean ProActive™ is a unique solution for blocking child-abuse images and videos. It is used by companies, governments and organizations to detect and stop child-abuse material before it enters the internal network. The product can be deployed either in the network or on every computer as a desktop agent.

NetClean works with law enforcement authorities which classify child pornography images that NetClean ProActive can stop. By comparing existing imagery, NetClean ProActive can stop a

photo or video, in contrast to traditional web filters that block prohibited addresses. NetClean ProActive is a natural complement to organizations' existing security solutions.

The product is licensed per computer and year with a yearly subscription fee which is based on the number of seats.

## NETCLEAN WHITEBOX

NetClean WhiteBox™ is an extremely powerful solution for Internet Service Providers (ISPs) designed to block access to Web sites containing abuse material. NetClean WhiteBox is a hybrid solution using BGP (Border Gateway Protocol), packet inspection and a redirection mechanism that is robust. The solution is very flexible and can easily be deployed and managed. The benefits are many:

- **Does not affect the performance in the ISP-CORE.** Very important since an ISP does not want to downgrade their performance.
- **Easy to deploy.** It is a very difficult task to implement a solution in the network of the ISP and the implementation cost could be higher than the product cost. NetClean WhiteBox is extremely easy to implement, which makes it cheaper to buy a solution from NetClean rather than using Cleanfeed, which is free.
- **No overblocking.** Overblocking means censorship. We do not want to contribute to that.
- **No proxying.** In the UK they are using a system called Cleanfeed which proxies the traffic. BlueCoat and other proxy servers are also proxying the traffic, which has serious impact on the users' network access.
- **http-responses are routed the normal way, and the NetClean WhiteBox sees only the http-requests.** Important for the redundancy and scalability of the product.

## NETCLEAN ANALYZE

NetClean Analyze™ is a software dedicated for law enforcement agencies working with child-abuse content. NetClean Analyze has been developed together with the Swedish National Police and it is free for police forces and Hotlines worldwide to make their job easier, quicker and simpler. The software is based on an advanced image recognition technology in combination with a scalable and customized user interface to help police officers who investigate child-abuse cases. NetClean Analyze is our way of giving something back to police forces around the world working against child-abuse images. The software is spread among police forces by recommendation, it is updated frequently and it is free.

The key for NetClean is to find a business model which enables poorer and less developed countries to have the right tools to work against child-abuse images, but where we also can offer even more advanced solutions to the developed countries, which can pay for it. Since most countries in the world have not come very far in their work with identifying child-abuse images, NetClean Analyze is still a powerful solution for them and, since it is free, it is also a solution easy

to use. But for other countries, like Sweden, NetClean also offers a Victim Identification Server – an advanced solution which enables all investigators within a country to collaborate more efficiently when using NetClean Analyze. By introducing NetClean Analyze for free and the possibility to add the VIS-server for a fee and when the police in a country is ready, we have found a working business model, where we can spend money and resources to do research and develop new tools while being able to offer some solutions for free.

## THE START OF THE COMPANY

The idea behind NetClean comes from an article in the computer magazine Computer Sweden (see Figure 1) about how the organization Save the Children worked against child-abuse images on the Internet. The article indicated that Save the Children had a database with 300,000 images. I read the article on a Saturday morning in December 2002 and the initial idea came to my mind: "If we know which images are illegal and should be blocked, why don't we just block them like we do computer viruses?"


*The article published in Computer Sweden on 6 December 2002, which I read on a Saturday morning.*

## NOT A COMPANY, BUT SOMETHING FOR A NGO

When I got the idea I did not envision a company, but rather something for an NGO like Save the Children. To earn money and do something good for society was not something normal for me back then. The term "sustainable business development" was hardly invented yet, and when I made my first presentation to business people I got the reaction that this was not something anyone would pay for. Everyone agreed that it was good, for a good cause, but who would want to know if people were downloading child-abuse images on the corporate network?

Therefore I decided to contact the World Childhood Foundation, which is the Queen of Sweden's foundation. In June 2003 I met with Gunilla von Arbin, Secretary General and Martin Ingvar, chairman of the board at this foundation and presented my idea. I brought along a prototype with me and the offer to World Childhood Foundation was that they could have the product and I could develop it for them if they paid me by the hour.

**Excerpt from the diary 2003-06-10 when I met with World Childhood Foundation for the very first time.**

*I had a meeting today at 14.00 with Gunilla von Arbin (CEO) and Martin Ingvar (Chairman of the board). Martin was a little late to the meeting and a little stressed so we went directly to the technology part. My first feeling was that he did not really believe in the project but during the presentation he realized that this would actually work.*

*I demonstrated my two versions and gave away four documents with information about the concept. They said that they would get back to me within a week.*

*During the meeting, which was longer than planned (I guess that is good), we spoke about profitability and organization questions. Martin Ingvar was familiar with the technology and the existing problems and possibilities which existed. He also confirmed that child-abuse images on the Internet were a large problem. Martin also saw the business potential and after a while he was the one who presented my idea for himself. I felt that he liked the idea.*

## WHO IS THE CUSTOMER?

Childhood got back to us with the proposition: "Start a company and we will help you on the way." We then started to think about customer value. We identified several customer benefits from installing NetClean products, but none were of the "Return on Investment type" showing how much money could be saved by buying our product. It is still hard for us to make that calculation. But it is the same with all security products. There is a risk, and if you invest in these products, you minimize the risk.

For NetClean we identified three customers. First of all, the children who are abused. We do not know who they are, but we want to block their images and prevent people from watching these,

which will encourage them to commit their own abuses. The "customer benefit" is quite obvious to most people. Secondly we think of our "normal" customers, the paying customers. We know who they are and to whom we are selling. The customer benefits for them will be described in the next section. The third customer is law enforcement. We are helping law enforcers in their work of identifying pedophiles. We do this by giving them our software NetClean Analyze for free and offering our expertise in computer knowledge.

We realized that our products would have to fulfill customer benefits for all three groups. A product which protected the company but made things more difficult for the police would in that sense not be a good product for NetClean, even it could be profitable.

## THE UNIQUENESS AND PROTECTION AGAINST FUTURE COMPETITORS

At first we discussed what was unique and how we should protect the technology. We quickly realized that it is not the technology which alone creates the unique parts of the company. It is the combination of technology, the working field, and partnering with the police and nonprofit organizations. This also became our protection against future competitors.

Today, the technology is unique. But it is not the initial technology or idea that is unique, it is the whole system. All the support systems, all the products and everything about the technology make our solution unique. Anyone with some basic computer knowledge can create the first application, but it is very hard to create the whole system, which is needed to make everything work.

*In 2003 NetClean participated in the business plan competition Venture Cup.*

*During the competition we said that we were going to patent the algorithm and we also heavily promoted our unique technology, even though we knew that the technology is not alone the most unique aspect of NetClean.*

*The reason?*

*In 2003 NetClean was among the first companies to have a product which did not sell with the Return on Investment argument, based on a unique research-based technology from Chalmers. To gain acceptance, we needed to adapt our business model to fit into the Venture Cup model.*

*We finally managed to win a second place in the competition.*

## ENGAGED PEOPLE AND DOING BUSINESS

Many people tell me that "it must be fantastic to work with something that positive, as you are doing." In fact, I mostly do not have time to think about it. In my everyday work I have a lot of problems, which is probably the same for all CEOs. If I think about the subject we are working with, I think more about the bad part, the problem, than about the solution – because it is vital to understand the problem in order to create the right solution!

At NetClean we have had people who apply for a job within the company because they are interested in the problem and talking about it. All members of the team are highly skilled and very well informed about the problem, but I think it is important that we do not become evangelists. We have a company and we need to earn money by selling our products, because if we do not sell, we cannot create next-generation products, we cannot afford to sell and in the end our solution will not be used to protect children online.

It is not 100% true that we only focus on selling our products. We do spend a lot of time discussing and teaching people about the problem and what they can do to be a part of the solution. At NetClean we also develop several products for free as a part of our engagement, like NetClean Analyze for law enforcement and Keep my net clean.org. However, what we see is that since NetClean is a company, we need to focus on earning money and we need to find a business model for each product we create, because otherwise it does not get the attention it deserves. What is most important is to create a long-term solution. Therefore we need to see that the solution is profitable. I think it is the same for all organizations, NGOs, governments and companies. If it only costs money and the benefit is not valued, it will sooner or later come to an end.

## A SUSTAINABLE SOLUTION NEEDS A SUSTAINABLE BUSINESS MODEL

There is a delicate balance problem between being profitable and creating value for society. Our model is based on a combination of the two: if we do something new, both have to be fulfilled. We needed to find a sustainable business model for a product or solution to create a sustainable solution.

Our thoughts about this have changed over time. In the very beginning, we only thought of society, since we wanted to give away our idea and solution for free. After the first meeting with Childhood Foundation in 2003 it changed a little and we realized that the more products we sell, the more we are helping society to find pedophiles. We support this by developing software for the police and Hotlines (which receives tips on child-abuse material) for free.

We obtained a small room at the incubator Framtidens Företag where we could squeeze in two tables, two computers and a server. This was a fantastic time for the company. Mattias and I were working 60 hours a week to create the product. When we nowadays have a beer after work at NetClean, Mattias and I usually talk nostalgically about that period.

*I met with Ann-Christin Appelgren who was managing the incubator at this time. We spoke about the period at the incubator Framtidens Företag and she reminded me that when all the other companies met for a Friday beer we were sitting and developing our product.*

*The others thought we were boring, only working. But today we can see that we succeeded more than the others, and it is a part of working hard. You simply cannot underestimate the importance of working focused and hard.*

## LEARNING FROM OUR FIRST LARGE CUSTOMER

When we started to develop the product, our time schedule was set for August 2004. We were to finish in 8 months. Why no one reacted to this is strange. But it takes more than 8 months for two developers to create a product like NetClean ProActive. The product was finished a year later than we estimated. The problem was that since we had too short a time schedule, we had to cut corners when we were developing the product, which later on had the result that we got bugs or problems which were hard to fix.

Since we had a project and product which were of great interest to many people, we were afraid to tell anyone about the product before it was finished. Consequently we did not involve any customers in the development process. When we did our first installation, the product was unfinished and extremely difficult to install.

When TeliaSonera – our first large customer – bought NetClean ProActive in 2005, they found a bug in the management console which showed up when they installed more than 10,000 agents. The NetClean ProActive system consists of a management console that controls agents, which are installed on each computer, and what happened was that the management console crashed when all agents connected.

We visited Niclas Olsson and his team at TeliaSonera and could confirm it. However, he said: "This is not something unusual for us. A lot of large corporations come to us with millions of installations, but in the end they will patch the system. Fix the problem and we are happy."

Mattias Shamlo and I went home. Working 24x7 for two weeks to find the problem, we found it in a third-party component we were using, but we did not know how and why it crashed.

On Thursday the 1st of December, Niclas Olsson at TeliaSonera called Mattias and asked how we were proceeding. I can hear him respond – "We have found the problem and fixed it. We can meet on Tuesday for an installation." At this point we hadn't solved it, but we had started to realize what the problem was.

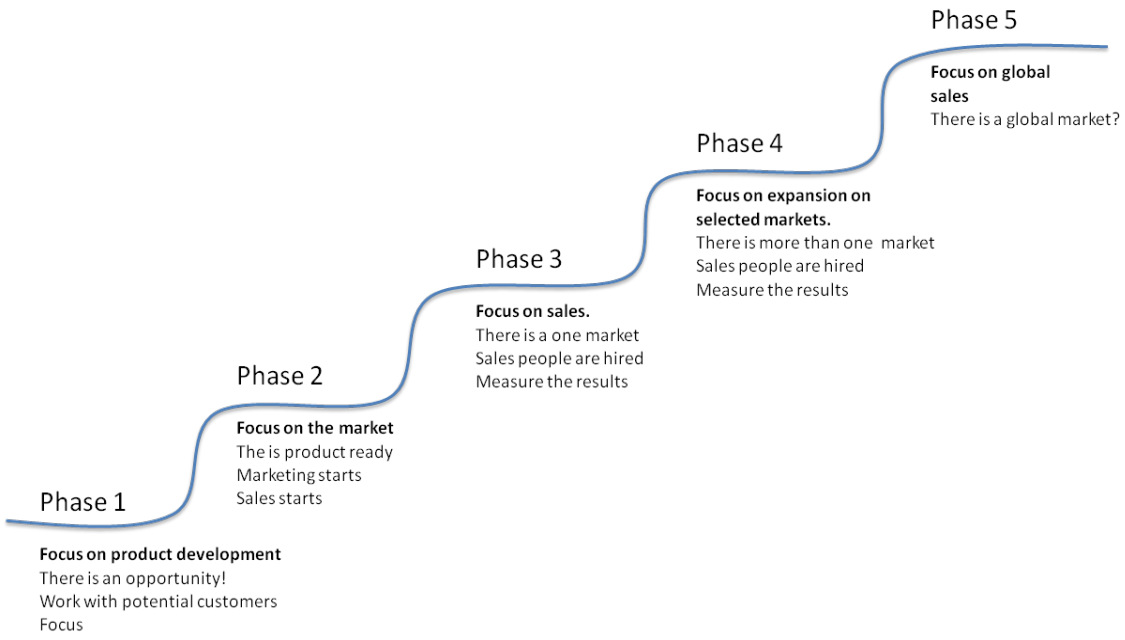
During the weekend we found the bug and fixed it. TeliaSonera installed the patch and got the system working. This has given rise to a saying within NetClean: "How hard could it be?"

We failed, but we went back and fixed it professionally and correctly. Almost all companies make mistakes (have you ever had a crash in Microsoft Windows?…) but everyone accepts your errors **if you fix them properly and quickly**. If you do so, you will get a closer relationship to the other party, because you have shown that you are a good organization and handle problems professionally and rapidly – something you couldn't have shown if they didn't have to interact with you.

It is important to state that I do not think there are any big differences in creating a company based on a "sustainable business model" rather than just a business model. You will meet the same challenges. You might get a slight advantage out of being of interest to the media, but you have the disadvantage of not being able to present a solid ROI model to the customer. In the next section I will describe key phases in NetClean's history and share important learning related to each stage.

## START-UP PHASES AND IMPORTANT LEARNING

This section will discuss the different steps and what we needed to focus on before going to the next step. A company is built in stages and you cannot get to the next stage before you stand stable on the platform for each phase. For NetClean I have identified five phases (see Figure 2). I argue that it is vital that you understand in which phase you are. If you do not understand this, you will fail. For each stage I have a special part discussing how to finance the stage, since this issue has been a constant although changing concern.




*Firgure 2. The five phases for NetClean. You cannot go out and market and sell the product before you have a good product and have finished Phase 1. That is obvious to most people, but the corresponding need is not as clear when moving from Phase 3 to Phase 4.*

### PHASE 0. FORMING THE TEAM AND RAISING INITIAL MONEY

So far I have primarily described the very first stage, Phase 0 – forming the team and the venture. It was natural for me to discuss with my colleagues at the company where I was working when I got the idea, and I got two of them to join the team. We agreed that NetClean (at this time the company was called Barlind after my grandmother) should be a large company, and we agreed that we were going to strive for a small part of a large company rather than a large part of a small company.

Therefore we needed a professional chairman of the board. During my studies at Chalmers School of Entrepreneurship I had met with Kristina Fahl and liked how she could give critical feedback without being patronizing. I sent her an email and asked if she would be interested in meeting with us. "It was a project with good intentions for society." Kristina later on told me that it had sounded cryptic, but after the meeting she was positive.

You have the team. You have the idea. Now you need to finance the first part of the company to create the product. The financing part will be discussed in more detail in Chapters 8 and 9. It is important to focus on raising enough money in this phase. If you raise too much you will lose too much of the company, and if you raise too little you have problems reaching the next phase, which will set you back a lot!

It is vital that you have enough money to achieve this. Most financiers are going to give you an option that you get this money now and when you have finished your product you will get another round of money. Try to avoid this. The product development always takes more time than you expect, and this will only favor the investor. If he believes in the team and the product, he should be able to invest.

I assume that it is easier to find financing when you are working in a sustainable business because you talk to the heart of people. For in the early stages you can only invest with a combination of the brain and heart.

*In the autumn of 2004 we met with the top management of TeliaSonera. It was the former CEO Marie Ehrling and two close colleagues of hers. We presented our business plan and asked if they would be interested in investing 10 MSEK. We would offer them 10% of the company for this (which would have given NetClean a valuation of 100 MSEK…)*

*They said no, but offered to sponsor NetClean and, what is most important, told us that TeliaSonera was going to buy the product when it was finished and said that we could use them as a reference.*

*We got 100,000 SEK from Innovationsbron as a grant, and the founders invested 100,000 SEK which was co-financed with 400,000 SEK from the West Region.*

*We had almost 1,000,000 SEK but no product, no agreement, no customers. It was enough to finance NetClean for six months and we were ready to go!*

## PHASE 1. PRODUCT DEVELOPMENT

In January 2004 we moved into our room at the incubator Framtidens Företag. We had a tight schedule, as we were supposed to be finished in August. In fact it was finished in August the following year…

To finish the product we needed both an agreement with the police – so that we should know which images to block – and a ready product, which could do the job. Needing an agreement was a very good excuse for the development because we could blame the fact that we didn't have the agreement, giving us time for the development team to finish the product.

Neither the development team nor the board had any idea how long it would take to create the product, and the only focus was that it should be finished so we could start selling it.

*Our first office was 2.5x3 meters and hade just enough space for two persons. It was horribly hot in the summer because the only window was a room window. A great place to start NetClean. Photos: Christian Sjöberg*

The most tricky and important part in this phase is that you need to give enough time to create the product, keeping the right focus and allowing yourself to freeze the product at a certain level and focus on finishing this. I really have no way of describing how you do this, but you need to find a model which helps you to create the right product with the right features.

There are two vital things that need to be in place before entering phase 2.

- You should have a working, tested product with sales and marketing materials in place.
- You need to have financing to be able to execute phase 2.

At NetClean, we had neither. But… How hard could it be?

## FINANCING PHASE 1: WHAT ARE YOU SELLING?

Before entering the first phase you have put together a team and a business plan. You might also have a patent or a technology. You are selling yourself and a future. When you have a sustainable business idea you are also selling that good feeling in the stomach: the possibility for the investor to make a difference. You need to think about these three things before meeting the investors, and make sure you value the company based on these premises.

If you speak to a professional investor, he or she will most certainly try to value the company by using some kind of P/E model, because it is devastating to your value. Do not accept that. Make sure the team has a track record or at least that one person has a track record. This minimizes the risk for the investor and he or she will feel more secure about your company. An investor invests in people, not in an idea, so make sure you have the right team in place. You are selling a potential. Your technology could be the one which succeeds. No one wants to be standing on the platform when the train is leaving. You have to transfer that feeling to the investor. The investor needs to be on the train.

You are running a sustainable business and you should use that to raise money. You are selling a good feeling. Use it but do not abuse it. If you abuse it, the feeling is no longer a good one and this will follow you for a long time afterwards.

*When we had a first share issue at NetClean one of our first investors called me and we discussed the company, what we wanted to achieve, what we were planning and what our vision was. "To decrease child-abuse images by 50% on the Internet."*

*At the end of the call he told me: "I will invest in your company. I hope and believe that you will succeed, but if you fail, the money has at least gone to something good."*

*I have met investors who think of the investment in NetClean as a social good, and others who see it from a ROI perspective. I think it is best when you have both mindsets, because that is how NetClean is run. One part business and one part of social value.*

## PHASE 2. BUILD AND INVEST IN YOUR MARKET

The product is ready. There is a market ahead of you. Now you only have to go out and sell the product. Your expectations are sky-high and so are the expectations of shareholders and others. Realize this: it takes time and costs money to sell. You will meet a new market, with a new product, for a new problem, with an unknown brand. In NetClean's case we are delivering a product which should be put on all computers. If it has bugs, we can crash the whole customer's infrastructure.

The purpose of this phase was unclear for us at NetClean. We did quite well, but we could have done a lot better if we had understood the phases before the launch. So what is the purpose? It is to build the market. The more you spend in this phase, the easier it will be to sell your products, and the more you will earn later on. It is not as simple as spending a lot of money on marketing, because you have to build trust with the customers, so you have to invest in people.

If you want to measure this phase, do not measure it in money, revenue or profit. You need to find another way of measuring this phase. If you focus too early on revenue, you will end up investing too little money in building your market.

*We measured this in income and it has been both positive and negative for NetClean. Since we are dealing with a subject which is of great interest to the media, we got extremely intense media attention, but when I look back I wish we had spent more time and money on building the market. At the time we did not have that amount of resources/money and we had to focus on revenue-generating, but I believe it would have helped us in the future if we had spent more money then. On the other hand, we became profitable after five years and in the same year we were nominated as the fastest-growing technology company in Sweden, so I guess there are no real rights or wrongs.*

**Respect the time**

I cannot say this often enough. Respect the fact that things take a longer time than you expected or want to accept. It is normal, and probably happens because you are spinning at a much higher frequency than the rest of the world. You have an axe in your back and a large carrot in front of you.

*NetClean introduced its first product in April 2005. The summer came quickly and we started to meet a lot of companies during the autumn of 2005. If a company wants to buy a product, they have to enter that into their budget – they need to test it and plan for the implementation. We didn't realize this and we struggled during the autumn for our survival, not understanding why companies didn't buy our product.*

*In the end we had sold for 728,000 SEK. It was TeliaSonera and some other customers who were the real innovators or early adopters according to the Chasm theory[1], which by the way I think is 100% correct.*

*Before the launch in April 2005 I had several shareholders who called me and asked:*

*"How many telephone lines do you have?"*

*I was a little bit unsure.*

*"We have two lines," I answered.*

*"That is not enough – soon the customers will start calling."*

*Even the board expected that the customers would stand in line, just waiting for our product. "Everyone is going to want to have this product." That might be the truth, but the truth is also that no product sells itself and you need to work with customers to make them understand why your product is the best.*

*As a result, in the summer of 2005 we realized that we were running low of cash again, and we needed to make a new share issue.*

*Our self-confidence was the lowest possible and it felt like we were letting down everybody, because we had failed to sell the product and fulfill expectations.*

*In the rear mirror, it is clear that we did quite well, but the expectations were too high and wrong, and at NetClean we were not prepared to start selling, because the product was not finished and the financing was not in place.*

*We did a new issue of shares during the autumn of 2005. It was heavily over-subscribed because the investors realized that the valuation of the company was the same as it had been when we didn't have a product, but now we had a product and our first customers, a positive launch and sales material.*

**The most important things in this phase**

This is a very difficult phase, so do not hurry it. I have done so on several occasions when launching new products for NetClean or launching NetClean in new countries, and we make the same mistakes: not respecting the time and cost involved, which results in our seeing the launch as a failure. Nowadays we realize that it is not a failure, but rather a failure of expectations.

The main need in this phase is to do the right things. You are going to spend a lot of money on either marketing or sales, and it is probably also worth spending some money on brand consultants. The more money and resources you spend in this phase, the higher the risks are, but also the higher the profit will be in the next phase. The level is decided by how much capital you have and how good your nerves are.

It is important to focus on building a base for revenues, that is, on attracting customers – but it is equally important not to focus on profit yet. It is simply too early. If you do that, you will sub-optimize the process of building the market.

In this phase you need people who are business developers, focused on building relations and meeting customers, but not 100% focused on closing deals. You will need the latter as well, but if you have employees who are only interesting in closing deals they will be disappointed and most probably destroy the market and relations, because they do not have the respect for the time that is needed.

**What you need to accomplish before entering phase 3**

There are several things which have to be accomplished before entering the next phase:

- You need to have created a market and platform for sales people to work on.
- All the marketing and sales material need to be in place.
- You need to have the first reference customers in place.
- You need to hire sales people and create an incentive system for them.
- And you might have to lose some of your sales employees, because the people who build the market are probably not the same as those who later start to sell on that market.

*My friend from Chalmers School of Entrepreneurship, Lars Bern, was with NetClean during this phase. In his previous company he had successfully built relations to potential customers and partners which later on would become customers of NetClean.*

*In February 2007 we took the first step toward the next phase by introducing a provision system and starting to measure meeting frequencies etc.*

*Lars quit NetClean and began to work as the CEO in all small companies at the incubator Chalmers Innovation. This is a natural part of the process. The first part, to establish relations, is a very tough part – and one must have respect for that.*

*When I look back at phase 2, I realize that we did not fully understand this and I remember it as a tough and quite dark time. Otherwise I do not remember much at all from it. But if I could have done it differently, I would have focused on more social events for all employees, with a clearer target for the sales people who were dealing not only with revenue but also with relations.*

## FINANCING PHASE 2: RAISE MONEY BEFORE THE PHASE STARTS!

The product development phase is coming to an end and you feel ready to enter the market. Remember to raise money before you enter this phase. If you need 1 MSEK to create the product, you will normally need 10 MSEK to enter the market. Since you have not sold anything yet, you

have the problem that you cannot show the potential investors how profitable you will be. This is both good and bad – but used correctly, it can be in your own favor.

You have created the product, as said before. You have shown that you can deliver. Be proud of it and understand that most people have never accomplished what you have just done. Even if you think that the technology is straightforward, it is rocket science for most investors. Let them believe that it is rocket science, because it is probably that to 99% of the population, even if it is not to you.

You have to communicate that there is a possibility to invest now, before we go public and we start to sell, because then the valuation of the company will rise significantly. This is a golden opportunity. Focus on the opportunity and the potential. Since neither you nor the investor have anything to show in terms of results, the valuation is built only on expectations.

**Creating a difference**

You will find more people who want to participate. "We are going to stop child-abuse images on the Internet. Are you interested in participating?" We never used that phrase, but I have seen other companies communicating in a similar way – and if you use it right, wisely and not crossing the "abuse border", I think it is a good communication.

The people who invest in your company are proud of it. They will talk about it and they will brag about it, because they are doing something good. Let them do it and give them the tools. They are fantastic ambassadors for our company. Let them also know that if they invest in your company they, too, are a part of the solution.

*Before the launch in 2005 we issued new shares. We spoke to friends and the investors who invested in the first round, and we raised 1.2 MSEK. From the perspective that it costs ten times more to sell and market a product than to develop it, we should have raised 10 MSEK. Another mistake we made was that we didn't raise the value of the company. At this moment, we had created a product and were ready to go to market (at least we thought so…).*

*I think we were a little afraid, and besides, it had taken a longer time than we had said to develop the product, so our self-confidence was low. We managed to fill the share issue but, since we raised too little, we were forced to make a new share issue in the autumn of 2005.*

*Since we hadn't realized how expensive it was going to be to sell the products, the money we had raised was consumed at a high speed. As always when this kind of crisis happens, everyone asked themselves whether it was due to a bad product or bad sales. No one really had the answer – it might take a little longer to sell such a product.*

*Everyone agreed that the product was good, and we didn't know about the sales representatives we had. Some years later it would turn out that they were really good, but neither they nor the management had understood this.*

*In October 2005 we did another share issue.*

## PHASE 3. SALES STARTING IN ONE MARKET

At some time it is important to start focusing on sales and measuring the results from a revenue perspective. It is still too early to focus on a profit perspective, but the focus is to sell as much as possible and measure that. I will discuss the sales process and how to sell a new product on a new market later below.

To conduct sales, you need sales knowledge within the company and within the board. One of the hardest parts is to change what is driving the company. In the earlier phase, the market department was a driving force for the company, but now we are switching the power over to the sales department. You could compare it with a cycling race where different people are trading the lead, with the first bicycle taking all the air resistance and helping the rest of the team behind.

In the first phase it was the development, in the second phase it was the marketing department, but now we are switching to the sales department which will lead from here on.

In this phase you have to accomplish the following things:

- Create a working and stable sales model that proves how you can earn money on your product.
- Build a working provision system.
- Turn your company from a development company into a sales company.
- Create all services and material needed to have other people working for you, i.e. material for distributors and resellers that will help you to leverage your business.

- And most importantly: prove that you can get one market to be profitable. This enables you to raise money to invest in sales in new markets.

## FINANCING PHASE 3: IT COSTS TO EARN MONEY.

Most certainly it will take more time to sell than you expect, and sales cost money, so you need to have the right finance in place. During this phase it is certain that you need to raise capital.

**What do you sell?**

A tricky situation arises when you want to raise capital because you have not sold enough. It is a natural situation, however, because it happens to everyone. Almost all companies underestimate the time it takes to sell a new product and the costs involved.

This is also the reason why the valuation is fairly low compared to phase 2 and the next phase: because you need money urgently and you cannot sell the next phase. You simply have to admit that we need more money. It does not mean that this is negative. To invest in sales is usually not negative but very positive, yet you are raising money in a negative situation.

The potential you are selling is that now you have some knowledge about the market and hopefully you can better estimate how money you need until obtaining a positive cash-flow. This means that the risk is a little lower than in the preceding phase. The potential is still a good opportunity to invest in before the sales start and you become cash-positive. This is what you are selling. We have the product and the first customer, so the risk is lower and it is an opportunity to invest before the valuation goes up.

**How do you value your business?**

Your business is still valued on the basis of future potential in combination with lower risk. Now you and the investors know what the market thinks about your product. You can estimate a sales forecast a little better. The value of the company is therefore totally based on how good you are at selling your company and future potential, and how much you and the investors believe in your potential. It is still more about the person than the product and company.

*At NetClean we made exactly this mistake. We raised far too little money before starting to sell, with the result that we had to do a share issue during the autumn of 2005. At that time we got TeliaSonera as a customer. I had a meeting with a potential investor (who became a real one as well) in our office when one of the sales people came in and put a piece of paper on the desk. It was the purchase order from TeliaSonera. At first he thought it was made up, but it was actually just a coincidence.*

*We raised 4 MSEK. The issue was heavily oversubscribed, probably because the investors realized the situation we were in. We had a finished product and the first customer (indeed an impressive one), but we didn't have enough customers to finance the on-going business. The valuation of the company was the same as it had been in the earlier phases. This was one of our biggest mistakes, but in return we got the share issue oversubscribed and could focus on sales instead of looking for investors.*

*So if you are an investor, finding companies with good products and the first customers but a need for more money to finance the sales, invest in them!*

*If you are an entrepreneur in this situation, understand your value. The risk is much lower now.*

## PHASE 4. EXPANSION INTO A SELECTED NUMBER OF KEY GEOGRAPHICAL MARKETS

You have successfully gone through phase 3. You have a good, tested product and a lot of reference customers, and your self-confidence is high. People within your market know who you are and you can feel the flow. It is time to start over. NetClean is in the middle of this phase, so it is very hard to give an objective view of what we are doing and not doing. I am curious to see which mistakes we are making at this point.

What we have learned so far is that the markets are similar and the rules are the same on the Danish and U.K. markets as they have been on the Swedish market. As always, it is the relations which are most important. We can use our existing relations from companies in Sweden to bridge over to companies abroad.

Moreover, we see that there is a small group of people among our customers whom others listen to. It seems a simple task, but you need to find these people and present yourself and your products. Hopefully they like what you are doing and will help you to establish relations with more customers. So, always try to figure out who will be your reference customers and approach them!

You won't get these contacts without being honest and proving over time that you are trustworthy. It will take some time, but afterwards you not only get loyal customers, you have also acquired new friends and – of course – strong references for the future.

We have gained a lot of learning from the processes in Sweden and how we established NetClean here. Each market seems to follow the same phases again – even the first step with product development, since we might have to adapt the product to fit within the legal system of the given country. The next phase is the market-building phase, finding reference customers and investing in the market to enter phase 3 and really start selling. Our experience from Sweden helps us to do this much more rapidly and correctly without making too many mistakes.

## FINANCING PHASE 4: YOUR VALUATION MODEL WILL START TO CHANGE

The sales phase is coming to an end. You have learned your lessons. You have become cash-positive. You know how to sell your products. You have all the reference customers in place. You are ready for the next step: scaling!

**How do you value your business?**

Now it is time to read those books about valuation again, because they are becoming relevant. I am no expert when it comes to valuation models. The Discount Cash Flow model is a good model as long as your valuation depends on price/sales (P/S) rather than price/earnings (P/E). What is a normal P/S number is up to the market of your company. But do not forget that you are a sustainable business.

Because you are doing something good for society, it is more likely that people will invest in you rather than in another company of the same size with the same turnover and similar profit. This in turn has a positive effect on the valuation of the company, something which is hard to implement in a mathematical model.

The best model, which I also find most relevant when running a sustainable business, is to use a peer valuation in terms of other companies doing something unique and positive for the environment – look at their valuation.

**Why will you need a share issue when you are cash-flow positive?**

If you are going to expand you need more money. You can do it the organic way and invest your revenues in growth, but at some point it could be better to raise some capital in order to grow faster. My experience is that there are no miracles. If you see a fast-growing company it is usually because they have a lot of capital.

**What do you sell?**

You are selling the exit. If you have external investors, this implies that you need to sell the company at some point or are doing an IPO. In this chapter I will focus on the IPO, because you can control it better in timing than the other option, a trade-sale.

You have the company, a working business model and working products. The risk is fairly low. You have proven yourself. Now you need money to scale your business. The valuation and sales process is somewhat simpler because you can put your numbers into the –Discounted Cashflow model – or you can look at peer companies that are 2-3 years ahead of you, see what their value is, and base your value on them.

Still, the value will depend on two things in general (at least if you are a software company): turnover and growth rate. Therefore you should focus on using the P/S model and not the P/E model. The reason is very simple. You should invest as much as possible in growth rather than profit. This results in a model where the P/E should be high, because you are investing in growth.

However, if you have a high P/E and a low growth rate, it could be dangerous. This may imply that the company is to grow or that you have reached one of the platforms. NetClean has a positive cash-flow. We can create good projections of our future income and revenues, and we can look at peer companies listed to see how NetClean would be valued in the future.

**How much is the society part worth?**

Is it attractive that we do something good for society? In the beginning, people invested in NetClean because they liked what we were doing. "I will invest in NetClean, and hopefully it will turn out well, but if it fails, the money will have gone to something good". Now, however, it is not the same. Those investing in NetClean will do so strictly from a perspective of return on investment. Or will they? Not totally true. The value of NetClean at the exit point will hopefully be higher, because people want to be part of stopping child-abuse images in the world, and because the investor is also a human being.

### PHASE 5. EXPANSION INTO A GLOBAL MARKET

I cannot share any learning from this phase, since NetClean is not here yet. I assume that we will make as many mistakes as we have done in the earlier phases, but we do not yet know which ones. It also comes to my mind that this is the reason why investors invest in the people and not in the product or idea. We all make mistakes, but it is the ability to realize that something is going wrong and to make changes that differentiates us.

### FINANCING PHASE 5: CHANGING TO THE P/E MODEL

Since we are not here yet, I have no knowledge of this phase. But it is likely that NetClean will be either listed or acquired by a listed company which will give the value of NetClean based on a (high) P/E number, since it is a growth company. If NetClean is bought by a software firm, the growth rate will be even higher, since the technology could be integrated in their existing customer base, so the model applies to both a listing and an acquisition.

## REFLECTIONS UPON SOME LEARNING CHALLENGES IN NETCLEAN

In this section I reflect upon issues that required learning and sometimes rethinking. In hindsight, we were often wrong or had no knowledge of the problems we would face or the challenges involved. Examples are the following situations regarding sales:

- We thought that people had understood that child-abuse images were a problem. They had, but companies did not know that it existed in their own computers, and it took us a couple of months to realize this. Everyone praised the product and was interested, but no one was interested in buying.
- We did not understand whom we should talk to within the company: the CIO, the CMO, the CFO, the CSO, the CEO? First, we had to learn what the acronyms stood for!
- We underestimated the time it would take to sell our products, simply because people wanted to see if we were a stable company or not.

Well, we managed to get over the first obstacles and started to sell…

## SALES, SALES, SALES…

At Chalmers University of Technology, the subject of sales was rarely on the schedule. In fact we almost never spoke about it. During my 1.5 years at Chalmers School of Entrepreneurship, we had two hours of sales education. A guy came from one of the bigger IT consultancy companies and told us how to deal with it.

No, it is not simple and it is even more difficult for a startup. The point is that, if you manage to sell your products, you are going to succeed. If not, you are going to fail, regardless of how good your products are. And no product will sell itself.

## "THERE ARE A LOT OF SHARKS BUT ONLY A LITTLE WATER"

One of the first investors I met told me that the sharks were far more abundant than the water. We met in the lobby of the Park Avenue Hotel in Gothenburg. I thought this venue was a little strange, but nowadays I think it is the most natural place to meet investors in.

Back to the quote: he meant that there are few really good ideas but many sharks who want to have them. With help from the Chairman of the Board of NetClean, we have had a lot of protection against sharks. My advice to you is to make sure you have a guardian angel, because if you have a good idea you are going to need it.

## "FOCUS, FOCUS, FOCUS"

This is something Professor Sören Sjölander introduced during our courses. It was like a mantra and we joked about it. Focus, focus, focus… bla bla bla..

In reality this is one key thing to do if you would like to succeed. Focus. One simple word. When you think that you are focusing enough, re-think. You can focus even more.

It is focus in all areas. Focus in product development: make sure you create the right product with the right features for the purpose. Focus in marketing: build a simple platform to use and apply it. Focus in sales: continue to sell where you stand. It is easy to move to another customer when things are getting tough, but this is part of the process and you need to get through. If you are a small company you should focus on a limited number of customers to address, because if you are trying to get to all customers at the same time, you will not have enough resources to finish them all.

Focus, focus, focus. Three important commandments. Live by them.

## "USE PEOPLE AND CONTACTS BUT NEVER ABUSE THEM"

One of our first shareholders told me this, and we are trying to use it within the company. The meaning is simple – involve friends, talk them and make them help you. But never ask too much, or ask for too much. Failure is not an option.

A lot of people are helping NetClean on our way, but we always think very carefully before asking someone for help. If we are only asking and not giving back, we will end up using them in a bad way, and this will not create long-term positive relations, which are of most importance for being successful.

So… Don't be afraid to ask, but think before you do it.

## "HOW HARD COULD IT BE?"

This is our mantra at NetClean. How hard could it be? When we launch a new project we always start with: "How hard could it be?" Most of the time this is a stupid thing to think or say, because it is usually hard. But when we begin a project, it is good to have an open mind for the effort.

## "NOW THAT YOUR PRODUCT IS FINISHED, YOU HAVE TO FOCUS ON SALES"

Let's face it. Your product will never be finished. It is hard to know when it is finished enough to be sold on the market, but as soon as you have sold it, you need to start thinking of the next version, new features etc.

This is something I often hear from venture capitalists, and in some ways they are right if you mean: "Now we can sell the product and do not have to develop it any more before that." But the reality, I think, is a mix between product development and sales.

## "NO ONE WILL BUY YOUR PRODUCT BECAUSE THEY DO NOT WANT TO KNOW ABOUT THE PROBLEM"

This was the advice I got from a board of people who listened to one of my early presentations. The board consisted of around ten men who were supposed to give feedback to NetClean. Their conclusion was that it would not work and no one wanted to buy the product.

That was in 2003. Sustainable business had not yet been "invented". I think it is the same for all companies with a new product. Since the product is new, most people will not understand or believe in what you are going to do, because if most people did understand, you would probably not be among the first to do it.

## "YOU CAN HIRE 100 SALES GUYS WHO VISIT THE TOP 500 COMPANIES IN THE WORLD"

This is one of my favorites. We met with a Venture Capitalist who suggested that we should do what the subject says. It was that simple. Just hire them and they will sell the products to the Top 500 companies in the world.

To build a sustainable business, I think that the long-term perspective is even more important than with a "normal" company. People investing in you do not want a quick fix; they want a sustainable solution to a problem.

Furthermore, I think that when you sell a product which deals with a problem in society, you need to have respect for it and understand it, and your customers must believe in what you are doing, because you are selling something which is much larger than just a product. It is more than a product that is bought. Customers are buying a solution, and since neither you nor they can prove that it is the right solution for society, you have to make them believe in your solution as strongly as you do.

# 15 SOCIAL ENTREPRENEURSHIP IN THE GARMENT INDUSTRY: THE CASE OF DEM COLLECTIVE

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This chapter first introduces the Dem Collective enterprise, describing the business and activist aspects of the company. After a brief discussion of the existing literature on social entrepreneurship, the text focuses on the case. The company is then discussed in light of the roles of an entrepreneur. Not only producing and selling products and services, the entrepreneur is also an agent that propagates the spread of new ideas, production practices and consumer desires. The text is concluded with a brief note on how this type of social entrepreneurship relates to the wider notion of sustainability in business.

## INTRODUCTION

Dem Collective is a producer of cotton garments and jeans, founded in 2004. The two entrepreneurs who set up the company met during a course in project management, and got into garment production for one simple reason: they wanted to create the product that they themselves wanted to buy, but had failed to find on the market.

More specifically, the Dem Collective story begins when one of the founders – then working in the Gothenburg music scene – was looking for a T-shirt to be used as merchandise for music acts. None of the suppliers she spoke with could guarantee that their T-shirts were produced in good labor conditions, by decently paid, non-under-age workers who were free to unionize themselves. Having discussed among themselves, the founders decided not simply to complain about the state of contemporary global capitalism – they chose to create an enterprise that would provide a fairer deal to the workers. As the other founder had worked with development issues in Sri Lanka, it was natural for the two to set up a production facility in the country.

In many ways, Dem Collective is more than a company – it is also an effort to change how business is being done in medium- and low-income countries such as Sri Lanka. Hence, in the plant that the entrepreneurs set up in Kadawata, near Colombo, the workers are paid according to what the fair trade movement refers to as a "living wage" – a salary that a worker can actually live on. (The level of the minimum wage can sometimes be too low to provide sufficient funding for a worker and his or her family.) Moreover, the entrepreneurs have focused on improving the working conditions

in the production facility, encouraging the formation of independent trade unions – something that has yet to emerge in some of the countries in question.

Thus, improving the working conditions in low-income countries, while being as transparent as possible, is a key to the enterprise. This is in line with other parts of the fair trade movement, which can be seen as an effort to put consumers in the rich world in touch with producers in the poor world, letting the former group know about the everyday lives of the latter group (Luetchford, 2008). Indeed, this aspect of Dem Collective's work – spreading knowledge about global inequalities, and demonstrating the fair trade alternative, at conferences or in the media – is an integral part of the business.

In this way, the Dem Collective enterprise is an effort to intertwine the business of setting up a production facility, and the activism of advocating a fairer deal for the poorer countries which produce the garments that we wear. The entrepreneurs are thus balancing between "traditional" entrepreneurship and social activism, engaging in an activity that is often referred to as social entrepreneurship.

## THE SOCIAL ENTREPRENEUR: THE CHANGE AGENT THAT WANTS TO BE IMITATED

Recently, social entrepreneurship – as already exemplified above by Dem Collective – has become a topic of political and academic discussion. Entire volumes devoted to social entrepreneurship have thus been published by major publishers (cf. Nicholls, 2006; Bornstein, 2007; Elkington & Corrigan, 2008; Yunus, 2008). These discussions should be seen in the context of earlier socio-political deliberations on the need for social enterprises in contemporary Western societies (cf. Leadbeater, 1997; Mayo & Moore, 2001; Westall, 2001; Maltby, 2003; Palmås, 2003; Bode, Ivers & Schulz, 2004; Palmås, 2005; Young Foundation, 2006).

In a number of the studies mentioned above, there is one characterization of the social entrepreneur that constantly recurs, though it might be phrased in different ways. This is the notion of the social entrepreneur as a "change agent". Thus, Elkington & Corrigan (2008) speak of "world-shaping change agents", Nicholls (2006) uses the term "social change-makers", and a number of similar characterizations have been used.

Swedberg (2006) has shown that the notion of the entrepreneur as a social change-maker can be traced back to Joseph Schumpeter. Amongst Schumpeter's characterizations of "The Man of Action" who is the origin of "the perennial gale of creative destruction", Swedberg argues, the field of social entrepreneurship research can find a theory (albeit a Great Man one) of entrepreneurship – something that it badly needs.

The writings of Schumpeter notwithstanding, the contemporary characterization of the social entrepreneur as a change agent stems from Bill Drayton's work with Ashoka in the 1980s. David Bornstein describes Ashoka's social entrepreneurs as "transformative forces", more specifically as people with new ideas to address major problems who are relentless in the pursuit of their visions,

people who simply will not take 'no' for an answer, who will not give up until they have *spread their ideas as far as they possibly can.* (Bornstein, 2007: 1-2. Italics added.)

The spreading of ideas is another theme that can be found in many definitions of social entrepreneurship (cf. Clinton, 2007, chapter 9). Indeed, as Roger Martin and Sally Osberg have argued, a venture or organization should not be called social entrepreneurship unless it is designed to achieve a large scale or is so compelling as to *launch legions of imitators and replicators.* (Martin & Osberg, 2007: 36. Italics added.)

Having reviewed the literature, let us return to the case of Dem Collective: in what way can we conceive of the company as a "change agent" that wants to "launch legions of imitators and replicators"?

## SETTING AN EXAMPLE, PROPAGATING A CONTAGION

In what ways are the "business" and "activist" aspects of Dem Collective intertwined? How does setting up a production organization create synergies with the activity of advocating a better deal for the poor?

If we first consider the business side of the enterprise, one could simply argue that Dem Collective is meeting a demand for fair trade garments. This is, however, a simplification of the matter; the company is also creating a demand for fair trade products, through its advocacy efforts. This is, some would argue, always the case with companies that market their products. In this case, however, the creation of this market is motivated by a political, rather than purely commercial, ambition.

Conversely, if we consider the activist side of the enterprise, Dem Collective is not a traditional advocacy group or non-governmental organization. Rather than spurring change through demonstrating, mobilizing members or lobbying governments, the company hopes to set an example by constructing a viable business operation. This focus on the implementation of tried-and-tested techniques for fair production does, however, provide Dem Collective with an asset that "traditional" activists lack – the company can discuss and promote a tangible, actually existing alternative to existing business practices.

By proving that it is possible to produce according to Dem Collective's standards of fair production, and sell that product at a modest profit, the company does two things. First, they provide ammunition to the advocacy groups that pressure incumbent garment manufacturers to change their practices. Secondly, they show other would-be entrepreneurs (the potential "legions of imitators") that fair production is a fruitful path to choose. In this way, the act of putting together a business can be a political act – something that opens up new alternatives for the future.

In this way, the operations of Dem Collective's "activist-entrepreneurs" are not to be judged on the basis of the company's turnover or profit – and not even on the basis of how many people the company manages to employ. Rather, the company is a success if it manages to propagate the spread of fair production practices in an effective manner – whether these are used by Dem

Collective, an imitator, or any of the incumbent garment producers. Thus, the company structure itself is merely a vehicle from which the company's founders promote new fair production practices, which are meant to be imitated by other actors. Dem Collective is secondary to the "contagion" of fair production techniques that it creates in the garment producing industry.

This perspective – seeing the Dem Collective founders as social entrepreneurs focused on getting "imitators" to follow their lead – takes us away from Schumpeter's theory of "Men of Action". Indeed, this view of social entrepreneurship brings us closer to the theory of innovation and entrepreneurship put forward by Gabriel Tarde. Rather than the individual entrepreneur, Tarde was interested in how new ideas, production practices and consumer desires flow through the economy, as actors imitate each other. In these contagions of thoughts and habits, the entrepreneur is merely a conduit – albeit an important one (Tarde, 1902).

## SOCIAL ENTREPRENEURSHIP AND THE ROAD TOWARDS MORE SUSTAINABLE BUSINESS PRACTICES

This case demonstrates that the interplay of business and its stakeholders – a very complicated process – is further complexified by the advent of social entrepreneurs such as Dem Collective. The creation of sustainable business practices is not to be seen as a simple, straightforward process in which corporations must try to meet the demands of sustainability put forward by either governments or civil society organizations. By creating new products and business solutions, designed specifically for their sustainability merits, social entrepreneurs shape and configure the discussions between corporations and stakeholders. After all, it is the contagious ideas of these entrepreneurs that open up new routes forward, providing both business and its stakeholders with new strategies and ambitions.

In this way, social entrepreneurship can be seen as an activity that intensifies the process of innovation in the area of sustainability. By short-circuiting entrepreneurship with activism, social entrepreneurs can explore new paths that traditional business opts out of. For instance, it was a social entrepreneur – Muhammad Yunus, and his Grameen Bank – who rolled out microfinance on a large scale. It took a social entrepreneur to explore that path; what other paths towards sustainability have yet to be explored by other activist-entrepreneurs?

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# 16 CASE IKEA: A SMALL PERCENTAGE WITH BIG IMPACT

*Gunilla Clancy, Chalmers*

*Gunilla Clancy received her Ph.D. at the division of Chemical Environmental Science, Chalmers University of Technology in 2014. She has several years of industry experience, including having worked as an Environmental Specialist within product development at IKEA of Sweden. During this time, she participated as an IKEA representative in the Center for Environmental Assessment of Product and Material Systems (CPM). The research focus for her Ph.D. dissertation was on guiding product development towards more sustainable products.*

*In this chapter she presents the IKEA way of working with product sustainability, using cotton as an example. At the end of the chapter she points out three lessons to be learned from the IKEA way of working with sustainability.*

## INTRODUCTION

IKEA is one of the pioneering companies in Sweden consciously working with sustainability issues. Similarly to several of the other pioneers, the starting point was a combination of an experienced environmental problem (in the IKEA case the popular bookcase 'Billy', present in most Swedish homes and all over the world, turned out to provide their customers with smelly and toxic formaldehyde gases) and a sincere interest in providing real value to its customers in line with its vision of *to create a better everyday life for many people*.

The result was that IKEA already in the mid-1990s started training all its employees in sustainability thinking – something that today can be seen as naturalized into the IKEA way of doing business.

## CULTIVATE SUSTAINABILITY THINKING INTO THE BUSINESS

The aim is to cultivate sustainability thinking into the company. To cultivate means to introduce, develop and maintain sustainability thinking to be the natural way of thinking for every employee.[44] Sustainability thinking is not something for just the environmental department or management to do. Everyone needs to understand and take responsibility. Hence, sustainability thinking needs to be an integrated part of every employee's daily work. And since every employee has diverse work descriptions and responsibilities as well as learning and solving issues differently, together with a continuously changing world, employees have to repeatedly rediscover their way to use

[44] To implement is a common term used by engineers. However, it implies to include something alien (implant) that will never be integrated, accepted and used, and therefore to cultivate is a more proper descriptive term to use here.

sustainability practically in their work. Management should support its employees in this progression.

## THE IKEA APPROACH: ADAPT THE 4 PRINCIPLES FOR SUSTAINABILITY INTO THE IKEA WAY OF DOING BUSINESS

IKEA started to approach sustainability thinking in the mid-1990's by introducing a training program according to the Natural Step concept, i.e. based on the 4 principles (or system conditions) of sustainability. The Natural Step (Karl-Henric Robèrt and John Holmberg) supported IKEA to create the first version of a training program. The training was given repeatedly to reach all employees, and the training content was gradually developed internally by connecting it to the 'IKEA Way of doing business', which is based on the 'IKEA Vision *to create a better everyday life for many people'* and the 9 theses in the 'Testament of a Furniture Dealer'. This document is a very important internal steering document for IKEA in which the founder, Ingvar Kamprad, has formulated his thoughts about the essence of IKEA into 9 theses:

1. *The product range – our identity*
2. *The IKEA spirit – a strong and living reality*
3. *Profit gives us resources*
4. *Reaching good results with small means*
5. *Simplicity is a virtue*
6. *Doing it a different way*
7. *Concentration – important to our success*
8. *Taking responsibility – a privilege*
9. *Most things still remain to be done – Glorious future!*

This training is now available for all employees at IKEA on the company intranet through its e-learning tool. All new employees are instructed to go through the various modules and pass the test at the end of each module.

The word sustainability is not used inside IKEA since its meaning is perceived as unclear. Instead, examples of how IKEA takes care of resource management and people are described in a life cycle manner. The stories specify the minimum requirements that IKEA places on suppliers concerning protection of the environment, working conditions and child labor. These stories also describe what the suppliers can expect from IKEA in return.[45] However, although being the initial inspiration, the Natural Step is not mentioned inside IKEA. Instead the principles of sustainability are presented and adapted in line with the business idea and told in numerous success stories.

In other words, the four principles of sustainability are presented as four pillars to be used as guidance for responsible resource management and for showing respect for customers, suppliers

[45] See www.ikea.com/ms/en_GB/about_ikea/pdf/IKEA_SER_08_GB.pdf

and co-workers. Examples of guiding stories or, as IKEA calls them, *"small improvements towards a more sustainable IKEA"* are published on IKEA's homepage.[46] At IKEA, action competence is promoted by allowing learning by doing and viewing failure as an early warning to find a way of saving money. Consequently, it is official to work towards the same goal by trying to solve it in different ways. This brings out a sort of competition within the company and results in a resilient, innovative organization. For example, demanding an 8-hour working day at a supplier in China had the result that all the employees left. Hence, it is necessary to have respect and work with long-term relationships with suppliers, i.e. with continuous small improvements, and thereby to obtain a win-win situation.

*Example: IKEA's use of sustainability thinking in the Organic Cotton Initiative*

*Conventional cotton plantations use huge amounts of water, artificial fertilizers and pesticides: of the worldwide use, 6.8% of herbicides and 16% of pesticides are used for cotton fields, although cotton is grown on only 3% of the arable land. It is one of the worst polluters in agriculture. Therefore, the use of genetically modified cotton has increased tremendously and in 2009 it amounts to 54% of the total production. Although the organic cotton production is very limited, 0.55% of world production, it is growing strongly – 21% growth predicted for 2009 (according to the Organic Exchange).*

*Organic cotton is cultivated mainly by small-size farms that sell their cotton on the market. Thereafter the cotton goes through several steps, such as spinning and weaving, before it is used to manufacture a cotton article. Hence, the traceability of organic cotton is difficult. There is not yet a test for cotton fabrics to prove if they are made from organic or conventionally cultivated cotton.*

*In the 1990s, IKEA introduced a product range manufactured withi organic cotton. It included diverse uncoloured textile products such as towels and sheets. However, this ecological product range with its dull colors only attracted 'green consumers' and not the majority of people, which is central to the IKEA vision. Therefore this ecological product range was short-lived.*

*IKEA uses around 0.5% of the total world production of cotton, which is similar to the annual production of organic cotton. This means that if IKEA were to use only organic cotton, it would have to purchase all available organic cotton and no one else would be able to use organic cotton in their products.*

*The IKEA approach to promote more sustainable cotton sourcing:*

[46] www.ikea.com/ms/en_GB/about_ikea/our_responsibility/the_never_ending_list/index.html

- *IKEA today blends most of its cotton articles with some percentage of organic cotton to show that there is a market for organic cotton. In 2009, of the total IKEA use of cotton, 5.4% was organic cotton.*
- *Works together with the WWF to educate around 2,500 farmers in India and Pakistan in more sustainable cotton techniques. For instance, this means a more efficient use of water and chemicals, which results in an increased income and healthier watersheds. In addition, the result is that other local farmers get inspired to introduce sustainable cotton techniques.*
- *Works with UNICEF to eliminate child labor in the cotton-producing areas in India.*
- *IKEA is a founding member of the Better Cotton Initiative (BCI). BCI aims to promote measurable improvements in the key environmental and social impacts of cotton cultivation worldwide to make it more economically, environmentally, and socially sustainable.*

### SUSTAINABILITY NEEDS TO BE REJUVENATED

New employees start, others change responsibilities, and work is done in different projects with various groups of people. This means that sustainability thinking needs to be introduced, developed and maintained continuously when new employees and projects start. In other words, the employees must adapt the sustainability way of thinking to their local contexts to be able to use and spread it further. To do this demands interest, understanding and motivation of people rather than diverse tools.

### BALANCING SHORT TERM AND LONG TERM

Innovation and sustainability thinking are very closely connected. Middle managers are common sustainability bottlenecks, partly because they have difficulty balancing new ideas with current priorities. Their current priorities usually are short-term, and the triple bottom line for numerous middle managers is 'price, price and price'. One way around these bottlenecks is to intentionally create networks of managers charged with encouraging sustainability thinking. This kind of decentralized team can identify promising new concepts and prioritize them so that they receive the attention they deserve. The focus on 'price' is an important part of the IKEA culture as the products are meant to be affordable for the majority. However, if the incentive system only emphasizes cost-cutting and price, which is well in line with the sustainability focus of eliminating waste, then the other side of sustainability linked to more long-term innovation will suffer.

## THREE LESSONS LEARNED

1. In order to make sustainability a natural part of daily work for IKEA employees, the learning from outside was **integrated into the IKEA vocabulary and linked** to other important policy documents. By connecting the 4 principles of sustainability to the IKEA way of doing business, IKEA made the principles its own.

2. Through **repeatedly describing success stories** in a sustainability way of thinking, IKEA inspires and educates its employees, i.e. **cultivates the sustainability thinking** in the company. However, this sustainability thinking **needs to be rejuvenated** each time a new project is started or a new person joins the group.

3. As **middle management** commonly has a short-term agenda focusing only on cost, there is a need of specifically focusing on their way of understanding and 'acting' sustainability. Hence, there is a need of both considering learning opportunities and middle managers' incentives for sustainability. Their motivation can be influenced both by the **design of incentive schemes** (how leaders are remunerated and promoted) and by social pressure through their **participation in experience-sharing networks**.

# 17 CONCEPT DEVELOPMENT IN LARGE CORPORATIONS AND IN SMALL TEAMS

*Per Gyllenspetz, Yacht and Car*

*The author of this chapter, Per Gyllenspetz, is an industrial designer with 30 years of experience primarily from the automobile industry, where he has been involved in developing several concept cars, numerous designs, inventions and patents - including many sustainable concepts.*

*In this chapter he presents personal stories about concept development and creative work. In nine individual sections he explains the major learnings.*

Showing unceasing and continuous belief in your strong ideas will have impact on the organizations in which you work. Your attitude provides visionary energy. That is what almost all successful industries and labs have in common and have rooted from; people who describe a new future. This is the opposite to the all too common culture of controlling current measurables. If you will succeed in the lonely quests - well that is what is up to you.

I would like to keep these tales of technology development focused on the humanistic angle on creative work. My chapter is an encouragement to those aspiring to create new solutions for the environmental problems that surround us. The aim is to focus on the important non-technical aspects for making successful businesses based on technology concepts development.

*"Having fun and being irrational is productive"*

## CARS, CONCEPTS AND PEOPLE

Advanced Engineering[47] (AE) that works in real life doesn't always follow a logical or consistent line. Even simple and playful activities such as finding a piece of mechanical scrap and asking yourself "What use might there be for this thing?" may lead to unforeseen leaps in advancement for humanity. The resulting purpose or product use may also be different than the original intention. Toyota, 3M and other corporations have practiced similar strategies to find nuggets of innovation. AE and science research are related in their nature.

[47] Advanced Engineering (AE) is the engineering development phase where concepts are created, and the phase prior to a product development project. The phases in product development are: Needs – Idea – AE Concept – Product Development – Industrialization – Product

In some parts of Volvo in the 1980s, the work environment resembled a research lab more than the car producer it is. The company had a reasonably small bureaucracy. But Volvo was not just any car producer. It had a reputation of making the world's safest cars. Also they were mostly made with outstanding quality. Things like the seats were rated the best in the car world. It was a car created with a lot of honesty and brainpower. Those intellectual ambitions spoke with a clear voice and attracted a group of customers that were not so tempted to buy the regular car. Volvo became the car choice no. 1 particularly among American college professors, doctors and lawyers. There seemed to be a reflection and **intuitive communication** through the product between the creators and the customers. Volvo made huge income from selling a funky-looking 3rd edition of its 140/240 model. The company seemed committed to turn that revenue into even better products.

## THE THERMAL CONCEPT CAR – TCC

In 1985-86 I had the luck to co-work with some of Volvo's 'in-house researchers'. One group of men and women had set out to create the ultimate climate system for cars, the Thermal Concept Car (TCC). No limits. Expert researchers and consultants were contracted.

The TCC team was consulted to evaluate an idea I had: that very large air outlet areas covered by breathable textile would be beneficial to a comfortable and cooling car climate. Their answer was yes, true to some extent. But only when the initial extreme heat conditions that usually occur in parked cars were replaced after a 5-to-10-minute cool-down. I resisted accepting the TCC team theories at first. Not until I had the chance to experience their prototype built into a running car – with a ventilated seat, super-laminar air vent spouts and lap cooler – did I realize the importance of the suggested two-step process. It consisted of first and quickly cooling down the occupant body with fast jetted air, and also by evacuating moist air and heat from the seat. Less energy was needed to produce an improved performance.

The experience of the energy crisis in the late 1970s had not faded yet. Means to reduce fuel/energy use were researched. A traditional air conditioning system uses several kW, as much as the energy needed for propulsion of the car in congested traffic on hot roads. There were good reasons to increase climate system efficiency in cars. But in the TCC project this was not a priority. In today's light, the application of the solutions had evident environmental advantages.

I remember how impressed I was by the TCC test vehicle. It had a full size manikin with numerous sensors covering its surface, and it was connected to a large computer that registered statistics when testing on the road and in the climate wind tunnel. The computer occupying most of the trunk had support current delivered from a photovoltaic panel on top of the trunk lid. Voltman, the manikin seated in the front passenger seat, had a dignified appearance, dressed up complete in a suit and bowtie. It all looked smart, efficient and innovative – and definitely fun. It seemed that the **teamwork** in the group was inspired, too. In order to get proper testing data in realistic conditions, the vehicle and the team including Voltman also traveled large distances on road.

Several things spoke to me: by analyzing human needs first and thinking impartially, new downsized and better solutions can emerge. More and bigger is necessarily not better. The TCC team also

created difficult challenges; every aspect of climate interaction with humans was taken into account and controlled. The challenges energized the team. So did the work environment – trips crisscrossing grand landscapes north and south in the world, dining and lodging in attractive locations, getting many positive moments together discussing, solving problems, reinventing. There were periods of working all the time and they were having **fun at work**. They created smart and **fun solutions**. The research results were impressive and world-class, and in fact still are, more than 20 years later. So why were these research results never commercialized? I would like to use this and a few other exemplary projects/businesses to describe my findings to date. And I will get back and give the startling answer to that question later.

## THE VOLTAIR AE PROJECT

Personally, I had the ambition to create a driver's environment and an interior optimized to human factors by use of the emerging new information technology (IT). There was no particular environmental ambition in this scope at the start. The project had a clear focus on active safety: keep the driver's attention on the road, make easy-to-use controls and do away with the maze of confusing buttons in the centre stack, and free surfaces for human needs like climate, acoustics and storage. Like many innovative initiatives at the time around the mid-1980s, the Voltair AE project was granted a fair amount of finance.

I ended up incorporating the new small TCC vent design. The form was actually quite beneficial to the general impression of the dashboard. Although the TCC-prototype vents were made of aircraft-type aluminum honeycomb blocks, I envisioned possibilities of designing attractive patterns for laminar air streams in future products.

The Voltair AE project was presented about a year after start for the middle management at VCC. I designed a special showroom for the car with the built-in interior and the adjoining slide show. I think that the way an AE project is shown to decision-makers is crucial for the success of the implementation of the findings in future products. But at this time in my career I was not aware of the needs of decision-makers and the very important selling aspect of my projects.

Let's look at the mental circumstances surrounding decision-making for AE and early concepts. Most companies have **structured methods for how product projects** should proceed. The systems may work reasonably well in the product engineering and production phases. But I have rarely seen an AE project flow smoothly according to a prescribed plan, through all stages and ending in production – let alone an efficient show sequence making all the sense needed for the people who are to decide the continuation.

## SELLING THE NEWS

I want to stress the highly important moment when it is time to review and decide about the future of the AE project. The show may typically be scheduled as the last item on the agenda of the

Engineering Department manager meeting. Normally there will be an exhausted group of people that have difficulties in looking up from the near-focus of fire brigade action that may often be the normal task of company leaders. The AE project leader and inventor must try to sell the created baby with a limited perspective on their own deeds and probably using poor pedagogical methods. And there is probably just one chance to succeed. If the aim is to make people understand something they didn't know about and enable them to make good decisions about this, then the chances are poor, or very poor. If the presentation is part of a dedicated joint AE show, there is a better focus on the strategic and futuristic nature of circumstances that an AE project has. In this type of show and decision point, other problems may arise.

*We need to hear unexpected news several times - before we may believe and act. Photo: Per Gyllenspetz*

Media researchers have found that entirely new news which has no previous reference is usually dismissed by the public. "FIR TREE - MUSHROOM MUTATION GROWS UPSIDE DOWN, recently found on minus gravity spot in Tiveden National Park crevasse". We don't have any similar previous information in our brains; there is no existing "folder" to put the information in. Not until you have received the information a few more times and also preferably from different sources do you create this new folder. Then you may start to believe the strange news. Advertising professionals know that **a new message has to be repeated** to reach successful customer action.

The bottom line of this is: the "selling" activity around the AE findings must have a success strategy before, during and after the decision point. The receivers should have two or three chances before the show/decision point to get familiar with the general aims and solutions. Also at the beginning and ending of the show, the show talk and text need to be summarized in easy language and clear pictures. It is beneficial to **allow the audience to experience the result with several senses**, especially those supplementing the intellectual understanding. It may be wise to declare that decisions are not asked for at this main presentation event. Follow-up shows and meetings are productive. Hand-out 3D models or the like, as gift reminders, can help to create that awareness folder in the brains of the people who are given the responsibility for the future product content. There is room for huge improvements in this selling aspect of AE projects. The Voltair project was an AE success but a communications failure. Only a few of the ideas had an impact on future products.

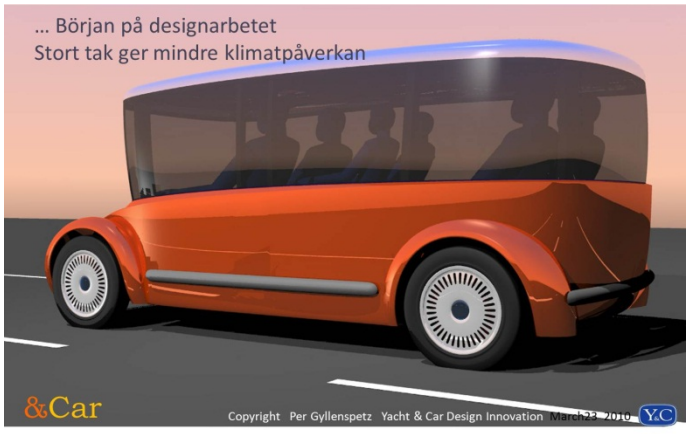
## DISAPPOINTMENTS

The disappointing effect of the usually poor AE surrounding conditions in practice is that an organization like Volvo's, as I know it, has put relatively few of the many researched solutions into production. A management with a utilitarian mindset on decision-making easily and paradoxically fails. This organizational failure, coupled with negative self-esteem, acts as a corroder on the company. The fact that competitors later have presented similar solutions may in some instances have encouraged leaders to finally put some of that in-house AE into a product release. This gives the appearance that the company is a slow or at best a fast follower, when in reality the case is much the opposite if one looks only at what the staff is capable of.

Here are some sequenced examples:

- The TCC ventilated seat of 1986 reached production 20 years later in the Volvo S80 Mk II, only after a wide range of competitors had offered similar products for several years.

- The big Light Weight Design (LWD) AE project made several world-class findings in 1997. The aim was to test and develop new technologies with lower environmental impact for future full-size cars. This and the subsequent FVL concept made radical, yet realistic, propositions for cutting car weight and emissions by half. There were no competitor references – i.e. a difficult decision point for a system with poor self-confidence. Several reorganization attempts, the merger with a larger car manufacturer, plus what I think was a management and product planning unable to renew the innovative and profitable house culture of the 1970s and 80s, followed. Despite a very thorough presentation campaign, the management did not decide on any implementation. In 2007 Toyota presented a full composite Prius-size lightweight car concept, the 1/X Concept. Volkswagen showed a similar technology for a smaller vehicle in 2008.




*&Car is an idea for a lightweight composite city car. A large and shading roof on a slow speed car reduces the need for energy consuming air-conditioning*

LEARNING:

Both projects would have benefited from having a strategy for **in-house marketing** from the start (see below). Preferably the AE manager who signed the project grant should be given personal updates on a regular basis so that the project would become his or her "own" project. This would make way for the top management to start asking when it would be ready, rather than being more or less unaware until the presentation day.

ANYBODY TO BLAME?

If anything is to be blamed, it is the house culture, with procedures focused on measurable engineering factors as well as product planning centered towards benchmarking and on linear pragmatism, where there had to be quantified logic reasoning behind all new propositions. Productive chaos and contradictions were not always popular, let alone arguments like "it feels good". The product design function rarely managed to reach its full potential beyond styling. AE projects driven by "believer enthusiasts" needed a lot of skunk working and a lot of luck to reach outside lab doors. Several of the above-mentioned benchmarking companies left Volvo way behind.

LEARNING:

**The production of a car is basically a linear system – but its creation isn't.** This observation points at potential opportunity treasures for a modern car company. Today's fast-changing market wants products that nobody actually makes yet. Rather than asking whom to blame in this experience, it is more interesting to ask: **Who will make those cars with true dedication to family needs, to intellectuals, to the elderly, and for clean city use?**

## THE IMPORTANCE OF A CONFIDENT HOUSE CULTURE

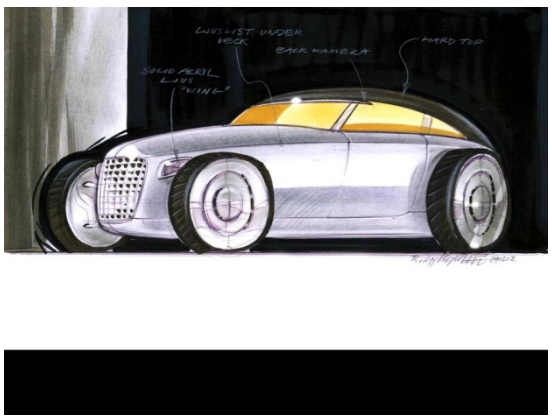
There are, of course, examples when things went right. One is the Volvo Environmental Concept Car (ECC) of 1990. Here the Volvo in-house "believer enthusiasts" and brainpower made a fantastic joint effort. They connected with a courageous management. Great ideas went public and made a huge impact worldwide, both on competitors and on policymakers.

*The 1991 Volvo Environmental Concept Car, ECC. A great team effort with new shapes and environmental initiatives combined to create an outstanding concept. Photo: Volvo Cars*

The concept also strengthened the Volvo house culture. But the idea of a product derivative was debated for long, largely negatively influenced by the financial crisis in the beginning of the 1990s.

Volvo has a reputation of being a world leader in car safety. Many safety innovations are the result of in-house ideas. For example, read the story about the SIPS bag below. Today this life-saving system can be found in most current cars worldwide.

It may seem to some that it should be enough for a small car manufacturer to be a leader in one area, like safety. It is expensive to invest in new technology and patents. This discussion ranges out towards the business models that owners and leaders use for their companies. With my limited experience in this field I cannot paint the full perspective. But there are (car) companies that do encourage a high level of free innovation in many parallel fields. These companies also reach a positive effect in getting a more **positive relationship with the employees**. Moreover, they probably reach the market first and have a good chance to charge a price that covers those special R&D expenses.





*The price winning light weight V8 Speedster. Hands-on work gives enhanced idea creation. Photos: Per Gyllenspetz*

Many Swedish companies, like Volvo Cars, house a development staff that has innovation in its blood. If this innovative skill, whether of a particular Swedish character or not, could be incorporated in more long-term business models, it may turn out to be a yet **unused industrial**

**motor**. In this particular era of ours when new methods for a sustainable society are urgent, it appears to be something to take a good look at: **profitable sustainability** provides **sustainable profitability**.

*V8 Speedster; carbon, aluminum and ethanol power. Photo: Bilsport Magazine*

Besides, there is an unawareness of the totally different natures of AE and production engineering. In addition, there is a house culture often lacking the knowledge of the benefits of in-house marketing of AE projects. Inventors and project leaders of AE projects, like myself, have been seen too many times confused and dumbfounded at the summons of a presentation. The question from responsible managers has been put time and time again: **"If this new solution really does have all the advantages you show, why have we not seen it before on the market?"** What can you answer? Maybe this would be a proper answer: "All great success involves great risk." Presumably the more impulsive and opportune answers like "I am a great inventor" or "If you ask that question, how can you have that job?" should be avoided.

This is the specific point that differentiates leaders in innovative companies, i.e. innovators (leaders who can lead their companies to innovate and build new markets), from managers who can only administer and follow. As a curiosity, this 'follower management' is very similar to what existed in a 'commando economy' – i.e. this behavior is very close to what was the main reason why the Soviet system never could innovate.

> "When a new invention was made, such as an advanced Soviet machine tool manufacturer winning first prize at an international trade show – then the inventing Soviet company as global leader in this segment expected to get orders for their new machine. However, the response was *'no, there is no need for such machines, so you are not included in the next 5 year plan'*.
>
> The reason was that the Soviet Planning Ministry carefully researched the need for new machines by studying the markets in the US and Western Europe, and when they did not find any such machines in the industry in these markets, they concluded that there is no need for it. I.e. the Command Economy was designed as an imitation economy (except in Space and Military areas) and hence, innovation by being first in the global market place was blocked by administrative rules." (Alänge et al. 1992)

## CREATIVE IDOLS

When highlighting how concept creation happens in the truest manner, the major factors seem to point to **positive relations between people**, i.e. social matters. The obstacles are seldom physical or technical. It's the people that do it – or can't do it. One of the driving forces is the attraction that mindful professionals have: people whose way of thinking and working radiates the confidence that someone has, who trusts their personal capacity to make original solutions and creations. I have had the opportunity to co-work with several such people. They are creative idols to me – like my stepbrother, the professional inventor Göran Palmers, my good friend and CEO at OZ Marine R&D AB, Stefan Larsson, and the always merry torrent of innovation at Volvo, Stig Pilhall.

Read the article by **Al Gore 1994 on Stig's** award-winning airbag:

http://discovermagazine.com/1994/oct/1994discoverawar431

> "Volvo's Side Impact Air Bags
> Automotive air bags mounted on steering wheels and in dashboards can dramatically reduce injuries from front-end collisions, so it's no surprise that they are becoming more common in production cars. But engineers have long been stymied in developing a means to protect drivers from side-impact collisions – which are responsible for more than one-third of all passenger-car collision fatalities. The trouble has always been finding the right place to mount them. Volvo, it seems, has finally found a good answer.
>
> Led by Stig Pilhall, Volvo engineers in Gothenburg, Sweden, realized that the obvious place was in the door. The problem was that they needed a very large bag because you can't anticipate whether the driver will be sitting close to the wheel, stretched far back, or somewhere in between. And the bigger the bag has to be, the longer it takes to inflate.
>
> So instead of developing a door-mounted air bag, the design team produced a system in which an air bag pops out from a seam along the outside edge of each of the front seats. This guarantees the bag's proximity to the driver's or passenger's torso, so that the bag can act as a cushioned barrier to a crunching door. When the car's frame is bent enough to make contact with the seat side, a sensor trips a firing pin that sets off a tiny explosion inside a tube lined with a pyrotechnic powder that burns at the rate of 7,000 feet per second. When the flash reaches two gas generators mounted in the seat back, the 6-by-12-inch bag inflates. The entire process takes just 12 milliseconds. This side-impact protection system will debut in Volvo 850 Turbo sedans and wagons before the year is out, with other models to be equipped next year. On models for which the protection system is not standard, Volvo expects the option to cost around $500."

Stig had a daring attitude on how to get through with his inventions. I witnessed one occasion when several middle management people together with supplier representatives had a fairly large and cumbersome conference about interior panels. Many important things had to be treated; the long list of the agenda lay on the overhead machine.

Suddenly the door opens and a humble yet confidently smiling man strides towards the machine and removes the agenda and instead puts one of his drawings in the light. He excuses himself and

says he only wants to use a few minutes of our time. He finds it useful to show his new seat hinge now that all the people needed for a decision are present. Everyone in the room is astonished.

Nobody else but Stig Pilhall would do this. I think he calculated that the only chance he had to get his information through was at this specific point in time; the benefit for the company in implementing his solution was bigger than the inconvenience he created for himself and the conference participants.

LEARNINGS:

Well, this is nothing I advocate as a general mode of behavior. But the example shows that useful unconventional thinking may need the use of unconventional acting.

## THE PRECIOUS CONTRADICTION

Those creative people and other developers, project leaders and managers that I have preferred to work with all share a quality that may be very surprising. They **contradict themselves** now and then. And they don't excuse themselves for this, or they don't care, or they are unaware of it. I respect this irrationality, because it says to me: "This person does what I do; it resembles my own irrationality".

Small children seem to be creating irrationally. Schools put great effort into teaching children and young people instead to think rationally and promote logical argumentation. Some graduates manage to escape with their irrational holistic fuzzy thinking more or less intact. Becoming professionals in industry or academia, some of them learn to play by rules of **the game of 'linear is true'**. They supply the current paradigm with what it asks for, so that they can get the project approvals or grants needed to proceed with their work. They know it is a necessary *pro forma* activity. They are the ones who may succeed. Back in the lab or wherever the thinking goes on, they do things their own way in any case. A few of those people become heroes in science or innovation. There is solid evidence for this. News published only in the past year is telling the same story; a few of the greatest success products from Sweden's largest companies would not have happened if they had been developed in accordance with the in-house development systems and decisions.

So, here is probably a bit of news for you: **Contradiction and irrationality are productive**. Do you have a folder yet for this? By the way, do you also have a folder for what happened in the National Park? No? Okay, I thought so – and you don't need to, because it never happened. But perhaps you may benefit in your developer career if you create a folder or space in your thinking for the productiveness of irrationality.

If you want visual evidence of this productive irrationality, go out into the forest on a sunny day in late spring. I am not expecting you to find mutated fir-mushrooms. No, this is much easier. Find a large anthill (try to avoid getting pinched) and study the activity going on in the surroundings. See one ant carry a pine needle around in circles and eights, see a group of ants trying to move a piece

of wood that is not only way too large, but watch some of the ants also trying the impossible struggle in different directions. See thousands of worker ants marching in straight lines as well as others milling about seemingly with no purpose. Then look at the magnificent result of this activity, the anthill.

The well-written book *Extreme Toyota* by Osono, Shimizu, Takeuchi treats the topic of contradictions in an interesting way.

Organizational charts and ISO proofing à la Bonheur, for a production organization they work reasonably well. For innovative functions we need **other kinds of qualitative rules** and measuring methods. I also think that the innovation systems in the eco-era need to be reformulated. We can't afford to waste good concepts because they don't fit into a template.

Sustainable concept development is prolific when fed with input from an **interdisciplinary discussion**. If you are not able to look at several aspects simultaneously, the success can be hard to reach. There is an advantage in being able to keep many balls in the air at the same time.

So what happened to all of the new science that the TCC team created? Well, if you are by now beginning to accept the view of industrial irrationalities, you may see the obvious in this: the Public Relations Department was given the project. All findings were successfully used in **international PR activities!** None was transferred to production projects.

## OZ MARINE R&D AB

One of the persons in the TCC team in 1986 was Stefan Larsson. As a Volvo employee in the 1980s he was not attracted by the practice. He quit his secure position at the large company and started his own. We stayed in contact and became friends. Many business lunches with Stefan, or seaside encounters aboard for that matter, have resulted in new ideas. Those creative moments can be likened to a **mutual game of building solutions to a problem**. One person launches an idea that would solve a problem. The other person quickly responds with approving and supporting with additional ideas – or questions the idea, even disregarding it. The moments are mingled with sailing or attending to kids. No apparent order. In a yet steeper innovative process, the respondent trumps with a better proposal and challenges the original initiative.

This is the case with OZ Marine and it is the foundation of the company. The OZ Marine line of innovations stems mainly from a discontent with the state of our seas. Over-fertilizing, exhaust pollution, oil spilling, smell, noise – our society's simultaneous loving/destruction of the marine environment. Sure systems for pleasure crafts can be made cleaner, and why not simpler and easier to use?! Larsson has a remarkable ability to work efficiently through all the aspects of innovative engineering. He makes simple drawings on paper and develops inner visions as a kind of 3D "brain-CAD" of the ongoing projects where he twists, turns and builds ideas, preferably before going to sleep.


*A fun, irrational and creative process can make rational and perfect products*

The results include several entirely new products as well as detailed solutions. Many are patented. Most of them offer great solutions to the problem above. Stefan Larsson has a good number of supporters around him who have been crucial to his success. His device rules for his work are these: A. Do it yourself, B. Have fun, C. Make profit.

## THE SEAT FOR THE FVL PROJECT

This was a pre-production environmental concept car. The vehicle needed ultra-lightweight seats with entirely new demands and functions. The seat was one of the key components in the car, because the reduction of weight in the seats would make a considerable impact on the reduction of weight in the rest of the concept. Car seats weigh in the range of 20-50 kg depending on exclusivity.

I remember a mid-vacation summer meeting in the late 1990s with a very large supplier and automotive parts manufacturer. There were seven representatives with expensive-looking suits, middle management men, looking to sell more of the things mass-produced in their worldwide network of factories. On the other side of the table were two Swedish guys in T-shirts with summer-tanned arms. The Volvo seat department manager and I had a different interest. "Are you able to make an AE concept seat with full comfort and flat-foldable to 10 cm thickness weighing 10 kg?" The men across the table had difficulty in understanding and acknowledging the question. Their mindset was something different – they wanted to convince us to buy what they were able to produce today. Two different interests, two cultures were clashing. So the question was repeated: "Would you be interested in making a revolution in car seating?" It took a while and long listening to broad and loud talk until we got a chance to convince the company representatives about our needs. By the end of the meeting they promised to deliver.

But there seemed to be trouble in the communication. Looking back at this occasion and reflecting about how to introduce an entirely new issue to a group of people, I think also here I would work more pedagogically. The manufacturer people needed a "folder" to hold a novel functional and lightweight concept like this. In a way it would also be **my responsibility as the visionary** to help them create that. This takes efforts that have little to do with the physical world of engineering.

As it were, we learned very late and right before the deadline that the large company failed to deliver what we asked for. This was big trouble for the project. Instead, an innovations firm was asked to create solutions and deliver the foldable prototype seat. The small Norwegian company was already working on another lightweight arrangement. They were now also hired for this new task. Amazingly, in just a few weeks and just in time for the presentation they delivered the seat. This was a great relief for me as the project leader. This company had focus on solving problems and creating innovations. They were "living" innovation, every day. Their tech manager had an exemplary capacity to understand engineering problems and device solutions. His methods were to use styling sketches to envision for himself and his staff what to do. He enjoyed building trial mockups and prototypes by himself in the downstairs workshop.

Savoring an extra-long coffee break by a sunny window in the cantina after the FVL concept presentation show, the tech manager Ulf Tolfsen and I spoke about our experiences in our professions as advanced engineering doer managers. It was fun to talk and we seemed to share the same view about the early phases of product development. We agreed that too little effort is spent on the start-up phase of projects and that **far too much time and resources are used in later stages** on trying to correct all the failures and neglected issues in the early phases.

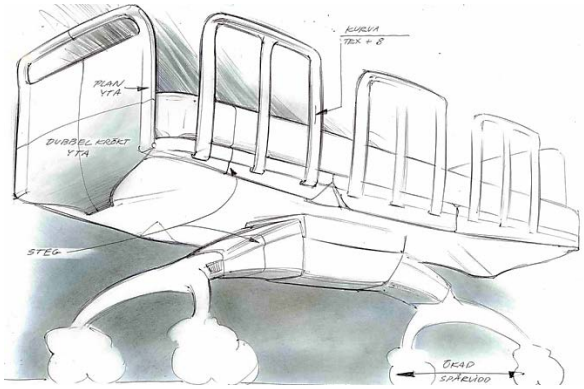
We invented the term Reduced Lead-time Development (RLD). This means:

- Formulate what you want to do, the problem to be solved, so that everyone on the job understands.
- Find out prerequisites valid for the target user, investor, development capacity, production, etc. first.
- Involve the top management and key people, including AD/PR people from day one.
- Scan solutions to the problem by ideation processes, use both brains and hands, have fun.
- Save a lot of time and money when you enter the later stages of production engineering, because you have made the effort to take most of the bugs out of your project in the early stage. All key people know and accept what you are doing.

## THE HOSPITAL BED

This Norwegian innovations firm "walked the talk". They were doing it: being practical, using hands and pencils and paper a lot – using CAD only when it is better. And the firm's innovation record was admirable, with many patents. I was offered a position in this company. One of my

main tasks would be to develop design and function for a hospital bed. A new innovative composite material was to be industrialized. The perspective included production of car parts in a later stage. The material and process offered several environmental and engineering advantages. I accepted the job and a new great challenge.




*So-called innovation systems may stop ideas and entrepreneurship despite the good intentions*

The Sahlgrenska University hospital and other governmental and private initiatives had interests in the project. It looked very promising. A bed that would be much lighter, easier to clean and easy to use, plus many new functions. Everybody wanted it – the bed seemed to be a given hit. Then there was the financing bit. Our CEO spent much time in meetings with officials at the financing institutions. After a couple of years of ever more detailed preparations, complying with prescriptions and writing plans, it seemed that there was an immeasurable need for this administration at the public institutions. There was a great gap in understanding how product development works in the small free enterprise world.

The still reigning paradigm for innovation systems, where the academic institutions are playing a central role, does not truly include the small business conditions. Here, there are limited resources to spend on projects that are not billable at the end of the month. I remember my boss visiting my Swedish branch office on his way home to Norway after one of the frustrating meetings with officials. "This is insane, it can't be true!" he sighed. "I have written every possible paper that may be needed and still there is no conclusion. I can't take this anymore." The fantastic rational and innovative hospital bed project has slept since that day in 2003.

The co-project, the high-volume environmentally advanced composite factory, is yet to be built as well.

Instead, I had the chance to work with many other interesting and groundbreaking AE projects with the Norwegians – some with great success. In summary, several years with this Norwegian firm, developing concepts for a good number of customers, provided an important experience to convey: **The more advanced and different your finding is, the more effort you need to spend on making the job initiator understand the solution.**

## SMALL COMPANIES

I often put this question to my small company customers: **Are your products green enough to meet new market and legislative demands?** It is a painful question to ask, since many company managers know their products are not and that it is a problem. I see this as an opportunity, and by this I invoke an 'aha-experience'. My view is: of course you can sell products/services that have much more sustainable characteristics. It is very much a matter of looking at the company in a different perspective. What is the service or the experience that you really are selling, what is the effect of current products? **Are there other ways to deliver that service or that experience?**


*Hands-on development with small company CEO's keeps administration low and gives results fast. Icelandic Arctic Trucks produces ultimate low environmental impact arctic vehicles. Photo: Per Gyllenspetz (left) and Arctic Trucks (right)*

My success in pursuing and leading projects depends on my network of associate professionals in related engineering fields. I am very interested in understanding the basics and the news in each area, as well as being respectful of professional expertise. I spend much time reading, e.g. about clean tech, and I take all the chances I get to listen and talk to experts in technology, sustainability, societal change, etc. I gladly share any non-confidential knowledge because I know that something always comes in return sooner or later. This **open knowledge exchange** is very important for my capacity for problem-solving and sustainable concept generation.

An interesting fact is that small company customers/leaders often are non-specialists themselves; they are mostly **holistic viewers** as I am. That is why the CEOs of small manufacturers and I have few problems in understanding each other. Meetings with my customers may crisscross many topics that nurture the mutual ideation. Nice experiences and stimulating environments often feed the interactive thinking and talking. A trip on my yacht, my wife's freshly baked scones or an experimental mock-up demo may inspire. The trick is to take meeting notes and sum up what has been said and take decisive steps. This is the **equally healthy opposite** to the enthusiastic chaos discussions.

I am also a firm believer in **planning projects accurately**. I (almost) always begin by making a list of prerequisites, and I cherish many of the concept and ideation development methods. First find out what are the needs for the function or service to be created. There is ample literature treating all these topics.

Altogether I have three decades packed with innovative concept work, and much of that in the sustainability frame. I hope that my outlook on the nature of concept development can shed some light for students and professionals on how to become successful developers – how both small and large companies can improve their ways to create attractive products for our time.[48]

## MAIN LEARNINGS

1. A fun, irrational creative process can create a rational and perfect product.

2. Use planning, use development methods AND embrace contradictions.

3. Put considerable effort from the start into communicating what you do.

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[48] Also read about small-scale chaos when creating concepts vs. large organization discipline, which is a topic treated in Gyllenspetz 2007, *The creation of car concepts in small vs. large organizations.* This paper is available to download as a Cumulus Working Paper.

# PART III

# QUESTIONS AND REFLECTIONS

# 18 QUESTIONS AND REFLECTIONS

*Sverker Alänge and Mats Lundqvist, Chalmers*

Throughout this anthology you have been confronted with concepts, solutions, questions and reflections that have been more or less new for you. Although some of the chapters are based upon extensive interaction among the authors, most were written in relative isolation, receiving only comments from the editors. Some of the authors participated in an inspiring half-day workshop in December 2009. During spring 2010 the first beta version of the book was used, first in the idea evaluation course at Chalmers and University of Gothenburg and then in a 10-universities course in Nicaragua. Experiences from these two courses were used as input for two authors' workshops in April and October 2010. In addition, some of the experiences gained from teaching 'sustainable business development' were presented at the EESD 10 conference in September 2010[49]. The further use of beta 2 and beta 3 versions in the 2011 and 2012 courses in idea evaluation provided further feedback and improvement of the content. In 2013, chapters 2 and 4 have been updated and a new chapter 7 on Life Cycle Analysis (LCA) has been added. We are now ready to publish the first official version of the book at Chalmers University Press.

To our knowledge, this type of anthology is relatively unique. We see few examples of authors writing about their own entrepreneurial experience in reflective ways. We are very proud to display this strong example of not only learning-by-doing but actually writing-while-reflecting-upon-learning-by-doing. In a world where most texts about business and also sustainability are written by academics or consultants and for big business, this anthology displays another perspective: more entrepreneurial, less "corporate", and more experiential. We believe that these voices from engaged and entrepreneurial individuals, regardless of where they have been situated, bring some unique values.

Here we will only begin a process of asking questions and reflecting beyond what is presented in the separate chapters. You as a reader, of course, should feel free to share any reflections you have gained through reading the anthology. When we receive feedback and also gain some distance to this beta version, then a new version will be produced.

This chapter will subsequently be focused around the following questions raised by the examples and reflections in the anthology:

- What can we learn about sustainability?

[49] Alänge, Sverker and Mats Lundqvist (2010), "Sustainability through business development of early stages ideas: experiences from an action based pedagogy", *EESD 10 International Conference on Engineering Education in Sustainability*, Sept. 19-22, Gothenburg
http://eesd10.org/conferenceproceedings/pdf/EESD2010_0113.pdf

- What is special about sustainable business development?

## SUSTAINABILITY

Most but not all chapters in this anthology have related to "sustainability". Many of the cases promote products that are ecologically sustainable, e.g. Ecoera and Vehco. Some of the cases focus more on social sustainability – such as Dem Collective and NetClean. Regardless of which type of sustainability is in focus, a key reflection is that any fuzziness around the concepts becomes very clear when related to specific offerings, products and business models. Sustainability in terms of minimizing climate change might not be solved once and for all through these offerings. However, we as citizens, customers, etc., are taught through the way all cases communicate about sustainability that they offer solutions which make the world a somewhat better place, at least relative to what is offered today by others. Sustainable Business Development is thus a matter of communicating and convincing not only about customer utility and/or business utility (which is what most literature focuses on) but also about societal utility. We have learned that there seem to be creative ideas and solutions that do not force us to compromise one utility at the expense of another. This insight is analogous to the wisdom within quality management: that there is always a way to improve quality while simultaneously also reducing costs. In our sustainable business version the axiom can be: there is always a way to improve societal utility, customer utility and business utility in tandem – never one utility at the expense of another.

While we would argue that ecological and social sustainability is relatively well explained and understood once it is concrete, we are more concerned about the third: economic sustainability. Cases Vehco and NetClean, perhaps more than other cases, emphasize also economic sustainability. These cases are, of course, further downstream and have gained more experience. However, the point they make is really about the importance of securing your economic business model, if you really want to make a long-term and big impact. Economic sustainability in these cases and many other cases is something far from short-term profit-making, "clever" financial engineering, and the greed that in 2008 resulted in a financial crisis. Economic sustainability, on the contrary, judging from the examples from this book, is about being very close to your stakeholders, always learning, while consciously packaging this learning into robust products and services. All this can be done while also paying respect to ecological and social sustainability.

Most of the cases are directed towards different needs. However, in the Dem Collective and IKEA cases we actually have some interesting overlapping activities that both seemingly have some effect on the overall textile industry. The global production of sustainable cotton amounts to around 0.5% of the world production, which can be directly compared to IKEA being a very large purchaser, buying 0.5% of the world production of cotton. Dem Collective is much smaller, but is also highly versatile and able to influence big actors in the garment industry towards more sustainable behavior, whether the ecological or social (fair trade) aspects of cotton production. IKEA can be seen as Corporate Social Responsibility (CSR) while Dem Collective is portrayed as Social Entrepreneurship. The latter is an example of a venture fully focused on one mission. IKEA, of course, has a much more history and complexity. Yet the two together arguably complement

each other, and also potentially create more change in an industry than one of them would have done alone. We also learn that sustainability can be on the agenda regardless of whether you choose to work for a big CSR-engaged firm or a social entrepreneurial venture. Sustainability is no longer a concern only for politicians, authorities, agencies or NGOs. It much more involves different types of structures interplaying through the actions of engaged individuals.

*Questions:*

- *How will you steer your career and creativity in relation to creating more sustainability?*
- *What role-models have you found in the presented examples as regards increasing sustainability?*

## SUSTAINABLE BUSINESS DEVELOPMENT

There are many reflections to make around the process of sustainable business development. How is it different from what we are used to and where is it similar? Here we will focus on the following:

- Not forgetting about the basics
- Using your network and your sustainability mission to learn and develop you business
- Applying new tools
- The role of the university

### BUSINESS-DEVELOPMENT BASICS STILL APPLY

Most of the venture cases are set up in ways very similar to ventures not having a focus on sustainability. Many of them also emphasize business-development basics over and over again. Striving for sustainability does not seem to excuse you from paying attention to customers, investors and employees (i.e. your team), or learning from mentors and others with experience. Nor does it mean that any product or service you develop should not be of good reliable quality. However, initial customers in our cases are showing engagement and understanding, perhaps slightly more than in many other cases. Such confidence is crucial for surviving into a next phase, as is indicated by e.g. NetClean. However, once you have learned from your early adopters, we also see that a traditional focus on delivering distinct value as well as having strong sales capabilities built up is important in our cases, e.g. Vehco. So…sustainable business development is still to a large extent about business development: do not forget about the basics!

## GROWING WITH AND THROUGH YOUR NETWORK

Entrepreneurs with sustainable business ideas can probably utilize networks to a large extent. In the Ecoera case this is perhaps most obvious. An initially promising agropellets idea evolved into a whole new platform – the Biosfair – in which biochar became a new key component, not just for heating and energy, but for improving crops as well as reducing(!) $CO_2$ in our atmosphere. Ecoera seems to have benefited largely from its wide network, which in turn is attracted by the ability of Ecoera to champion new ideas through this network. A traditional business-development process rarely shows such dynamics. However, here the adaptability and entrepreneurial drive of Ecoera interacts with an expanding network while having attractive sustainability (not just the customer offering of Ecoera but multiple offerings for many actors, altogether creating societal utility) as the fuel to evolve the business, a new platform and even potentially a new market. Although perhaps most apparent in the Ecoera case, the other cases also show similar development dynamics. For instance, the Cefibra case emphasizes the aspect of being humble and learning from others. This obviously has attracted relevant competence to the venture and has helped evolve a difficult materials business towards more focused (and paying!) customers.

## APPLYING NEW TOOLS AND PERSPECTIVES

Tools such as Scenario Planning, Backcasting, Team Learning, etc., are not just theory in this book – they are also enabling real-life ventures. While all ventures including those with sustainability ambitions need to stick to the basics indicated above, there also seem to be new tools especially suited for this type of developments. Most cases, more or less, emphasize teamwork and utilizing team dynamics. Cefibra especially highlights "Appreciative inquiry" as valuable in aligning all stakeholders towards sustainability, i.e. the board, the management and owners. Scenario Planning and Backcasting were also used by Cefibra, just as they were crucial in the case of IKEA. Thus, although tools never can replace good judgment, team play and commitment, they seem to be able to enhance such important ingredients in a venture.

New tools, such as Scenario Planning and Backcasting, arguably will increase in popularity. As markets and societies undergo more dramatic changes, tools that do not take the existing as a starting point to extrapolate the future will most likely gain ground. In order to create a sustainable future, we need to imagine it, put ourselves in that future and then figure out scenarios to actually get there. We know from most radical innovations (not only from sustainable business ideas) that incremental extrapolation normally is useless in making predictions. Thus, one can assume that the tools developed to embrace a sustainable future will increasingly become normal practice in everyday life. Hopefully, this anthology has increased the sense that such everyday life is soon to come, including all the lucrative, enjoyable and sustainable business yet to be imagined and realized!

Three of our authors (Boo Edgar, Per Gyllenspetz and Mats Williander) have a background in large corporations, but are now working with smaller entrepreneurial firms in order to contribute to innovation. All emphasize the need of changing perspectives, on different levels, in order to innovate. Mats provides ideas for unlocking the macro-, meso- and micro-levels, including what the eco-environmentally interested entrepreneur can do. Boo presents the scenario approach,

which in itself is a tool for changing the participants' perspectives. And Per points at the importance of considering social processes, having fun together working in small groups of competent people, and living with contradictions in order to shape creative processes. This understanding of creative work is also expressed in an interesting way in the Ecoera case using nature and its biodiversity as a platform model, allocating 20% of the time to explore new perspectives. Several of the cases also touch upon the importance of communication for entrepreneurial ventures; the Framing chapter further emphasizes the importance of communication; and an inferior communication process was also seen as a major contributor to the discontinuation of extremely promising sustainability concepts in large corporations; and finally, communication and conflict are specifically addressed in the chapter about team dynamics for sustainable business development.

## THE ROLE OF THE UNIVERSITY

Some of the cases explicitly point at the university as an important actor to leverage sustainable business development. The social entrepreneurship projects of CSE and GIBBS as well as the Dem Collective case are clearly benefiting from their connection with the university. The CSE/GIBBS projects allow students to gain experiential learning, while attracting resources and involving actors, thanks to being at a university. The whole philosophy of action learning linked to CSE and GIBBS ought to inspire university educators and educations. The model is simply too attractive: learn more and make a real difference when you are investing time in education anyhow!

Dem Collective shows how a strong cause also is enhanced by scholarship. Here the author has received research funding to study Dem Collective while as an added value contributing to the story (and value) of Dem Collective. The university thus creates legitimacy, whether through education or its research. Sustainable Business Development can therefore in many ways can be seen as a joint project between business entrepreneurs and academic entrepreneurs; both benefit and no one is compromised, as long as all utilities – societal, customer and business utility – are cherished. Universities that realize the potential in action-based education for sustainable development are arguably going to become important places through which the world becomes a better place. The strong university links of all the authors of this anthology support this argument.

*Questions:*

- *What is old and what is new about sustainable business development?*
- *If sustainable business development is so promising, why are there not more books about developing sustainable ideas? Why is almost all literature written for big business?*
- *How can you use any association with a university to enable sustainable business development?*