**University of Stellenbosch**
**Department of Industrial Engineering**

# A Sustainability Strategy Development Tool for Manufacturing Enterprises

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Thesis presented in partial fulfillment of the requirements for the degree of Masters of Industrial Engineering at the University of Stellenbosch, Department of Industrial Engineering

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## Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Ek, die ondergetekende verklaar hiermee dat die werk gedoen in hierdie tesis my eie oorspronklike werk is wat nog nie voorheen gedeeltelik of volledig by enige universiteit vir ’n graad aangebied is nie.

March 2010

# OPSOMMING

Die doel van hierdie studie is om ‘n metode te ontwikkel wat vervaardigings maatskappye sal help om ‘n onderneming spesifieke volhoubaarheids strategie te ontwikkel.

In die studie word die besigheids realiteit van vervaardigingsmaatskappye bespreek van sistemiese perspektief. Die konsepte van volhoubaarheid en volhoubare ontwikkeling word verken. Spesifieke aandag word gegee aan die bou van modelle van wat hierdie konsepte behels. Spesifieke strategieë en modelle soos die “Five Capitals Model”, “Natural Step” en ”Industrial Ecology” word uitgelig. Hierdie konsepte en strategieë word dan saamgevat op ‘n sistematiese manier in ‘n “Volhoubaarheids Padkaart”, ‘n padkaart wat maatskappye kan volg om ‘n volhoubaarheids strategie te ontwikkel.

Die “Volhoubaarheids Padkaart” word getoets deur dit toe te pas op ‘n gevallestudie.

# ABSTRACT

The objective of this study is to develop a tool to enable manufacturing enterprises to develop a sustainability strategy suited to their specific business.

In the study, the business reality that faces enterprises is discussed from a systems perspective. The concepts of sustainability and sustainable development are explored. Specific attention is paid to building mental models of what these concepts entail and the application thereof in individual manufacturing enterprises. Specific strategies and concepts, such as the Five Capitals Model, the Natural Step and Industrial Ecology, are highlighted. These tools and strategies are then consolidated into a "Sustainable Roadmap", a tool to facilitate the development of a sustainability strategy.

The "Sustainability Roadmap" is tested by applying it to a case study.

# ACKNOWLEDGEMENTS

I want to thank my family, small group, friends and supervisor, Theuns van Schalkwyk, for all their support.

I dedicate this thesis to Phia. Neh. 8:9.

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# GLOSSARY

**Backcasting**

A scenario planning method which entails moving back from a future envisioned state to the current state and then determining the optimal path to the future state.

**BHAG**

BHAG stands for Big Hairy Audacious Goal, and refers to the long term vision of a company

**CFCs**

Chlorofluorocarbons

**Double Loop learning**

Double loop learning occurs when changes are made to the governing variables of an organisation as a result of learning.

**DDT**

Dichloro-Diphenyl-Trichloroethane

**Design for the Environment (DFE)**

A product development strategy that takes environmental, social and economic considerations into account.

**Flexible Platform**

A step in a sustainability strategy that allows consequent steps to satisfy the system conditions.

**GRI**

The Global Reporting Initiative.

**Low Hanging Fruit**

A step in a sustainable strategy that is economically feasible and easy to execute.

**PET**

Polyethylene Terephthalate.

**PCBs**

Polychlorinated Biphenyls

**PVC**

Polyvinyl Chloride

**Resilience**

The capacity to flourish in the face of unforeseen changes, even catastrophic incidents.

**System Conditions**

Four high level conditions developed by the Natural Step organisation that a sustainable society would adhere to.

**Sustainability Conditions**

It includes 12 conditions pertaining to the natural, human, social, manufactured and financial capital that a sustainable society would adhere to.

# 1 INTRODUCTION

## 1.1 Problem Statement and Research Objectives

The problem statement for this research is the following, "How would a generic tool look like that could facilitate the development of a sustainability strategy for manufacturing enterprises?"

## 1.2 Research Methodology

### 1.2.1 Main Research Areas

*Sustainability and Sustainable Development* – The concept of sustainable development and sustainability is investigated and explored. Particular attention is paid to building mental models of what the concepts entail and the application thereof in individual manufacturing enterprises.

### 1.2.2 Synthesis of Literature

A model is build called the "Sustainability Roadmap", which consolidates the knowledge gained through the study in a systematic fashion.

### 1.2.3 Application and Testing of Model

The Sustainability Roadmap is then tested by applying it to a case study.

### 1.2.4 Conclusions

Conclusions are then drawn based on the findings of the study as whole.

# 2 UNDERSTANDING THE CONTEXT

## 2.1 Industrial Revolution

Industry, as we know it today, only developed during the industrial revolution. The industrial revolution started in Britain in the latter part of the 18th century and continued until the early 19th century. Prior to the industrial revolution economies were based on manual labour and wealth created per capita was constant over many years. The invention of the steam engine, powered machinery (mostly in the textile industry) and iron making techniques during the industrial revolution led to dramatic increases in labour productivity (Beck, 1999). New transport networks also developed thanks to new canals and railways (Wilde, 2008).

From the second half of the 19th century until the 20th century there occurred a second phase of the industrial revolution sometimes referred to as the second industrial revolution (Mokyr, 1998). This period brought dramatic technological innovations in the chemical, electrical, petroleum and steel industries. The invention of the assembly line led to the mass production of consumer goods. Other developments included steam-driven ships, the aeroplane and food preservation techniques such as mechanical refrigeration. Germany and the USA took a leading role in this phase. In the USA the electrical pioneers Nikola Tesla, Thomas Edison and George Westinghouse helped placing the USA at the forefront of technological innovation.

These technological inventions coupled with good management lead to dramatic productivity increases. This era can also be considered the start of modern management. Frederick Taylor developed his theory of scientific management during the 1880's and 1890's. He did groundbreaking work by applying scientific methods to manufacturing rather than managing operations by "rule of thumb". His work on work design, standardisation of tools and work methods, and communication between managers and factory workers led to large productivity increases and is still applied today. He replaced "working harder with working smarter" (Sandrone, 1997).

His work was critical as this was the time that the first large enterprises took shape and management of large amount of people became more and more important. At that time most of the large organisations that existed were armies or other

government related organisations.

The successes of the industrial revolution also lead to a dramatic increase in quality of life as life expectancy, because of medical advances, almost doubled and literacy rates of the countries involved grew exponentially. It brought undeniable benefits through all the services and products that are to offer from entertainment, communication, consumer goods, medicine and education (Senge et al., 2008).

## 2.2 Environmental Impacts

There is a downside to this radical success that was achieved through the industrial revolution. Although it was not apparent at first some signs that the industrial system was busy destroying the system that its success was built on began to show. Environmental side effects started to show which lead to various social consequences. For instance, air quality in London grew so bad that in 1952 more than 4000 people was killed as results of toxic smog that was trapped for four days over the city (Senge et al., 2008). Another consequence related to the industrial revolution, which went unseen for decades, is the effect of $CO_2$ emissions on the climate. The exact effects of these emissions on the planet and the social consequences coupled to that are still to be seen. The consequences might be enormous.

Although these distresses have been recognised for a long time, much of our thinking in the current industrial age are still grounded in the thinking patterns that existed in industrial revolution, for which the basic premise are, unlimited production with unlimited supplies. This limited systems thinking is depicted in the first diagram below.

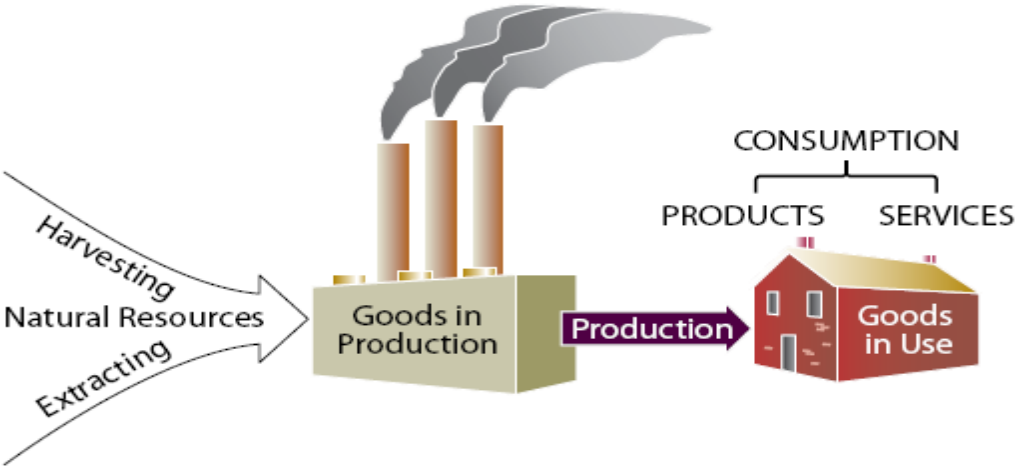


**Figure 1 Limited systems view of the industrial system (Senge, 2008)**

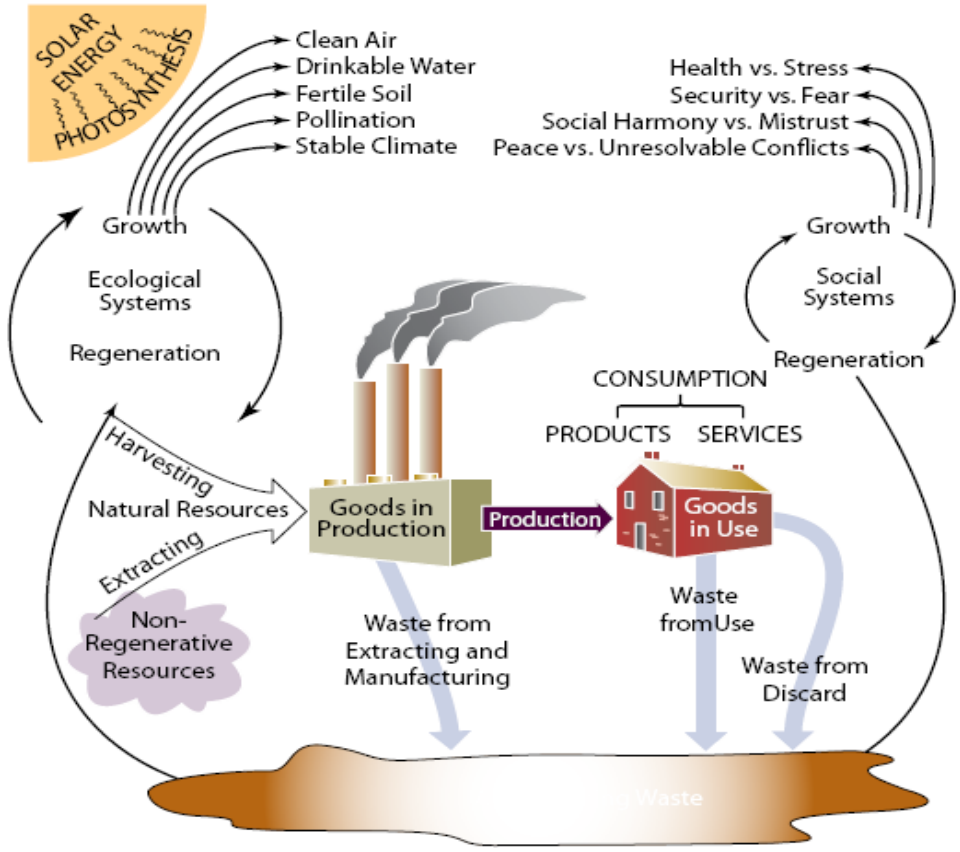


**Figure 2 Whole system perspective of the industrial system (Senge et al., 2008)**

Taking one step back to see the system within its larger systems context reveals a much more complex and interdependent system (Figure 2). This larger systems perspective reveals that many of the problems we are facing today are actually part of a larger systems problem; which is caused by the way industrial production is done.

The figure depicts that non-generative resources (mined materials) and generative resources (organic materials) as inputs to the industrial production system which are transformed to product and services, but eventually almost all the materials will end up as waste (including emissions). Only a miniscule percentage of these materials are recycled. According to the Rocky Mountain Institute, 99% of all industrial inputs will return as waste in the USA (Lovins, 2007). Braungart et al. (2007) state, "At the deepest level the industrial system we have today is linear: it is focused on making a product and getting it to a customer quickly and cheaply without considering much else." The Industry takes natural resources and turns them into waste. Waste is accumulating faster than society can manage.

This accumulation of waste and the extraction of resource in turn affects the regenerative capacity of the ecosystems and directly or indirectly (through the degradation of the environment) affect social systems.

According to the UN report "Ecosystems and Human Wellbeing", declining ecosystems and the increase of pollution correlate with people's nonmaterial wellbeing (Senge et al., 2008). The impact on the poor is more severe than on the rich as they do not have the necessary means to adapt to these circumstances (Senge et al., 2008). Rich countries can simply pay more to apply symptomatic solutions to their environmental problems. For instance New York are exporting about 12,000 tons of waste away per day (Correal, 2007), or as rich countries' regulations gets stricter, heavy polluting industries are moved to less strict countries usually in poorer developing countries. Secondly, people whose basic needs are not met also tend to neglect their environments. Societal and environmental degradation inevitably reinforces each other (An extreme example would be the declining of the environment such as wild life and natural degradation of Zimbabwe, during its rapid economic decline).

The South African economy is resource intensive and the National Framework on Sustainable Development (NFSD) states that "much of the growth in economic activity (measured as a percentage increase in GDP) is achieved by consuming natural resources and degrading our habitat at accelerating rates with the inevitable consequence that future economic growth and development objectives will be prejudiced" (NFSD, 2008). For instance in South Africa 394 million tonnes of minerals were mined in 2005 (DME, 2005). This is only the useful minerals extracted. Every mineral has a different material intensity, or ecological rucksack e.g. for every tonne of ore mined only 2-4 grams of platinum are produced (Kruyswijk, 2008). Computing the ecological rucksack of mining the total earth moved by mining each year equates to 3000[1] million tonnes. This is equal to excavating Table Mountain every 4 years.

Industry is equally energy intensive. The South African industry uses directly and indirectly 73%[2] of all coal produced for South Africa. It uses 99.5% of all gas produced, 53% of all electricity produced and in total 41% of al primary energy (DME, 2005b). Industry also contributes 35%[3] (NEAA, 2003) of the total $CO_2$ emissions in the country.

### 2.3 Direct social impacts of industry

Industrial success also had direct social impacts. During the industrial revolution management had great success in applying systems tools in the economic sphere. Think of the successes that Frederick Taylor's "Scientific Management" and Ford's manufacturing philosophies have brought to companies. It can be argued that these philosophies, gave a better understanding of processes, for example large efficiency gains were achieved, but the understanding of people's role in the system was often warped. For instance extreme work specialisation, a feature of Taylor and Ford's philosophies led to low worker morale and resistance as their jobs became less and less meaningful and heavily controlled (Forza, 1996). Neglecting the social aspects of production led to efficiency ceilings being reached and social problems.

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[1] The material intensities were primarily obtained from the Wuppertal Institute (2003)

[2] This includes the mining industry and the indirect use of coal through electricity consumption.

[3] This also includes indirect emissions through the use of electricity.

After Ford and Taylor, philosophies emerged, such as the management theories of Edward Deming, Peter Drucker, total quality management (TQM) and lean production that gave more attention to meeting the needs of employees (especially factory workers). Deming emphasised that his management theory is designed to promote "joy at work" (Gitlow et al., 2005).

Progress has certainly been made to ensure workers experience more "joy at work", but unfortunately there are still many workers that are treated as machines especially in developing countries, where much of the worlds' manufacturing are done. Industrial action, workers striking over their grievances, have also become commonplace in South Africa, which shows that there is an underlying "unhappiness" of workers.

Another social consequence of the success of the industrial age is linked to the products and services that are produced. Industrialism has certainly increased society's material comfort, but the availability (and heavy marketing) of products/services for every human need, material and non-material, have lead to people's appetite for material goods becoming unappeasable, even though it has been shown that apart from satisfying basic human needs increase in material wealth does not necessarily guarantee wellbeing (Senge et al., 2008). In a society based on materialism, feelings of inequality will continue to cause conflicts and other social defects.

McDonough and Braungart (2002) also point out that health factors such as avoiding dangerous chemicals in products are many times not considered, because the customer is incapable of determining the danger thereof.

## 2.4 Outside Social Influences

There are also other social influences, that are not necessarily related to industrial activity, but which certainly affect the economic system and the enterprises in it, especially those enterprises in the developing world. Some of the issues included here are HIV/Aids and malaria, equality (e.g. between previously disadvantaged groups and genders) job creation, education and the lack of critical infrastructure such as water and electricity (Sachs, 2007). Overarching to these issues is the issue

of poverty. The effects of poverty related problems on enterprises may be seen in the availability and quality of workforce, the buying power of customers to regulatory measures that will force business to comply with certain equity principles (e.g. the black economic empowerment (BEE) policy in South Africa).

These issues are not the sole responsibility of the business community, but considering the systems context of economic activity these issues are undeniable part of the larger business reality and therefore should be approached strategically.

### 2.5 Enterprises can make a Difference

As shown before, much of the environmental and social degradation in the world could be attributed to the industrial system and the larger business community, but equally important is the potential that business holds to transform society. Karl-Henrik Robèrt states the following, "Business is the economic engine of our western culture, and if it could be transformed to truly serve nature as well as ourselves, it could become essential to our rescue" (Nattras & Altomare, 1999).

Proactive enterprises should turn these above mentioned challenges into business opportunities, for instance from a systems perspective the waste on the landfill sites could be seen as representing unsalable production. It represents energy, time, money and valuable resources. This value must be captured. On the social side each manufacturing enterprise is part of a larger value chain. The economic benefits of this value chain to communities could be carefully considered and optimised e.g. an independent study on SABMiller's operations in South Africa has shown that although SABMiller only employs 9000 people, 380 000 people (3% of the South African workforce) are dependent on its value chain (SABMiller, 2009). Considering this reach, businesses can prove to be powerful tools in combating poverty.

To achieve the above, industry should be designed to create wellbeing for society from a whole system perspective and it should start by addressing our limited thinking.

### 2.6 Sustainable Development

Lately many people, organisations and governments have realised and are realising that the systems (social and natural) that our industrial system depends on are not

boundless and that growth in the industrial system does affect the social and natural systems that it rely on. They are realising that there is indeed "Limits to growth" (Meadows et al., 1972).

In 1980 the concern for growth that will constrain humanity to meet its needs was formally expressed when the International Union for the Conservation of Nature (IUCN) published the World Conservation Strategy and expressed the need for "sustainable development" (IUCN, 1991). This term received further publicity and widespread acceptance at the 1992 Rio Earth Summit held by the United Nations.

## 2.7 Defining Sustainable Development

Before any action can be considered towards sustainable development, sustainable development as a concept must be explored.

### 2.7.1 The United Nations Definition

The most often cited definition of sustainable development is that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition was put forward by the United Nations World Commission on Environment and Development (WCED) (known as the Brundtland Commission) in their famous report "Our Common Future" in 1987, which laid the ground work for the Earth Summit (WCED, 1987). This report was the first to propose the concept of interlocking crises, where many of the crises in the world are recognised as interlocking parts of a crisis of the whole, which is unsustainability.

The report states the following:

*"Until recently, the planet was a large world in which human activities and their effects were neatly compartmentalised within nations, within sectors (energy, agriculture, trade), and within broad areas of concern (environment, economics, social). These compartments have begun to dissolve. This applies in particular to the various global 'crises' that have seized public concern, particularly over the past decade. These are not separate crises: an environmental crisis, a development crisis, an energy crisis. They are all one."* (WCED, 1987)

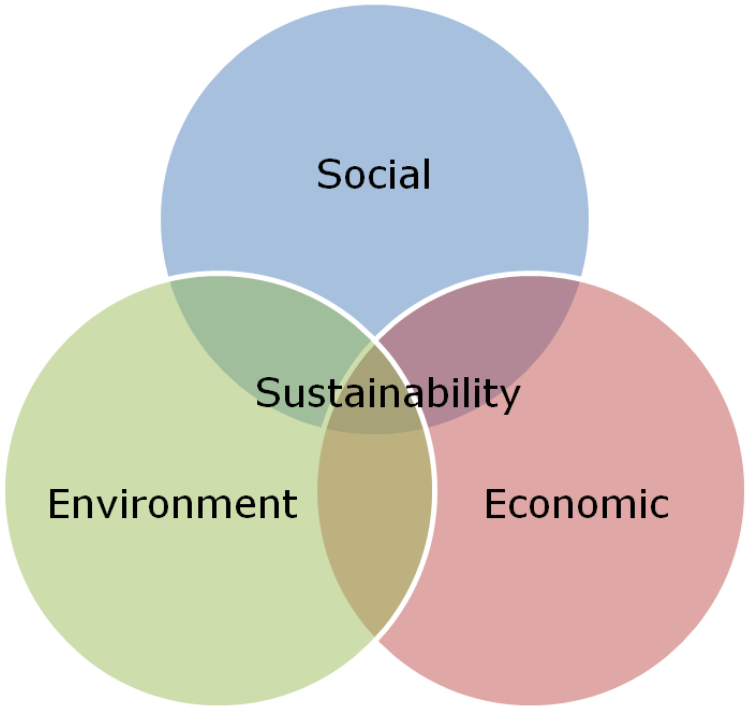


**Figure 3 The famous sustainability diagram**

Basically the report recognised the systemic nature of the world's problems and also that these problems can only be addressed in a systemic way. Another important milestone in the quest for sustainable development and seeing many of the world's problems as part of a larger whole was the setting of the eight Millennium Development Goals (MDGs) that was put forward by the United Nations in 2000. The MDGs includes ambitious targets (for 2015) to many of the world's biggest problems, such as poverty, gender equality, disease and environmental degradation and includes a commitment of global partnership between countries to achieve the goals.

### 2.7.2 Definitional Complexity

The definition given in the "Our Common Future" report is a very high level and since the publication of the report there have been many attempts at defining sustainable development and sustainability in a more concrete way (see Gladwin et al., 1995). The definitional diversity of sustainable development indicates that sustainable development is an ambiguous term with multiple objectives and ingredients, complex interdependencies and moral questions (Gladwin et al., 1995). Atkisson and Hatcher (2001) state that a definitive definition for sustainability is impossible. It should

rather be likened to democracy, which is a "lofty goal that can be expressed in many different ways, and whose perfect realisation eludes us". However they also state that there are some basic elements that these definitions should at least include "the health of nature, the economy, social institutions, and individual humans effectively integrated over the long term". These are the basic elements that should be included when sustainability is described.

Next, sustainable development models, which contain the above elements, that have emerged in literature as useful ways of presenting the challenge of sustainable development in a more operational way will be discussed.

## 2.8 Five Capitals Model

The Five Capitals model was developed by Forum for the Future, a sustainability think tank (Forum for the Future, 2003). Their thesis is that sustainability and sustainable development depends on maintaining certain "capital" stocks in order for society and future societies to live of the "income" of these stocks. If there are more "expenditures" than "income" it would mean that the capital stocks are decreased, which in turn will reduce the income. This scenario would then be considered unsustainable.


**Figure 4 Capital stock**

The five capital stocks that should be maintained are:

1. **Natural Capital** includes all natural resources (matter and energy) and ecological processes that are needed to maintain life and to produce goods and services. They include renewable resources (water, wood, animals and plants), non renewable resources (such as fossil fuels and other mineral deposits in the earth's crust), sinks that absorb, neatralise or recycles waste (oceans, forests) and ecological processes such as climate regulation and the geochemical cycles.

2. **Human Capital** refers to skills, health, knowledge and the capacity to form relationships with other humans, which enables humans to be productive, but also to lead a joyful and fulfilling life. Human capital is improved by learning, encouragement, healthy living and creativity.

3. **Social Capital,** where human capital referred to individual persons, social capital represents the relationships between individuals that help maintain the development of human capital. Social capital increases when the quality of relationships increases between people and contain attributes such as trust and honesty (Meadows, 1998). Families, community, business organisations, schools and churches are expressions of social capital.

4. **Manufactured Capital** represents goods, technologies and infrastructures that add to the production of goods or to service delivery and is the result of human capital (skills and labour) being applied to natural capital (energy and material).

5. **Financial Capital** is unlike the other types of capital in that it has no intrinsic value, but is representative of natural, human, social or manufactured capital e.g. shares, bonds or banknotes. For sustainability it is crucial that financial capital represents the other capital stocks not just the manufactured capital.

(Adapted from Forum for the Future (2003))

### 2.9 Substitutability of capital stocks

For sustainability to be achieved these capital stocks should be maintained independently and cannot be replaced by other forms of capital, especially human, social and natural capital, the so called weak-vs-strong-sustainability argument (Argyris, 1998). For instance if the depreciation of natural capital could be replaced by manufactured capital it would also imply that manufactured capital would in some way have to be transformed to natural capital in order to avoid complete destruction of natural systems and society, which is not possible (Argyris, 1998). Today the world is heading in an unsustainable direction, because the stock of human, social and natural capital is consumed faster than it is regenerated.

## 2.10 Capitals in a Systems Perspective

For sustainable development a systems perspective is needed and therefore these capitals must be seen as a whole. The interdependencies between these capitals should be studied and also how they contribute to the fulfilment of human needs. In the literature the author found two useful frameworks to understand how the five capitals are related to each other. Each one of the frameworks helps to clarify a certain aspect of the challenge of sustainable development.

### 2.10.1 Daly Framework

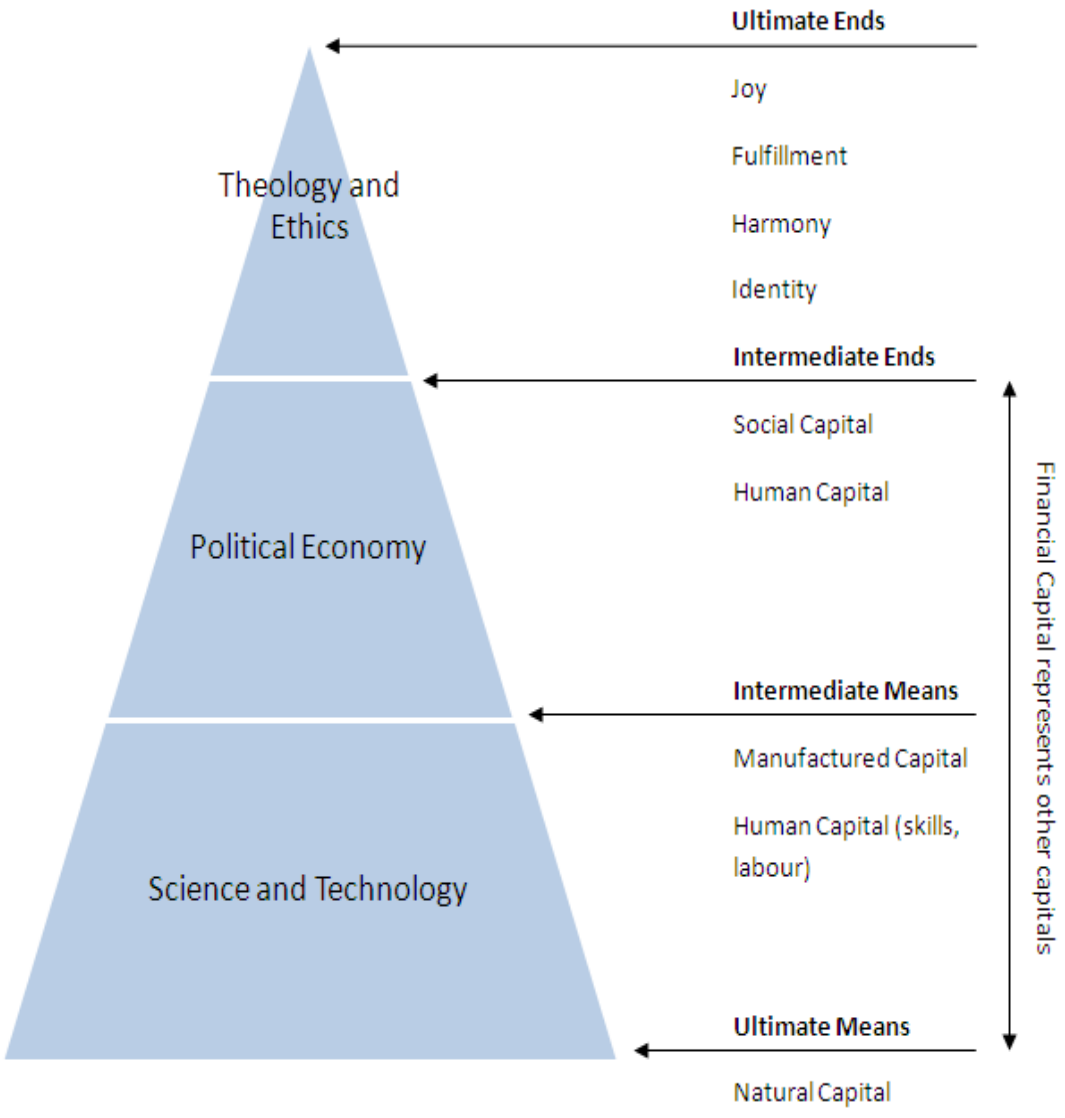


**Figure 5 The triangle depicting the 5 capitals in a hierarchy (adapted from Meadows, 1998)**

The first one is the Daly framework (Daly, 1973), that was already described by the economist Herman Daly in 1973 and modified later by Donella Meadows (Meadows, 1998). It gives a logical and useful view of how society and the economy relates to nature and human wellbeing. It is known as the "Daly triangle" and is depicted in Figure 5. The core idea that the framework conveys is that the economy has its foundation in natural capital (ultimate ends) and are only a means to a higher purpose (ultimate ends, human wellbeing), the top end of the triangle (Meadows 1998).

The intermediate means represent manufacturing (e.g. tool and machines) and human capital (e.g. labour and skills) as the productive capacity of the economy; it is the capital that is created with the application of science and technology. These intermediate means are then transformed to intermediate ends. These are the things that the government and the economy try to deliver on and which are traditionally seen as outputs e.g. health, wealth, convenience, mobility, good governance, well regulated markets and healthy communities etc. Human capital can be both an intermediate mean and end as things such as health and education can also contribute to a fulfilling life, beyond being productive. Social capital are also seen as an intermediate end as it concerns collective attributes such as trust, knowledge and honesty that is critical for institutions such as government, markets, organisations and community life. Human and social capital are called intermediate ends because they will by no means guarantee the wellbeing and fulfilment of people, but can only exist to achieve the ultimate ends. It must be noted that financial capital is not seen at one of these levels, because it has no inherit value and is a tool which allows the other capitals to be traded. At the top the ultimate ends are abstract notions such as fulfilment, harmony, joy etc. Daly (1973) stated that "Our perception of the ultimate is always cloudy, but necessary nonetheless, for without a perception of the ultimate it would be impossible to order intermediate ends and to speak of priorities."

Today society is very much focused on optimising the middle of the triangle, the political economy. For example think of how growth of countries is measured in terms of gross domestic product (GDP) and the status this indicator enjoys. Sustainability asks that the narrow economical perspective should be grown to include the top of the triangle (wellbeing of people) and the bottom (health of nature). Economic activity should be assessed from this broader view. Meadows

(1999) states that the top represents development (improving human wellbeing) and the bottom sustainability (using resources sustainably), which is connected through the intermediate means and intermediate ends in the middle. Thus Daly (1973) and Meadows (1998) puts the emphasis of the problem not on the scarce resources (means) but rather on the unnatural and unlimited ends.

From the triangular perspective investing in human and social capital gives an opportunity for much more leverage in transforming means to ultimate ends than just technological efficiency e.g. investing in the learning and development of people could potentially increase production capacity much more than with only technological means. Similarly if culture could be developed to ensure that people's self worth and status are not derived from the material things they consume or own, but rather affirmed by their communities, efficiency of contributing to the ultimate end could be increased by much more.

Considering the above, sustainable development should also consider questions of theology and ethics, because without them, efforts will be meaningless. Questions such as, for what purpose are knowledge, wealth and health for? It is these difficult questions that should guide sustainable development solutions. Unfortunately sustainable development solutions are often only guided by the intermediate ends rather than considering the ultimate ends. The goals of a sustainable society would be to create as much of the ultimate ends with the least possible means. Meadows (1998) sums it up "Somewhere within the concept of social capital, combined with clever technical design of built capital(manufactured capital) and loving development of human capital, is the capacity to meet material needs materially and non-material needs non-materially with great efficiency in the use of ultimate means."

### 2.10.2 Interpretation of Hierarchy

This is only a model and should be viewed as a representation of reality only, rather than reality itself, inevitably some interpretation difficulties will occur. For instance, looking at the hierarchical nature of the model, natural capital could be easily interpreted as only serving human purposes, while according to the author's opinion it is not true and nature has its own inherit value. It should rather be viewed to represent the logical dependency that the economy has on nature in order to serve higher purposes.

### 2.10.3 System within a System View

Where Daly's framework is useful in depicting how the economy functions, a second useful way of visualising the capitals is in terms of how the different social and economic systems fit physically within each other. See Figure 6 below.

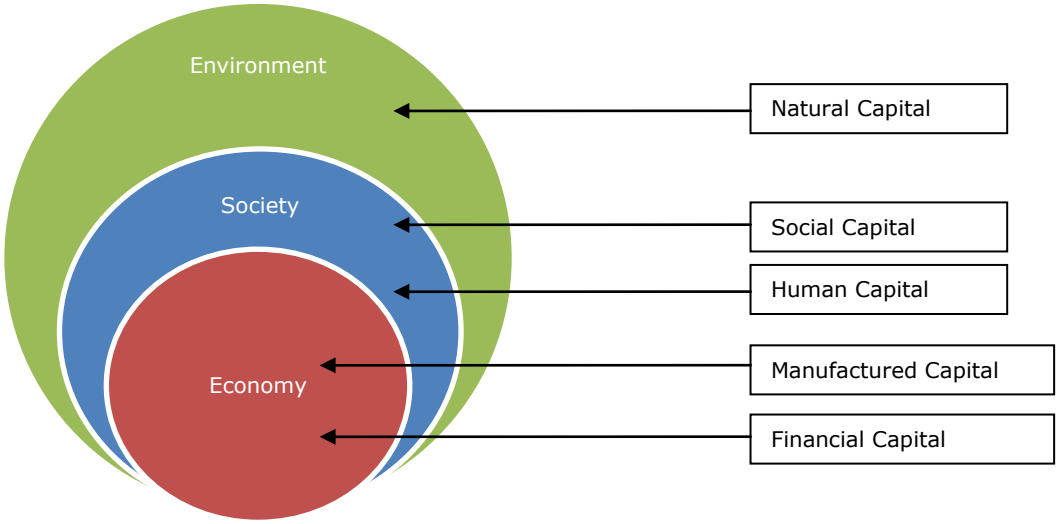


**Figure 6 Economic and social systems within the environmental system**

The environment is seen as the base of the system and contains all the natural capital. The society fits onto this system and houses all the social and human capital. The economy is a sub system of the society and contains all the financial and manufactured capital. When these two subsystems were small relative to the larger ecosystem, natural resources were seen as boundless, but now the earth is becoming full (see Figure 7) with manmade (financial and manufactured) capital, but also with people.

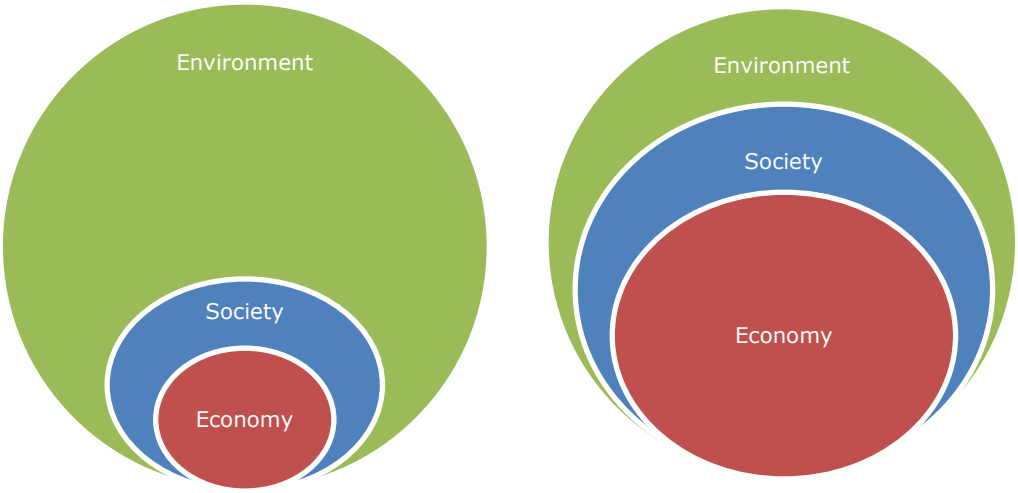


**Figure 7 the economic and social system is "growing" relative to the earth**

While the Daly framework focused on how human wellbeing is dependent on all the capitals, this model shows how the capitals fits into the larger systems view, especially that the economic system are only a system within a system. Both are considered useful for building a systems mental model of what sustainable development entails. The ability to see from a whole systems perspective is one of the prerequisites if sustainability wants to be achieved.

# 3 THE ENTERPRISE

## 3.1 Systems Paradigm

Now that the larger social, economic and environmental context is understood, there can be considered how individual enterprises fits into this context and the role of enterprises in society can be explored. Again the key is to look at the enterprise from a systems perspective.

## 3.2 The Purpose of the Enterprise

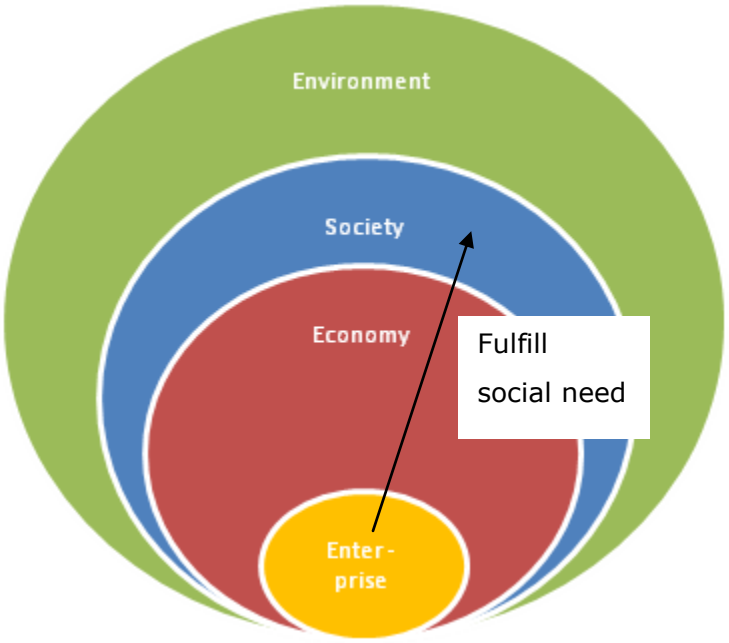


**Figure 8 An enterprise is only a small subsystem of larger systems**

The business enterprise as an institution is an organ of the economy and society (Drucker, 2001). Therefore an enterprise does not exist for its own sake, but for the sake of society. It is also logical to conclude from the previous discussion on the Daly framework that an enterprise, as a sub system of the economy, should exist to fulfil a specific social purpose and to satisfy a specific need (the intermediate and ultimate ends) of a community or individuals.

According to Drucker (2001) a business's purpose is always coupled to the customer it serves and therefore business does not exist to care for its employees or to care

for the environment or its neighbouring communities, but to fulfil the specific need of its customer. The hospital does not exist for the sake of the doctors, but for the patients. Similarly Pick 'n Pay does not exist for its staff or its shareholders, but for ensuring convenience to customers who wants to buy groceries. If there is no customers, the business will not survive, even though there are still employees, shareholders etc. A sustainable enterprise would then foremost understand that the biggest contribution it makes to society is by fulfilling its customers' needs in the best way possible e.g. Google's social responsibility contributions are minute in comparison to the value of the fast and relevant internet search results they bring to millions of people.

The purpose of an enterprise should not be confused with the multiple goals or objectives a business has. It is only when the purpose of the business is understood that the objectives, the basic strategies to achieve the purpose, can be formulated. These strategies should be formulated in every area that is necessary for a business to survive, which include making a profit, innovation, human resources and social responsibility (Drucker 2001). In other words these strategies concern the optimum application of the five capitals to fulfil the enterprise's purpose.

### 3.3 Enterprise and stakeholders

Outside of fulfilling an enterprise's purpose an enterprise needs to manage two other areas: The impact the business has on its stakeholders, and the impact these stakeholders will have on the business (Drucker 2001).

#### 3.3.1 Impact on Stakeholders

In order to achieve its purpose, delivering the service or product to the customer, the business will inevitable impact society and the environment in many ways (Drucker 2001). Business impacts the different capital stocks of society by its interaction with its stakeholders. For an enterprise to be sustainable it would need to identify its stakeholders and the impact that it has on them. These impacts would need to be carefully and strategically managed. The negative impact should be eliminated while the positive impact should be maximised, because business existence depends on society. As long as society believes business contributes to society it will be able to stay in existence (Drucker 2001).

### 3.3.2 Impact of Stakeholders

The social and environmental problems are part of the larger system, as described previously, that the business takes part in and may not be the result of the individual business, but it will inevitably affect it. It is the enterprise's responsibility to anticipate these problems and changes and transform it into business opportunities. For instance Ford in 1913, saw the challenge of increasingly bad labour relations as a business opportunity. Ford more than doubled its standard wages, which resulted in happier workers (less staff turnover), more profits and changing America's labour landscape (Drucker, 2001). Today the environmental challenges of waste accumulation and climate change, and social challenges such as poverty and HIV/Aids represent similar business opportunities.

### 3.3.3 The Stakeholders

As noted above it is crucial for the sustainability of a business to identify and know the impact it has on its stakeholders. Unfortunately businesses often only limit their perspective to those stakeholders in the economic sphere (see Figure 9). It was argued in section 2.3 that these stakeholders' needs are also only narrowly considered.

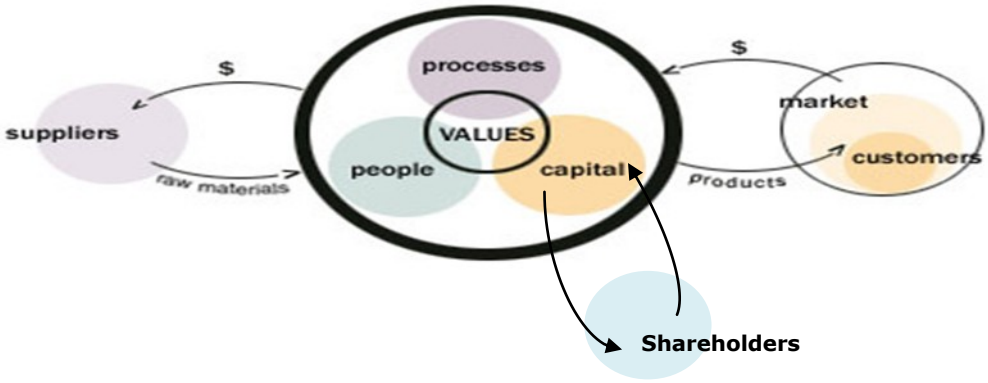


**Figure 9 A limited systems perspective exists of an enterprise and its stakeholders (Adapted from Interface Inc. (2008))**

Sustainability, however entails that a broader perspective on stakeholders and their needs be taken. From a sustainability perspective the entities shown in Figure 9, also have interdependent relationships with entities outside the economic sphere, which cannot be ignored. These outside stakeholders may include; families, communities, business partners, governments and the natural environment (see Figure 10).

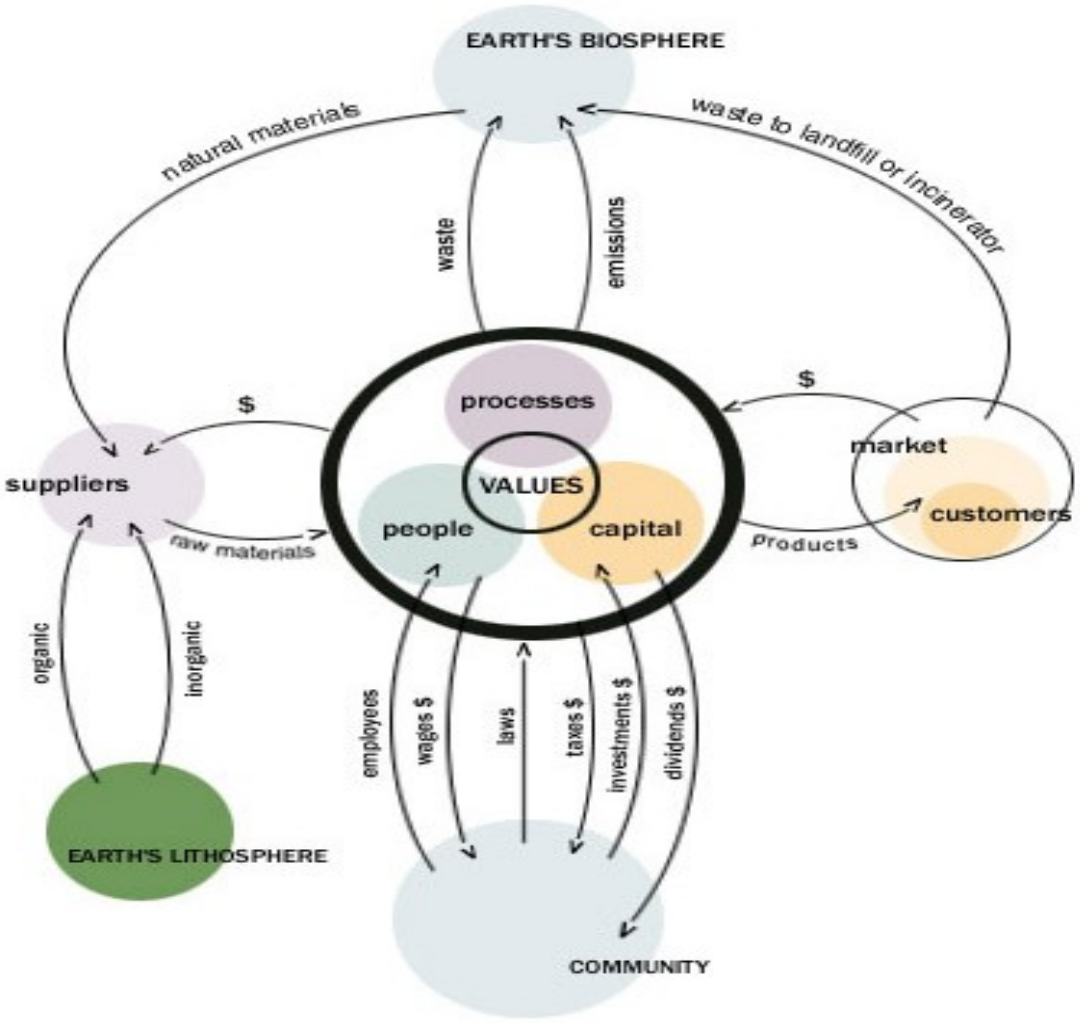


**Figure 10 The stakeholders of an enterprise (Interface Inc., 2008)**

These stakeholders often have strong linkages to future generations and their needs. For instance creating vibrant and healthy communities would have a direct impact on how children will be brought up in the future, or wasting natural resources would affect future production capacity.

### 3.4 Shareholder Value and Profit

There is one group of stakeholders that demands specific attention: the

shareholders. Shareholder value is the value every company must deliver. Creating a sustainable business, this necessary condition for existence cannot be ignored. A company that does not provide value for its shareholders over the long term will not contribute to sustainable development.

Milton Friedman stated that the only "social responsibility of business is to make a profit." (Laszlo, 2003, p 46). Sustainability challenges this perspective. Profit maximisation or profitability, cannot be considered a purpose, although profit is necessary for the survival of business to meet its purpose (Drucker, 2001). In the same way a human body does not exist to breathe, an enterprise does not exist to make a profit, but to fulfil a certain social function. Profitability is necessary, but not sufficient to create sustainable value for shareholders (Fiksel, 2003b). For instance many have attributed the downfall of companies, such as Enron and K-Mart (Laszlo, 2003, p 36) to an unnatural obsession with short term shareholder results. Short term financial growth does not guarantee long term financial success; other factors also play a role. Focusing on short term financial growth only, may come at the expense of the other capitals, which often contributes value that is only realised over the long term.

A systems approach is needed, which often lacks in businesses and leads to sustainable development being seen as balancing profits against social and environmental criteria letting the many synergies between economic, social and environmental performance go to waste, which is a common problem with the popular triple bottom line approach (Fiksel, 2003). Sustainable value is created when shareholder and stakeholder value is created, while value is only transferred when shareholder value is created at the expense of the stakeholders (other capitals) (Figure 11). In other words financial capital and manufactured capital should not be produced, at the expense of natural, social and human capital.

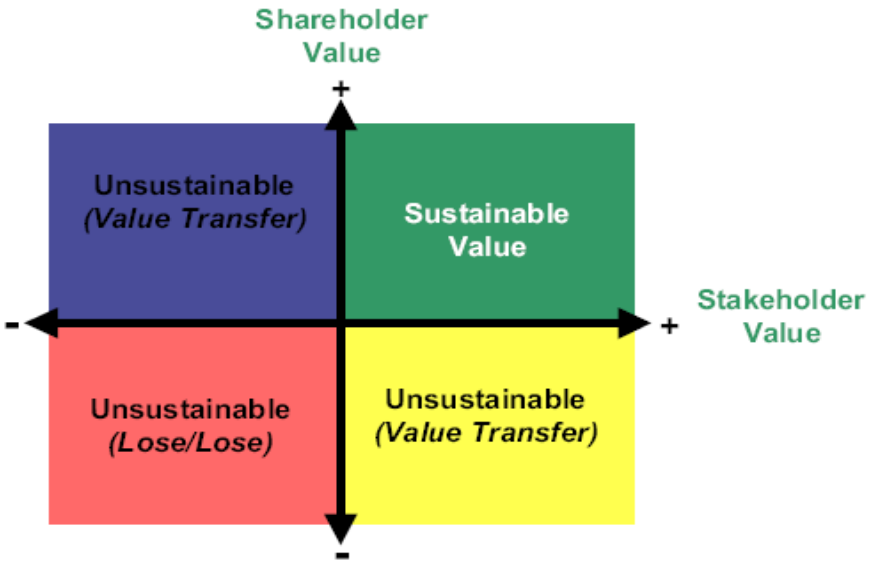


**Figure 11 Sustainable value map (Laszlo, 2003)**

When optimising the application of the capitals it contributes to shareholder value, in the short term through resources savings as a result of better use of natural capital and manufactured capital, but it especially contributes to the intangible drivers (non financial drivers) of shareholder value (Fiksel, 2003b) The intangibles can be seen as the result of strengthened human and social capital and include reputation, brand equity, strategic relationships, human resources, and innovation (Fiksel 2003b).

Figure 12 shows how intangibles drive shareholder value. Research has shown that a statistical correlation between the strength of the intangibles of a company and its market value (Low & Kalafut, 2003, cited in Fiksel, 2003b). It was found that intangible (non-financial) performance accounts for 35 % of institutional investors' valuation. The process (human capital, manufactured and social capital) and the results (financial capital) are important (Deming, 1986 cited in Gitlow et al., 2005).

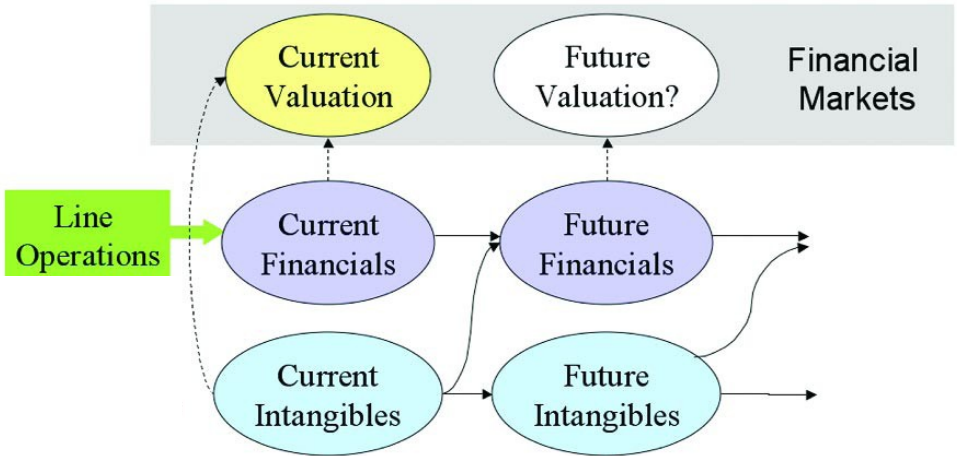


**Figure 12 Intangibles drive future shareholder value**

Businesses have started to realise that intangible assets are important to their business and their bottom line. An example of this is the wide adoption of management tools such as the Balanced Scorecard[4] that focuses on optimising intangible business drivers to create business value (Kaplan & Norton, 1996), but sustainability asks that an even wider perspective should be taken to include community stakeholders and nature (Fiksel, 2003b).

The business logic therefore of sustainability is to help grow a company's intrinsic value over time by looking strategically at all the business stakeholders to ensure that its purpose are achieved, which will be reflected in shareholder value in the long run.

### 3.5 Resilient Enterprises

Collins and Porras (1994) and De Geus (1999) studied long lived visionary companies that made and are making, long lasting contributions to society, in other words, enterprises that create value for society and their shareholders. In their study Collins and Porras (1994) identify key strengths of what make these companies enduring or "sustainable" when compared to similar companies. These companies seem all to understand the significant leverage human and social capital could give in the process of fulfilling their purpose and creating value for their shareholders.

One of the central theses of Collins and Porras (1994) is that long lived visionary

[4] The Balanced Scorecard includes customer, learning and business process perspectives.

companies' success are not ascribed to any "part", such as an idea, charismatic leadership, technology or innovative products, but to the system itself. The enterprise and what it stands for is the ultimate creation. The company is a system that is reliant on the five capitals, it is how these capitals are optimised together to fulfil the enterprise's purpose that the success are ascribed to.

According to Fiksel (2003) in the quest to build a sustainable enterprise, it is useful to think in terms of a resilient enterprise, where resilience, a word borrowed from ecology, is defined as the "the capacity to flourish in the face of unforeseen changes, even catastrophic incidents". From this perspective sustainability is viewed as a system property rather than an end goal. De Geus (1997) also supports an organic view of an enterprise. He proposes that an enterprise be seen as living system rather than a mechanical, "command and control" one. An organic systems perspective is necessary, because "the true nature of an organisation is that of a community of people" (De Geus, 1997, p 3). The people (human and social capital) of the enterprise will in the end determine if an enterprise will be resilient. Drucker (2001) states that people of the enterprise are the only true resource. The complexity of humans and their interactions with others makes achieving resilience a difficult task. It implies that people's physiological and psychological traits and abilities should be taken into consideration.

### 3.5.1 Characteristics of a Resilient Enterprise

From the above it can be agreed that people rather than system architecture or other technological quick fixes should be the focus when designing a sustainable system or enterprise. Architectures and technology are necessary to translate these concepts into tangible mechanisms, but the true constraints of any organisation are in the minds of people. Taken from Collins and Porras (1994) resilience in a company can be divided into two parts: The first being preserving the core, the higher purpose and values of the company, and secondly continually stimulating progress in line with this core.

#### 3.5.1.1 Preserve the Core

Enduring companies shows a strong commitment to their core ideology (purpose and values). Visionary companies have a deep commitment towards their purpose and values, which many times have been articulated by their founders. Everything is

done to translate this core ideology into concrete mechanisms. The core ideology is the highest ideals that the company holds which transcends other goals such as profit making and focuses on creating wellbeing for society. In these companies profit is not the main aim, but rather a means to an end.

The cultures of the companies are perceived as "cult-like". The core ideology of the company is engrained in every part of the social fabric ensuring a special bond between them and giving the employees a sense of being part of something great.

To ensure continuity of the core ideology through time, the companies are highly committed to and skilled at employee and leadership development. The companies almost exclusively rely on leaders "grown" within these companies. Of the 113 chief executive officers that were studied in Collins and Porras (1994) only 3.5% of them came directly from the outside.

#### 3.5.1.2 Stimulate Progress

Companies that have shown to be resilient also show urgency towards continual progress and self improvement. This is catalysed by sensitivity to their environment (De Geus 1997). These companies set challenging and risky long term goals; Porras and Collins (1994) call them BHAG's, big hairy audacious goals. They emphasise constant movement and reward creativity and risk-taking that is aligned with their core ideology. Failures and mistakes are seen as inevitable and part of the learning process. Continual learning and improvement is fundamental to these visionary companies. In De Geus (1988) learning faster than your competitors is proposed as the only sustainable source of competitive advantage. An organisation must learn in order to be resilient in an ever changing business landscape. Enduring companies have mastered this process (Collins & Porras, 1994; De Geus, 1997).

Senge (1990) introduced the term "learning organisations" referring to companies that are able to learn collectively. The following are useful definitions of the concept. Learning organisations are:

*"Organisations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to learn*

*together*" (Senge, 1990)

*"a model of strategic change in which everyone is engaged in identifying and solving problems so that the organisation is continuously changing, experimenting and improving, thus increasing its capacity to grow and achieve its purpose."* (Rowden, 2002)

In a learning organisation, learning happens individually as well as collectively (in teams and as an organisation). Just as a person can learn, organisations should also be able to learn collectively.

According to Argyris (1999, p 68) it is important to distinguish between single and double loop learning (Figure 13).

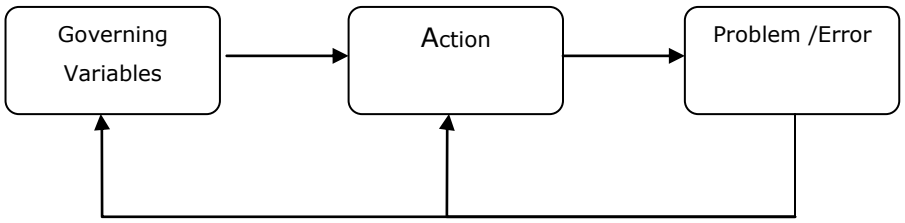


**Figure 13 Single and double loop learning**

Single loop learning refers to learning that happens when a problem is solved by acting on it. Double loop learning occurs when a more fundamental shift in the governing variables of organisation occurs, before an action is taken. The governing variables are not the same as the core ideology of the organisation, but rather the underlying beliefs, assumptions or policies that employees adhere to. For example when a pipe system is designed, single loop learning would occur when pipe thickness is optimised for minimum friction and minimum cost of the pipes. Double loop learning would occur if the assumption of optimising against friction and cost of the pipes is evaluated and changed to a policy of optimising the pipes against the cost of the motor driving the fluid through the pipes. Bigger pipes will lead to smaller motors which will lead to large cost savings. Thus double loop learning means challenging the status quo or current operating paradigm. To embed resilience in a system both single and double loop learning must occur.

Similarly in Senge et al. (1994, p 21) it is proposed that any change program's goal should be focused on initiating a "learning cycle" in the organisation, which eventually must lead to changes in attitudes and beliefs of employees. It is these deep changes in individuals and in the company's culture that will ensure true sustainable competitive advantage.

Relying on technological fixes, many continuous improvement programs have failed, because it has failed to realise that "continuous improvement means a commitment to learning seeing the world in a new light and acting accordingly" (Garvin, 1993). However, these deeper changes in organisations are very difficult to "engineer" on their own. Therefore the best way to initiate and establish this learning cycle is to focus on business architectural changes (Senge et al., 1994).

# 4 THE CONDITIONS OF SUSTAINABILITY

As was described, a resilient enterprise is highly skilled at investing in its capital stock (especially human and social capital) in order for it to be quick to adapt to changes in the business environment and to seize opportunities that may be presented.

These changes in the environment have a systemic nature and to be able to adapt to these new circumstances it would be necessary for the enterprise to understand the rules that govern these systemic impacts, e.g. how does the depreciation of natural capital or social capital affect the business and when is the enterprise depreciating these capitals.

As was proposed in section 2.10, natural capital puts certain constraints on how wellbeing is created. While the other capitals affect the efficiency of wellbeing creation e.g. strong investment in social capital and human capital would ensure that less "material goods" is needed for people to be "happy". Considering this, there will be started at the bottom of the triangle (nature) and looked at what the specific environmental limits are in which business must operate.

## 4.1 Environmental limits

The Natural Step, a non-profit organisation, has developed such a framework for understanding, especially the environmental limits that organisations have to operate in. The framework has been shown to be particularly useful for creating a shared mental model for people when planning for sustainability in organisations (Robèrt, 2000). In developing this mental model, the Natural Step organisation found that despite the complex issues facing the world, the problems can be presented in a simple and systematic way.

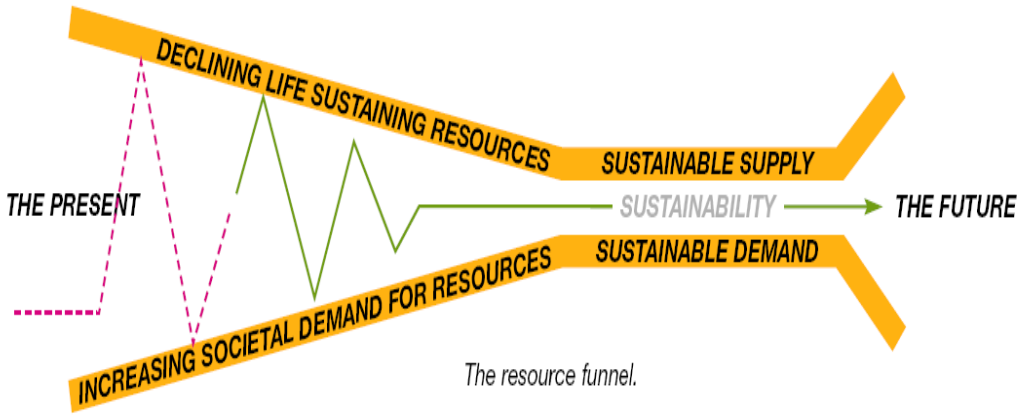


**Figure 14 Natural Step Funnel**

One of the focus areas of a systems thinking is the interrelatedness of events. Events cannot be considered individually, but as part of "patterns of behaviour" of the larger system (Haines, 1998, p 14). The funnel metaphor of the Natural Step framework is a tool to visualise this environmental limits in which organisations must operate (see Figure 14). The top wall represents a decline of natural capital and the bottom wall the societal demand for these resources. The area between the walls of the funnel represents the space where business finds itself.

The gap between the walls of the funnel narrows as nature's ability to provide natural capital declines, while the economy is demanding more resources from the natural systems. Narrowing of the funnel leads to increased competition for the remaining natural capital, which leads to social problems such as inequality, conflict and limited access to resource that fulfils basic needs such as water.

Business must negotiate these walls which may appear as separate "events" such as higher costs for natural resources, energy, fuel and environmental taxes, regulations and environmentally concerned customers. In most businesses today these problems are seen as separate events rather than "patterns of behaviour" of the larger system, which leads to reactive rather than proactive behaviour. The resilient company would recognise the systemic nature of these problems and avoid the walls by aiming at the centre of the funnel.

High level abstractions of the conditions that govern these walls are necessary.

According to Robèrt, (2000) and Robèrt et al. (2002) many organisations that commit to sustainable development lack this systems approach and starts at a level that is too complex. The many tools and strategies available to ensure sustainability often adds to the complexity.

### 4.1.1 The System Conditions

What a sustainable future will look like is unknown, but it is possible to know what the basic conditions will be that a sustainable society will subscribe to. Robèrt et al. (2004) draw an analogy with a chess game. For a chess game there are millions of outcomes (futures), but all the outcomes will subscribe to the basic principles of checkmate. Similarly a sustainable future of society cannot be known exactly, but the basic conditions that a sustainable society would adhere to can be described. Based on scientific consensus the Natural Step organisation has defined four basic, none overlapping, system conditions for a sustainable society[5].

The four conditions are the following:

In a sustainable society, nature is not subject to systematically increasing:

1. concentrations of materials from the earth's crust.
2. concentrations of substances produced by society.
3. physical degradation of nature.

and, at the same time, society does not systematically

4. undermine people's capacity to meet their needs. (Robèrt, 2000)

Below follows a description of each system condition.

[5] For a detail discussion on the scientific basis of these conditions see Appendix 2

#### 4.1.1.1 System Condition 1: Materials from the earth's crust

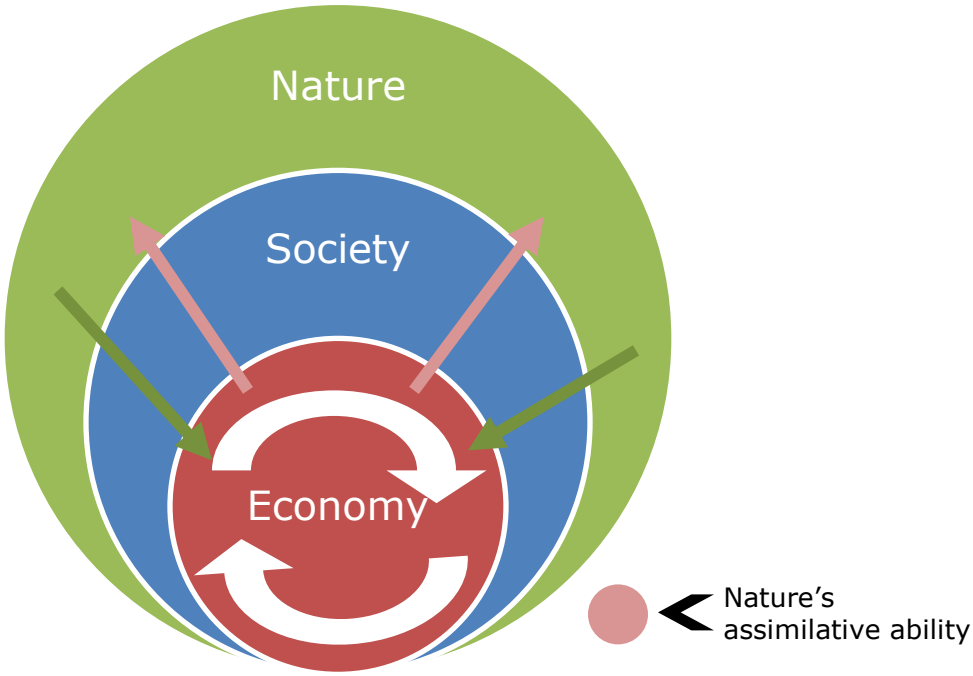


**Figure 15 Mined and manmade substances should be kept in closed loops in the economy to prevent breaking system condition 1 or 2. Leakages should be kept smaller than nature's assimilative ability**

Material from the earth's crust refers to mined substances. System condition 1 entails that all materials that are mined e.g. metallic minerals, non-metallic minerals and greenhouse gas emissions from fossil fuels should not increase to a level above nature's assimilative ability. Therefore particular attention must be paid to the persistence, abundance and eco-toxicity of minerals (Chambers, 2008). This implies that mined materials should be kept in society without leakages to the environment. This can only be achieved if materials are kept in closed loop cycles (see Figure 15) in the economy without losing its raw material qualities. For more on closing material loops refer to section 5.2.1.

Problems associated with breaking this condition include climate change, metal contamination of ground and surface water, acid rain, metal toxicity affecting animals and cancer caused by metals in human bodies.

#### 4.1.1.2 System Condition 2: Materials produced by society

Condition 2 refers to all manmade compounds, such as plastics, polyvinyl chloride (PVC), dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyls (PCBs),

anti-inflammables, chlorofluorocarbons (CFCs), medicine and other manmade substances (Chambers, 2008). This condition states that the flow of these materials to the ecosphere should be equal or smaller than the ability of the ecosphere to take up these chemicals (See Figure 15).

#### 4.1.1.3 System Condition 3: Physical degradation of nature

The first two conditions referred to polluting nature. The third system condition states that society must not harvest nature at a rate that is faster than nature's regenerative capacity e.g. deforestation, overgrazing, overuse of groundwater, soil compacting, degrading of soil by bad agricultural practices, over fishing, over hunting and erosion (Chambers, 2008).

#### 4.1.1.4 System Condition 4: Undermining people's capacity to meet their needs

The fourth condition is a social condition and suggests that people must be able to meet their needs efficiently. All needs for humans to stay mentally and socially healthy are included. If the fourth condition is not met, the other conditions will also not be met.

### 4.2 Including other Capitals

The environmental limits of business were defined above, and this is particularly important for manufacturing companies, as they are more dependent on natural capital than other more service orientated enterprises, but conditions for the other capitals should also be considered. It will depend on the other capitals whether the system conditions will be broken. The Natural Step only addresses the other capitals very generally in the fourth condition.

The problem is that the other capitals, like human and social capital, represent "soft" issues and cannot be described in the same concrete way. It can also not be based on the same rigid scientific principles as the first three system conditions, but it may be argued that general principles could be agreed on. Such general principles were the object of a study conducted by Forum for the Future and Keele University, which involved 60 academics and practitioners. They identified 12 features, which included the first three system conditions, of how a sustainability society would look like. These features are considered comprehensive of what sustainability would entail,

even though the extra conditions, mentioned below, are more open for interpretation than the first three.

The extra conditions are described below (adopted from Forum for the Future (2003)). From here onwards the 12 conditions will be referred to as the sustainability conditions.

### 4.2.1 Human Capital

1. At all ages, individuals enjoy a high standard of health.
2. Individuals are adept at relationships and social participation, and throughout life set and achieve high personal standards of their development and learning.
3. There is access to varied and satisfying opportunities for work, personal creativity, and recreation

### 4.2.2 Social Capital

1. There are trusted and accessible systems of governance and justice.
2. Communities and society at large share key positive values and a sense of purpose.
3. The structures and institutions of society promote stewardship of natural resources and development of people.
4. Homes, communities and society at large provide safe, supportive living and working environments.

### 4.2.3 Manufactured Capital

1. All infrastructure, technologies and processes make minimum use of natural resources and maximum use of human innovation and skills

### 4.2.4 Financial Capital

1. Financial capital accurately represents the value of natural, human, social and manufactured capital e.g. externalities such as pollution are priced in cost of goods.

# 5 STRATEGIES TO REACH SUSTAINABILITY

## 5.1 Introduction

In the previous chapter basic constraints were proposed within which business must operate, but it does not present a specific methodology to achieve this. The framework can be likened to a canvas limited by the different conditions on which the business leader can create sustainable solutions. Industrial Ecology could be an approach to fulfil the basic conditions of sustainability in a creative manner.

Nature has always inspired man. Man has marvelled at the way nature seamlessly and elegantly works. Industrial ecology takes nature as metaphor for designing systems. Although many of the concepts of industrial ecology have been around for decades, it was only after Robèrt Frosch and Nicholas E. Gallopoulos authored an article in the Scientific American, called ”Strategies for Manufacturing”, in 1989 that the field was popularised (Ayres and Ayres, 2002).

## 5.2 Nature’s design Principles

Industrial ecology has its foundation from the biological or ecological metaphor (Ehrenfeld, 2004). Nature is held as a model for designing a sustainable industrial system. This approach to system design is also called biomimicry (Benyus, 1997). Industrial Ecology seeks to understand the industrial system and how it interacts with nature, and then based on what is known about nature seeks ways to make the industrial system similar in principle and compatible with nature. It builds on the previously discussed notion of the organic nature of companies (see section 3.5). Fiksel (2003) states that the industry must mimic nature in order to achieve resilience, because nature is inherently resilient, being able to adapt and flourish in unforeseen circumstances. Ehrenfeld (2007) also argues that the best road to sustainability would be to replace the modernist paradigm with one based on the systems principles of nature. Therefore the properties of nature that ensures its resilience ought to be studied and understood and applied to business in order to achieve sustainability.

Most work done in the field of industrial ecology has been focused on the cyclical material flows of nature, but Ehrenfeld (2007), Korhonen (2001), Fiksel (2003), McDonough and Braungart (2002) suggest that other features of ecosystems are also

worth imitating, characteristics such as diversity, interdependence, connectedness, cooperation, community and locality. These characteristics are especially important to ensure that industrial ecology has the necessary width to be applied as a design framework towards sustainability, and not neglecting social issues.

Therefore broad system design principles from literature based on nature were identified. These principles are not necessary conditions for sustainability, but rather strategies and principles to achieve the state of sustainability. Therefore these principles must still be applied within the context of the conditions for sustainability that was indentified previously. These principles are discussed next.

### 5.2.1 Closed Loop Material Flows

Closed loop material flows are probably the most emphasised principle in the field of industrial ecology (Korhonen, 2004). It is sometimes called the "Waste as food" principle (McDonough & Braungart, 2002) and refers to the fact that in nature, "waste" from one process can be food for another process. For instance humans exhale $CO_2$, while plants uses $CO_2$ in their processes and among other products produce $O_2$ which humans inhale again and thus completing the loop. Closed loop strategies will be important strategies to satisfy the natural and manufactured capital sustainability conditions.

The cyclical flow of nutrients in nature is in direct contrast to the linear "cradle to grave" material flow of the industrial system. The industrial system should be designed to imitate these cyclical flows. McDonough and Braungart (2002) states that by closing material loops the concept of waste is eliminated which is a better strategy than the minimisation of waste. This principle should not to be mistaken with traditional recycling, which is actually "downcycling", because the quality of the materials is not maintained through the recycling process and the materials will eventually end up on landfills (McDonough & Braungart, 2002; Braungart et al., 2007).

To maintain the quality of materials through product lifecycles McDonough and Braungart (2002) proposes a strategy called "cradle to cradle[6]". They differentiate

[6] Walter Stahel is credited for inventing the term "cradle-cradle" (Hawken et al., 1999)

between two nutrients, biological nutrients and technical nutrients. Biological nutrients are organic substances and technical nutrients are all other substances such as mined and manufactured materials (Figure 16). The biological nutrients enter the industrial system only temporarily and after its use go back to nature. In contrast, the technical nutrients enter the industrial system and continue to be used in closed cycles. These are powerful metaphors which are being used in large companies such as Ford, Nike, Herman Miller (Waste = Food, 2006) and Interface Inc. (Natrass & Altomare, 1999).

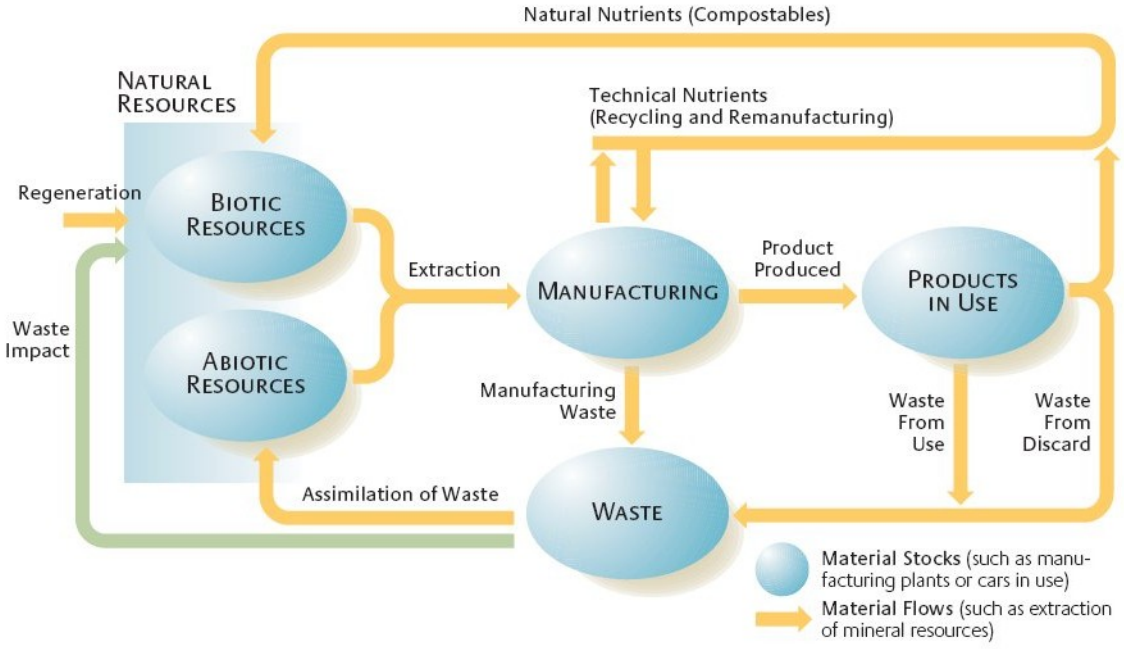


**Figure 16 Cyclical material flows (Senge & Carstedt, 2001)**

The work in the field of industrial ecology has largely focused on this principle from which the concepts of industrial metabolism and industrial symbioses have emerged. Industrial metabolism refers to industry behaving like an organism with a metabolism (see section 5.3.1), and industrial symbiosis (see section 5.3.2) refers to entities in an industrial community using by-products from each other in a symbiotic manner.

### 5.2.2 Diversity

Diversity is nature's defence mechanism. Nature's survival is based on its diversity of species and their interdependency. Diversity could be likened to nature's "human

capital", every actor in nature much fulfil its unique role in the best way possible. By having a large amount of actors contributing to the natural system, nature is highly adaptable and flexible in an always changing environment. In large monoculture agricultural systems the contrary is seen. Here the survival of the natural system must be artificially secured by pesticides and other methods (Korhonen, 2001).

The learning organisation concept (see section 3.5.1.2), popularized by Senge (1990), can be seen as an application of the diversity principle. A learning organisation relies on the diversity of its workforce, to gain competitive advantage. The emergence of the so called Web 2.0 applications in businesses is also a trend, which relies on the diversity of many different actors to ensure innovation (Mckinsey, 2007). Strategies to make use of the diversity of humans would be important to fulfil the human capital sustainability conditions.

From a product perspective diversity as a principle is in contrast to traditional mass production, focusing on large volumes of homogene products. However these ideals are increasingly challenged by the increasing emphasis on "quality, variety and diversity in industrial products" (Korhonen 2001). No doubt the increase in popularity of lean manufacturing and total quality management, where emphasis is placed on smaller diverse lots of products has played a significant role in this shift.

The move to more decentralised energy systems, with many small scale diverse energy producers playing a role, is an example of diversity being recognised as an important strategy to ensure resilience of an energy system (O'Kennedy, 2006).

### 5.2.3 Connectedness

The actors in nature are not only diverse, but connected and interdependent. Similarly an enterprise is part of a web of complex relationships with many different stakeholders.

Taking into account the connectedness of actors will ensure a systems approach is taken. Enterprises should be skilled at identifying interdependencies in their business environment in order to avoid "problems caused by solutions" (Lovins & Lovins, 1996). Solutions based on the knowledge of these hidden connections in a system, will produce solutions to one problem that will also create solutions to other

problems. The goal should be to maximise economic, social and environmental benefits and create win-win-win solutions. The sustainability conditions is an example of using high level conditions to ensure that benefits are maximised on a systems level.

To ensure that multiple benefits are captured each actor must be designed for multiple roles. For instance in nature a tree does not produce oxygen alone, it also sequesters carbon, fixes nitrogen, distils water, accrue solar energy as fuel, makes complex sugars and food, creates micro climate, changes colour with the seasons, provides habitat and self replicates (McDonough, 2005). Similarly a company could contribute multiple benefits to society, by optimising its impacts on society from a whole system perspective (see Figure 23 for an example of these benefits).

Connectedness also refers to relationship and community; every actor in nature is interdependent on other actors, these relationships are necessary for its existence, but these relationships also contribute to the whole being greater than the sum of the parts. Similarly, an enterprise is also dependent on many stakeholders. It needs to maintain these relationships with stakeholders in order to ensure its resilience. Therefore it is important to develop trusting partnerships with stakeholders in and outside the organisation. These relationships could include business partnerships to form industrial symbiosis networks (5.3.2) or partnerships with nongovernmental organisations, academia, and government or even with labour unions. It could also include the relationships inside the organisation between management and staff and between staff etc. Strategies relating to the connectedness of humans and institutions as described above would be important to fulfil the sustainability conditions relating to social capital.

### 5.2.4 Locality

The locality principle stems from the fact that nature's solutions are always highly adapted to the local environment. Ecosystems need to respect the limiting factors of the local environment. When the locality principle is applied, feedback loops are shortened drastically which allows for quicker reaction to issues that may arise and better resilience (Korhonen, 2001).

The locality principle implies that companies must rethink their relationship with the

local natural and social environment. Emphasis must be placed on using local resources e.g. material, energy and people. Products, processes should be designed to take into account local limiting factors e.g. products and machinery that conserve water in water scarce areas. Enterprises should also adapt to and manage local social ills such as poverty, HIV/AIDS etc, which will have an impact on its business.

## 5.3 Industrial Ecology Concepts

### 5.3.1 Industrial Metabolism

Industrial metabolism is a metaphor that is based on the cyclical material flows of nature. Ayres and Ayres (2002) state, "Industrial Metabolism conveys the descriptive idea of the industrial system as a living complex organism, 'feeding' on natural resources, material and energy, 'digesting' them into useful products and 'excreting waste'".

Industrial metabolism analysis highlights the difference between nature's material flows and industry's material flow. In nature materials flow in closed loops, however in the industrial system material flows linearly from cradle to grave. In industrial ecology these flows are studied with analytical tools such as material flow analysis (MFA) and life cycle assessment (LCA). Using these tools a better understanding of impacts related to human activity on the environment are gained.

### 5.3.2 Industrial Symbiosis

Industrial symbiosis is a high level application of industrial ecology. The concept involves the use of by-products from one industry as inputs for other industries, in imitation of natural systems where every output is an input to another natural system. Doing so, mutually beneficial relationships between firms in an area are established.

The most famous case of industrial symbiosis exists at Kalundborg in Denmark, where an industrial ecosystem has spontaneously evolved over the last three decades (Fiksel, 1996). The main role players in the industrial ecosystem are a power station, a refinery, a plasterboard factory, a pharmaceutical company and the municipality of Kalundborg.

In Figure 17 the energy and material flows are shown of the industrial symbiosis at

Kalundborg.

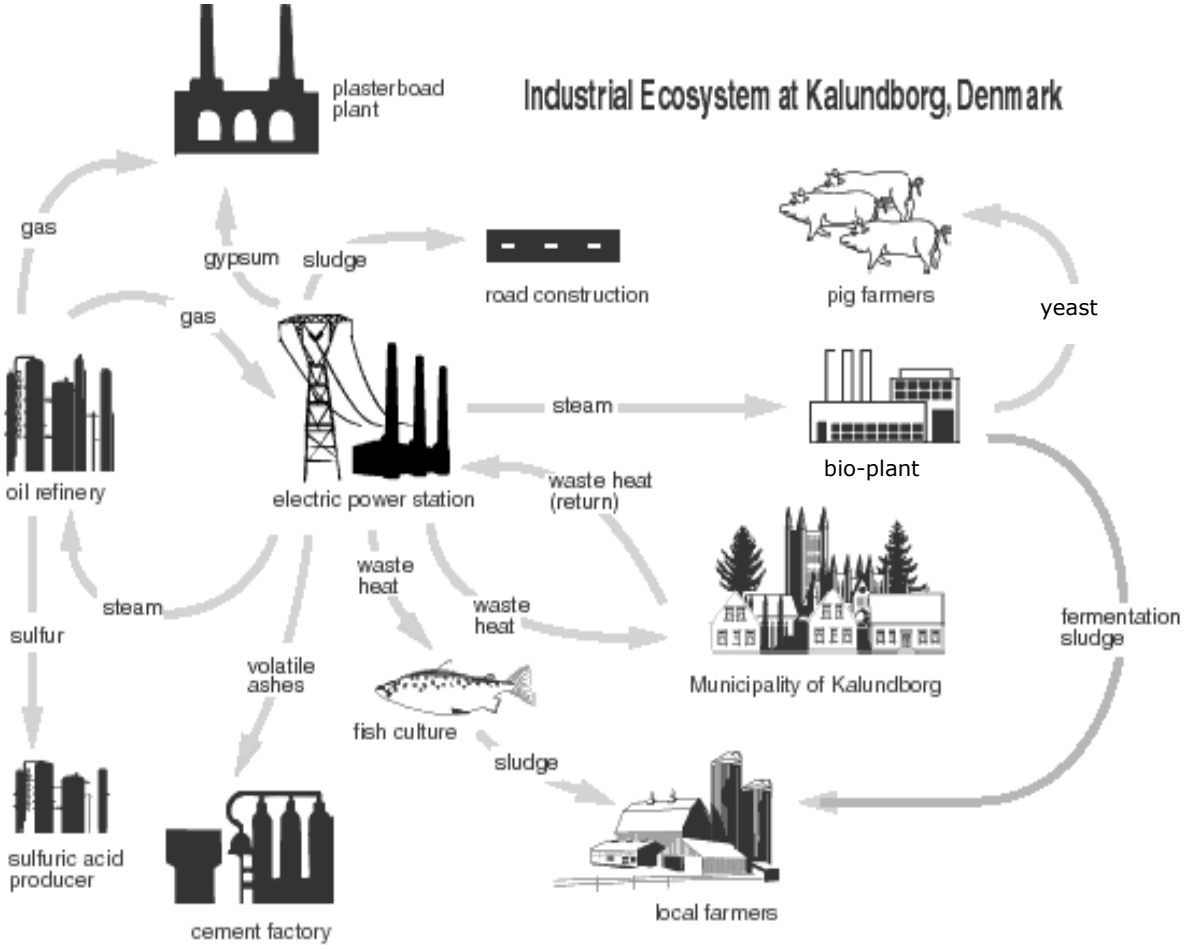


**Figure 17 The industrial symbiosis at Kalundborg (Peck, 1996)**

### 5.3.3 Service Economy

The service economy is a concept or business strategy that is often mentioned together with industrial ecology and is of great importance for sustainability in enterprises (Fiksel, 1994; Brent et al., 2008). It implies rethinking the way companies, specifically manufacturing companies, create value for their customers. It shifts attention away from selling products to selling the utilisation of the product. The premise of the service economy is that the wellbeing of the customer is not primarily related to the physical product, but to the function of the product. Thus if value could be disconnected from the material itself, then it would also be possible to disconnect human wellbeing from the rapid flow of materials through the industrial system to landfills. The concept was first proposed by Walter Stahel and Michael Braungart in the mid-1980's independent of each other (Hawken et al., 1999, p 16).

In a service economy the focus is on what the customer really wants, what is the true need of the customer? How does the producer perceive the value that the customer gets out of a product? Customer satisfaction and wellbeing becomes a priority. In such a business model, a car company does not sell cars but mobility, a lighting company does not sell light bulbs, but illumination and an air conditioner company sells comfort. The long term competitive advantage for companies will then come from the service provided. Revenues would come from leasing rather than selling equipment. Such a business model extends the producer's responsibility towards the product and lays the platform for cultivating long term relationships with customers and also for closing material loops (Figure 18).

Implied in the service economy is product life extension. Products must be designed to maximize service over its life time, while at the same time considering reusing, remanufacturing and recycling of products. Design strategies to accomplish this are part of the design for the environment (DfE) field (see section 10.5) a field closely related to industrial ecology, which focuses on product development. Figure 18 describes the different material loops. Stahel (1994) states that the smaller the loop the more financially feasible is the process.

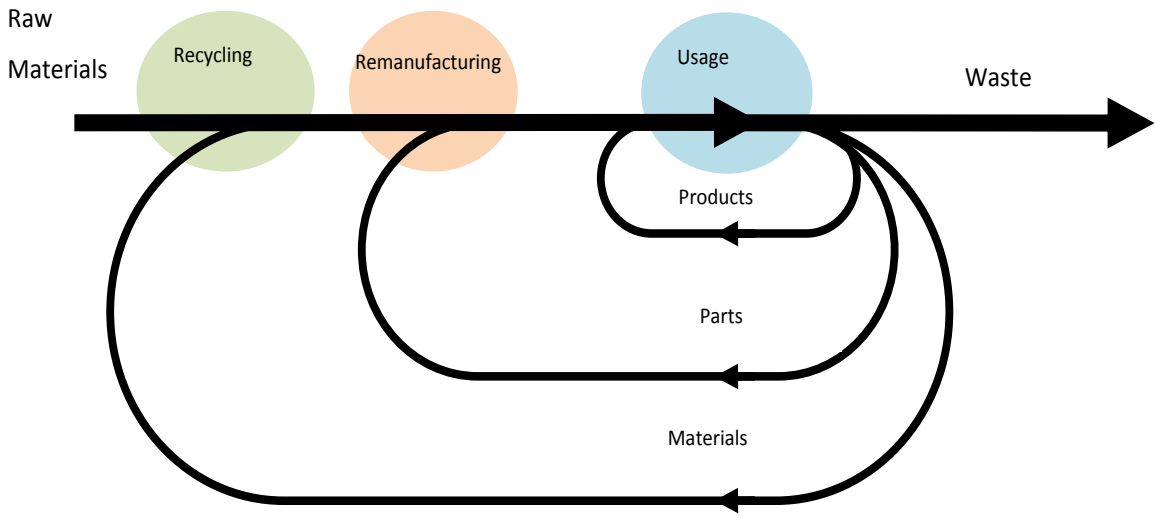


**Figure 18 The closed loop service economy (Stahel, 1994)**

A service economy would theoretically create an economic incentive for the manufacturer to focus on the whole lifecycle, since the long term competitive advantage would come from providing the service and the service cost is mostly

related to the operating cost. Thus minimizing operating cost would maximize profit. In other words a company manufacturing state of the art, quality products, that is energy efficient and use environmentally friendly materials, will be rewarded through the lifecycle by reduced operating costs. An added advantage would be created for the customer, because a capital expenditure would be turned into a tax-deductible expense, although there are some accounting restrictions on this. See Appendix 3 for the details.

Stahel (1994) adds another advantage that a service economy would bring; job creation. The service economy would substitute labour for energy, because mining and primary industries involved with the extraction and beneficiation of raw materials are energy intensive, while remanufacturing and recycling associated with the service economy are more labour intensive.

Xerox has applied the service economy principle rather successfully. Xerox reported that it saved an estimated $200 million dollar in less than 10 years and diverted 30 million tonnes from the landfills through its program that recover photocopiers at the end of their life time (Fishbein et al., 2000). Another photocopier company Agfa-Gevaert has long term flexible agreements, with customers, which combines all consumables, maintenance and other services in a price per copy which gives designers of the copiers a strong incentive to optimise the copier's operating costs (Fiksel, 1994). It was found that these schemes are more successful for products that have a high residual value at the end of their lifecycle, which makes remanufacturing or reclaiming economically feasible (Fishbein et al., 2000). Carpet manufacturer, Interface, tried to implement a leasing scheme which failed, because of the low residual value of carpet. Ray Anderson, the company founder, cites the subsidised oil price as a reason for the low residual price (Anderson, 2004). In other words the financial capital does not fully represent the value of natural capital (in this case oil).

### 5.4 Pitfalls of Strategies towards sustainability

The following pitfalls must be carefully considered when strategies for sustainable development are developed.

### 5.4.1 Neglecting Social Aspect

Many of the tools and methodologies developed for sustainable development (Korhonen 2004, Ehrenfeld 2007), have been guilty of focusing on parts of sustainability and in most cases a narrow definition of sustainable development. For instance the term environmental sustainability is often heard and gives the wrong impression that sustainability is just about the environment. Social questions have often been neglected, in the pursuit of sustainability. Industrial ecology have also lacked in this sense (Ehrenfeld, 2007). The biological metaphor of industrial metabolism have dominated the field of industrial ecology, while other parts of the biological metaphor, that are relevant to social issues have been overlooked. This concern was addressed in this work by identifying connectedness, diversity and locality as design principles which ensures that social aspects (human and social capital) are not neglected.

### 5.4.2 Metaphor as Weakness

The industrial ecology strategies identified has its foundation in the biological metaphor, but what can be considered the field's strength can also leave opportunity for misuse. Metaphors are useful as it have great imaginative strength and help with transferring meaning. Often, however, metaphors are taken so far as to convey values and feelings, which cannot be justified by science (Ayres & Ayres, 2002). This is something to be guarded against when applying industrial ecology. Science, the system conditions in this case, should always remain the basis of the metaphor.

### 5.4.3 Eco-efficiency and the Rebound Effect

Eco-efficiency, also called resource productivity, is an important subject of industrial ecology (Ayres & Ayres, 2002) and other sustainability related fields, but should not be the central aim. The term eco-efficiency can be defined as doing more with less. Eco-efficiency seems noble to pursue, but following it blindly could even be detrimental to the sustainability cause, due to the rebound effect (Braungart et al., 2007). The rebound effect can be explained as follows: Eco-efficiency measures lead to decreased cost of production. The lower cost of production makes it possible to produce more. If production increases by a certain amount it may cause a net increase in overall ecological impact (Centre for Resilience, 2006). Therefore Korhonen (2004) argues that eco-efficiency is not a condition for sustainability.

### 5.4.4 Redefining Sustainability

Many frameworks and strategies for sustainable development, including in some ways industrial ecology, focus on being "less bad". These strategies usually articulate ways to reduce negative impacts. Zero waste initiatives, eco-efficiency, cleaner production, climate change mitigation and pollution prevention is designed to make society "less bad". Adding value to society is not considered. Industrial ecology "has largely focused on reducing unsustainability rather than strengthening the systemic underpinnings of sustainability" (Ehrenfeld, 2006). Even the term sustainability is a negatively stated concept. On this Michael Braungart asks the following, "If a man describes his relationship with his wife as sustainable, what does it say about the relationship?" (Waste = food, 2006).

McDonough and Braungart (2002) suggest that the ecosystem metaphor be taken further to mean a world, like an ecosystem, of "abundance, not of pollution and waste", conveying the message that industry should be a place where wellbeing is added to society in the same way nature adds value to life.

They see the future industry as the following design assignment:

1. Buildings like trees produce more energy than they consume and purify their own waste water.
2. Factories that produce effluents that are drinking water.
3. Products that when their useful life is over does not become useless, but can become food.
4. Billions of dollars of materials accrued for human and natural purposes.
5. Transportation that improves the quality of life while delivering goods and services.
6. A world of abundance not of limits, pollution and waste.

(McDonough & Braungart, 2002)

Ehrenfeld (2007) shares the same vision. He says, "When I think of sustainability, I think of flourishing, not merely some improved form of development." According to him "sustainability is nature at work" and "flourishing is natural". Applying the ecosystem metaphor in this way creates a positive future vision beyond sustainability where society is restoring. Ray Anderson, visionary leader of Interface, a company

renowned for its sustainability vision, states the following,

*"At Interface, we seek to become the first sustainable corporation in the world, and following that, the first restorative company. It means creating the technologies of the future — kinder, gentler technologies that emulate nature's systems. I believe that's where we'll find the right model."* (Anderson, 2000)

In Robèrt et al. (2002) it is also suggested that society must move away from decreasing environmental impact to restoration. Taking the system conditions they state that the following questions should be asked, "do we contribute to decreased concentrations of compounds in nature, decreased degradation of nature by physical means, and do we always contribute as much as we can to the meeting of human needs in our society and worldwide, and with a responsible attitude to all people on whom we have an impact?"

# 6 DEVELOPMENT OF THE ROADMAP

## 6.1 Sustainability Roadmap

The previous chapters have focused on defining sustainability and the sustainable enterprise. Conditions for sustainability were identified and also strategies and principles to achieve these conditions based on the field of industrial ecology. Pitfalls were also identified that should be avoided when developing a strategy towards sustainability. Using the knowledge gained from the preceding chapters a roadmap will be developed to guide organisations in developing a sustainability strategy.

The sustainability roadmap is a strategy development tool and its aim is to facilitate a top-down and bottom-up process of integrating sustainability into an organisation (see Figure 19). The logic is that the sustainability vision is driven from the leadership, while employees are empowered to create solutions that would move the company towards this vision. This would allow the company to be in a state of continual change and ensure that it is adaptable in a constantly changing business environment.

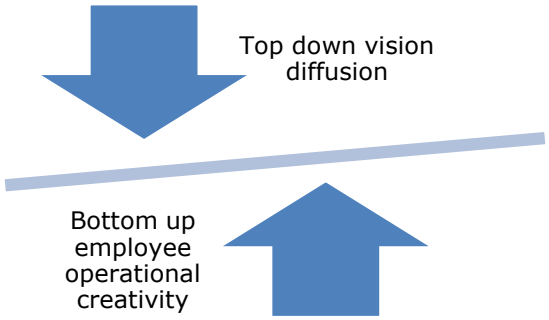


**Figure 19 The down-up process of the Sustainability Roadmap**

The roadmap places emphasis high level design considerations and basic principles, such as the sustainability conditions, which sets the boundaries in which employee creativity can be encouraged. The training and learning plan will play a critical role in fostering bottom-up innovations.

## 6.2 Visual Representation of the Roadmap

The visual representation of the roadmap is shown below. The roadmap follows linearly through 7 steps from *awareness* to *implementation*. The *implementation* step

is different from the other steps as it represents the physical implementation of the projects that have been identified in the *projects* step and does not deal with strategy development. A feedback loop is shown to indicate that the results from the *implementation* step should be measured against the critical success factors of the strategic plan and the sustainability indicators that were identified mainly in the As-Is analysis. Based on these measurements the necessary adjustments should be made to the strategy.

Throughout the roadmap attention must be paid to all stakeholders of the company and everything must be done within the constraints of the sustainability conditions. The enterprise is divided into six architectures (described in section 8.1.1) to ensure that every aspect of the company is addressed in the development of the strategy.

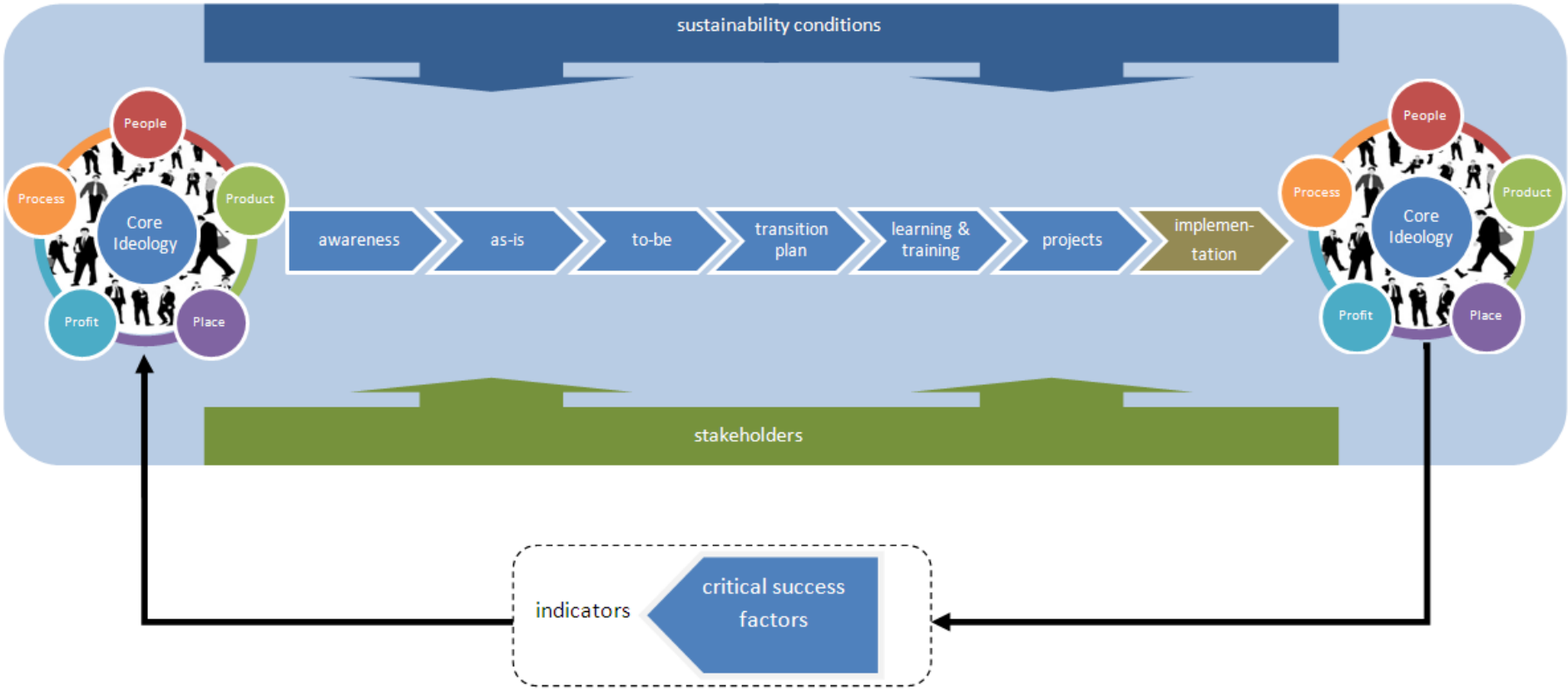


**Figure 20 a graphical representation of the Sustainability Roadmap**

# 7 AWARENESS

Starting with the development of the sustainability strategy the first priority should be to engage key decision makers in the enterprise. This should be done by creating awareness of the whole system context of the enterprise and the business reality of sustainability. The aim of this stage is to ensure all key decision makers have a shared mental model of what corporate sustainability entails.

In the preceding chapters sustainability and the role an enterprise should play in sustainable development have been discussed. In this step this material should be used to create awareness of sustainability. In these awareness sessions it is important that sustainability is not "preached" as a "doomsday" message. The business opportunities that are linked to sustainable development and the positive role that business could play in achieving sustainability should rather be emphasised.

The following are assumptions that the key decision makers should reach consensus on:

1. Business as a whole is unsustainable and will not be able to meet the needs of the present society without comprising the future societies' abilities to meet their needs.
2. Business will play a vital role in moving society towards sustainability and sustainability presents a business opportunity.
3. Sustainability is a systems problem that should be solved from a systems perspective.
4. The company's main purpose should be to serve society by fulfilling the needs of its customers (especially focussing on human well-being). It should fulfil these needs by the optimum application of natural, human, social, manufactured and financial capital.
5. Sustainability makes business sense; it is necessary to make money now and in the future. Therefore sustainability should be part of the strategic intent of the company.
6. Sustainability initiatives should be driven by the core ideology (vision and values) of the business.
7. When creating change in the organisation, humans (human and social capital)

not business architecture should be the main focus point. Everything else must be subordinated to ensure that employees contribute their full potential to the organisation.

### 7.1 Sustainability Conditions and Industrial Ecology

The sustainability conditions and industrial ecology should help bring consensus on the above mentioned points. A useful tool for creating awareness of the need for sustainability in business is the funnel metaphor.

In this step management should start to identify the drivers of change towards sustainability. Generic drivers are identified below in Table 1, in terms of the stakeholders of the business. In this part, it is particularly important to identify the drivers that are unique and specific to the local area in which business is done. For instance in developed markets environmental regulations will be drivers, while in developing markets HIV/AIDS and poverty will most likely be more critical.

**Table 1 The drivers of sustainability in terms of the stakeholders**

| Stakeholders | Examples of drivers |
|---|---|
| Shareholders | Shareholder pressures for sustainable management |
| Customers and markets | Customer complaints, demand for sustainable products, competition, higher resource prices, higher insurance costs |
| Suppliers | Unsustainability of suppliers, lack of trust |
| Employees | Employee complaints, employee turnover, union pressures |
| Communities | Community relations, Government regulation, taxes |
| Nature | Climate change, higher resource prices, |

### 7.2 Outcomes

1. The outcome of this step should be total commitment from the top management towards sustainability and the development of a sustainability strategy, based on a shared mental model of what sustainability in the organisation entails.
2. Drivers of sustainability in the organisation.

Out of this phase, the following people/teams should be selected (these roles are adapted from William et al. (2001)):

### 7.2.1 Program Champion

The Champion is the individual who is knowledgeable in sustainable development, who has a passion for promoting sustainability and who has the needed energy to ensure that others also join in the effort. Therefore, his /her peers must respect the champion. The champion is dependent on getting the right support from the management (through the program sponsor and the steering committee).

### 7.2.2 Program Sponsor

The sponsor is a person at senior management level who has "budgetary influence, technical credibility, and both formal and informal political strength in the corporation." (Williams et al., 2001). This is important as the sponsor provide leadership in the early stages of the program.

### 7.2.3 Steering Committee

The steering committee plays a supervisory role in the program. Their role is to ensure strategic direction and supplying resources. To fulfil this role it is important that the members of the steering committee should have among them a wide variety of experience and expertise.

### 7.2.4 Planning Team

This team will do the actual analysis and prepare the sustainability strategy under the management of the steering committee. The members of the planning team should have experience and skills in all the areas of the enterprise so that the planning team may function autonomously.

# 8 AS-IS ANALYSIS

In this step the current situation in the enterprise (the As-Is) is analysed from a sustainability perspective. In order to avoid unnecessary data collection and analysis, there must be drawn as much as possible from previously prepared documentation, such as process flow diagrams, layout plans and other company documents. It is also important that the entity is analysed as operated, not as-designed, as many times there are a discrepancy between the two (Williams et al., 2001).

The goal of the As-Is phase is not a complete detailed view of the entity under study. The focus should rather be to understand the whole systems perspective of the business concerning business stakeholders and the capitals they represent. The areas most critical to the business should receive preference in the analysis.

The As-Is analysis is necessary to ensure accurate evaluation of progress made after the implementation of the sustainability plan and also to serve as input to the To-Be vision (chapter 9) and transition plan (chapter 10). It also serves as a platform for identifying possible business opportunities.

It should be remembered that the view of the As-Is state of the enterprise will evolve with each iteration of the Sustainability Roadmap.

## 8.1 Whole Systems Perspective

Sustainability is a whole system endeavour and when doing the As-Is analysis, it is important to take as broad perspective as possible.

### 8.1.1 Sustainability Architectures

For analysing the company itself in the context of sustainability a useful way of describing an enterprise, is in terms of the following architectures (see Figure 21, for the graphical representation):

1. *Core Ideology* –the guiding philosophy of the business.
2. *People* – the human and organisational architecture (is concerned with human and social capital).
3. *Process* - the business process architecture (manufactured capital)

4. *Product* - this describe the physical products and services delivered by the company.
5. *Place* - the physical architecture e.g. buildings and physical infrastructure (Manufactured Capital).
6. *Profit* – this architecture refers to the distribution and management of the money in the company (financial capital).

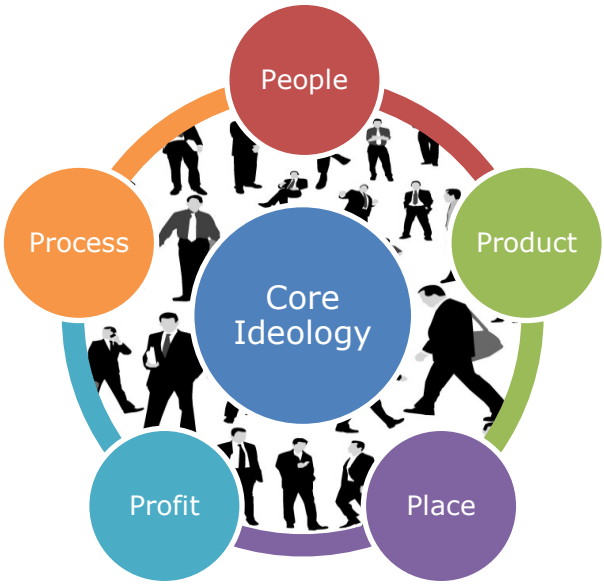


**Figure 21 The sustainability architectures of an organisation**

There should be differentiated between the people architecture and employees. As was shown in chapter 3, the most important part and the critical constraint of a sustainable enterprise is the people in the company. Collins (2001) state that it is the principle of "First Who then What" and Catmull (2008) confirms that the "right" people are more important than the right ideas. Therefore the diagram, Figure 21, include the employees (the silhouettes) as the background of the diagram, while the people (human and organisational structures) architecture is represented by the top circle. Employees are involved in and influenced by all the architectures.

### 8.1.2 Stakeholder Engagement

Figure 10 (page 21) shows a diagram of a typical modern company, developed by Interface Inc. (2008), within which many of the stakeholders of an enterprise are recognised. This model can be used as a basis for analysing the As-Is state of the enterprise.

To gain a whole systems perspective the organisation's engagement with its various stakeholders should be identified. Below is a list of possible important stakeholder groups.

1. Shareholders
2. Customers, Markets
3. Employees(Unions)
4. Business Partners (Suppliers, distributors and alliances)
5. Communities (Families, NGO's, Government, Regulators)
6. Nature

### 8.2 Analysing Architectures and Stakeholders

To identify the relationships between the firm and its stakeholders the architectures, as described in 8.1.1, is mapped to each stakeholder that is affected (Table 2).

**Table 2 Architecture and stakeholder map**

| | Shareholders | Customers | Business Partners | Employees | Communities | Nature |
|---|---|---|---|---|---|---|
| Core Ideology | • | • | • | • | • | • |
| People | | | | • | • | |
| Process | | | • | • | • | • |
| Product | | • | • | • | | • |
| Place | | | | • | • | |
| Profit | • | | | • | • | |

The As-Is sustainability analysis should now focus on analysing each architecture's relationship with the stakeholders. Below follows a tabulated description of what to analyse in terms of core ideology, people, processes, products, place and profits. At the end of this analysis the company should know what the current sustainable value creation situation is (see Figure 11), whether the company is creating value or transferring it.

For the architectures relevant indicators from the Global Reporting Initiative (GRI) are shown in Appendix 5. The GRI is "a multi-stakeholder governed institution

collaborating to provide the global standards in sustainability reporting" (GRI, 2008). By basing the analysis on the GRI standard it is ensured that the analysis is compatible with standard sustainability reporting.

**Core Ideology**

Is the enduring character of the company. It aligns the entire workforce to act in unison and influences culture and corporate identity. It affects all the enterprise's stakeholders as shown in Table 2. The core ideology can be broken down into two parts: core values and core purpose.

**Core Values**

Identify the basic guiding principles of the enterprise, which exemplify what the organisation stands for.
Are these values the core principles by which the company operates day by day?
Are the values tranlated into tangible mechanisms?

**Core Purpose**

Identify core purpose, beyond making money, of the company.
Is it stated formally/informally?
Is the purpose translated into tangible mechanisms?

**Table 1 Core purpose examples**

| Company | Core Purpose | Founding Date |
|---|---|---|
| 3M | To solve unsolved problems innovatively | 1902 |
| Hewlett-Packard | To make a technical contribution for the advancement and welfare of humanity | 1938 |
| Mckinsey | To help leading organisations and governments be more successful | 1926 |
| Merck | To preserve and improve human life | 1891 |
| Nike | To experience the emotion of competition, winning and crushing competitors | 1972 |
| Walt Disney | To make people happy | 1923 |

| | |
|---|---|
| **People to Involve** | Top-management<br>Surveys from other stakeholders eg. employees, customers, suppliers and members of local communities |

**People**

The people architecture refers to human and organisational architecture. People are critical to the success of a change program (Williams et al., 2001).

**Employees**

| | |
|---|---|
| **Organisational Structure** | Overall organisational structure together with who makes the major decisions and where. E.g. Organograms |
| **Employment** | Employees (operational and management) by age, sex, race, employment type, employment contract and region?<br>Employment effect of value chain e.g SABMiller- for every one job created in South Africa 40 other jobs created in their value chain. |
| **Training Programs and Learning** | The current level of training, skill level of employees and the training structures.<br>Assess organisational learning using the following questions.<br>1. Are experiences continuously tested?<br>2. Are there feedback mechanisms in place?<br>3. Does the company produce knowledge?<br>4. Is the knowledge shared and how? |
| **Human Relations** | "Do employees experience joy at work?"<br>1. Staff complaints<br>2. What is the Employee turnover rate?<br>3. Have there been industrial action? |

**Community**

| | |
|---|---|
| **Employees and their Families** | Does the company recognise employees' relationships to their families?<br>Are family issues taken into account when considering employees' work conditions such as work hours, overtime, compensation etc? |
| **Community Involvement** | Effects of company activities on local communities.<br>Broader community perceptions of company<br>Current projects in the communities<br>Review policies relating to hiring from local communities |

**People to Involve**

Human resource management
Survey employees and community members

| **Process** | |
|---|---|
| All business processes except product development. | |
| | |
| **Suppliers** | |
| **Supplier relationship** | The company's suppliers and relationships.<br>The degree of collaboration and cooperation.<br>Identify local suppliers |
| | |
| **Employees** | |
| **Occupational Health and Safety** | Current occupational health and safety performance |
| **Higher Needs** | Assess job design (see transition plan, Joy at Work front). |
| | |
| **Communities and Nature** | |
| **High Level Material flow Analysis** | |
| **Process Flow Diagram** | Draw high level process flow diagram and...<br>**Identify and Quantify Outputs**<br>*Emissions* – Directly or indirectly resulting from the activities of the organisation. Direct emissions may include greenhouse gases, ozone depleting substances and other significant air emissions such as $NO_x$ and $SO_x$. Indirect emission sources include electricity, business travel and transportation of products.<br>*Effluent* - In general this is any water outputs.<br>*Solid waste and other liquids excluding waste water* – It refers to all other waste not identified above, such as packaging and paper.<br>**Identify and Quantify Inputs**<br>Next all the inputs should be assessed.<br>*Materials* – All raw materials, process materials, semi manufactured products and material for packaging . Distinguish between the potentially technical and biological nutrient inputs. Assess inputs in terms of persistence, abundance in nature and eco-toxicity.<br>*Energy* - All energy inputs direct (energy-produced onsite), indirect (energy-produced outside the organisation) energy feedstock (e.g. petrol, diesel and coal) used to produce energy.<br>*Water* - The water consumption of processes |
| **Biodiversity Impact** | Impacts directly on the environment e.g. Agricultural activities |
| | |
| **People to Involve**<br>Employees involved in the process | |
| | |
| **Product/Services** | |
| The product/service architecture pertains to the products of the company. It relates to the how the enterprise is fulfilling the a societal need. | |
| **Customer** | |
| **Need Fulfilment of Product** | Products/services the company sells and the needs it fulfil of the end customer. |
| | |
| **Customer and Nature** | |
| **Analysis of Impacts** | Identify lifecycle impacts of products |
| **Identify the Recyclability of Products** | Use Process flow diagram from Process architecture<br>Identify renmanufacturability and recycling physical design features. |
| | |
| **People to Involve**<br>Product designers and engineers and other personnel working on product development. | |

<table>
<tr><th colspan="2">Place</th></tr>
<tr><td colspan="2">The physical plant and offices, the company's infrastructure and the immediate physical natural environment.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2"><u>Employees</u></td></tr>
<tr><td>Suitability for Humans</td><td>Is the indoor air quality satisfactory?<br>Is there enough natural light in the building?<br>How is the temperature controlled?<br>Is layout of the building/plant conducive to the management structures? E.g. does it encourage collaboration.<br>Complaints from the employees.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2"><u>Nature</u></td></tr>
<tr><td></td><td>Energy use - lights, HVAC, lifts etc. Exclude energy consumption of processes<br>Water consumption - water for sanitary use. Exclude water consumption of processes.<br>Biodiversity - Impacts of the company's infrastructure (buildings and roads) on natural environment .</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">People to Involve<br>Facility manager</td></tr>
<tr><td colspan="2"></td></tr>
<tr><th colspan="2">Profit</th></tr>
<tr><td colspan="2">The management of the financial capital</td></tr>
<tr><td>Economic Value Distribution to Stakeholders</td><td>Focus on how money is distributed to stakeholders. Example shown below.<br><br>Assessing economic contributions to stakeholders (adapted from GRI, 2006)
<table>
<tr><th>Component</th><th>Comment</th></tr>
<tr><td>Direct economic value generated</td><td></td></tr>
<tr><td>a) Revenues</td><td>Net sales plus revenues from financial investments and sales of assets</td></tr>
<tr><td>Economic value distributed</td><td></td></tr>
<tr><td>b) Operating costs</td><td>Payments to suppliers, non-strategic investments, royalties, and facilitation payments</td></tr>
<tr><td>c) Employee wages and benefits</td><td>Total monetary outflows for employees (current payments, not future commitments)</td></tr>
<tr><td>d) Payments to providers of capital</td><td>All financial payments made to the providers of the organization's capital.</td></tr>
<tr><td>e) Payments to government</td><td>Gross taxes</td></tr>
<tr><td>f) Community investments</td><td>Voluntary contributions and investment of funds in the broader community (includes donations)</td></tr>
<tr><td>Economic value retained (calculated as Economic value generated less Economic value distributed)</td><td>Investments, equity release, etc.</td></tr>
</table></td></tr>
<tr><td>Measures to Quantify other capital</td><td>Is measures to quantify other capitals in use?</td></tr>
<tr><td>Equity indication</td><td>Equity indication= executive's salary/average salary.</td></tr>
</table>

| **Normalised Indicators** |
|---|
| For a whole systems perspective normalise indicators against economic output. This Integrates sustainability criteria with business criteria.<br><br>Examples of whole sysem indicators are shown below:<br>1. Materials Productivity = Material input/Economic Output<br>This metric measures the amount of material needed for every Rand of products sold.<br><br>2. Waste accumulation = Waste(kg's) /Economic output<br>The amount of material that is wasted for every Rand of product sold.<br><br>3. Energy productivity = Total energy usage(Joule)/Economic output<br>Energy, including electricity, needed for each Rand of product sold.<br><br>4. Knowledge intensity = Shareholder value/material output<br>DuPont use this to indicate knowledge intensity of products (Fiksel, 2003b).<br><br>5. Contribution to employees = wages, salaries/economic output<br>This may serve as indicator of how the company contributes to poverty reduction. |
| |
| **People to Involve**<br>Finance department |
| |
| **Outcome of As-Is Analysis** |
| **1.** Whole system view of the enterprise, showing all the relationships with the social and natural environment.<br>**2.** A documented analysis of each architecture and its effect on stakeholders.<br>**3.** Process flow diagram with quantifiable inputs and outputs.<br>**4.** Indicator values based on the standardised Global Reporting Initiative (GRI) indicators.<br>**5.** Indicators that is normalized against economic output for an integrated view of sustainability. |

# 9 TO-BE

The To-Be state refers to the long term sustainability vision of the organisation. Creating a vision is crucial to motivate and stimulate innovation among employees. This To-Be vision will be defined using the method of backcasting described below

## 9.1 Backcasting

Backcasting is a scenario planning method. Backcasting entails moving back from a future state (where all the conditions for success have been met) to the current situation and then determining the best path towards this vision. Backcasting in the context of sustainability differs from normal scenario planning since the future scenario is developed with the sustainability conditions as constraints, rather than backcasting from different scenarios (Robèrt et al., 2004).

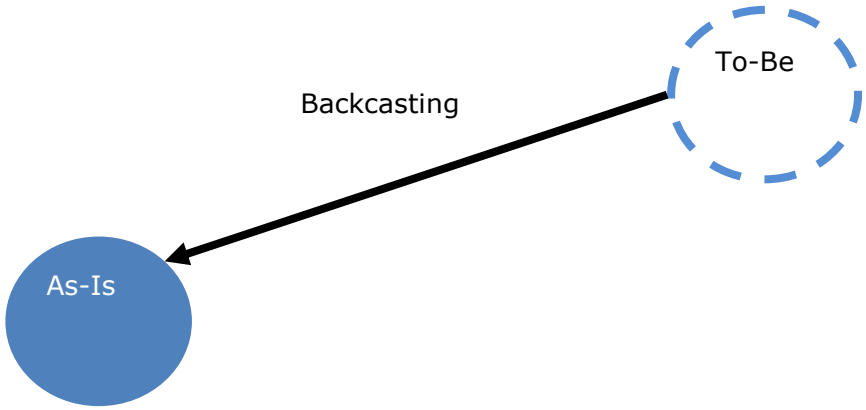


**Figure 22 Backcasting**

Backcasting has been recognised as an important planning method. Dreborg (1996) states that backcasting is particularly useful when:

1. The problem to be studied is complex.
2. There is a need for major change.
3. Dominant trends are part of the problem.
4. The problem is largely a matter of externalities.
5. The scope is wide enough and the time horizon long enough to leave considerable room for deliberate choice.

Above conditions for backcasting are all conditions that are associated with sustainable development. Consequently, backcasting is considered an important tool in planning for sustainability. Backcasting stands in contrast with the traditional approach of forecasting, where today's trends and problems are "realistically" projected into the future. Using the wrong planning methods can inhibit sustainability. "What is realistic today should only be allowed to influence the pace of transition, not its directions. This is the essence of backcasting." (Robèrt, 2000).

This step builds on the As-Is analysis and it might be necessary to go back to the As-Is for more data gathering, if deficiencies in the data becomes evident.

### 9.2 The Restorative Vision

Collins and Porras (1994) calls this positive, future state a BHAG, a big hairy audacious goal, and emphasises that enterprises that want to endure in the long run must have one. They remark that when applied correctly the BHAG serves as "unifying focal point of effort" which stimulates progress and creates team spirit. For this roadmap the enterprise's BHAG would be sustainability. To achieve sustainability the success conditions are the sustainability conditions, but these conditions are only end points and do not include a specific methodology to articulate the future state. To envision this future state industrial ecology can provide the design blueprint. The logic is to use the easy understandable metaphor of nature to spark creativity (Korhonen, 2004) towards ways to satisfy the sustainability conditions.

Win-Win-Win situations should be considered as the main objective, in other words solutions where the company adds value to all the three sustainability spheres and do not just add value in the economic sphere while "no harm" is done to the social and environmental sphere (McDonough & Braungart, 2002). The goal of the enterprise should be to become a restorative enterprise. E.g. Interface Inc. has the vision to become a restorative company by 2020 (Interface, 2008).

Next, a generic To-Be vision is presented, which can be used to develop a specific To-Be vision for any company. It must be noted that this should be a long term vision, therefore there is a need to "dream big".

## 9.3 Whole Systems Perspective

As in the As-Is analysis the whole systems view of the enterprise is the first priority. Below, Figure 23 shows a useful whole systems perspective of the To-Be (state the restorative state) of an enterprise.

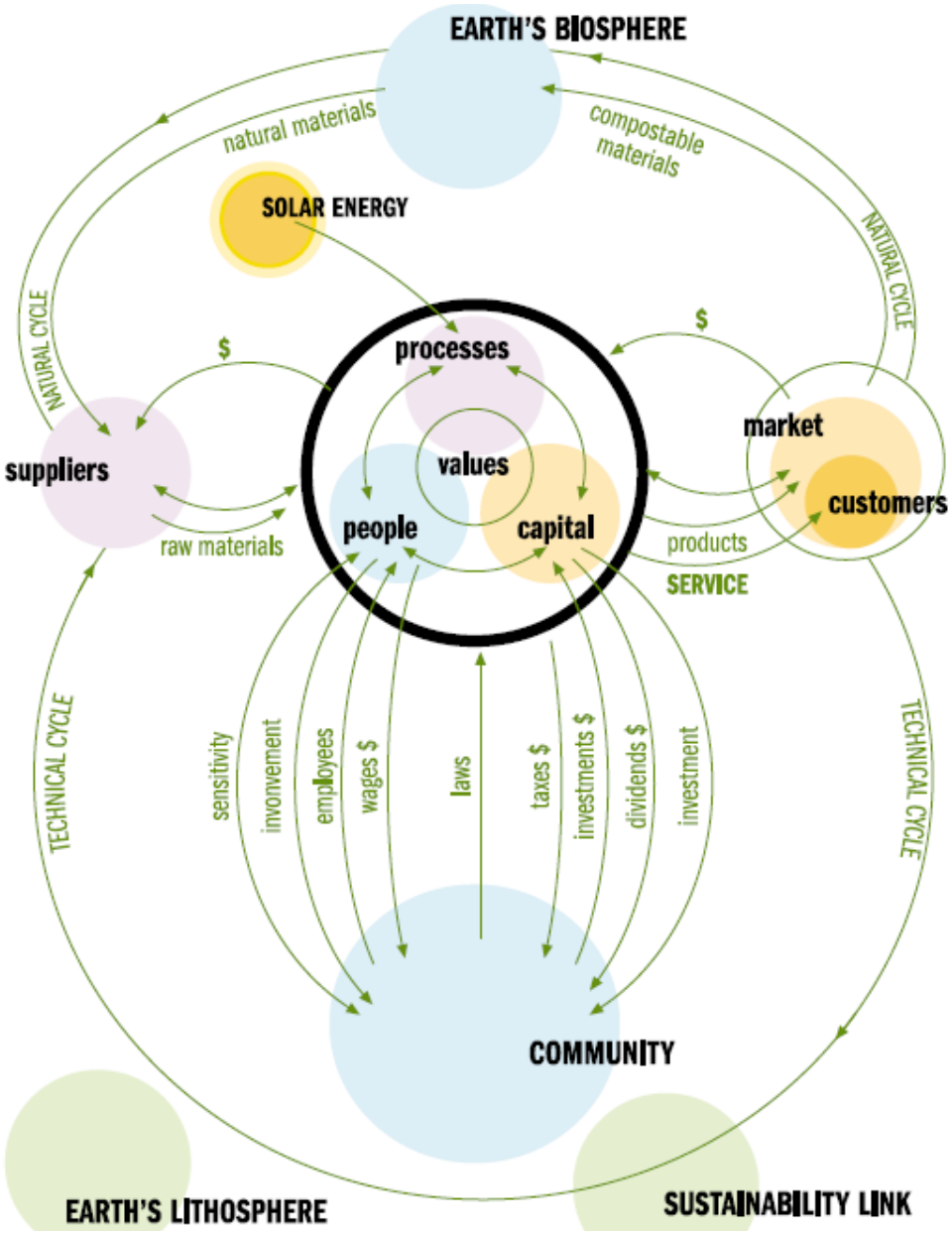


**Figure 23 A whole systems perspective of a sustainable enterprise developed by Interface Inc. (2008)**

Firstly the enterprise is primarily focused on the need it fulfils in society (specifically how it contributes to the ultimate end), by focussing on the service/products it delivers to its customers. By doing this, it has optimised its impact through its value chain to create the most benefit for its stakeholders (see contrast with Figure 10 on

page 21). These relationships are fostered and built on trust. The people in the company are highly valued and skilled at learning individually and in teams. All material loops are closed with technical nutrients being taken back into the supply chain and biological nutrients are returned to nature. All processes are driven by energy from the sun (renewable energy).

This To-Be state will be further elaborated on, by paying attention to the sustainability architectures of the enterprise and using the industrial ecology principles, to develop a To-Be vision for each. The core ideology and profit architectures are only generally described and not in terms of the industrial ecology principles.

| **Enterprise Level** |
|---|
| The principles applied on an enterprise level |
| **Closed Loop**<br>Industrial symbioses functions as byproducts from one enterprise are inputs for others, ensuring that its materials loops are closed. |
| |
| **Diversity**<br>The enterprise surround itself with diverse industries in order to ensure industrial symbiosis can take place. |
| |
| **Connectedness**<br>The enterprise has good relationships with authorities and communities and is a trusted part of society. The enterprise uses these relationships, to contribute their expertise in policy matters and doing so add value to the broader society. The enterprise is also continually collaborating with NGOs and academia in a strategic way to develop new competencies in mutually beneficial way. It also fosters relationships with other businesses forming part of the larger industrial symbiosis. Market stakeholders relationships are also valued. These relationships are build on trust and transparenc and ensures that it is open to changes in its environment. |
| |
| **Locality**<br>The enterprise is very concerned with the areas and communities that it operates in and continually strives to be more locally relevant, rather than adopting one size fits all approaches. |

| People | |
|---|---|
| The human and organisational architecture is critical to the success of a sustainable enterprise, since its impact on human and social capital. | |
| **Diversity**<br>The human and organisational architectures are designed to ensure a company culture that flourishes on the diversity and participation of its employees. The company draws on the diversity of its employees in expertise, experience, age and culture to drive innovation. The company have become skilled at learning individually and collectively and double loop learning ensures that the company are continually adapting in an unpredictable business environment. Employees are seen as individuals who are respected in terms of their personal goals and aspirations.<br><br>Employees acting as the proactive process engineers (Womack & Jones, 1996), are and feel empowered as they are the master minds behind many innovative business solutions (Leadbeater, 2008). WEB 2.0 applications such as blogs, portals, wiki's and collaboration software are increasingly used for these purposes (Mckinsey, 2007). The management are trained in facilitating this process. | |
| | |
| **Connectedness** | |
| **Connected to the Communities** | The wellbeing of each employee is valued and is connected to the performance of the company. People are seen as connected with families and through their families to their communities. These relationships are highly valued and looked after. Families are taken into account when considering working hours and working conditions, such as flexible time schedules to allow for family responsibilities. They are also skilled at forming mutually beneficial relationships with labour unions. |
| **Connected to other Employees** | The company has a strong peer culture where everybody at all levels is connected and supports each other (Catmull, 2008). All employees are viewed as peers. In the organisation there is differentiated between communication and decisions making hierarchy, making it possible for "everyone to communicate with everyone" (Catmull, 2008). Great effort is made to break down traditional departmental boundaries to facilitate possible synergistic relationships and inspire cross functional innovation. In this regard lean techniques promote the creation of cross functional teams to facilitate better flow through the company (Womack & Jones, 1996). |
| | |
| **Locality**<br><br>Priority is placed on employing local people (McDonough & Braungart, 2002). Employees are committed to their local communities and encouraged to do voluntary work and they feel they are making a difference in their respective communities. | |

| Process | |
|---|---|
| **Closed Loop** | |
| Environmental criteria have been integrated into normal continuous improvement strategies, such as lean production to ensure that environmental waste is done away with. All toxins have been eliminated from the input materials. All the technical nutrients entering the production processes are coming from the customers through the closed loop supply chain or from a material bank (Braungart et al., 2007).<br><br>The manufacturing processes have no harmful emissions (satisfying the system conditions 1 and 2) to the environment. The only waste the company produces is called "by-products", which is sold to neighbouring companies using it as inputs into their processes, this includes biological nutrient material which is used by local farmers to fertilize their soils. (Rhoner Textil AG sells their waste from their carpet factory to farmers as mulch (Waste = Food, 2006). | |
| | |
| **Diversity** | |
| Processes are all based on lean principles. Processes are not anymore designed around big large "batch and queue" technologies but processes use smaller diverse technologies in order to increase flow (Womack & Jones, 1996).<br><br>The processes producing the energy are also designed around the diversity concept. Energy comes from a diverse mix of small renewable energy generators, such as solar, wind, biomass and hydro technologies, implemented in a network. This allows the company to make maximum use of all local energy flows. | |
| | |
| **Connectedness** | |
| **Connected to Employees and Nature** | The relationship between the processes, the operators and the environment are taken into account when processes are designed. People enjoy being part of the processes and their productivity increase, since they experience the processes as user friendly. The processes' designs are optimised for capital and operating costs from a whole systems perspective, which ensures that the system is more resource efficient (see tranisitionplan for a description of techniques to accomplish radical resource savings). For the manufacturing processes, technologies such as efficient motors, variable speed drives (VSD's) and efficient compressed air technologies are used (Romm, 1994). |
| **Connected to Business partners** | The company fosters long term mutually beneficial partnerships with its suppliers based on transparency and trust which ensures collaboration. This allows the company to ensure that sustainability is maintained throughout the supply chain.<br><br>Extra revenue is made from selling the by-products of the processes to other companies. This also minimises the waste produced. |
| | |
| **Locality** | |
| The processes are situated as far as possible near the local markets. Mass customisation, the ability to postpone processes that differentiate products for specific customers, are applied to ensure that the products are adapted efficiently for local markets. Priority is placed on raw materials that are sourced from local suppliers and the energy system is adapted to make full use of the local energy flows (McDonough & Braungart, 2002). | |

| Place | |
|---|---|
| **Closed Loop**<br>All new buildings of the company are built using environmentally friendly materials. Old buildings are retrofitted with energy saving measures such as efficient HVAC and lighting systems, and super-windows. Components that are worn-out are replaced by sustainable components e.g. replacing old carpets with recyclable carpets. All buildings clean and recycle their own waste water using natural methods. Sewage systems are used as energy generators (using biogas digesters) while the sewage is processed (e.g. by earth worms) as fertilizer for the gardens around the building. The rainwater catchment system supplies the building with fresh water. | |
| **Diversity**<br>The biodiversity of the areas surrounding the buildings are highly valued and invested in. | |
| **Connectedness**<br>**Connected to Employees and Nature** | The buildings are built and designed for multiple benefits such as saving energy and water, while at the same time increasing employee productivity and having aesthetical value. E.g. Pixar Animation Studio's offices are designed to maximise worker interactions to foster collaboration (Catmull, 2008). Passive solar design features and day lighting are central to the building's design. |
| **Locality**<br>The buildings/plants are situated near the market to ensure short lead times and eliminate unnecessary transport. It is at harmony with the local environment, realising and protecting the value of local ecosystem e.g. the wetlands, bird species etc. "Green roofs", where local indigenous plants and shrubs are planted on a building's roof is an example of this e.g. Ford's headquarters have one of the largest green roofs. | |
| **Profit** | |
| The company is doing well while doing good, maximizing shareholder and stakeholder value. Value is created not transferred. The company have a balanced view towards short term financial results and continually strive to grow intangible assets that will be needed for long term financial success. The enterprise has developed ways to value the other forms of capital, especially human, social and natural capital. Sustainability performance measurements have been integrated with traditional business measurements.<br><br>The company realises that making money is not the main purpose, but a means to an end. Making the company more profitable will expand the positive influence it has on society. The company mainly invests its capital in local communities through market related salaries to employees, but also through funding strategic community projects to take maximum benefits from doing the projects. The company invests in the environment as a supplier of "key components", either directly planting trees (from which the carbon offsets can be sold) or indirectly by investing in environmental research (Hawken et al., 2007). | |
| **Outcome of To-Be visioning** | |
| **1.** Whole systems perspective of the To-Be state (BHAG).<br>**2.** A description of the To-Be state of each of the six architectures. | |

# 10 TRANSITION PLAN

## 10.1 Identify Gap between As-Is and To-Be

The first step in developing the transition plan is to identify the gap (the difference) between the current As-Is situation and the To-Be future of the enterprise. The gap should not immediately be broken down in the different architectures of the enterprise. The whole system gap, the net system gap, must first be studied in order to understand and grasp the interrelationships and possible synergies between the different architectures.

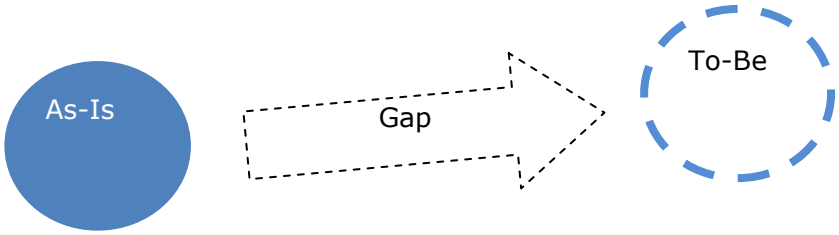


**Figure 24 Whole system gap between the As-Is and To-Be must be identified**

Proposals now need to be generated on how this gap can be bridged. When generating these proposals take into account that this is a high level transition plan and therefore specific implementations procedures do not have to be considered yet (this will be done in the Projects step).

## 10.2 Generic Transition Plan

Since this is a sustainability change program, the gap will always be between unsustainability and sustainability. Through reviewing literature, specifically literature relevant to industrial ecology, the Natural Step framework and manufacturing enterprises the following generic transitional plan is proposed to help an enterprise plan towards sustainability.

This transition plan is based on the following strategies, which are not tools, but rather strategic guidelines:

1. Lean Thinking (Womack & Jones, 1996)
2. Natural Capitalism (Hawken et al., 1999)
3. Interface's 7 Fronts (Interface Inc, 2008)
4. Cradle to Cradle (McDonough & Braungart, 2002)
5. Natural Step Investment strategy (Robèrt, 2000).

The vision that was created in the To-Be phase is long term and therefore it is necessary for it to be broken down into small steps. This will allow progress to be more systematic without being overwhelmed by the long term vision. The transition plan can be divided into five steps each with its own descriptive milestone.

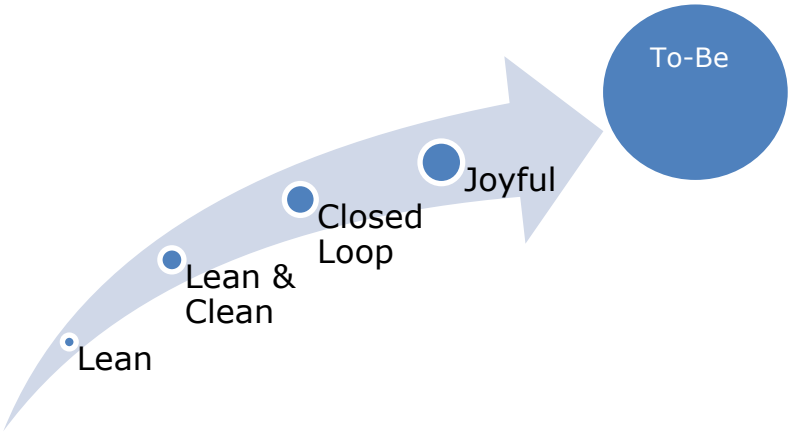


**Figure 25 The 5 steps towards the To-Be vision**

In addition, the four steps are also sub-divided into five fronts (see Figure 26), which should be executed in parallel. The five fronts are:

1. Radical Lean
2. No Emissions
3. Closing the loop
4. Joy at Work
5. Business Logic

The word front is borrowed from Interface Inc., which likens their strategy to achieve sustainability, the 7 fronts, to the faces of "Mount Sustainability", emphasising that the different fronts are executed simultaneously and are directed towards one goal

(Interface Inc, 2008). Each front is strategically relevant to a specific step e.g. the Radical Lean front is critical to reach the lean milestone, just as the Joy at Work front is of strategic importance in reaching the joyful milestone. See the graphical depiction of the transition plan below (Figure 26).

A transition plan was designed based on the following criteria.

### 10.2.1 Flexible Platforms

When an organisation looks to take steps towards sustainability, each step toward this goal should be a flexible platform. A flexible platform is a step that lays the foundation for subsequent steps to reach the sustainability conditions, to link short term decisions to long term decisions. This ensures that investments now are fully compatible with the long term sustainability vision, as a result avoiding dead ends and investment losses. "The key is to maintain the overall direction for long-term development despite suboptimal solutions for minor short-term problems and challenges." (Korhonen, 2004)

### 10.2.2 Low Hanging Fruit

In order to make the initial short term steps economically feasible, the flexible platform investments that gives the best return on investment should be done first e.g. those actions that are inexpensive, can save resources or save regulatory costs. These so called "low hanging fruit" will enable the long term economic feasibility of investments (Robèrt, 2000).

### 10.2.3 Precautionary Principle

The precautionary principle should be applied when there is doubt whether the proposed investments will comply with the sustainability conditions or not, particularly when large amounts of resources will be tied up (Robèrt, 2000).

On the next page the transition plan is depicted graphically(. It shows how the different fronts are related to each other. For each front the relevant architectures and stakeholders are identified. The profit architecture and shareholders are not linked to a specific front, as all the fronts contribute to them; they are linked to the results of the company. The basis or starting point of each front and therefore of the

transitional plan is the Radical Lean front. The training and learning plan is also included in the depiction as it will support the transition plan (Figure 26).

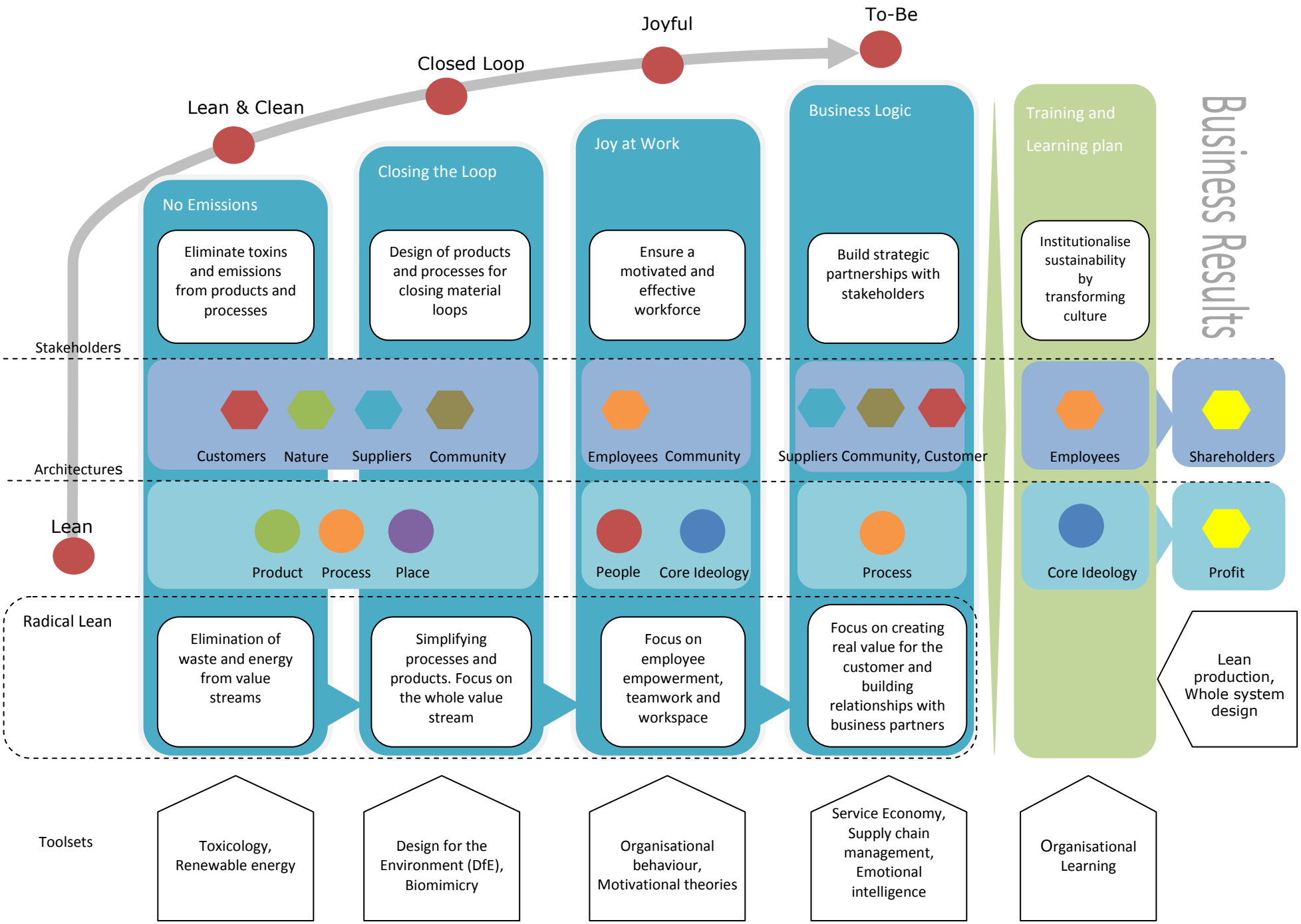


**Figure 26 Generic transition Plan**

### 10.3 Radical Lean

The *Radical Lean* front, which is based on the already established field of lean production, will lay the foundation (see Figure 26) for the rest of the transition plan. Lean is well recognised for its business successes and will therefore give credibility to the transition plan. It is essential that this front be carried out with diligence.

The *Radical Lean* front incorporates parts of the other fronts which are more focused on specific aspects of the "road" to sustainability. For instance lean as an offspring of Total Quality Management (TQM) have a strong focus on employee empowerment which will pave the way for the *Joy at work* front. Lean's focus on the value for the customer and on partnerships through the value chain wil also be a stepping stone towards building strategic partnerships with other business stakeholders, which is part of the *Business Logic* front.

Lean is a philosophy which aims to systematically design out all waste. Material waste is not the only form of waste. Waste is defined as "all human activities which absorbs resources, but do not create value" for the end customer (Womack & Jones, 1996, p 15). There is a bulk of literature available on the detail applications of lean techniques in business. However it is beyond the scope of this report to explain these techniques in full. Only the main principles as identified in Womack and Jones (1996) are shown in the table below.

**Table 3 The five principles of lean thinking (Womack and Jones (1996))**

| | |
|---|---|
| **Value** | Define value from customer's perspective (speed, cost, quality). |
| **The Value Stream** | Identify and map the value streams.<br>A value stream is all the actions required to bring a product to the customer.<br>Identify all actions where value is not added (Muda) and eliminate them. |
| **Flow** | Optimise flow of product through value stream.<br>Create continuous flow in small lot production.<br>Use continuous flow processes, rather than "batch and queue" processes. |
| **Pull** | Customer pulls the value through the value stream.<br>Pull means: produce exactly what is needed when it is needed (Just-in-time). |
| **Perfection** | Aim at perfection (Similar to backcasting).<br>Focus on process and products. |

These points will be used in the evaluation below.

#### 10.3.1 Sustainability Evaluation

Next the lean methodology will be evaluated from a sustainability perspective. The

analysis is done from different stakeholder viewpoints.

#### 10.3.1.1 Stakeholder: Customer

Lean has a strong focus on the needs of the customer and is consistent with the service economy concept of industrial ecology. Applying the lean principles may well be a valuable flexible platform to achieve the goals of the service economy.

#### 10.3.1.2 Stakeholder: Employees

Although worker satisfaction is not an explicit aim of lean techniques Womack and Jones (1996) states that it is has positive psychological effect on employee morale, as the type of work layout (job design) and other lean measures creates conditions which employees regards as rewarding. This includes having a clear objective, the need for intense concentration, lack of distractions and immediate feedback.

Improving the workspace of employees is also an aim of lean. Here the 6Ss[7] workspace management philosophy advocated by lean (Figure 27) plays an important role. Over and above productivity improvements, these principles will also improve worker satisfaction in a firm.

[7] The 6Ss is better known as the 5Ss, excluding safety.

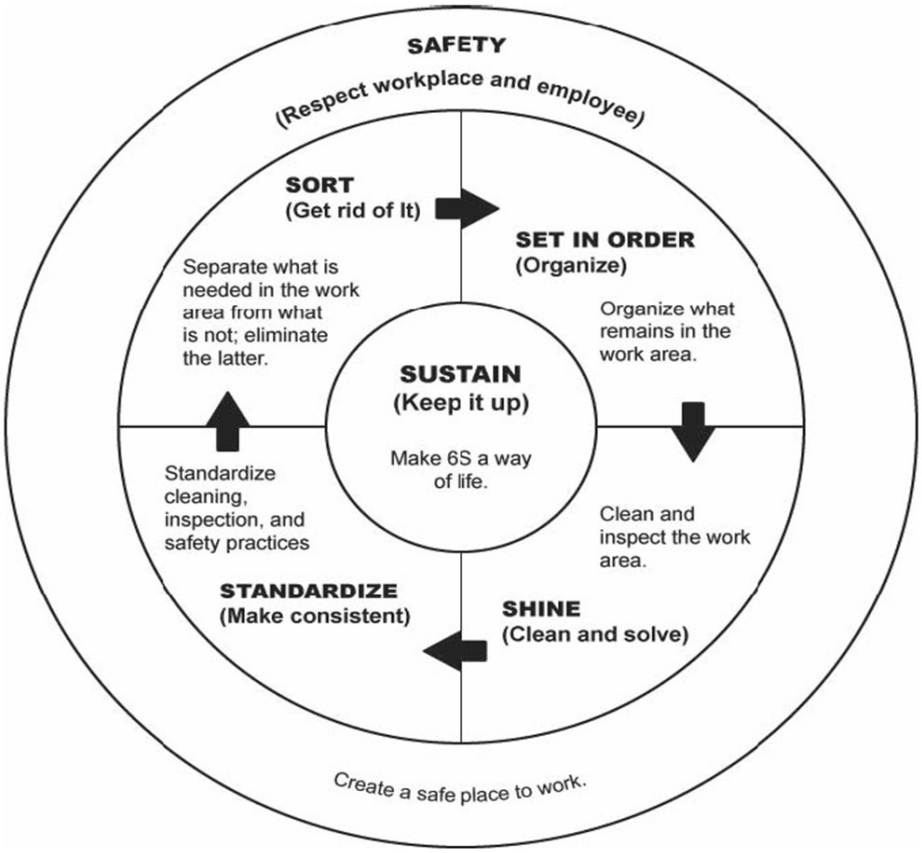


**Figure 27 The 6S workspace philosophy (EPA, 2007)**

Lean techniques also strongly advocate teamwork through cross functional teams, which make lean strategies "inherently egalitarian" (Womack & Jones, 1996, p 97). Although the initial planning for the lean transformation of an organisation is a top-down process, the rest of the problem solving should be driven by employee suggestions through the cross functional teams (Womack & Jones 1996), which is in line with the To-Be vision.

#### 10.3.1.3 Stakeholder: Nature and Communities

Lean techniques, as mentioned, focus on reducing waste. Environmental waste is not directly included in the so called "deadly wastes", however the systemic nature (connectedness) of the manufacturing system implies that environmental waste are also reduced when applying lean (see Appendix 7).

Community stakeholders are only indirectly considered, because lean techniques lead

to reduced flows of waste and emissions to the community.

Lean techniques can be considered eco-efficient and thus be prone to the rebound effect, which may cause the overall environmental impact of lean measures to be negative even though the environmental impact per unit produced have decreased.

#### 10.3.1.4 Stakeholder: Suppliers

In order to pursue perfection and create a lean enterprise these lean principles should also be realised outside the organisation in the supply chain. This can only be achieved with pursuing better relationships, through transparency, collaboration and trust, with all firms in the supply chain (Womack & Jones 1996, p 227). These strengthened relationships will benefit the other fronts of this transitional plan as good supplier relationships are important in order to become a sustainable enterprise. For instance, supplier cooperation will be critical in eliminating toxins from raw materials and thus products.

### 10.3.2 Radical Resource Productivity

Lean techniques are valuable systems approaches (Hawken et al., 2007) in the quest for sustainability and could be made more valuable by incorporating a systems approach to natural resources. Radical resource productivity (as specified by Natural Capitalism from Hawken et al., 2007) integrated with the lean principles can help attain this goal. Radical resource productivity refers to the use of whole system design techniques to create system wide resource productivity gains (Hawken et al., 2007). Every part of a system should be designed while considering the whole. Considerable attention is paid to understanding synergies (connectedness) between the various elements of a system when designing it.

An example of whole system design applied to processes follows: pipes are often optimised according to the thickness and cost, while the motor as part of the broader system should also be considered (Hawken et al., 2001). In this system, the motor would be the component associated with the largest cost. Minimising friction by using larger pipes, a smaller and less costly motor can be used. Optimising in this manner would save capital cost and energy (operating cost).

This technique can also be applied to building design (Place architecture). An

example follows: Much electricity can be saved by incorporating day lighting, energy efficient lights, superwindows and better HVAC (heating, ventilation and air conditioning) controls into the building's structure. These measures seem to be costly, but when considering the whole system, the smaller HVAC system that is needed and the increase in worker productivity would yield a high return on investment.

### 10.3.3 Integrating Lean and Radical Resource Productivity

The integration should start at the value stream mapping. EPA (2007) proposes that natural resource flows be integrated with the value stream mapping. Value stream mapping focuses on time used for each process, but can be expanded to incorporate natural resources such as materials, water and energy. Lean analysis of the processes would then explicitly identify natural resource waste (see Figure 28). The diagram can be adjusted for water, energy or any critical substance. Whole system design techniques can then be used to identify radical resource productivity opportunities by studying the processes.

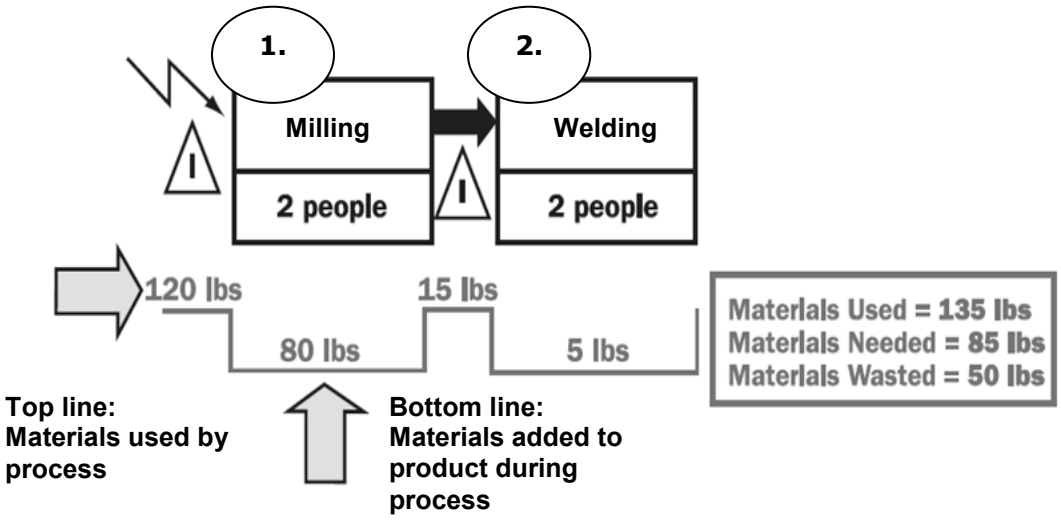


**Figure 28 An example of how environmental criteria can be integrated into value stream mapping**

*Evaluation of the Radical Lean front based on:*

### 10.3.4 The Sustainability Conditions

Lean techniques and radical resource productivity is a step towards complying with the natural capital sustainability conditions as it contributes to resource efficiency, but strategies for substitution of harmful substances and closed loop material flows are not included. It also contributes to human and social capital sustainability conditions with its emphasis on teamwork and health and safety.

### 10.3.5 Flexible Platform

The following reasons are identified why the front is a flexible platform.

1. It contributes to resource productivity.
2. Integrating lean with sustainability methods gives sustainability credibility from a business perspective, because the lean toolkit consists of tested tools that are recognised for providing a competitive advantage to organisations.
3. Lean provides a systems approach to production, in which many stakeholders' needs are considered. See section 10.3.1 for the sustainability evaluation.
4. Lean focuses on delivering value to the customer. The customers do not want negative environmental impacts or health risks (EPA 2007).
5. Lean measures integrated with sustainability measures lay the foundation for all the other fronts of the transition plan (see Figure 26 for the transition plan).

### 10.3.6 Low Hanging Fruit

To justify the *Radical Lean* front as the first strategic priority in this transition plan, the front should be shown to be a "low hanging fruit".

According to (Womack et al., 1996) lean is a strategy that requires very little capital investment, and thus it can be considered a "low hanging fruit". Hawken et al. (1999) echoes the same for radical resource productivity. They propose an investment strategy where these radical resource productivity measures can be "piggybacked on improvements being made anyway for other reasons, such as renovation of aging equipment, renewal of deteriorating building facades, or removal of such hazards as CFC's, asbestos, and PCB's."

The Radical Lean front allows the company to buy time, by ensuring cheap efficiency improvements. The money freed up must be reinvested towards this transition plan.

### 10.3.7 Risk

A lean or resource efficiency strategy is not sufficient for a company to obtain sustainability. It can only be applied to the sustainability transition plan if it is done in the context of achieving the overall aim of the To-Be state defined in the previous step. Otherwise, the radical lean front can be detrimental towards the environment as result of the rebound effect. (Korhonen, 2004; McDonough & Braungart, 2002)

## 10.4 No Emissions

The *Radical Lean* front's aim was to increase resource productivity and lay the foundation for the rest of the transition plan. The goal of the *No Emissions* front is to eliminate harmful substances emitted to the environment. This includes eliminating or substituting toxins contained in materials and eliminating greenhouse gases and other harmful emissions, by substituting fossil based energy with renewable energy. This particular front is mostly focused on the process and product architectures.

### 10.4.1 Substituting Harmful Substances

McDonough and Braungart (2002) have proposed the following five step strategy to get rid of harmful substances in products.

**Table 4 Strategy to remove harmful substances (see Mcdonough and Braungart (2002)**

| | |
|---|---|
| **Step 1: Get Free of Known Culprits** | Avoid substances that are known to be bio-accumulative and to cause harm. E.g. PVC, mercury, lead and cadmium. |
| **Step 2: Personal Preferences** | The enterprise should choose substances based on informed personal preferences. Make decisions based on available information rather than selecting the cheapest materials. |
| **Step 3: The Passive Positive List** | Assess each component's toxicology i.t. of capability to be a biological or technical nutrient.<br>Identify optimisations needed for substances to be fully biological or technical nutrients. |
| **Step 4: The Active Positive List** | Design substances of the products to be part of the cyclical material flows to retain quality through endless lifecycles.<br>Optimise all substances to be either biological nutrients or technical nutrients. |
| **Step 5: Reinvention** | Reinventing business in terms of how the business fulfil the customer needs and optmise impacts to nature and society. Also see *business logic front* . |

### 10.4.2 Substitute Unsustainable Energy Sources

An important part of *No Emissions* front will be to move to renewable energy sources to eliminate greenhouse gas emissions. It builds onto the *Radical Lean* front in which

energy efficiency is increased, by whole system design techniques.

Local energy flows must be investigated to ensure the most feasible solutions are chosen. This will vary with location. A company may opt to import green electricity from a renewable energy producer, or produce energy onsite with renewable technologies such as solar, wind or biomass technologies. There are many options available for producing energy onsite, but detail descriptions of options are beyond the scope of this report. When considering renewable energy options it is important that an integrated approach is taken, for instance if a company is producing wood products it may use the woody by-products in the generation of energy and heat (cogeneration) for its processes. This approach has already been well established in the sugarcane industry, where sugar bagasse is used in energy generation.

*Evaluation of the No Emissions front based on:*

### 10.4.3 Sustainability Conditions

This front is specifically focused on reducing the company's contribution to breaking the sustainability conditions pertaining to natural capital.

### 10.4.4 Flexible Platforms

The *No Emission* front is considered a flexible platform as it lays the foundations for closed loop strategies which is central to the To-Be state of the enterprise. Eliminating harmful substances ensure materials can become genuine biological nutrients and technical nutrients. Moving toward renewable energy sources eliminates the company's environmental impact as a result of energy use.

### 10.4.5 Risks

A no emission strategy on its own, the same as with resource productivity strategies, will not accomplish meeting the system conditions. Taking this into account it is crucial that this front be executed in the context of being a stepping stone for closing material loops (see next front). Projects in this front must be consistent with reaching closed loop material flows and eventually the To-Be state. Moving to renewable energy sources may result in extra costs, particularly in geographical areas where cheap energy from coal is available.

### 10.5 Closing the Loop

The goal of the *Closing the Loop* front is to design products and processes that allow the material loops to be closed, but with particular focus on product development. Design for the environment (DfE) is a field with this aim. DfE can be defined as the design of safe and environmentally friendly products (Fiksel, 1996, p 51), thus not only considering the impact of product designs on the environment, but also on humans. DfE focuses strongly on optimizing design over the whole lifecycle (Fiksel, 1996, p 67). DfE strategies broaden the product design scope by incorporating life cycle considerations such as recycling and disassembling. There is a considerable overlap with other, well established design strategies, such as design for manufacturing and assembly, which allows for synergies between these strategies (Fiksel 1996, p 93). For example making products simple to manufacture and assemble would also reduce the effort of disassembly and recovery of materials.

Practical guidelines, from (Fiksel 1996, p 93) for integrating DfE considerations in the product lifecycle are shown below. The DfE field consists of many "design for" strategies which are mostly closely related and overlapping.

**Table 5 Examples of "design for" strategies**

| | |
|---|---|
| **Design for Life Extension** | Life extension is a key strategy in the quest for a service economy.<br>Products are designed to optimise the flow of service over its lifespan. |
| **Design for Recovery and Use** | The product is designed to maximize its end of life value.<br>The product is designed to be remanufactured or for the reuse of its components. |
| **Design for Disassembly** | Products are designed to minimize cost and time of disassembly.<br>Reducing the complexity of products and changing the way products are assembled.<br>E.g. using snap fits to join components rather than adhesives. |
| **Design for Energy Conservation** | Energy can be conserved by reducing energy needed for the production, operation and distribution of the product. |
| **Design for Material Conservation** | Designing products with multiple functions, using less material but providing more functionality.<br>E.g. all in one washing and drying machines, can achieve material conservation.<br>The use of renewable materials (biological nutrients) in products.<br>Designing products for easy recovery of recyclable materials (technical nutrients) |
| **Design for Toxicity Reduction** | Avoiding the release of harmful substances (see No Emissions front). |
| **Design for Accident Prevention** | During the design stages products is assessed for possible hazards to ensure product safety.<br>E.g. includes avoiding flammable materials, minimising leakage potential and discourage misuse (Fiksel 1996, p 108). |
| **Design for Material Conservation** | Designing products with multiple functions, using less material but providing more functionality. |

### 10.5.1 Multiple Criteria

As is seen from the above table, incorporating sustainability into product development means that multiple strategies be considered. The complex interconnections between the various social, environmental and economic criteria often lead to complex tradeoffs in designing these products (Fiksel 1996, p 92). For example consider the trade off between designing durable products and designing products for disassembly. The former implies stronger fastening while the latter requires separable parts. Therefore, it is important that the broadest possible system view be taken when these decisions are made. Below in Table 6 are criteria for taken a whole systems perspective on the design of a product.

**Table 6 Whole system design criteria (TNP, 2007)**

| ***Resource*** | **Minimise** | **Maximise** |
|---|---|---|
| Materials | Materials un-recovered<br>Materials adversely disturbed | Retention of raw material quality<br>Materials favourably dispersed |
| Energy | Energy un-recovered | Energy retained |
| Space | Space required | |
| Biological Impact | Toxic impact | Restorative impact |

*Evaluation of the Closing the Loop front based on:*

### 10.5.2 Sustainability Conditions

This front contributes especially to the natural capital sustainability conditions as it focuses on designing products especially for closed loop material flows, which would eliminate waste. Some of the strategies would also result in increased resource productivity.

### 10.5.3 Flexible Platforms

This step is considered a flexible platform as it lays the foundations for a business model based on service, rather than consumption.

### 10.5.4 Risks

The design for environment (DfE) strategies as discussed many times present complex tradeoffs which needs consideration. DfE strategies may also make products more expensive than other products when they are sold for consumption and not leased. Therefore these strategies must be accompanied by a service orientated business model (see *Business Logic* front) to provide a competitive advantage.

## 10.6 Joy at Work

The previous two fronts, *No Emissions* and *Closing the Loop*, have mainly focused on incorporating nature and customers as stakeholders into product and process architectures. This front focus on promoting "joy at work" by focusing on the people architecture in order to enhance the social and human capital inside the company, but also on employees' families.

Proverbial wisdom states "people are a firm's most valuable asset" and in most

businesses, salaries represent the largest business costs. Fulfilling the needs of the employees is crucial to create a sustainable organisation. At the end fulfilled employees will contribute more to the organisation than unhappy employees.

According to Nohria et al. (2008) people are guided by four basic emotional needs. The need to acquire (obtain scarce goods, including intangibles such as social status), bond (form connections with individuals and groups), comprehend (satisfy their curiosity and master the world around them) and defend (protect against external threats and injustice). They propose that organisations that fulfil these needs will enhance employee motivation and thus worker productivity.

It is important to differentiate between intrinsic and extrinsic motivation. Intrinsic motivation refers to motivation an individual experience from the sheer joy of doing the work (Deming & Edwards, 1986 as cited in Gitlow et al., 2005). Extrinsic motivation stems from the desire to be rewarded. A mix of both best motivates people.

Nhoria et al. (2008) identifies four basic organisational levers to accomplish better motivation of employees, by focusing on the above mentioned needs.

### 10.6.1 Reward System

Goldratt (1990) stated the following "tell me how you measure me and I will tell you how I will behave". The reward system is critical in satisfying the "acquire" need of employees and is a source of extrinsic motivation. Incentives which reward the achievement of organisational goals should be implemented. The reward system should be unambiguous and clearly differentiate between low and high performance. Rewards should not only include monetary rewards, but also other forms of recognition and advancement opportunities. It is critical for the reward process to be fair, otherwise employees' need to "defend" themselves will affect productivity.

### 10.6.2 Culture

In order to fulfil the drive to bond of employees, a culture of teamwork, collaboration, employee participation and friendship should be promoted. Here it is important that the organisational structures be aligned with the company's core ideology. E.g. for a culture to be build on teamwork departmental boundaries should

be broken down and communication structures should allow everyone to communicate with everyone (Catmull, 2008).

Employees feel intrinsically motivated when corporate values and their personal values are aligned and give them a sense of deeper purpose. Involving the company and its employees in corporate social responsibility projects (see next front) may also be a good strategy to establish this sense of greater purpose.

### 10.6.3 Job Design

Jobs must be designed to be "meaningful, interesting and challenging" (Nohria et al., 2008) to satisfy the "comprehend" need. Every employee must feel that his/her job is contributing to organisational goals, which will ensure that employees are motivated intrinsically. Jobs must be clearly defined with goals and methods. Regular objective feedback on the progress being made is important. Employees must be empowered by giving them responsibility and decision making authority in their jobs.

### 10.6.4 Performance and Resource Allocation Processes

People have a natural tendency to defend themselves. People want to have security, especially job security, and perceive fairness in processes as consequence of this. Specifically, employees' performance management and resource allocation processes must be perceived as fair by employee. Effort must be made to clarify the rationale behind the decisions made relating to these processes.

Further on employees also have other needs pertaining to their relationships to their families.

### 10.6.5 Family in the Workplace

Family is an essential part of employees' life. In a study cited in Glass and Estes (1997) 87 % of 2958 employees surveyed claimed day-to-day family responsibilities. Taking family needs of employees into account will benefit organisations as deteriorating families often manifests in lower productivity, higher absenteeism, and greater turnover of staff (Glass & Estes, 1997).

The best strategy, identified by the employees surveyed by Glass and Estes (1997),

to ensure that the family related needs of employees are satisfied is some form of schedule flexibility. Resolving work/family conflict can take on the following forms:

1. Policies and benefits that reduce work hours. This includes providing leave for vacation, childbearing or reduction of the average working hours per week.
2. Policies and benefits that give greater schedule and location flexibility while maintaining the same amount of work hours. These include flexible work hours to allow for family duties and working from home.
3. Policies and benefits that provide workplace social support, such as child-care assistance and other family support.

E.g. Interface Inc. have recognised that employees' families are important and therefore has a family therapist available free of charge for every employee (Nattrass & Altomare, 1999, p 109). It is important to take a balanced view when developing work/family policies, for instance job security and reasonable wages are still priority needs for parents.

*Evaluation of the Joy at Work front based on:*

### 10.6.6 Sustainability Conditions

This front is specifically focused on meeting the human and social capital sustainability conditions.

### 10.6.7 Flexible Platform

The front is considered a flexible platform as it aligns the human and organisational architectures with the needs of employees and their families, which will ensure that the workforce is motivated towards organisational goals. Positive attitudes among the employees in the company would be beneficial when change is introduced.

### 10.6.8 Risk

This front is critical in combating resistance to change by positively affecting the attitudes of the employees and the culture of the enterprise. Failing in this would mean that the successful implementation of the change program would be at stake.

## 10.7 Business Logic

Whereas the previous fronts have focused mainly on how to align the different architectures with sustainability, it was mostly focussed on the inside of the organisation. The *Business Logic* front focuses on the relationships that is necessary on the outside of the business to facilitate the move to a sustainable business model. The industrial ecology concept of the service economy is a central theme in this front.

### 10.7.1 Service Economy

The service economy is the business model that supports closed loop material flows (For a detail discussion of the concept see section 5.3.3). In a sustainable business relationships with stakeholders are valued highly. To employ the service economy principles, the companies must rethink its relationships with key stakeholders. These relationships are explained below:

#### 10.7.1.1 Customer Relationships

Firstly customer relationships must be grown. Making a company service orientated depends on knowing the real customer needs. Companies must move away from the traditional transactional relationship with customers to long term service orientated relationships. This means that the producer would need to be more involved with the customer and also devise a strategy for product take back, in the case where this is feasible (see section 5.3.3).

#### 10.7.1.2 Supplier and Business partner Relationships

This business model implies better collaboration with entities outside of the company. Particularly to ensure that suppliers fulfil the sustainability conditions. Suppliers and other business partners should be involved in long term strategic relationships based on loyalty and trust. The goal is to optimise the whole supply chain so that every role player benefit from it, rather than optimising only parts. For instance Deming (cited in Gitlow et al., 2005) proposes that there be moved to a single supplier of a single item in a long term relationship.

Additional social benefits could be added if the enterprise is involved in developing its suppliers' and other partners' businesses, by applying its business expertise.

Enterprise development investment into the value chain could bring the mutual benefits of higher quality inputs, while fostering economic activity and job creation, which is critical when doing business in the developing world. SABMiller have applied this strategy extensively in their business (see case study).

### 10.7.2 Relationships outside Value Chain

Enterprises should also manage strategically the relationships with stakeholders outside its direct value chain.

#### 10.7.2.1 Community Relationships

Employees are part of larger social communities. Many companies have recognised the benefits of being involved with communities. When approached strategically, corporate social initiatives (CSI) related projects can have many synergistic benefits for a company. These benefits include enhancing corporate reputation, attracting and keeping a motivated workforce, building strong community relationships and support marketing objectives (Kotler & Lee, 2005, p 243). To ensure maximum value is obtained from these initiatives it must be ensured that these initiatives are aligned with the company's business goals, products and/or services and are relevant to communities where business is done (Kotler & Lee, 2005, p 238).

#### 10.7.2.2 Relationships with other Stakeholders

Resilient enterprise will also foster partnerships with organisations such as academia, NGOs and governments. Creating mutually beneficial relationships with these actors will add an array of benefits. Collaborating with academia and NGOs could bring leading edge sustainability research and knowledge not necessarily feasible for the organisation to obtain on its own. Good relationships with government authorities could provide the organisation with influence in policymaking etc. See case study of SABMiller for examples of these relationships.

*Evaluation of the Business Logic front based on:*

### 10.7.3 Sustainability Conditions

This front revolves around fostering strategic relationships with stakeholders outside the enterprise. It focuses on fulfilling the social and human capital sustainability conditions outside of the enterprise.

### 10.7.4 Flexible Platform

This front is judged a flexible platform as it culminates in reaching the To-Be state.

### 10.7.5 Risks

As have been shown, for this front to be effective, relationships with stakeholders should be redefined. This implies that traditional assumptions and mental models about doing business wil have to be evaluated and changed. This would make implementation difficult and conflict unavoidable. At the same time the market may not be ready for some of the service economy principle and may need to be educated in the value this approach brings. Greater transparency among stakeholders may also leave the company more vulnerable to abuse.

## 10.8 Outcome

A high level transitional plan to reach the To-Be state

# 11 TRAINING AND LEARNING PLAN

The goal of this step is to empower every employee in the company, to support the fronts of the transition plan in order to create lasting change and enhance social and human capital within the company. The fronts have focused on specific structural changes in the company. This step, however, is focused on softer issues such as cultural change and skill development, where often the most leverage lies for sustainable change. The training and learning plan supports the transition plan by ensuring that employees have the right mental models and skills for the successful implementation of the sustainability strategy.

For the training and learning plan to be successful the following objectives need to be achieved.

## 11.1 Culture change

As already explained, in order to achieve sustainability a move to a new paradigm is needed. A mind shift in management is not sufficient, employees and management must develop the same mental model.

### 11.1.1 Sustainability Mental Model

Employees need to be trained in thinking in terms of sustainability. "Building a knowledge base about sustainability in the organisation is essential for successful integration of sustainable development into business practices" (Nattrass and Altomare, 1999, p 155). Nattrass and Altomare (1999) did a study of four companies who are leaders in the field of corporate sustainability and have found that all four instituted new training programs after they had adopted the sustainability vision. Training and learning programs should be aimed at mobilizing all employees to work together towards organisational goals.

At Scandic Hotel, one of the firms in the Nattrass and Altomare (1999) study, training of all employees in sustainability principles (in this case especially the Natural Step Framework) led to 1500 measures being launched to bring the company closer to its sustainability goals within one year. The measures were all suggested by employees.

For cultural change there should be started at the core ideology, but also the To-Be vision that was articulated as part of this roadmap. Employees must understand that sustainability is part of the company's DNA and not a separate business endeavour. They should be taught how the core ideology is practically implemented in day to day business. The vision and core ideology needs to be continually emphasised by the management verbally and affirmed with their action.

### 11.1.2 Institutionalised Learning

Cultural change further means that learning should be institutionalised. For a company to continually improve towards sustainability it must be "skilled at creating and acquiring knowledge, and transferring knowledge and at modifying its behaviour to reflect new knowledge." (Garvin, 1993). It is important that learning leads to changes in the organisation (double-loop learning) in order for changes to be sustained. Garvin (1993) identifies the following activities that will facilitate learning.

**Table 7 Examples of learning**

| Examples of learning activities in organisations | |
|---|---|
| **Systematic Problem Solving and Experimentation** | Scientific methods such as the PDSA (Plan-Do-Study-Act) method instead of guess work. Facts should inform decisions. |
| **Learning from Past Experiences** | Review and record past experiences, successes e.g. through reports, case studies, manuals or personnel rotation. |
| **Learning from Others** | Benchmark internal operations against other enterprises. |
| **Transferring Knowledge** | Develop knowledge transfer channels e.g. knowledge depositories such web portals |

## 11.2 Skills

Cultural change should be reinforced by skills development. Every employee needs to be trained how to embed the basic sustainability principles in his/her every day decisions and tasks. This will create a platform for bottom up idea generation from the employees.

Areas that employees will need to be trained in, are areas listed below. Employees do not have to be trained in all of the areas, but only in those areas applicable to their work and for them to have a general understanding of sustainable development:

1. The basic theory of sustainable development
2. The sustainability conditions
3. The investment strategy e.g. identifying the low hanging fruit and flexible platforms and how to act on these opportunities
4. Lean techniques
5. Whole system design techniques for radical resource savings
6. Design for the environment (DfE) techniques
7. Problem solving skills e.g. PDSA cycle
8. Systems thinking
9. Industrial ecology principles
10. Backcasting
11. Skills for operating effective teams e.g. dialogue techniques, holding effective meetings

### 11.3 Career Development

Collins and Porras (1994) have identified that enduring companies are more skilled than their peers in growing leaders from within the company. Thus the training and learning plan should also include mechanisms to ensure leadership and employee development happens inside the company. Instituting a mentoring program, where more experience employees train and equip less experienced employees may address this. Mentoring should not just include job related issues, but should include all other issues that less experienced employees might need help with.

### 11.4 Timing of the Training program

It is important that the training program is implemented at the right time. Each front will require specific and detailed training in certain areas, thus it is important that the deployment of the fronts and training be synchronized so that for each front training happens just-in-time (Womack & Jones, 1996).

### 11.5 Outcome

The outcomes of this stage should be:

**1.** A high level training and learning plan for all employees focusing on the cultural change and skills development needed for the sustainability strategy.

2. Estimated resources that will be needed such as personnel, equipment, space and money.
3. An implementation schedule for the training program.
4. Long term integration plan for continual learning in the organisation.
5. Plan for leadership and employee development.

# 12 PROJECTS

This step involves developing financially feasible projects out of the transition plan. It is these projects that will ensure that the fronts in the transition plan will become a reality. This step comprises of identifying feasible and measureable projects and prioritizing them. These projects will then form part of the sustainability strategy.

## 12.1 Prioritising

After these projects have been developed they should be prioritised. Prioritising includes analysing the projects against sustainability criteria, developing the business case for each project and determining the risk involved.

### 12.1.1 Sustainability Criteria

Each project should be evaluated against sustainability criteria, based on the sustainability conditions. This includes:

1. Does the project contribute to the company fulfilling the sustainability conditions and to what extent?
2. Does the project provide a flexible platform for future projects to accomplish the To-Be vision?
3. Does it satisfy the precautionary principle?

### 12.1.2 Business Case for each Project

Determining financial feasibility is essential for determining the "low hanging fruit" and prioritising projects. Also, one of the sustainable conditions is that financial capital reflects the value of other capitals. Laszlo (2003) defines six levels of strategic focus for identifying value creation, a useful tool for analysing how the projects would contribute to the intrinsic value of the company.

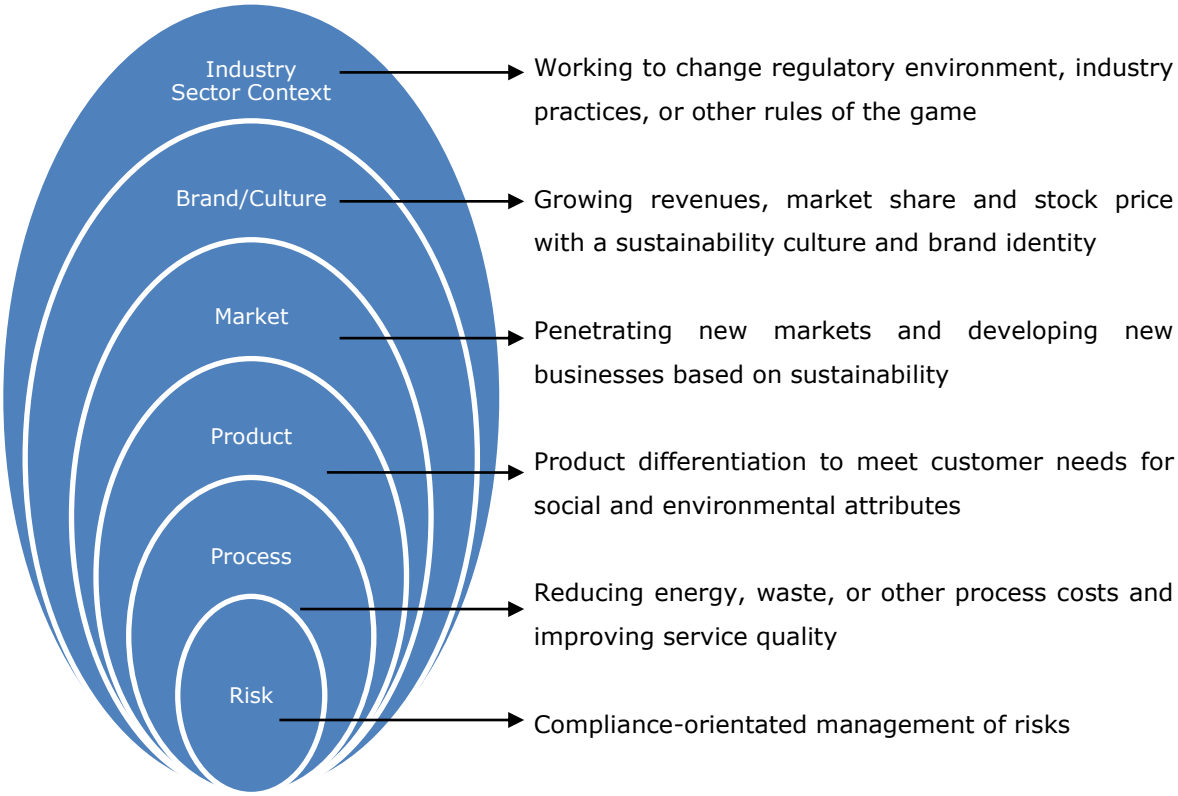


**Figure 29 the six levels of strategic focus (Laszlo, 2003)**

Most sustainability initiatives today are focused on the risk and process levels, while other levels that represent more opportunity for creating value for shareholders are often neglected. The higher levels represent intangible value drivers rather than just compliance or cost cutting initiatives (see section 3.4 for more on intangible value drivers).

Laszlo (2003) also identifies six drivers of shareholder value. The drivers are shown below.

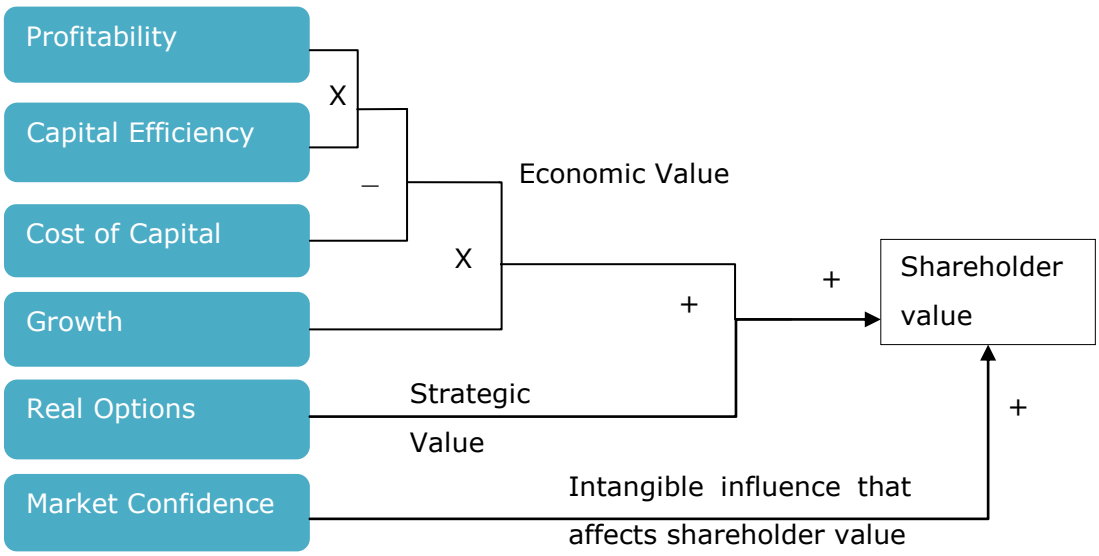


**Figure 30 The drivers of shareholder value (Laszlo, 2003)**

The first four drivers are the drivers of economic value added (EVA), but to incorporate the intangible drivers of shareholder value Laszlo (2003) propose that two additional drivers be added; real options and market confidence.

A real option is a new conceptual tool to quantify the value of management flexibility (Real Options, 2008). A real option gives a value to strategic plans or research programs that position a company to realise future opportunities that may occur by making an additional investment at that future time. For example if a car manufacturer anticipate that in the future people will all drive hydrogen powered cars, the car manufacturer will use a real option to quantify the value of the company's hydrogen research program even though the hydrogen future may not occur.

Market confidence is also a driver of shareholder value. Although some portion of the market confidence driver is reflective of the overall state of the market and the industry, a large percentage of it reflects management practices (Laszlo, 2003). The last two variables are crucial to translate sustainability projects to shareholder value as the value of these projects are often overlooked when using traditional financial analysis. This is especially true if considered that sustainable development initiatives are strong intangible value drivers (see section 3.4).

By combining the shareholder value drivers and the six levels of strategic value a sustainable value matrix can be developed that will allow the company to quantify how the value of each project influences shareholder value (Laszlo, 2003). See Figure 31 for an example of how a $CO_2$ reduction project could be analysed in terms of the value it will add to shareholder value.

| | Value Drivers | | | | | |
|---|---|---|---|---|---|---|
| *Levels of Strategic Focus* | **Profitability** | **Capital Efficiency** | **Cost of Capital** | **Growth** | **Real Options** | **Market Confidence** |
| **Business Context** | Influence regulators to cost effectively meet Kyoto targets | | | | | |
| **Brand/ Culture** | | | Attraction of socially responsible investors | | | |
| **Market** | | | | Sale of CO2 credits | | |
| **Product** | | | | | Research into new less-energy intensive products | |
| **Process** | Savings in fuel costs and in production costs | Fewer assets required for same level of production | | | | CO2 leadership is indicator of management quality |
| **Risk** | Avoid the costs and negative publicity of shareholder initiatives | Better capital investment decisions that include future carbon taxes and market values | | | Flexibility to move quickly if regulations are more severe than expected | |

**Figure 31 Sustainable value matrix tool example of a $CO_2$ reduction project (Laszlo, 2003)**

The methodology allows each project to be financially justified rather than to rely on ethical justification alone.

## 12.2 Outcome

Prioritised lists of projects corresponding to the fronts in the transition plan based on economic and other sustainability criteria.

# 13 IMPLEMENTATION AND FEEDBACK

The final output of the roadmap is a documented, long term, sustainability strategy. The roadmap has an iterative nature and therefore the outcome and results from the implementation step should be continually fed back into the roadmap to allow for adjustments of goals and planning (see Figure 20). This will ensure that the strategy stays continually refined.

## 13.1 Management and Monitoring System

To ensure that the feedback reinforces the sustainability strategy a management system should be designed to gather accurate data and information from the progress. The indicators that was defined in the As-Is analysis should form the basis of this system. The objective of this system is to ensure that a real time view of the progress towards sustainability is always available.

The feedback provided should be used to feed into business plans and there should be planned accordingly, otherwise the sustainable strategy will lose its value for the overall business.

## 13.2 Critical Success Factors

Progress should also be regularly tested against the critical success factors identified below. These are non-quantifiable principles that are important for the change plan. If these success factors are neglected the strategy may not succeed in the long run.

### 13.2.1 Leadership

In any change initiative leadership is crucial. Change towards sustainability needs strong leadership as the benefits and value of sustainability are often not intuitive. The sustainability vision should be driven from the top.

### 13.2.2 Whole Systems Perspective

Throughout the roadmap a systems perspective is propagated. Enterprises are complex and so is sustainability. A whole systems perspective should be pursued with committed dedication for true sustainability solutions to be realised.

### 13.2.3 People Focus

A recurring theme through the development of the roadmap is that change can only be enduring if people's deep rooted ideas and assumptions can change. Fostering human and social capital is critical. Operational changes are easy, but people's behaviour and beliefs are complex.

### 13.2.4 Long Term Perspective

Coupled to the above critical success factor is that change in people's minds take time and patience. Sustainability must be approached from a long term perspective, while also making sure that short term results are achieved, which makes it a difficult task, with complex tradeoffs. Critical here should be to identify low hanging fruit and quantify investments towards sustainability in financial terms.

## 13.3 Core Ideology

The way the core ideology is translated into tangible mechanisms in the company, will play a vital role in the success of this strategy. It represents the heart of the company and if the core ideology is well integrated into the business fabric, it will ensure that focus and unity can be established in the company.

## 13.4 Employee Participation

Employee participation in the sustainability strategy is crucial. Management must ensure that every employee participates and contributes his/her full potential to the organisational goals. For many traditional managers this would be a difficult mind shift to make.

## 13.5 Commitment to Learning

In uncertain business environments, a company must commit to continuous learning, because "there is an inevitably experimental, and experiential, nature to sustainability." (McDonald et al., 2006)

## 13.6 Foster Creativity in Framework of Roadmap

The roadmap is not intended to be a step by step instruction guide which should be followed religiously, but rather as a systematic framework within which creativity of the enterprise's workforce to create a sustainable enterprise should be fostered.

# 14 CASE STUDY: SOUTH AFRICAN BREWERIES

## 14.1 Applying the Roadmap

The Sustainability Roadmap discussed in the previous chapter will be applied in the next case study, in order to validate the usefulness of the roadmap. The method used will be to evaluate a company's sustainability strategy based on information that is reported in the company's sustainability report. SABMiller was chosen, for the following reasons:

1. It is a manufacturing company, the type of company which the Sustainability Roadmap is focused on.
2. It is a South African company.
3. It has already started with implementing a comprehensive sustainability strategy.
4. Information on its sustainability strategy is numerous and easy accessible, through reports and web sources.
5. Its sustainability report is independently audited by the Corporate Citizen.

Interpreting a sustainability report is a difficult task. It may be likened to the reading of a reference letter of someone; the content is important, but almost more important is the information that is left out. Using the Sustainability Roadmap as a basis of a sustainability strategy, the gaps that may be present in SABMiller sustainability strategy will be analysed. Useful elements in its strategy that will make a contribution to the Sustainability Roadmap will be integrated into the roadmap. The focus will be on the beer operations of SABMiller, which form part of the largest portion of its production and not on its soft drink operations. If not otherwise mentioned the data in this analysis is obtained from SABMiller's 2008 and 2009 Sustainability Reports.

### 14.1.1 Assumption on using the Sustainability Reports of SABMiller

The following are assumptions on which the analysis is based:

1. SABMiller's sustainability report reveals its Sustainability Strategy and reports progress regarding this strategy.
2. Information reported are true and comprehensive of what SABMiller deems its sustainability strategy is.

### 14.2 Overview of SABMiller

SABMiller is one of the world's largest brewers, it has brewing interests and distribution agreements across six continents. It owns more than 200 brands in the world and sells 210 million hectolitres of beer each year. Six of its brands are amongst the top 50 beer brands in the world. It is also one of the largest bottlers of Coca-Cola products in the world. In addition to its Coca-Cola operations, it also produces and bottles a range of soft drinks including Appletiser. Soft drinks make up 17% of total volumes.

Below is a graph depicting the historical growth of SABMiller

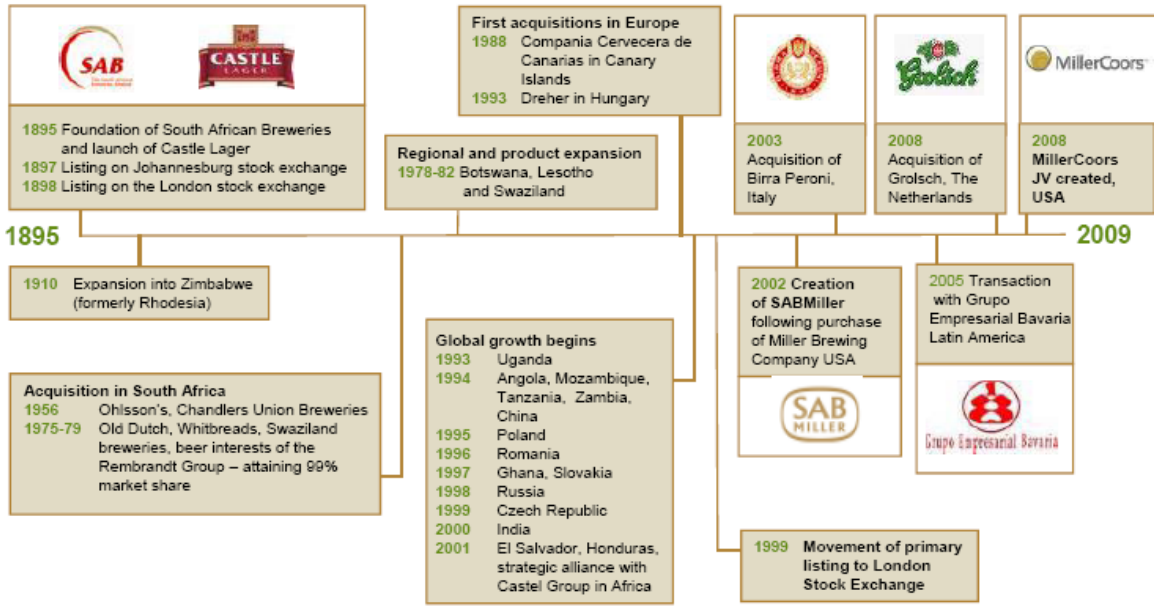


**Figure 32 History of SABMiller to date (SABMiller, 2009b)**

Today it employs almost 70 000 employees in its 139 breweries (2008) and 35 soft drink bottling plants. Its group revenue amounted to 25billion US$ in 2009 and SABMiller is one of the largest companies listed on the JSE.

SABMiller has a strong presence in developing countries and 64% of its operating profit comes from these countries.

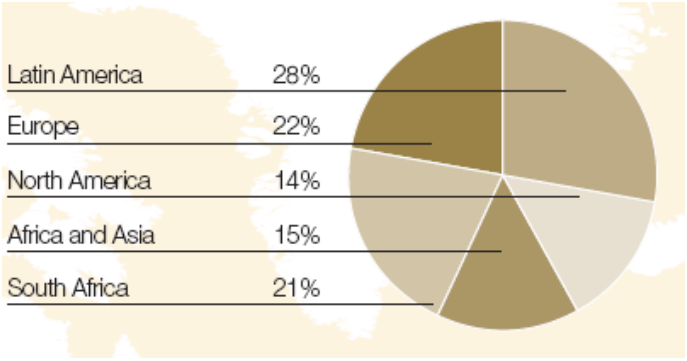


**Figure 33 Contribution to SABMiller group operating profit by region**

### 14.3 Overview of SABMiller's strategy

SAB has developed a sustainability strategy that is divided into 10 different priorities. They are:

1. Alcohol Responsibility - discouraging irresponsible drinking.
2. Water - water efficiency.
3. Enterprise development in our value chains- developing businesses in its value chain.
4. Energy/carbon - reducing its carbon and energy footprint in its operations.
5. HIV/AIDS - manage and prevent the disease.
6. CSI - corporate social initiatives other than those in other priorities.
7. Human Rights – embedding human rights in the value chain.
8. Waste - elimination of waste
9. Transparency and ethics – transparency towards all stakeholders
10. Packaging – the recycling and reuse of packaging

Out of the 10 priorities SABMiller has identified which priorities are the most material on a global scale and which are important in specific regions that SABMiller conducts business (Figure 34).

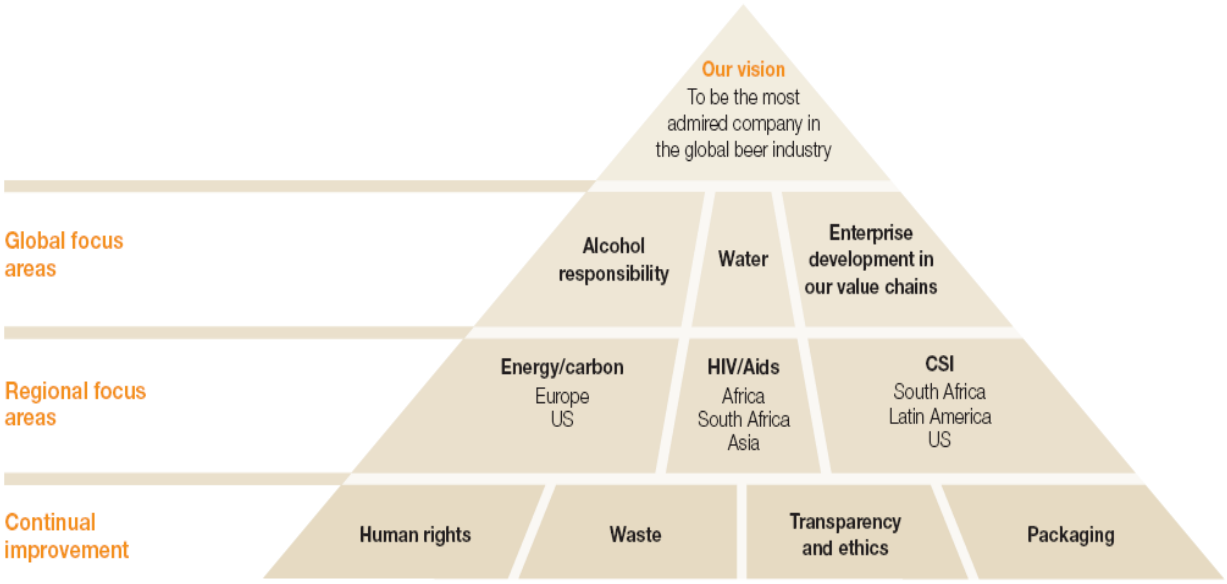


**Figure 34 SABMiller's approach to the 10 priorities**

It manages progress on these different priorities by a system called the Sustainability Assessment Matrix (SAM) which measures key criteria under each priority to determine the overall progress within each priority.

SABMiller's sustainability strategy will now be analysed by using the Sustainability Roadmap. Each step of the Roadmap will be followed to ensure that every part of the SABMiller sustainability strategy is evaluated.

### 14.4 Awareness

In the Awareness step, the awareness of sustainability issues among the key decision makers in SABMiller will be assessed.

#### 14.4.1 Top Down Approach

For initiatives to succeed in an organisation, it must be supported by leadership. It seems that high level leadership in SABMiller have a good understanding of sustainability and the issues it entails. For example, the following are evidence to this: The Corporate Accountability and Risk Assurance Committee (CARAC) who is responsible for overseeing the progress on sustainability in the company is a committee of the SABMiller board of directors. It is involved with "Business Call to Action on the Millennium Development Goals" of the UN, the Business Action for

Africa and is a partner company of the World Economic Forum.

SABMiller also seems to understand the value of its contribution to society, far beyond its own operations and the socio-economic impact it's activities has on communities where it operates.

### 14.4.2 The Systemic Nature of Sustainability

The multiple facets of sustainability; recognised as economic (enterprise development), social (Alcohol Responsibility, HIV/AIDS) and environmental issues (Waste, Water, Carbon, Energy) all get addressed in the 10 priorities.

### 14.4.3 Business Imperative of Sustainability

It seems that SABMiller's sustainability strategy is built on business sense, for instance, its 3 global priorities are clearly very important to business objectives, however, the value of these projects from a financial performance perspective are not often articulated in the sustainability report. Exceptions are SABMiller's awareness of water scarcity, which it might face in the future due to bad management of this resource. SABMiller has already identified possible markets where a lack of unsustainability in regard with water usage may have a serious affect on its business.

Apart from the above, SABMiller's leadership also understands that the main way in which to add value to economies, communities and environments are by being a responsible and profitable business. In its 2009 report, the CEO letter contains information on a study which found that, although SABMiller employs only 430 people in Uganda, 44 000 people depend on its value chain. A similar study for South Africa is also cited in the same address. This example speaks of an awareness of the synergies that maybe possible when sustainability and business priorities are pursued together.

Another example is that the SAM (Sustainability Assessment Matrix) results are used to inform action plans in SABMiller's five year business strategies.

### 14.4.4 Are the sustainability priorities driven by SABMiller's core ideology?

Although there is some mention of SABMiller's vision of becoming the "most admired company in the global beer industry", how the sustainability priorities fits in with this vision and with its corporate values, are not well explained. The corporate values are not even mentioned in its sustainability reports (2008, 2009).

### 14.4.5 Is there sufficient awareness of all the stakeholders involved?

Throughout the report it is evident that SABMiller has a good understanding of all the stakeholders involved throughout its value chains. Nature, governments, local communities, small holder farmers, distributors, tavern owners, employees, families of employees and more are all addressed in its strategy.

## 14.5 As-Is

In the As-Is phase it should be assessed whether SABMiller has a holistic perspective and data on the company's current sustainability. The As-Is analysis will be approached by assessing whether SABMiller has an in depth view of every component that makes up the As-Is analysis of the company.

SABMiller reports according to the guidelines of the Global Reporting Initiative (GRI). The Sustainability Roadmap's As-Is analysis is also based on this guideline. A table of SABMiller's GRI analysis are shown in Appendix 5. The most important findings of the As-Is analysis are discussed below.

### 14.5.1 Most Material Issues

SABMiller's has a rather good understanding of what sustainability issues is most material to its business. It has identified water, enterprise development and alcohol responsibility as global priorities and therefore it can pursue these priorities from a strategic business viewpoint rather than implementing arbitrary sustainability initiatives.

### 14.5.2 Lack of integrated Core Ideology

An organisation needs a core purpose to ensure that it has a constancy of purpose and it also creates a shared identity among each employee. The core purpose, the reason of existence, of SABMiller is never mentioned in the report. Although its

vision of being the most admired company in the beer industry fulfils this role in some way, it cannot be considered SABMiller's fundamental reason for existence. Its mission statement: "Our Group mission is to own and nurture local and international brands that are the first choice of the consumer" (SABMiller, 2009b), which is also not mentioned in the report, also cannot fulfil the role of a core purpose.

The nearest it comes to defining this purpose is the following statement: "Our beer adds enjoyment to life" which forms part of SABMiller's core principles on alcohol. Not defining its core purpose lets the opportunity, to define their sustainability priorities in terms of their overall purpose, go untapped.

Although SABMiller has stated core values, it was not included as part of its sustainable development report. Again, by showing how its sustainability priorities fit in with the company's value system, would have created a more unified approach.

Their core values are:

1. Our people are our enduring advantage.
2. Accountability is clear and personal.
3. We work and win in teams.
4. We understand and respect our customers and consumers.
5. Our reputation is indivisible.

Considering the above, SABMiller should consider how it sees itself, its core identity as a company and how this fits in with its sustainability strategy.

### 14.5.3 The need SABMiller's products fulfil and its impact

SABMiller states that its products "adds to the enjoyment of life", but what makes SABMiller's situation unique, is that its products can easily contribute to the "sadness of life" in the case of irresponsible use of alcohol, which has a negative impact on the health of the customer and the wellbeing of communities.

It seems that SABMiller already possesses and continues to acquire a thorough understanding of what impact its products have on consumers. Examples are the "talking alcohol" website and its involvement with the World Health Organisation's campaign to reduce the harmful effects of alcohol.

A thorough understanding on these needs and impacts and transparency regarding it will be crucial for SABMiller's strategy towards sustainability, because alcohol related products and the consumption will continue to be controversial issues, especially when sustainable development is concerned. Its involvement in poverty stricken areas adds to this sensitivity.

### 14.5.4 Whole Value Chain View

It may seem that SABMiller has not included its whole value chain in its As-Is analysis, e.g. water efficiency is only measured in water consumed at the production facilities and energy is similarly measured. However, SABMiller has put in an effort by conducting pilot carbon and water footprinting exercises to understand its products' full lifecycle impact on the environment (e.g. Carbon foot printing of the Peroni brand and water foot printing of the South African and Czech Republic operations). If it continues conducting these exercises, SABMiller will soon have a better understanding of the impact of its whole value chain and thus broadening its systems perspective. It is crucial that SABMiller continues to expand its understanding of the larger social, economic and environmental that its operations form part of.

### 14.5.5 Harmful Substances

As discussed above, SABMiller is pursuing a better understanding of its products in terms of the product's lifecycle impacts on the environment, but little analysis is done on harmful substances (except for $CO_2$) and compounds that are introduced to nature through the value chain. The substances introduced by agricultural activities, should be of particular concern. Knowing which and how much of these harmful substances are introduced into the environment is critical for developing and implementing strategies such as a closed loop production system and for moving towards satisfying the natural capital sustainability conditions.

### 14.5.6 Impacts on Biodiversity

The GRI (Global Reporting Initiative) indicators show that SABMiller does not report the impact its operations have on biodiversity, which is partly true. One of the biggest impacts that its operations have on biodiversity are its use of water, which is well analysed, but more analysis is needed to determine the effects of agricultural

activities and its facilities on biodiversity.

### 14.6 To-Be Vision

The To-Be vision will be assessed by looking at the long term goals that SABMiller has set out to achieve and also whether this vision has the necessary breadth and systems perspective to be called a sustainable vision. In other words; does SABMiller indeed envision a flourishing restorative enterprise?

#### 14.6.1 System Perspective

As mentioned previously, SABMiller's sustainability strategy is broken down into 10 priorities, but nowhere in the report is articulated how these priorities are linked to achieving the combined systems goal of sustainability. The connectedness of these priorities is not recognised and a combined sustainability BHAG for SABMiller as a whole is absent. The 30 year picture of how a restorative SABMiller would look like is not articulated. The BHAG is only left in its parts, with each priority having its own goals and targets.

The priorities set out by SABMiller covers a wide range of issues central to sustainability, but the systems perspective of sustainability is not fully pursued, because it is only left in its different building blocks.

The absence of this unified long term sustainability systems goal may hinder SABMiller in recognizing and achieving the synergistic benefits that would follow with seeing the priorities as only parts of a larger effort towards a sustainability vision. In this way action relating to one priority will be seen in context of other priorities and the effort towards the vision can be more effective. For example, encouraging enterprise development among rural farmers may have many hidden benefits for other priorities as well, such as lower carbon emissions, because these farmers tend (or maybe taught) to use less carbon and water intensive organic farming methods. Transport can be minimized, because crops are produced more locally, thus further reducing carbon emissions. These benefits can only be realised and maximised if actions in the enterprise development priority are optimised for creating multiple benefits for the other priorities e.g. by developing the farmers' enterprises, but also teaching them sustainable farming techniques which may create synergistic benefits that will strengthen other priorities. Similarly SABMiller's strategy of extending the

lifecycle of glass bottles and recyclable PET (polyethylene terephthalate) bottles may create more job opportunities as recycling of products tend to be more labour intensive than the manufacturing of products (as mentioned previously). Seeing the priorities from a systems perspective will allow SABMiller to choose actions in one priority that will also create benefits for other priorities and business objectives at the same time.

### 14.6.2 Long Term and Restorative Vision for Priorities

Most of its priorities lack a long term vision. The long term goals for the priorities are only articulated in a generic way, by the Sustainability Assessment Matrix (SAM) as "Best practice: Achieving what is currently considered global best practice." What this best practice means is never fully described and targets are mostly described in terms of short term actions such as "further increase the percentage of HIV-positive employees and spouses on our managed healthcare programmes" and not as progress towards a longer term vision. There are exceptions, notably SABMiller have long term targets set for water efficiency and carbon reduction. The lack of clarity of what the target is, will affect the progress towards it.

A very important aspect of a sustainability vision is that it should be a vision of restoration rather than one of being "less bad". An enterprise in an efficient state doing more with less cannot be the end goal, but should rather be a step towards a resilient, flourishing enterprise. Unfortunately many of the priorities are formulated in a "less bad" way for example: "Making more beer using less water", "Reducing our energy and carbon footprint", reducing the "carbon impact of packaging" and "Discouraging irresponsible drinking". However, in some areas a restorative vision is pursued. The enterprise development priority is an example of where restoration takes place in communities which is influenced by SABMiller's value chain.

It should be noted that sustainability is a long term vision that is pursued and as part of this becoming less bad, e.g. water efficiency, can still be an intermediate aim, but it is not enough. Industrial ecology principles and the sustainability conditions could help with the development of a restorative vision and priority specific strategies to reach it (see transition plan analysis).

### 14.6.3 SABMiller as Alcohol Product Supplier

Every company exists to fulfil a certain societal need and it does this through the products or services it provides. Considering this, the most important aspect of SABMiller's sustainability vision is related to how its products fulfil the need of the customer. SABMiller should ask itself how its business has to look for its products to create wellbeing (ultimate end) for society. This seems to be difficult, particularly for SABMiller as it is mostly active in developing countries where alcohol abuse tends to be more prevalent. Then there are additional concerns such as the connection of alcohol abuse and the spread of HIV/Aids. What can be done to keep the benefits of alcohol use, but eliminating the harmful effects? Or should alcohol remain a "matter of individual judgment" as SABMiller states in its reports? Could the loss of social capital through alcohol abuse be justified by the increase of social capital through the jobs that are created?

Considering the above education related to the use of their products should be an important aspect of its To-Be vision, SABMiller is already involved in many educational activities and campaigns (talkingalcohol.com, "We can all be parents" campaign to combat underage drinking) that aims to create responsible drinking cultures among its customers. SABMiller needs to formulate how it sees itself establishing, in the long term, responsible drinking cultures. Questions that the long term vision will need to answer are: How effective can these activities be if the success of these activities may influence the demand of the products? Could these activities grow past only giving SABMiller the right to stay in markets to impacting society positively and to increase social capital? Or should it finance independent NGOs to do the education?

Other issues pertaining to how SABMiller can pursue growth in a sustainable fashion or on what type of products it should focus are also necessary to consider. For instance, focussing on producing quality premium beers would certainly put more emphasis on the taste experience and enjoying beer more responsibly than when focussing on lower cost products. Looking at the markets where SABMiller operates, this does not seem to be financially the best decision.

These are all tough issues that SABMiller should consider, before it can formulate its sustainability vision and before this sustainability strategy can start to be effective,

which are unfortunately not addressed in its strategy.

### 14.6.4 Prototype Vision

Below a prototype is drawn up based on the points discussed above and the rest of the report. Some of the items indicated in the diagram are only discussed in the analysis of the transition plan.

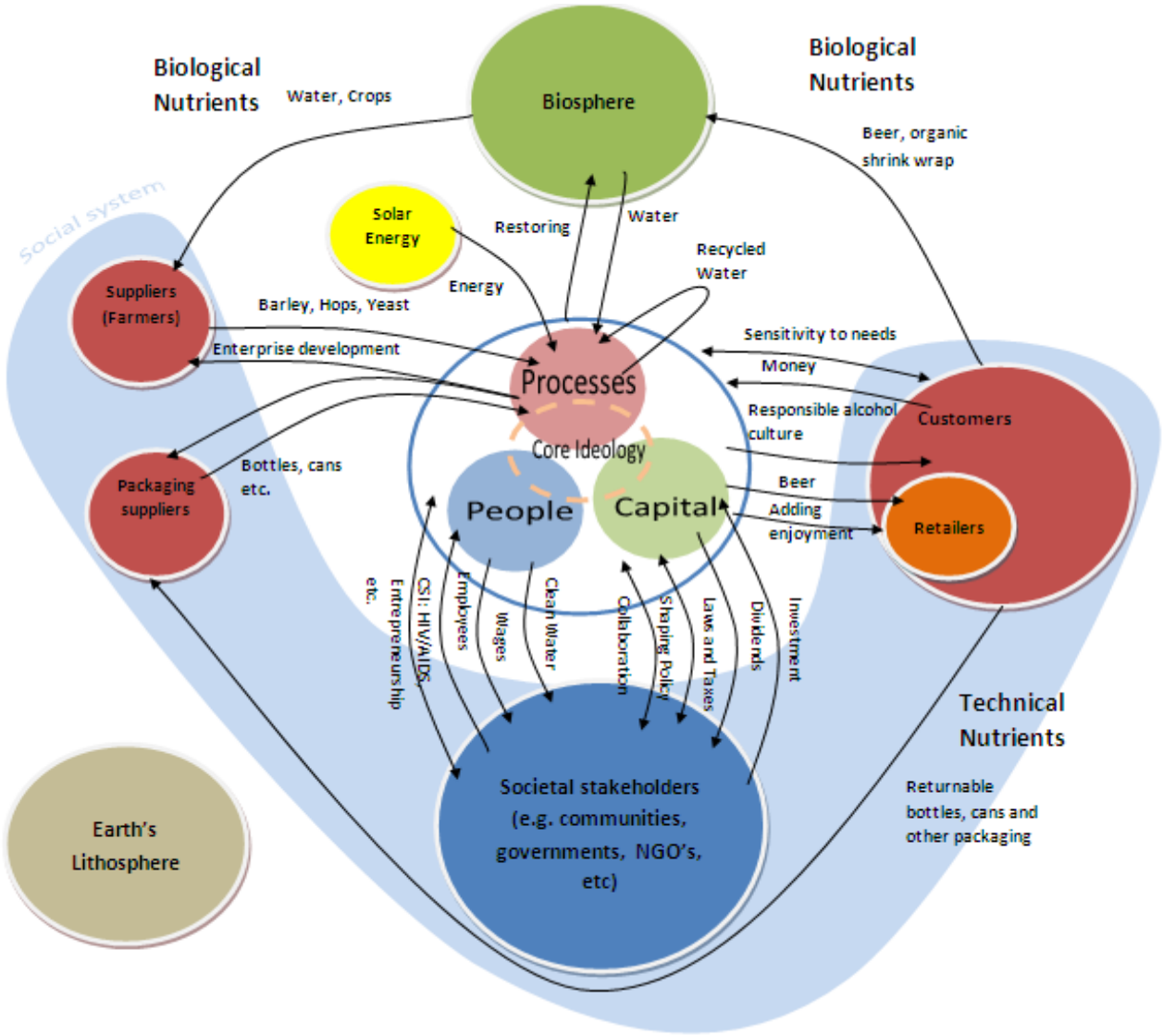


**Figure 35 a prototype To-Be vision for SABMiller**

### 14.7 Transition Plan

In this part of the analysis there will be looked at how SABMiller attempts to bridge the gap between its sustainability vision and the current state of its business that was developed in the As-Is analysis.

The analysis will be done by using the template transition plan that was developed as part of the Sustainability Roadmap.

Specific attention will be paid to the following:

1. Is the transition plan integrated into the business operations?
2. Does each priority provide a flexible platform to achieve sustainability?

#### 14.7.1 SABMiller Priorities

SABMiller's transition plan for reaching sustainability consists, as mentioned, out of 10 priorities.

Out of these 10 priorities SABMiller has identified and prioritised which of these priorities are most material for their business on a global scale and which are important in certain regions that SABMiller conducts business; the other priorities it categorises as continual improvement priorities (see Figure 34). SABMiller's transition plan will now be evaluated against the five fronts of the template transition plan that was developed in this report.

#### 14.7.2 Radical Lean Front

*Are SABMiller's operational strategies integrated with its sustainability strategies?*

Through this report sustainability as a systems problem is emphasised. Economic, social and environmental issues should be considered together and not in isolation. Therefore, in the transition plan the emphasis should be on integrating the normal business considerations (usually very economically orientated) with the other two (social and environmental) aspects. An integrated transition plan should be developed to path the road to the To-Be vision rather than developing separate plans for each part of problem. The transition plan must create a consistent plan towards the To-Be vision and not be developed as different spurts that aim at satisfying different elements of the same sustainability vision.

To achieve this it shall be important to integrate SABMiller's operational strategies with sustainability strategies. SABMiller uses operational strategies based on lean principles (SAB, 2009), but unfortunately the way these strategies interface with the sustainability priorities are not mentioned at all.

This leaves it difficult to conclude that SABMiller has a transitional plan that is sufficiently integrated into the decisions made on the shop floor. As was already explained, lean strategies could provide a useful flexible platform towards the sustainability vision by ensuring economic feasibility, while at the same time efficiency is gained by the elimination of waste in a systematic fashion. A transition plan based on a proven "business sense" operational strategy is crucial to ensure the resilience of an organisation's transition plan towards the To-Be vision. Economic performance in the end will determine if the SABMiller sustainability plan will stand the "test of time"[8].

### 14.7.3 No Emissions front

*Does the plan include the elimination of direct and indirect environmentally and socially harmful emissions from their operations?*

In SABMiller's European operations, the cutting of energy and carbon emissions are identified as specific focus areas and the reduction of carbon emissions and energy use are actively pursued over the whole value chain (only for certain operations such as the Peroni Brand). However, very little have been done to analyse other emissions and toxic compounds that may be released during the course of making its products. Considering the organic nature of SABMiller's products in its beer making processes, toxic compounds should not be a big problem, but in the other activities in SABMiller's value chains such as agricultural activities and packaging, this is not the case. At the moment SABMiller's transition plan does not have any detail on how to eliminate harmful pesticides and inorganic compounds from farming activities or compounds that maybe used in the production of glass, PET or Aliminium packaging. How SABMiller purifies water and waste water at its facilities has also not been

[8] One of SABMiller's most successful brands is Castle Lager, which has a slogan that says "the taste that stood the test of time".

addressed. These activities may include the use of environmentally unsustainable compounds such as chlorine. The only mentioned action in this regard is that zero CFC refrigerants are being employed in the distribution part of the value chain.

To substitute unsustainable energy sources, SABMiller is busy developing a toolkit that would identify the best possible solution. Key to its renewable plan is using the natural waste from its processes as energy feedstock. This can be considered a potential low hanging fruit for moving towards renewable energy sources as natural waste is an unavoidable by product of the brewing process.

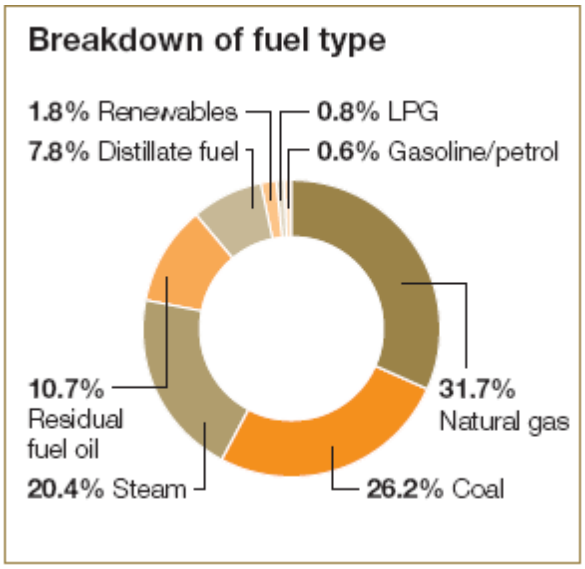


**Figure 36 SABMiller's energy feedstock usage (SABMiller, 2009)**

### 14.7.4 Closed Loop

*Closed Loops: Does the plan include the creation of a closed loop production system?*

The beer making process lends itself excellently towards creating closed loops of nutrients in the value chain and although not specifically calling it "closed loops", SABMiller has partly implemented a transition plan towards creating closed loop material flows.

The inputs to the beer making process are mainly barley, hops, yeast, water and packaging (referring to the bottles or cans that contain the beer), and therefore most of the waste (66%) is organic.

#### 14.7.4.1 Biological Nutrients (Water)

The barley, hops, yeast and water inputs are the main biological nutrients in the beer making process. Water is the most important and a strategic input for the sustainability of SABMiller. SABMiller each year uses 890 million hectolitres of water. SABMiller's water strategy is therefore also, rightfully so, one of the most detailed parts of its sustainability strategy.

For water to become a biological nutrient, water efficiency should not only be improved, but also the quality of the water outputs should be such that it can be taken up into natural systems without introducing foreign substances (e.g. beer making or cleaning chemicals), in other words not breaking system condition 1 and 2. In SABMiller's case the water loop (biological nutrient loop) should also be kept as small as possible (see section 5.3.3 for an explanation of this), because of the importance of quality water sources in the world today and SABMiller's high water consumption. Currently SABMiller uses 4.6 hectolitres of water to produce 1 hectolitre of beer.

For water, SABMiller follows its comprehensive 5 R strategy (P**r**otect, **r**educe, **r**euse, **r**ecycle and **r**edistribute). SABMiller invests in the protection of water sources and the clearing out of water consuming evasive species, it reduces, reuses and recycles water in its operations and, if necessary, distributes the recycled water to communities or makes clean water available to them.


**Figure 37 SABMiller's 5 R strategy (SABMiller, 2009)**

From SABMiller's 5 R strategy it is already apparent that it is progressing towards a closed system for water. However, for water to be a biological nutrient and for the third system condition (over harvesting of water) to be satisfied, SABMiller needs to

aim one step further. It must use the water it recycles as input for its beer making processes and not just for less value adding activities such as cleaning and irrigation as proposed in its report.

At the SAB Malting operations in South Africa there is already a project under consideration to install water treatment facilities that would use advance technologies such as membrane and reverse osmosis technologies that will be able to purify discharge effluent to potable water standards (SAB, 2008). If all discharged effluent can be treated in this way, the water loop will be closed in the process itself and not as part of the natural water cycle, making the only water outputs that of beer and evaporated water. This would mean that the water footprint of SABMiller's beer making facilities would reduce to near 1 litre of water per 1 litre of beer. Although not practically possible, a long term sustainability goal should be a state of perfection; a BHAG.

The water used in its operations is not the only water used in the process of making beer. In SABMiller's water footprinting exercise (WWF, 2009) with the WWF, it was found that through the whole value chain, 155 liter of water was used to produce 1 liter of beer with 95% of this water being used in agricultural activities.

SABMiller is busy developing plans, although still in the early phases, to ensure that the production inputs are produced by sustainable farming methods (WWF, 2009). SABMiller should make these plans a priority as it will be crucial for it to move towards sustainability.

#### 14.7.4.2 Other biological nutrients

The waste sludge, mainly from the malted barley, at some facilities is used and processed as soil boosting compost for agricultural activities. To use this waste as a renewable energy source (see previous front: *No Emissions*) is also part of SABMiller's long term plans. SABMiller has also been experimenting with biodegradable shrink wrap.

#### 14.7.4.3 Technical Nutrients

The technical nutrients in the beer making process are mainly the packaging materials used for the beer, bottles and cans. For the packaging to be technical

nutrients, the packaging should be able to be completely recycled at the end of its lifetime. The loop should be kept as small as possible. In SABMiller's case, it means that bottles and cans should be designed to be returned[9] for as many cycles possible rather than being re-melted into new bottles. SABMiller has already emphasised in its report some aspects that is necessary to ensure that the packaging is treated as technical nutrients. For instance, 46% percent of all beer packaging is returnable bottles which is strategic for SABMiller's business, especially in developing countries where there is no waste processing infrastructure available, but also a very sustainable manner of packaging, because the bottles are reused in multiple cycles (up to 40 cycles) before it is recycled.

Life extension of bottles, a design for environment (DfE) strategy, is implemented in some parts of SABMiller, to ensure that bottles go through more cycles. Extra efficiency advantages (design for energy conservation) are also gained by making the bottles lighter, resulting in less energy and material used to produce and transport bottles. SABMiller's Colombian business, Bavaria, has implemented this strategy in its "Super Returnable" campaign. SABMiller is also investigating recycling PET bottles. PET bottles are plastic bottles which are a more robust alternative than glass bottles.

### 14.7.5 Joy at work

*Does the transition plan recognise the importance of employees and fulfilling their needs?*

Here there will be analysed how employees' needs are valued and also what systems and structures are put in place to allow employees' needs to be fulfilled, in order for them to contribute their full potential to the organisational goals.

How employees are treated is not included as part of the 10 priorities, but is included separately in the sustainable development report, under "valuing and empowering our people". SABMiller states that "We recognise our employees' desire to make a difference and seek to provide a culture of accountability, challenge and opportunity that will enable them to do so. "

[9] This is not possible for cans.

Judged from the information portrayed in this segment, SABMiller is committed to fulfil the different needs of employees. Its corporate core values states that "our people are our enduring advantage", and that "we work and win in teams". These statements do not necessarily mean that this is the reality inside the company. It should be supported by evidence. Systems that reinforce the values in the company are mentioned. SABMiller has developed organisational structures to empower people and to create joy at work, which it has implemented in 2009. It is called: "Talent Management Way" and the "Performance management Way". SABMiller has also implemented IT infrastructure to facilitate teamwork and collaboration, such as web conferencing, "collaboration rooms" and IT tools to locate experts in the company. Employees and families of SABMiller receive HIV/AIDS counselling, but information pertaining to working hours to compensate for family responsibility is not available.

### 14.7.6 Business Logic

*Does SABMiller foster sustainable long term relationships with its stakeholder, such as customer, supplier and community relationships?*

In this front, the relationships of SABMiller and its stakeholders are investigated especially those most material to the business case. Generally seen, SABMiller has strong, established relationships with many of its stakeholders, which are certainly one of the strengths of its sustainability strategy.

#### 14.7.6.1 Relationships with business partners

SABMiller has already established relationships with many of its suppliers and retailers, through the enterprise developing initiatives ("Encouraging enterprise development in our value chain" priority), especially with local and small scale suppliers and distributors.

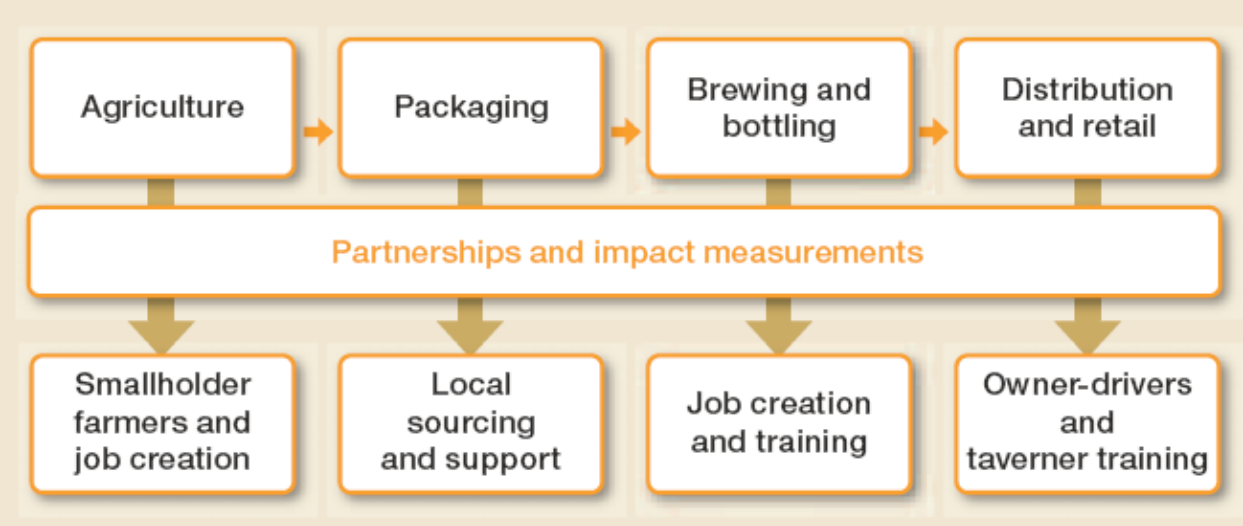


**Figure 38 SABMiller's enterprise development model (SABMiller, 2009)**

SABMiller's enterprise development model is depicted in Figure 38. Its enterprise development program is ambitious, for instance SABMiller engaged 20000 farmers in 2009 in its smallholder programmes. It uses a partnership model under which SABMiller retain overall control, whilst partners perform key activities. The enterprise development model is one of the most promising components of the transition plan, especially considering SABMiller's involvement in the developing countries.

These relationships through the value chain will lay the platform for embedding sustainability through the whole value chain and not just in its own processes and plants. For instance, the traditional beer value chain has in many respects adopted a service economy model where customers pay only for service that the beer delivers. The organic nutrients are consumed, but the technical nutrients (bottles and crates) are returned. Therefore, these partnerships with customers and retailers already exist, but it needs to be optimised. On the customer side, alcohol responsibility (see section 14.7.6.2), an aspect which is unique to SABMiller's business, should also be facilitated through these partnerships. An example of this is SABMiller's taverner training programme. On the supplier side of the value chain the embedding of sustainability principles into agricultural practices, need to be taken further.

#### 14.7.6.2 Relationships with community, government and other stakeholders

SABMiller has a well developed corporate social initiative plan. It focuses these

investments by giving priority to those issues related to its business. SABMiller calls it, "targeted local philanthropy". SABMiller makes investments to reflect its global and regional priorities. The approach further stretches good partnerships and participation with local and international stakeholders such as governments, suppliers and NGOs to ensure a proactive approach to its sustainability initiatives. For instance, SABMiller is actively involved in shaping national alcohol policies in developing countries such as Lesotho, Uganda and Malawi where it operates.

SABMiller also ensures that its initiatives are aligned with other initiatives such as the Millennium Development Goals (MDGs) and the South African Government's Accelerated and Shared Growth Initiative for South Africa (ASGISA).

Apart from the enterprise development, SABMiller's corporate social investment has three other priorities: alcohol responsibility, contributing to the reduction of HIV/Aids and normal corporate social investment.

**Alcohol Responsibility**

This part of SABMiller's social corporate investment is related to the use of its products and is one of the global focus priorities. These are well developed initiatives, which form part of SABMiller's alcohol framework. SABMiller is actively involved with the World Health (WHO) and other international stakeholders. These initiatives includes various alcohol education initiatives for example; internal alcohol related courses for employees, a website providing detail information on alcohol and the use of it and training for business partners such as the taverner training programmes.

SABMiller's leadership stance has much influence on alcohol related issues and in alcohol policy formulation especially in Africa where few national alcohol policies exist.

**Contributing to the reduction of HIV/Aids**

SABMiller's involvement in developing countries where the HIV/AIDS pandemic is prevalent, has necessitates its involvement with the fight of HIV/AIDS. SABMiller has therefore defined it as one of the regional focus areas. These initiatives mostly focus on employees (including those involved in the value chain) and their families and

involve a healthcare system, voluntary testing and counselling, and awareness initiatives.

**Other Corporate Social Investments**

1.3% of pre-tax profits were invested as part of other corporate social investments. This includes water and sanitation provision for local communities, which is an innovative way of adding value to communities by using its expertise in water management. Other initiatives include entrepreneurial development and charitable donations.

### 14.7.7 Learning and training

SABMiller has a strong focus on learning and people development (human capital) throughout its value chain.

Internally, SABMiller offers its employees over 400 training course offers (e.g. e-learning courses), which include leadership and management training programmes. In SABMiller, each employee received an average of 4.4 days of training during 2009. SABMiller also emphasises "on the job" training to coach employees in the development of new skills.

The institutionalizing of knowledge through the group and establishing double loop learning is also mentioned. SABMiller pursues the goal of becoming "learning and self-refreshing organisation" by actively encouraging the sharing of knowledge, especially best practice across the group, which is prerequisite for any organisation that wants to flourish over the long term. There is eight SABMiller "Ways" which are bodies of knowledge from talent management to Operational Finance, which contain best practices for specific areas of business. Another example is the way each local operation identifies the priorities most applicable to it and then focuses to establish best practice in that priority. This allows organisational learning to take place, because units can develop best practices and then share the knowledge gained with other operations in the company. E.g. the best practice for dealing with the reduction of carbon and energy in European operations can later be implemented in the African region. By doing this, operations do not have to develop its own approaches for all the sustainability priorities, but can just focus on those most important to it and then use knowledge gained from other operations to implement the other priorities.

Although training is emphasised by SABMiller, a plan to ensure that all employees work from the same mental model of sustainability, is lacking. On higher executive levels this mental model seems to be shared, but how SABMiller plans to diffuse this mental model to the lowest levels in the organisation, is lacking.

A suggestion would be to use the already established channels for embedding best practice, into lower level operations and to include sustainability teaching and coaching in these training and development programmes. As mentioned, SABMiller already has good relationships with its value chains, which provides an excellent platform for developing a shared sustainability mental model throughout the value chain.

Shortcomings in this area will inevitably affect the rate of progress being made towards SABMiller's sustainability goals.

### 14.7.8 Projects

Under the *Projects* step the particular projects that will be implemented to achieve the goals set out in the previous steps, should be analysed. Firstly it must fulfil certain sustainability criteria and then importantly, the business case for the specific project shall be developed.

In this analysis there will be considered how SABMiller defines the business case for its projects. Is SABMiller's primary justification for sustainability projects compliance orientated or does it use sustainability projects to strengthen its business' value proposition, thus creating shared value for its stakeholders and shareholders?

In overview, as mentioned, the projects SABMiller undertakes as part of its 10 priorities seems to be business case driven, although the business value is not often articulated in the reports. Especially the global focus priorities, water, enterprise development are strongly driven by the SABMiller business case.

As a massive consumer of water (890hl/year) the projects included under the water priority are critical for the business success of SABMiller. SABMiller has used its dependence on quality water as a driving force to make water one of its top

sustainability priorities. It has gone beyond compliance by using the strategy as a competitive advantage, for example involving other stakeholders to plan for water shortages in areas where it operates, thus positioning it to best influence water policies and strategies. SABMiller is also the founding signatory of the United Nations CEO Water Mandate, a water conservation mandate, which places it in a leadership position in terms of water conservation.

These water initiatives are proactive and although long term focused, build SABMiller's brand equity, by showing its concern towards water issues while ensuring a future where the water inputs are preserved and where it has influence in shaping water policy decisions.

Enterprise development projects are also strongly business case driven. Here SABMiller has used the enterprise development projects to ensure quality raw materials and better control over the supply and distribution of its products, while at the same time also benefiting communities by creating jobs, which is an important issue in most of the countries where SABMiller does business.

With the projects that form part of the alcohol responsibility priority, SABMiller has built its brand as a concerned corporate citizen. Being on the forefront of alcohol related issues, it has become influential when alcohol related policies are drafted. SABMiller is collaborating with the World Health Organisation (WHO) and other stakeholders who are developing a global strategy on alcohol. It has also consulted with many African governments on the development of national alcohol policies.

Throughout all the priorities, SABMiller has implemented clearly defined projects to achieve the goals set in the priorities. It seems that SABMiller has developed ways to justify the sustainability projects not only with ethical reasons, but has also designed these projects to achieve business goals.

Below is a good example how SAB, SABMiller's South African subsidiary, is justifying its HIV/Aids projects by looking from a system perspective what the financial impacts of HIV/Aids are.

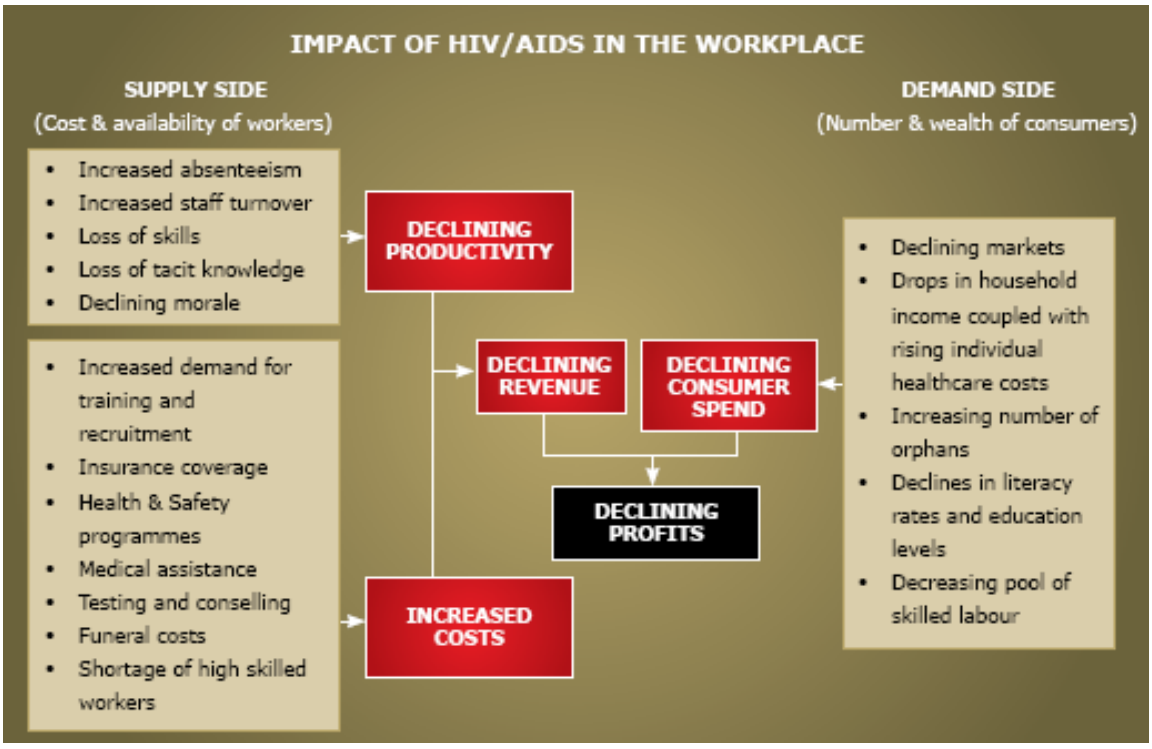


**Figure 39 The impact of HIV/AIDS on SAB (SAB, 2008)**

### 14.7.9 Implementation and Feedback

In this step of the roadmap, the following is analysed:

1. Is the sustainability strategy applied in an iterative way, in other words, is the transition plan and vision of the strategy refined as feedback is given from the progress towards sustainability?
2. Is a management system implemented that effectively measures progress towards sustainability?
3. Does it integrate feedback into business plans?
4. Does it pay special attention to the critical success factors that were identified in the sustainability roadmap?

SABMiller has implemented its own Sustainability Assessment Matrix (SAM), which is used to measure and monitor the progress made towards sustainability.


**Figure 40 SABMiller Sustainability Assessment Matrix (SAM) SABMiller (2009)**

From the sustainability reports it is clear that SABMiller refines its strategy from year to year. For example SABMiller engaged in stakeholder workshops in 2008 around the world to get feedback on the sustainability strategy and SABMiller has also worked on reflecting some of the suggestions of the workshop in its strategy. SABMiller states in its 2009 report "The framework is not static; rather we continually evolve our approach".

Each priority's progress is measured on a scale from 1 to 4, where 4 represents best practice and 1 the minimum standard. Each operation is assessed every six months on the different priorities as part of the business reporting cycles. The results are fed back into strategic business plans.

The overall management system looks impressive, but there are some aspects that are of concern listed below:

1. As already mentioned the scores achieved are already very high which means that level 4 of the SAM tool are probably not high enough for achieving sustainability. For example over one third of all priorities are at least at level 3 or above. A fifth level may be added to represent a restorative state.
2. Most of the criteria used for monitoring progress in the priorities are very vague (e.g. employee behaviour, corporate social investment strategy and

waste management), which leaves the concern that the results maybe very subjective. Adding to this the fact that there is no indication that level four (best practice, the sustainability state) have been defined, meaning that there is no defined point against which progress can be measured.

3. Overall there are relatively few indicators that measures progress towards sustainability. Important indicators that include economic performance e.g. material input/economic output or reflect the effect on economic performance are not used to measure progress.

### 14.7.10 Critical Success Factors

Based on SABMiller's implementation of its sustainability strategy the following grading was given on their attention to the critical success factors.

**Table 8 Attention to Critical Success Factors**

| | |
|---|---|
| **Leadership** | Strong |
| **Whole Systems Perspective** | Weak |
| **People Focus** | Medium, not empowering employees for sustainability |
| **Long Term Perspective** | Weak |
| **Core Ideology** | Weak |
| **Employee Participation** | Strong |
| **Commitment to Learning** | Strong |

Most of these factors are discussed next under section 14.8.

## 14.8 Strengths and Weaknesses of SABMiller sustainability strategy

First the strengths of SABMiller's sustainability strategy will be discussed and then the weaknesses.

### 14.8.1 Strengths

#### 14.8.1.1 Good focus most important issues to business operations

SABMiller's focus on the priorities most material to its business ensures that the sustainability initiatives are aligned with its business goals. It ensures that SABMiller's strengths are used to make the optimum contribution to the broader society. This will lay the platform for action in the other priorities as time goes on.

#### 14.8.1.2 Building networks

SABMiller has built up strong networks with many of its stakeholders and continues to do so. These partnerships are one of the most valuable parts of SABMiller's strategy and are and will provide it with a competitive advantage as this will allow SABMiller to be more open to the environment and adapt quicker to changes (resilience). These relationships are also a crucial platform to ensure sustainability is achieved throughout the whole beer value chain.

#### 14.8.1.3 Business model already lends itself to sustainable production systems

Closing the material loops on beer, should be simpler than for most, as the value chain is relatively simple and recycling has already been part of the value chain for a long time. Beer production is also a localised product. It is typically brewed locally, sold locally and consumed locally, making the recycling loops smaller and easier to handle.

### 14.8.2 Weaknesses

#### 14.8.2.1 One complete systems vision

The lack of a whole system vision of what it would mean for SABMiller to be a truly sustainable company is one of the biggest shortcomings of its strategy. Here inputs from the bodies of knowledge such as the sustainability conditions and industrial ecology would be helpful to create such a vision for SABMiller.

#### 14.8.2.2 Driven by SABMiller's core ideology

Although there is some integration of sustainability priorities into the business strategy, a more complete integration should be sought; starting with showing how the sustainability strategy is aligned with the core purpose and values of SABMiller, otherwise the strategy would remain separate from the day to day business activities.

#### 14.8.2.3 Integration with operational strategies

Following on the previous point, the integration of sustainability principles on higher levels of the organisation is progressing well, but how these principles will be

defused into everyday operations on the shop floor, are not shown. For the sustainability strategy to be effective more attention must be paid on how the sustainability principles will be imbedded in the existing operational strategies e.g. lean manufacturing.

#### 14.8.2.4 People as primary agents of change

The role people will play in the success of the strategy is not emphasised enough. There is some mention of employees helping to reduce electricity consumption in South Africa. Sustainability training and learning to ensure everybody in the organisation understands sustainability are not included in the SABMiller strategy. A clear plan should be develop to ensure that SABMiller employees have the necessary skills and knowledge to create the change towards a sustainable company. This is important for the strategy to not only stay a top-down approach, but for the employees to partake in bottom up operational changes.

#### 14.8.2.5 Measuring and monitoring

Good concrete feedback on progress towards the vision is critical to manage the road to sustainability. For this to happen SABMiller's measuring and monitoring system (the SAM tool) still needs refinement and indicators should be developed to ensure that the feedback is based on concrete data rather than on vague unquantifiable criteria. This will not be possible for every instance, but good indicators are critical to ensure progress is indeed made and in the right direction.

#### 14.8.2.6 Too many priorities

The ten priorities might be too many priorities to manage in the pursuit of sustainability. Some of the priorities show areas that overlap and these priorities could be combined. For example the "packaging reuse and recycling" priority and the "working towards zero-waste operations" could be combined into one priority called "closing material loops", because both priorities seek to ensure that materials are either technical or biological nutrients. The priorities "respecting human rights" and "transparency and ethics" are from the author's point of view not priorities, but rather values which affect all of the other priorities. Based on the findings above, a new priority that would include the training and learning plan could also be included in the strategy.

# 15 RESULTS FROM CASE STUDY

The following are results from the case study

## 15.1 Systematic Approach

The Roadmap presented a systematic approach to analyse SABMiller's strategy. Especially the high level structure of the Roadmap benefitted the analysis e.g. As-Is to Implementation and Feedback. The different fronts in the transition plan proved to be helpful to the analysis. Using the roadmap, gaps in SABMiller's strategy could be shown, while opportunities to rectify weaknesses could also be identified.

## 15.2 Not all elements could be tested

Although the high level framework was useful in analysing the strategy, unfortunately not all the elements presented in the roadmap could be applied. For example those elements relating to the Place architecture, could not be applied as very little information is available on how SABMiller manages its facilities. Also although the author managed to get some information on SABMiller's operational strategy, they use lean production, little could be identified on how they incorporate sustainability in their day to day operations. The more detail elements are still judged relevant in the roadmap as it was shown to be supported by literature. When an actual implementation of the roadmap would take place, the more detail elements may be useful as they are at a more practical level (e.g. the lean suggestion in the transition plan).

## 15.3 Local drivers

The SABMiller case study showed clearly how the local environment of the operations influences sustainability strategy. For example the focus differed much from SABMiller's operations in the developing countries to developed countries. This emphasises the locality principle; every sustainability strategy should be adopted for its local social, environmental and economic environment. The Roadmap was adapted to pay the necessary attention to this.

## 15.4 Connectedness of SABMiller

In the case study, it was shown that SABMiller has a good understanding of the

connectedness principle. SABMiller seems to be skilled at forming partnerships with many stakeholders. This result was integrated into the roadmap, mainly into the To-Be part and transition plan, to ensure that the roadmap emphasises the forming of strategic partnerships with stakeholders.

### 15.5 Business case driven

SABMiller showed that sustainability initiatives should be driven by a business case (e.g. water is critical to their business), which supports the emphasis that was placed, in this work and in the roadmap, on identifying the business purpose (need of the customer) as the centre of a sustainability strategy.

### 15.6 The softness of sustainability

As was shown, sustainability concerns itself with human wellbeing, which is difficult to define operationally in a business context. This was seen in the analysis of SABMiller's products and particular the question, how can SABMiller add wellbeing with its products? (To-Be visioning) The "softness" of the issues involved makes sustainability strategy development difficult, because it will inevitably be confronted with questions concerning the greater purposes of life.

# 16 CONCLUSIONS

Modern day enterprises cannot be blind to the issues facing the world today. Environmental, social and economical problems are threatening many parts of society and the manufacturing enterprise as part of the industrial system are playing significant parts in creating many of these problem and/or are and will be effected by these issues. Institutions such as the manufacturing enterprise have grown powerful and influential and therefore they may also be able to contribute to solving these problems of unsustainability. These issues present business opportunities.

For this to take place the enterprise and larger business economy's role in society should be viewed from a systems perspective. The first realisation that this perspective brings is the connectedness of all the elements that make up this larger system (social, environmental, economical) and how the success from the industrial age brought many unwanted side effects. The second realisation that a systems perspective brings is that the economy cannot be an end in itself, but rather a means to end, which is human well-being. How this wellbeing is created is restricted by nature (ultimate ends).

The manufacturing enterprise being part of the economic system should then serve a higher end; the real need of the customer, while ensuring that its impact on other stakeholders are positive, creating sustainable value rather than transferring it from one stakeholder to another. How enterprises can achieve the above goal, was investigated in this work, with particular attention being paid to bodies of knowledge that is available in literature that would help with developing a strategy towards sustainability. It was found that it is of particular value to consider an organisation as an organic system, with sustainability seen as a system property rather than an end goal. Sustainability equals resilience, the ability to flourish in unforeseen circumstances. To achieve this state, organisations should optimise how their different capital stocks are applied to fulfil their purpose (customer wellbeing). It was found that great leverage for success lies in the optimisation of human and social capital rather than technological means (Porras & Collins, 1994; De Geus, 1997). Employees need to contribute their full potential towards organisational goals.

Concrete high level environmental conditions which stipulate the environmental

limits within which businesses should operate were then identified from literature (the first three system conditions). Similar conditions were also proposed, from literature, for other capital stocks (social, human, manufactured and financial), although these conditions were found to be much less rigid and open to interpretation. The conditions are considered important, because as mentioned it is these capitals that will affect the efficiency of turning natural capital into human wellbeing.

To formulate strategies to fulfil these conditions through and in organisations the ecological metaphor as used in industrial ecology was found to be particularly useful. The premise of industrial ecology is to use nature's design principles, because nature is sustainable and resilient, and apply it to the design of manufacturing companies. The principles of closed loop systems, diversity, connectedness and locality were identified and helpful in envisioning strategies to fulfil the various sustainability conditions.

The strategies, concepts and frameworks were then used to formulate a strategy development tool, the "Sustainability Roadmap" to enable manufacturing enterprises to formulate a sustainability strategy in a systematic way. In developing the transition plan from the As-Is to To-Be, already successful operational strategies, such as lean production, was shown to present a valuable opportunity for integration with sustainability initiatives.

This roadmap was then applied in a case study. Data gathered from SABMiller's sustainability report was analysed based on the process and elements described in the roadmap. Using the Sustainability Roadmap weaknesses and strengths could be identified in the SABMiller strategy. Using the roadmap, opportunities to rectify these weaknesses could also be described. Although not all the elements could be tested, the high level framework and elements proved to be particularly useful. The Sustainability Roadmap is judged to be useful and will definitely add value to manufacturing companies that wish to become resilient.

## 16.1 Recommendations for Future Work

The following recommendations are made for future work on this subject.

1. The work done in this research has mostly focussed on a strategic level. In the limited scope of the research, detail implementation and specific tools for implementing strategies have not been discussed. Discussions on the application of life cycle assessment (LCA) tools, environmental management tools and other related tools could certainly add value to the roadmap.

2. The author sees the Sustainability Roadmap as a framework for organising knowledge regarding sustainability strategy and this knowledge should be grown over time as more knowledge are gained on the subject. To make this possible and the roadmap more accessible and dynamic, it can be incorporated into a collaboration software platform e.g. Eden collaboration software that was developed by Indutech.

3. The roadmap is particularly focused on manufacturing enterprises, but could be adjusted for service orientated companies as many of the principles in the roadmap would also be applicable to other forms of businesses.

4. The roadmap was only implemented in a limited way, a more detail implementation would certainly be very useful to further test the suggestions of the roadmap.

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# APPENDIX 1

# SCIENTIFIC PRINCIPLES UNDERLYING THE SYSTEM CONDITIONS

The system conditions are based on a scientific rationale. These principles will be discussed in brief below. The following summary is adopted from Nattrass and Altomare (1999).

**Matter and energy cannot be destroyed or created**

This principle follows from the first law of thermodynamics (energy conservation) and matter conservation. Energy is constantly transformed from one form to another. According to the law of energy conservation, energy cannot be destroyed through these transformation processes. Matter conservation deals with the conservation of atoms in material through a transformation process. The atoms of the raw materials are the same as the atoms in the products and residues produced by the transformation process. The only exception is nuclear transformations.

**Matter and energy tend to disperse**

This principle is based on the second law of thermodynamics which states that entropy will increase in a closed system. This implies that energy and matter will become less useful (available energy will be reduced and matter will become dispersed), as it passes through transformation processes. A landfill site is a good example of how matter has disperses through transformation processes. Metals, organic, manmade materials and other materials are all mixed and highly dispersed on landfill site.

**Material quality can be characterized by the concentration, purity and structure**

This principle follows from the previous two and it states that if matter and energy is not destroyed the only thing that can happen to matter is that it can lose its quality or value. The tendency of matter to dissipate is what reduces material quality. As entropy increases matter loses its concentration, purity and structure. Economic value is coupled to these characteristics. A can of water has economic value and also

a bottle of ink. If the ink is mixed with water, the water and the ink loses its quality and thus its economic and functional value. Contaminated water can even have a negative economic effect, as disposal maybe necessary.

**The net increase in material quality on earth is produced by sun-driven processes**

The second law of thermodynamics seems to be contradicted when applied to nature, because nature (when left alone) seems to improve in order. This is because the earth is not a closed system and has a constant flow of energy from the sun. The high quality energy from the sun is used to counter the entropy that is created as matter and energy disperses. Plants are the primary producers of this order through photosynthesis. Energy from the sun is used to increase the quality of the dispersed materials. Plants are the only ones that produce more order than it destroys. Animals and humans are net entropy producers.

# APPENDIX 2

# DEFINITIONS OF OPERATING AND CAPITAL LEASES

*Operating Lease*

A lease that is treated as a true lease (as opposed to a loan) for accounting purposes. As defined by the Financial Accounting Standards Board in its Statement of Financial Accounting Standards 13 (SFAS 13), an operating lease must have all of the following characteristics:

1. Title: Ownership is retained by the lessor during and after the lease term.
2. Term: Lease term is less than 75 percent of estimated economic life of equipment.
3. Value of Payments: Present value of payments is less than 90 percent of equipment's fair market value (FMV).
4. Purchase Options: Lease cannot contain a bargain purchase option (i.e., less than FMV).

*Capital Lease*

A lease that must be treated as a loan for accounting purposes because it meets at least one of the criteria outlined in paragraph 7 of SFAS 13. The four criteria are:

1. Title: Title passes to lessee automatically by the end of the lease term.
2. Term: Lease term is greater than 75 percent of estimated economic life of equipment.
3. Value of Payments: Present value of payments is greater than 90 percent of equipment's FMV.
4. Purchase Options: Lease contains a bargain purchase option (i.e., less than FMV).

Source: Leasing Terminology, www.steamgenie.com/leasing.html

# APPENDIX 3

## GRI INDICATORS MAPPED TO AS-IS ANALYSIS STEPS

| Global Reporting Initiative relevance to the Sustainability Architectures | | Relevant GRI sections and indicators | GRI rating |
|---|---|---|---|
| **Whole system view** | | | |
| | **Stakeholders engagement** | 4.14 - 4.17 of Profile disclosures | |
| **Core Ideology** | | | |
| | **Core Values** | 2.8 of Profile Disclosures | |
| | **Core Purpose** | 2.8 of Profile Disclosures | |
| **People** | | | |
| | **Organisational Structure** | no relevant indicator | |
| | **Employment demographic** | LA13 Composition of governance bodies and breakdown of employees per category according to gender, age group, minority group membership, and other indicators of diversity. | Core |
| | | LA14 Ratio of basic salary of men to women by employee category. | Core |
| | | LA1 Total workforce by employment type, employment contract, and region. | Core |
| | | LA2 Total number and rate of employee turnover by age group, gender, and region. | Core |
| | | EC7 Procedures for local hiring and proportion of senior management hired from the local community at significant locations of operation. This also relates to the community involvement section. | Core |
| | **Current promotion, compensation, reward and retirement policies** | EC3 Coverage of the organization's defined benefit plan obligations. | Core |
| | | EC5 Range of ratios of standard entry level wage compared to local minimum wage at significant locations of operation. | Additional |
| | | LA3 Benefits provided to full-time employees that are not provided to temporary or | Additional |

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|---|---|---|
| | part-time employees, by major operations. | |
| **Training programs and Learning** | LA10 Average hours of training per year per employee by employee category | Core |
| | LA11 Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings. | Additional |
| | LA12 Percentage of employees receiving regular performance and career development reviews. | Additional |
| **Human relations** | LA4 Percentage of employees covered by collective bargaining agreements. | Core |
| | LA5 Minimum notice period(s) regarding significant operational changes, including whether it is specified in collective agreements. | Core |
| **Employees and their families** | Number of employee/associate social events held | n/a indicators used by Interface Inc. |
| **Community involvement** | Contributions to externals organizations | n/a indicators used by Interface Inc. |
| | Employee volunteer hours in the community | n/a indicators used by Interface Inc. |
| | EC7 Procedures for local hiring and proportion of senior management hired from the local community at significant locations of operation. This also relates to the employee demographics section. | Core |
| | EC8 Development and impact of infrastructure investments and services provided primarily for public benefit through commercial, in-kind, or pro bono engagement. | Core |
| | SO1 Nature, scope, and effectiveness of any programs and practices that assess and manage the impacts of operations on communities, including entering, operating, and exiting. | Core |
| **Corruption policies *** | SO2 Percentage and total number of business units analyzed for risks related to corruption. | Core |
| | SO3 Percentage of employees trained in organization's anti-corruption policies and procedures. | Core |
| | SO4 Actions taken in response to incidents of corruption. | Core |

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| | | SO5 Public policy positions and participation in public policy development and lobbying. | Core |
| | | SO6 Total value of financial and in-kind contributions to political parties, politicians, and related institutions by country. | Additional |
| | | SO7 Total number of legal actions for anti-competitive behavior, anti-trust, and monopoly practices and their outcomes. | Additional |
| | | SO8 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with laws and regulations. | Core |
| **Process (Outputs)** | | | |
| | **Emissions** | EN16 Total direct and indirect greenhouse gas emissions by weight. | Core |
| | | EN17 Other relevant indirect greenhouse gas emissions by weight. | Core |
| | | EN18 Initiatives to reduce greenhouse gas emissions and reductions achieved. | Additional |
| | | EN19 Emissions of ozone-depleting substances by weight. | Core |
| | | EN 20 Other NOx, SOx, and other significant air emissions by type and weight | |
| | | EN29 Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce. | Additional |
| | **Effluent** | EN21 Total water discharge by quality and destination | Core |
| | **Solid waste and other liquids excluding waste water** | EN22 Total weight of waste by type and disposal method. | Core |
| | | EN23 Total number and volume of significant spills. (Hazardous waste spills) | Core |
| | | EN24 Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention Annex I, II, III, and VIII, and percentage of transported waste shipped internationally. | Additional |
| | | EN25 Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff. | Additional |
| **Process (Inputs)** | | | |
| | **Occupational Health and Safety** | LA7 Rates of injury, occupational diseases, lost days, and absenteeism, and total number of work-related fatalities by region. | Core |

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|---|---|---|---|
| | | LA8 Education, training, counseling, prevention, and risk-control programs in place to assist workforce members, their families, or community members regarding serious diseases. | Core |
| | | LA6 Percentage of total workforce represented in formal joint management-worker health and safety committees that help monitor and advise on occupational health and safety programs. | Additional |
| | | LA9 Health and safety topics covered in formal agreements with trade unions. Health and safety topics covered | Additional |
| | **Materials** | EN1 Materials used by weight or volume. | Core |
| | | EN2 Percentage of materials used that are recycled input materials | Core |
| | **Energy** | EN3 Direct energy consumption by primary energy source. | Core |
| | | EN4 Indirect energy consumption by primary source. | Core |
| | | Indicators EN3 EN4 relates to EN 16 and 17 which is the emission indicators related to the energy usage. | |
| | | EN5 Energy saved due to conservation and efficiency improvements. | Additional |
| | | EN6 Initiatives to provide energy-efficient or renewable energy-based products and services, and reductions in energy requirements as a result of these initiatives. | Additional |
| | | EN7 Initiatives to reduce indirect energy consumption and reductions achieved. | Additional |
| | **Water - The water consumption.** | EN8 Total water withdrawal by source. | Core |
| | | EN9 Water sources significantly affected by withdrawal of water | Additional |
| | | EN10 Percentage and total volume of water recycled and reused. | Additional |
| **Process (Biodiversity Impact)** | | | |
| | **Biodiversity impact** | EN12 Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas. (This indicator also relates to the impact of products and place on the biodiversity) | Core |
| | | EN13 Habitats protected or restored. | Additional |
| | | EN14 Strategies, current actions, and future plans for managing impacts on biodiversity. | Additional |
| | | EN15 Number of IUCN Red List species and national conservation list species with | Additional |

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|---|---|---|---|
| | | habitats in areas affected by operations, by level of extinction risk. | |
| | | EN25 Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff. | Additional |
| **Products** | | | |
| | **Need fulfillment of Product services** | PR5 Practices related to customer satisfaction, including results of surveys | Additional |
| | **Analysis of impacts** | PR1 Life cycle stages in which health and safety impacts of products and services are assessed for improvement, and percentage of significant products and services categories subject to such procedures. | Core |
| | | PR2 Total number of incidents of non-compliance with regulations and voluntary codes concerning health and safety impacts of products and services, by type of outcomes. | Additional |
| | | PR3 Type of product and service information required by procedures and percentage of significant products and services subject to such information requirements. | Core |
| | | PR2 Total number of incidents of non-compliance with regulations and voluntary codes concerning health and safety impacts of products and services, by type of outcomes. | Additional |
| | | EN26 Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation. | Core |
| | **Recyclability of parts** | EN27 Percentage of products sold and their packaging materials that are reclaimed by category | Core |
| | **Marketing Communications*** | PR4 Total number of incidents of non-compliance with regulations and voluntary codes concerning product and service information and labeling, by type of outcomes. | Additional |
| | | PR6 Programs for adherence to laws, standards, and voluntary codes related to marketing communications, including advertising, promotion, and sponsorship. | Additional |
| | | PR7 Total number of incidents of non-compliance with regulations and voluntary codes concerning marketing communications, including advertising, promotion, and sponsorship, by type of outcomes. | Additional |
| | | PR8 Total number of substantiated complaints regarding breaches of customer privacy and losses of customer data. | Additional |

| | | | |
|---|---|---|---|
| | | PR9 Monetary value of significant fines for non-compliance with laws and regulations concerning the provision and use of products and services | Core |
| **Place** | | | |
| | **Buildings** | EN11 Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas. | Core |
| | | EN12 Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas. (This indicator also relates to the impact of processes and products on the biodiversity) | Core |
| | | EN25 Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff. | Additional |
| | **Suitability for Humans** | No relevant indicator | |
| **Profit** | | | |
| | **Economic value distribution to stakeholders** | EC1 Economic value generated and distributed, including revenues, operating costs, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and governments. | Core |
| | | EC2 Financial implications and other risks and opportunities for the organization's activities due to climate change. | Core |
| | | EC4 Significant financial assistance received from government. | Core |
| | | EC6 Policy, practices, and proportion of spending on locally-based suppliers at significant locations of operation. | Additional |
| | | EC9 Understanding and describing significant indirect economic impacts, including the extent of impacts. (Additional) | Core |
| | | EN30 Total environmental protection expenditures and investments by type. | Core |
| | | EN28 Monetary value of significant fines and total number of non-monetary sanctions for non-compliance with environmental laws and regulations. | Additional |
| | | PR9 Monetary value of significant fines for non-compliance with laws and regulations concerning the provision and use of products and services | Core |
| | | SO8 Monetary value of significant fines and total number of non-monetary sanctions | Core |

| | | |
|---|---|---|
| | | for non-compliance with laws and regulations. |
| **Other** | | |
| | **To-Be vision, transition plan and projects** | 1.1 - 1.2 Profile Disclosures |

*** The sections, Corruption policies and Marketing communications, were considered outside of the scope of As-Is analysis, but are included here for completeness**

# APPENDIX 4

# ENVIRONMENTAL BENEFITS OF LEAN

| Waste Type | Environmental Impacts |
|---|---|
| Overproduction | · More raw materials and energy consumed in making the unnecessary products<br>· Extra products may spoil or become obsolete requiring disposal<br>· Extra hazardous materials used result in extra emissions, waste disposal, worker exposure, etc. |
| Inventory | · More packaging to store work-in-process (WIP)<br>· Waste from deterioration or damage to stored WIP<br>· More materials needed to replace damaged WIP<br>· More energy used to heat, cool, and light inventory space |
| Transportation and Motion | · More energy use for transport<br>· Emissions from transport<br>· More space required for WIP movement, increasing lighting, heating, and cooling demand and energy consumption<br>· More packaging required to protect components during movement<br>· Damage and spills during transport<br>· Transportation of hazardous materials requires special shipping and packaging to prevent risk during accidents |
| Defects | · Raw materials and energy consumed in making defective products<br>· Defective components require recycling or disposal<br>· More space required for rework and repair, increasing energy use for heating, cooling, and lighting |
| Over processing | · More parts and raw materials consumed per unit of production<br>· Unnecessary processing increases wastes, energy use, and emissions |
| Waiting | · Potential material spoilage or component damage causing waste<br>· Wasted energy from heating, cooling, and lighting during production downtime |

**Table 9 The hidden environmental benefits of lean (EPA, 2007)**

# APPENDIX 5

# SABMILLER GRI REPORTING