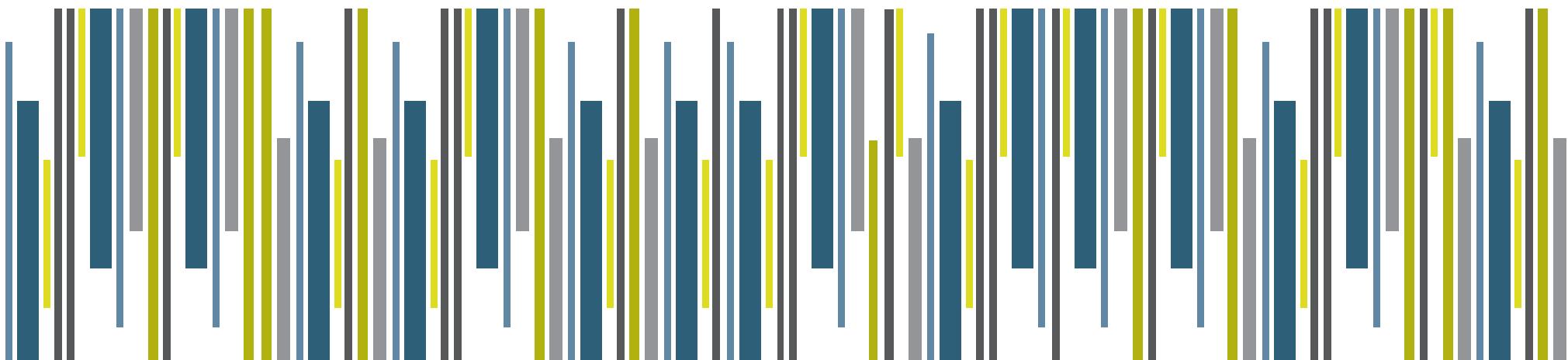


DESIGN FOR SUSTAINABILITY

**A PRACTICAL APPROACH
FOR DEVELOPING ECONOMIES**

WORKSHEETS



DESIGN FOR SUSTAINABILITY
A PRACTICAL APPROACH
FOR DEVELOPING ECONOMIES

UNITED NATIONS ENVIRONMENT PROGRAMME
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INTRODUCTION

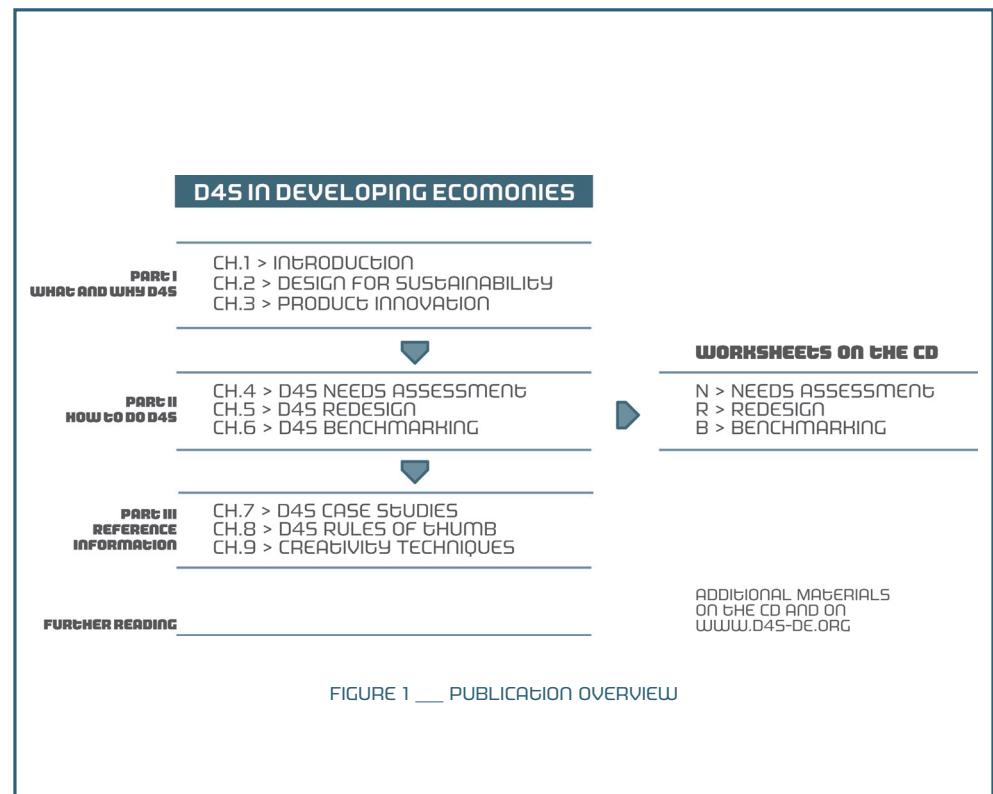
Welcome to the worksheets package of *Design for Sustainability: a practical approach for developing economies*. In the second part of the publication, *How to do D4S in practice* (Chapters 4 to 6), three practical, step-by-step approaches are presented to execute a D4S project in a company.

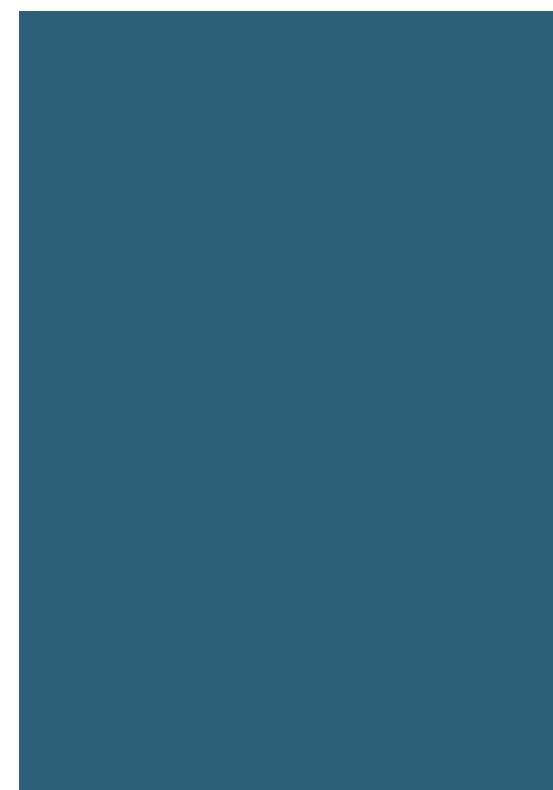
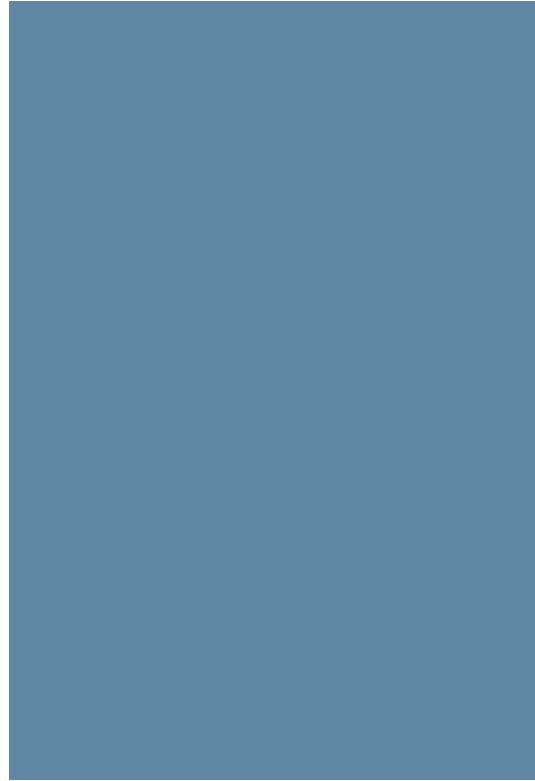
Chapter 4, the D4S Needs Assessment shows how to evaluate the economic position of a country and how to prioritize industry sectors in order to target the selection of demonstration project companies. This chapter is intended for intermediaries who set up a D4S programme or project. The set of Worksheets N accompanies this chapter.

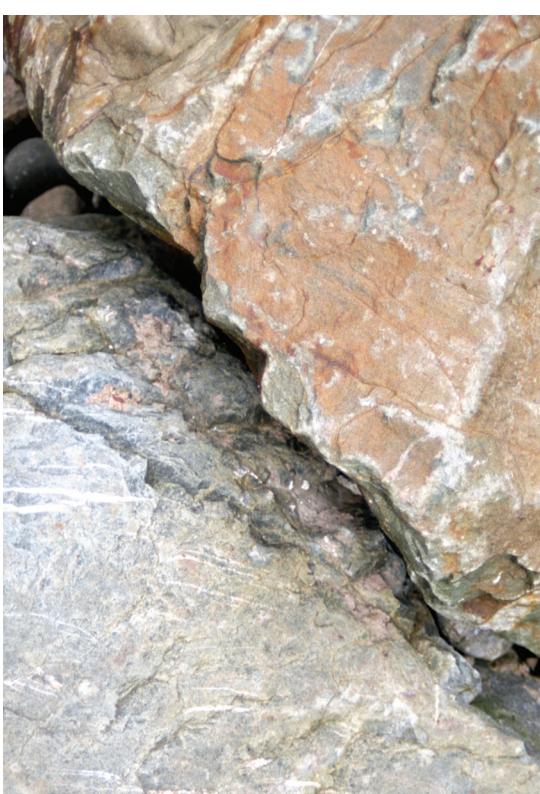
Chapter 5 outlines the step-by-step approach to carry out a D4S Redesign project, aimed at the sustainability-driven, incremental improvement of an existing product. The set of Worksheets R accompanies this chapter.

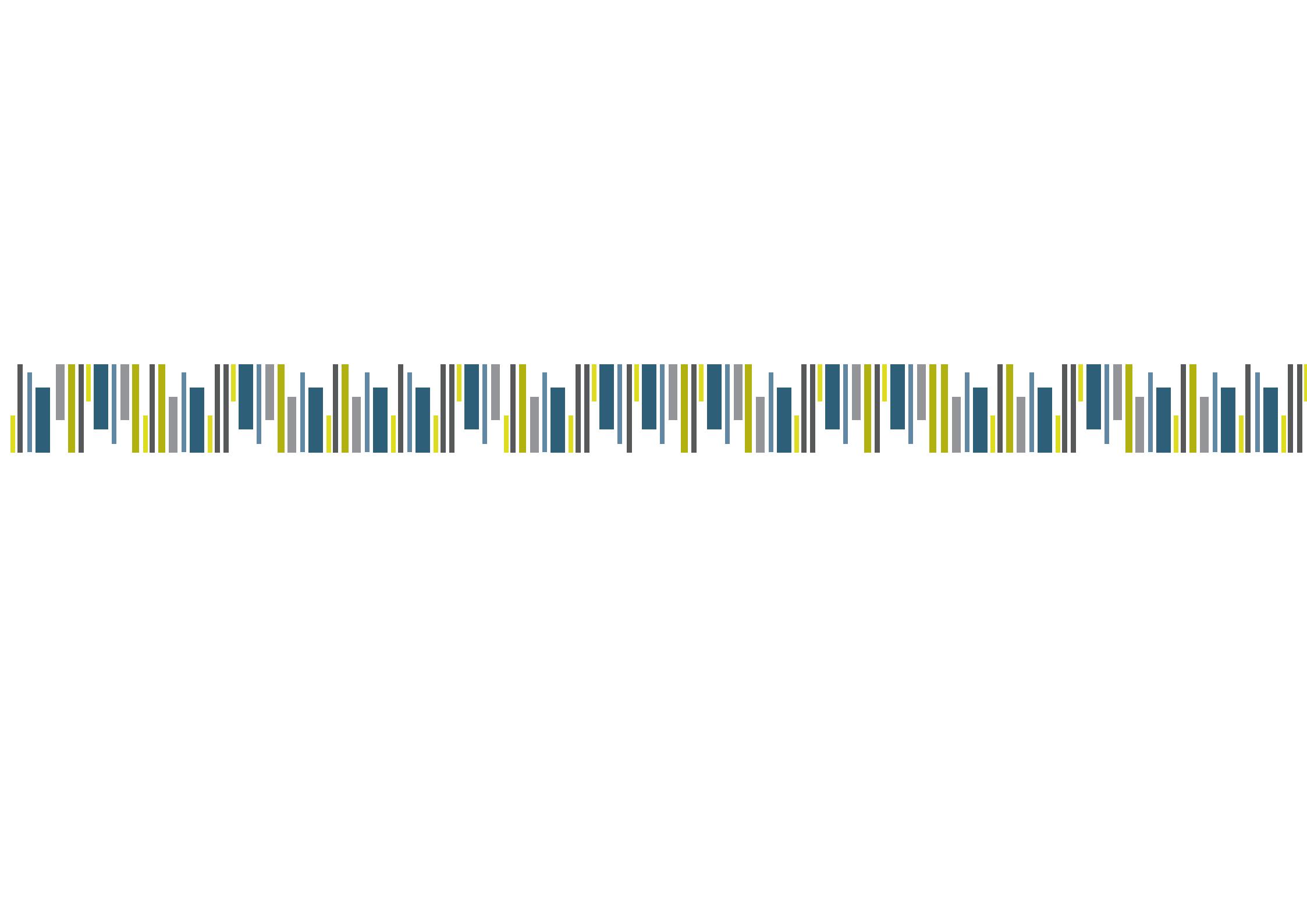
In Chapter 6, the D4S Benchmarking approach is presented. In short, the approach uses the work of competitors to develop new products. This approach is especially suitable for those companies that develop products based upon imitating existing products. The set of Worksheets B accompanies this chapter.

All worksheets are referenced in the chapters.











WORKSHEETS

ACCOMPANYING CHAPTER 4

D4S NEEDS ASSESSMENT



WORKSHEET

PROJECT LEVEL

> *What are the objectives of the project?*

Write down the objectives of the project. Put them in order of priority.

1_

2_

3_

4_

5_

> *Who are the main beneficiaries?*

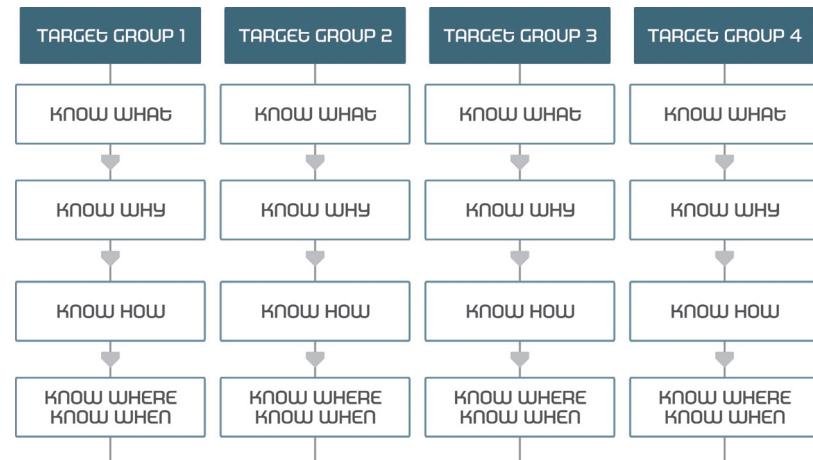
Write down the main target groups.

1_

2_

> *How deep an understanding is needed for each target group? Know-what? Know-why? Know-how?*

Indicate for each target group the proposed level of knowledge transfer within the project:





WORKSHEET

COUNTRY BENCHMARK STATISTICS

A digital version of Worksheet N2, an Excel Worksheet for collecting and processing country specific statistics can be found on the CD-Rom separately.

› *Select three countries to benchmark with (neighboring or best practice ones).*

1_

2_

3_

› *Collect the economic and social data for the countries.*

N3

WORKSHEET

NATIONAL LEVEL

Use the statistics gathered in Worksheet N2 to answer the following questions:

ECONOMIC AND SOCIAL DEVELOPMENT

> What are the GDP and GDP PPP for the selected countries? (Statistics 1,2 & 3 and Graph 1)

> Into which income categories do the countries fit? High, upper-middle, lower-middle or low class?

See: <http://www.worldbank.org/data/countryclass/>

> What are the current HDI ranks of the countries?
(Statistics 15)

COMPETITIVE POSITION

> What is the CGI ranking of the countries?
(Statistics 13 & 14).

> Have they been improved during the last year(s)?

IMPORT AND EXPORT

- > How big are the import and export levels (as a % of the GDP) in the country?
(Statistics 7,8 & 9).

- > Does the export market mainly consist of primary or manufactured goods?
(Statistics 10,11 & 12 and Graph 3).

- > What are the export countries (neighboring or international) and relevant sustainability considerations?

- > Should export oriented companies be one of the (specific) target groups?

AGRICULTURAL, INDUSTRIAL AND SERVICE SECTOR

- > What are the main sectors in the country? Agriculture, industry or service sector?
(Statistics 4, 5 & 6 and Graph 2).

- > What are the current developments?

- > Which sector(s) are attractive for a D4S project? Agricultural, industrial or service sector?

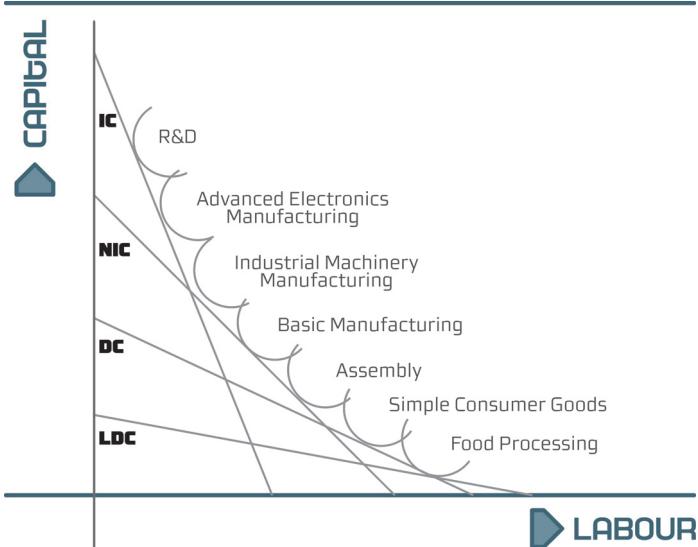
INDUSTRIAL DEVELOPMENT OF THE COUNTRY

- > Into which category does the country fit?

<input type="checkbox"/> Least Developed Countries	LDC
<input type="checkbox"/> Developing Countries	DC
<input type="checkbox"/> Newly Industrializing Countries	NIC
<input type="checkbox"/> Industrialized countries	IC

› What are the characteristics of the local industry? Labour, material, capital or knowledge intensive?

› Indicate in the next figure the industrial development level of most of the industries in the country?



› Can a trend be observed in which the local industry sector is 'climbing up the curve' in the above figure?

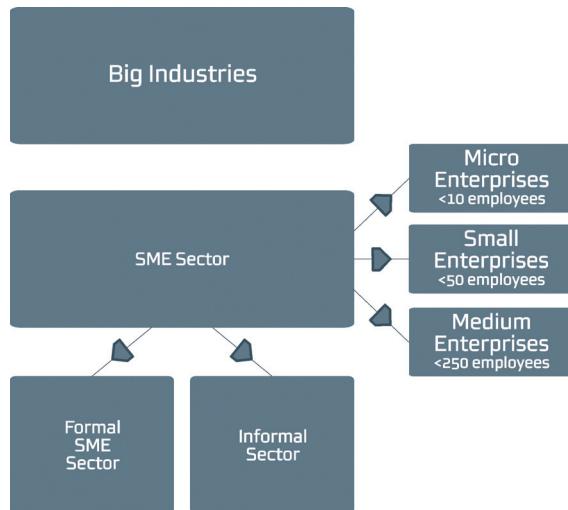
› Does the project want to support the majority of industries or those in the forefront of industrial development (higher up in the curve)? Or those lagging behind (at the lower end of the curve)?

LARGE INDUSTRIES AND SMES

› What is the role of the SME sector in the national economy? What is their share in the GDP and employment?
(Statistics 33, 34, 35, 36)

› What is the role of the informal sector in the national economy? What is their share in GDP and employment?
(Statistics 33, 34, 35, 36)

› What kind of companies will be targeted for the project?
Indicate this in the figure below:



D4S ASPECTS AT THE NATIONAL LEVEL

› What are the main sustainability issues related to production and consumption in the country?

Environmental Issues (Planet)

1_

2_

3_

Social Issues (People)

1_

2_

3_

Financial Issues (Profit)

1_

2_

3_

› Which industrial sectors are important for the national economy?

1_

2_

3_

4_

N4

WORKSHEET

SELECTION OF SECTORS

> Define the criteria for the sector selection

1_

2_

3_

4_

5_

> Select sectors based on these criteria

1_

2_

3_

4_

> Describe the selected sectors in more detail

N5

WORKSHEET

ANALYSIS OF THE SECTOR

Fill in this worksheet separately for each of the selected sectors.

› Identify the internal and external conditions of the sector and fill in the SWOT Matrix.

Use each of the four quadrants of the SWOT Matrix in turn to analyze the current position of the sector. List all the strengths that exist now. Then, list all weaknesses that exist now. Next, list all the opportunities that exist in the future. Opportunities are potential future strengths. Finally list all threats.

STRENGTHS

- ▶
- ▶
- ▶
- ▶
- ▶

WEAKNESSES

- ▶
- ▶
- ▶
- ▶
- ▶

OPPORTUNITIES

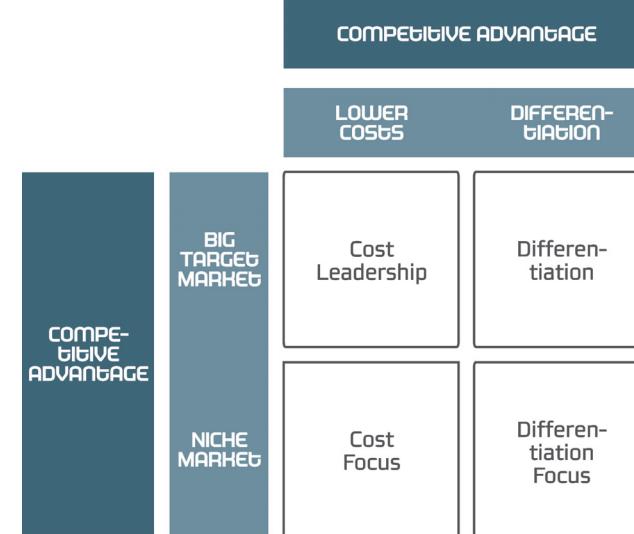
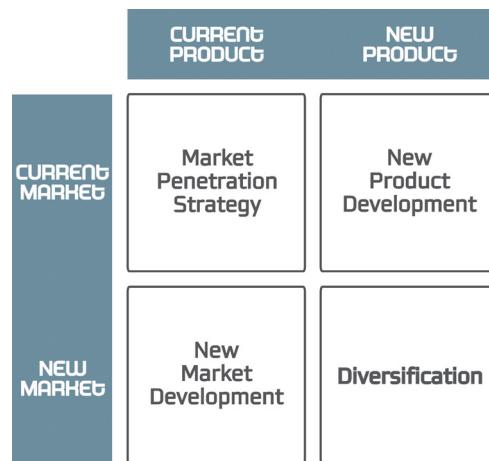
- ▶
- ▶
- ▶
- ▶
- ▶

THREATS

- ▶
- ▶
- ▶
- ▶
- ▶

- > Strengths need to be maintained, built upon, or leveraged;
- > Weaknesses need to be remedied or stopped;
- > Opportunities need to be prioritized and optimized;
- > Threats need to be countered or minimized.
- > What is the role of SMEs and large industries within the sector?

> *What are the main innovation strategies of the companies in this sector? Indicate them in the following figures.*



> *What are the main sustainability issues related to production and consumption in the sector?*

Environmental Issues (Planet)

1_

2_

3_

Social Issues (People)

1_

2_

3_

Financial Issues (Profit)

1_

2_

3_

> Determine which internal and external D4S drivers are relevant for the sector and prioritize them.

Indicate by    if the drivers are related to People , Profit , or Planet  or a combination.

PRIORITY INTERNAL DRIVERS



PRIORITY EXTERNAL DRIVERS



1_

2_

3_

4_

5_

NG

WORKSHEET

SELECTION OF COMPANIES

> Define the criteria for the company selection

1_

2_

3_

4_

5_

> Select companies based on these criteria

1_

2_

3_

4_

> Describe the selected companies in more detail



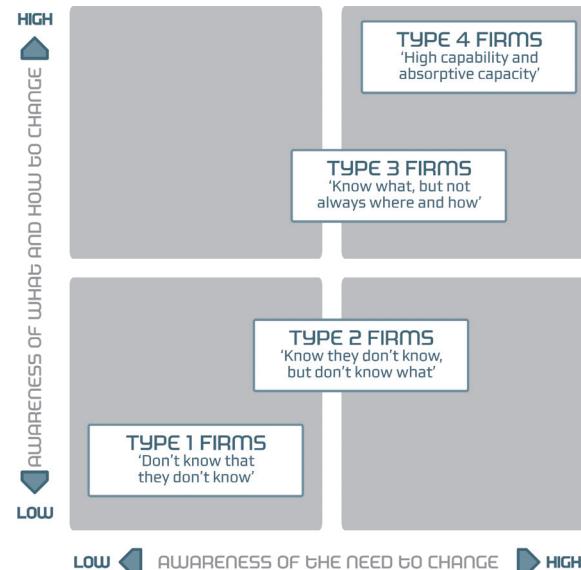
WORKSHEET

COMPANY LEVEL

Fill in this worksheet separately for each of the selected companies.

ABSORPTIVE CAPACITY

> What is the firm category (1, 2, 3 or 4)?



> Which of the following categories fits the company best?

1> Low technology SMEs and micro enterprises

*Business*_ To stabilize business and build competitive capabilities

*Innovation*_ Building awareness of scope and benefits of innovation

2> Minimal technology SMEs

*Business*_ To develop competitiveness

*Innovation*_ To introduce basic skills. To encourage adoption and application of new ideas

3> Technology competent enterprises

*Business*_ To support market development and internationalization of business.

*Innovation*_ To build in-house innovation capabilities

4> R&D rich enterprises

*Business*_ To develop international markets, entry to global supply chain

*Innovation*_ To encourage R&D engagement with international innovation networks, technology transfer and diffusion

> *What is the product development capacity and experience within the company? Do they have a product development department? What kind of staff is in charge of product development? Does the company regularly develop new products and bring them into the market?*

> *Are they a product company or a capacity company, or a mixture?*

N8

WORKSHEET

LOCAL PRODUCT INNOVATION AND R&D CLUSTERS

› Are there local R&D or higher education institutions with product innovation knowledge and experience? If yes, could they be involved in the project? How?

1_

2_

3_

› Are there local R&D or higher education institutions with knowledge and experience in the field of sustainability? If yes could they be involved in the project? How?

1_

2_

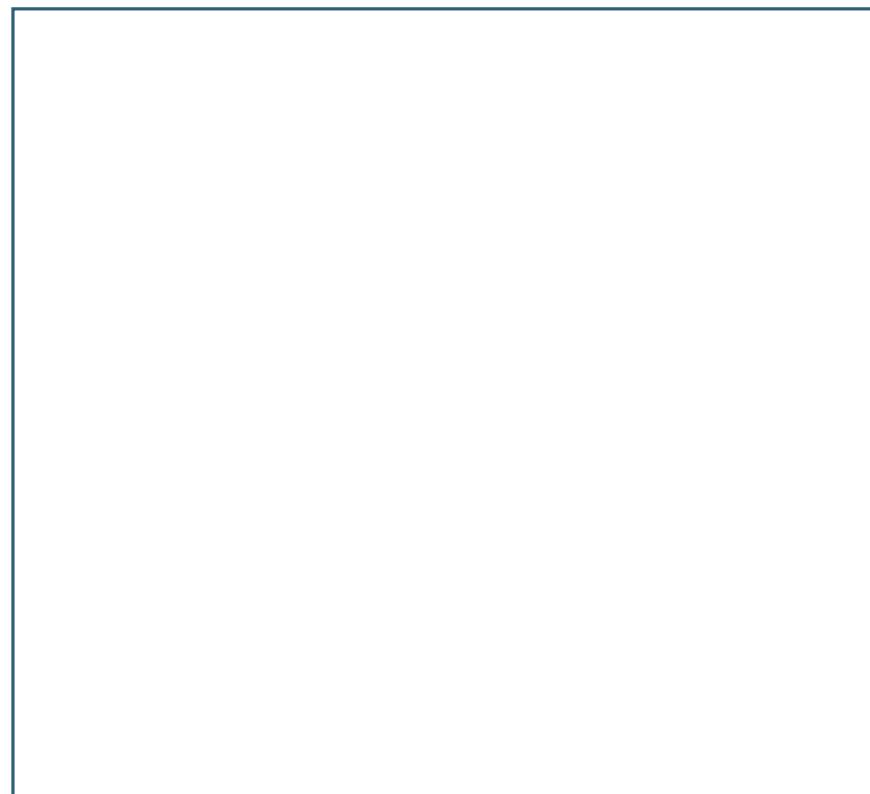
3_

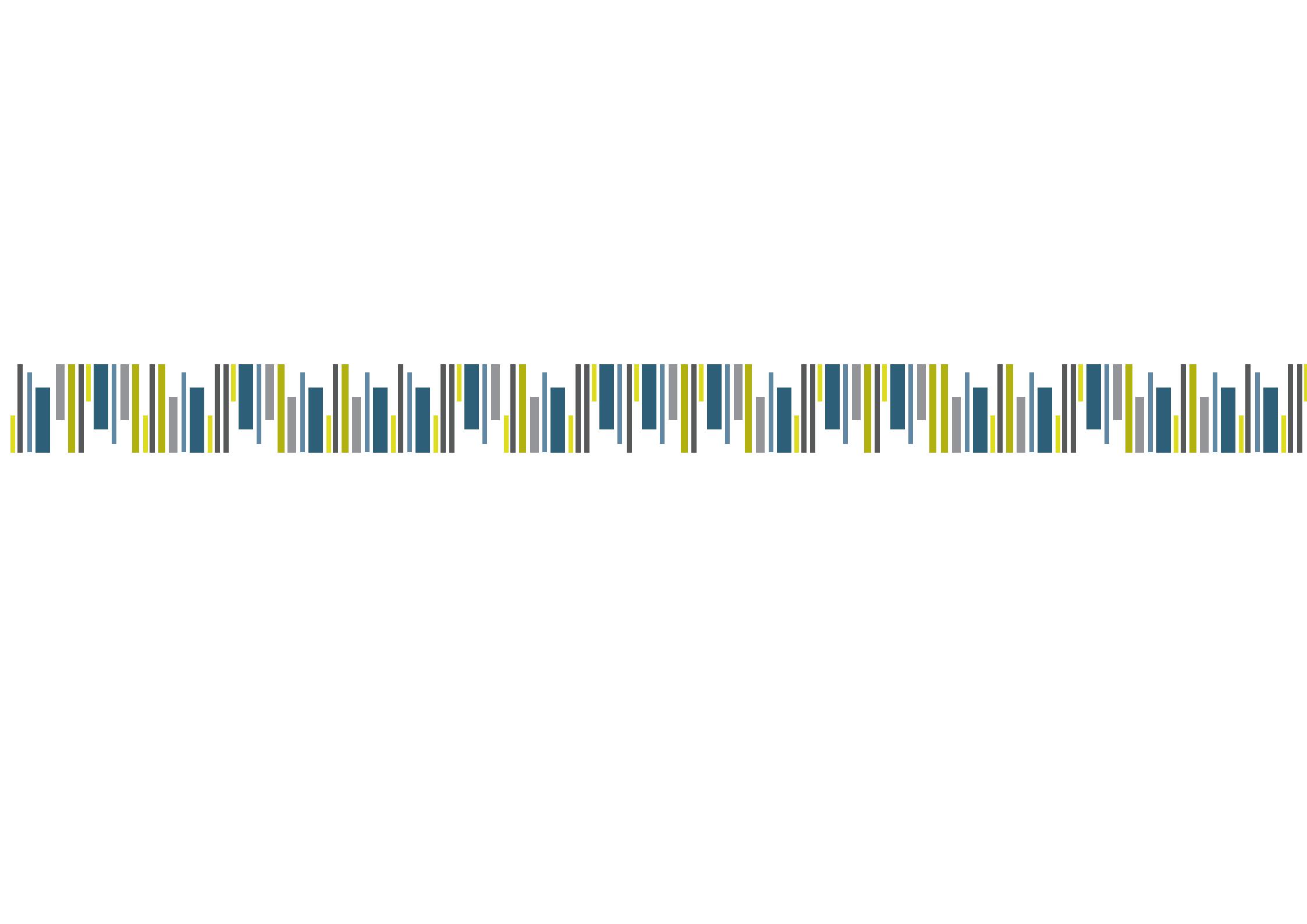
N9

WORKSHEET

D4S ACTION PLAN

> Make a Mind Map for the action plan of the proposed D4S project.







WORKSHEETS

ACCOMPANYING CHAPTER 5

D4S REDESIGN

D4S REDESIGN WORKSHEETS

Step 1: Creating the team and planning the project

WORKSHEET
R1

Step 2: SWOT drivers and goals for the company

WORKSHEET
R2

Step 3: Product selection

WORKSHEET
R3

Step 4: D4S drivers for the selected product

WORKSHEET
R4

Step 5: D4S Impact Assessment

WORKSHEET
R5

Step 6: Developing a D4S strategy and a D4S design brief

WORKSHEET
R6

Step 7: Idea generation and selection

WORKSHEET
R7

Step 8: Concepts development

WORKSHEET
R8

Step 9: D4S Evaluation

WORKSHEET
R9

Step 10: Implementation and follow up



WORKSHEET

CREATING THE D4S TEAM AND PLANNING THE PROJECT

› Which departments and staff members will be involved in the D4S Redesign team? What will be his or her specific role in the team?

DEPARTMENT

PERSON

SPECIFIC ROLE WITHIN THE TEAM

1_

2_

3_

4_

5_

6_

> Will it be useful to involve or contract external experts or stakeholders within the project or team? If yes what kind of experts or stakeholders, and what will be there role?

EXPERTISE	PERSON	SPECIFIC ROLE WITHIN THE TEAM OR PROJECT
1_		
2_		
3_		

> Will it be useful to involve students from (local) universities within the project?

UNIVERSITY/SCHOOL	DEPARTMENT	SPECIFIC ROLE WITHIN THE TEAM OR PROJECT
1_		
2_		

> *Discuss the proposed timeframe of the project and how often the D4S team will meet*

> *How will the D4S team communicate?*

> *How will the team communicate with the rest of the organization?*



WORKSHEET

SWOT MATRIX, DRIVERS AND GOALS FOR THE COMPANY

COMPANY SWOT MATRIX

› Identify the internal and external conditions of the company and fill in the SWOT Matrix.

Use each of the four quadrants of the SWOT Matrix in turn to analyze the current position of the company. List all the strengths that exist now. Then, list all weaknesses that exist now. Next, list all the opportunities that exist in the future. Opportunities are potential future strengths. Finally list all threats.

STRENGTHS

- ▶
- ▶
- ▶
- ▶
- ▶

WEAKNESSES

- ▶
- ▶
- ▶
- ▶
- ▶

OPPORTUNITIES

- ▶
- ▶
- ▶
- ▶
- ▶

THREATS

- ▶
- ▶
- ▶
- ▶
- ▶

- > Strengths need to be maintained, built upon, or leveraged;
- > Weaknesses need to be remedied or stopped;
- > Opportunities need to be prioritized and optimized;
- > Threats need to be countered or minimized.

PRODUCT DEVELOPMENT CAPACITY

> *What is the main activity of the companies? Developing and producing its own products (product-company), or does it use its production capacity for producing products for other companies (capacity-company)?*

> *On the average, how many redesigned products and how many totally new products are launched into the market annually?*

> *Does the company have a product development department or do they normally contract out designer services for product development?*

> *What is the general conclusion on the 'product development capacity' of the company?*

INTERNAL AND EXTERNAL D4S DRIVERS FOR THE COMPANY

- > Identify which internal and external D4S drivers are relevant to the company.

INTERNAL DRIVERS FOR D4S

'PEOPLE' ASPECT

- Social equity** Can reduce risks on social and labour problems. As a result it can help avoid liability and reputation problems.
- Strong social policy** Can increase employee motivation. Employees can gain energy and experience from social projects and programmes launched by a company.
- Governance and management systems on social aspects** Can make company achievements more visible to shareholders and stakeholders.

'PLANET' ASPECT

- Green marketing** The design and production of products with environmental value-added elements can boost brand value and reputation.
- Environmental awareness** Managers often are aware of the importance of environmental issues and want to act accordingly.

'PROFIT' ASPECT

- Reach new consumers** Surveys demonstrate that consumers are increasingly ready to purchase on ethical grounds.
- Product quality improvement** Reliability and functionality often go together with a more sustainable product.
- Saving costs** Cost reductions can be made on material use, energy, waste treatment charges, transport and the distribution system.
- Boost brand value and reputation**
- Product innovation** New possibilities from product innovation can find solutions to meet customer needs and wants.
- Brand differentiation**
- New opportunities for value creation**

EXTERNAL DRIVERS FOR D4S

'PEOPLE' ASPECT

- Public opinion** Consumers are increasingly interested in the world that lies behind the product they buy, which is leading companies to take environmental and social issues into account.

- NGO pressure** For years industries have been under fire from NGOs for controversial practices and the related impacts on the environment. For example: Irresponsible company practices may lead to boycott campaigns which can cause significant damage to a company reputation.

'PLANET' ASPECT

- Legislative requirements** on environment will increase in many developing economies and can force a company into a more proactive stance.

- Disclosure requirements** of environmental information towards suppliers and customers can start an improvement process in the company.

- Ecolabelling schemes** can be an additional element for a companies' marketing strategy.

- Consumer organisation requirements** such as safety, low toxicity and recyclability of products can be an incentive for D4S. Products failing to get 'a good score' on these aspects may no longer qualify as a 'good choice' in consumer tests.

- Pressure from dedicated environmental groups** have forced industry to eliminate substances like CFCs from their products. These often highly professional organisations will continue to expose environmental harmful products.

- Direct community 'neighbour' pressure** is often directed towards environmental and safety risks of the company and can have a large impact on production and products.

'PROFIT' ASPECT

- Norms and standards** on sustainability aspects of products will continue to become stricter and may force companies to improve products.

- Subsidy schemes** are available in some countries to improve sustainability aspects of products and production. At the same time, subsidies on energy and raw materials are ending, forcing companies to improve materials and energy efficiency.

- Suppliers competition** is evolving to enter or remain in the supply chain, pushing companies to become more sustainable.

- Customer demand** for healthier, safer and more environmental and socially responsible products is increasing in specific product categories.

- Market competition** is growing as competition increases at local and global levels. Industry may look to improve innovative performance, which might include reviewing the sustainability aspects of their products.

> Prioritize the internal and external drivres. Indicate by  if the drives are related to People , Profit , or Planet  or a combination.

PRIORITY INTERNAL DRIVERS



PRIORITY EXTERNAL DRIVERS



1_

2_

3_

4_

5_

> Discuss if people, planet or profit should be balanced for the project or if one or two should be prioritized. 

> What is the goal of the D4S demonstration project?

1.

2.

3.



WORKSHEET

PRODUCT SELECTION

> Based on Step 2, what are the product selection criteria?

1_

2_

3_

4_

5_

6_

> Select a product out of the company portfolio that fits defined D4S product selection criteria.

Selected Product_

Second Best Product_

R4

WORKSHEET

D4S DRIVERS FOR THE SELECTED PRODUCT

> Determine which internal and external drivers are relevant for the selected product and prioritize them.

Indicate by    if the drivers are related to People , Profit  or Planet  or a combination.

PRIORITY INTERNAL DRIVERS



PRIORITY EXTERNAL DRIVERS



1_

2_

3_

4_

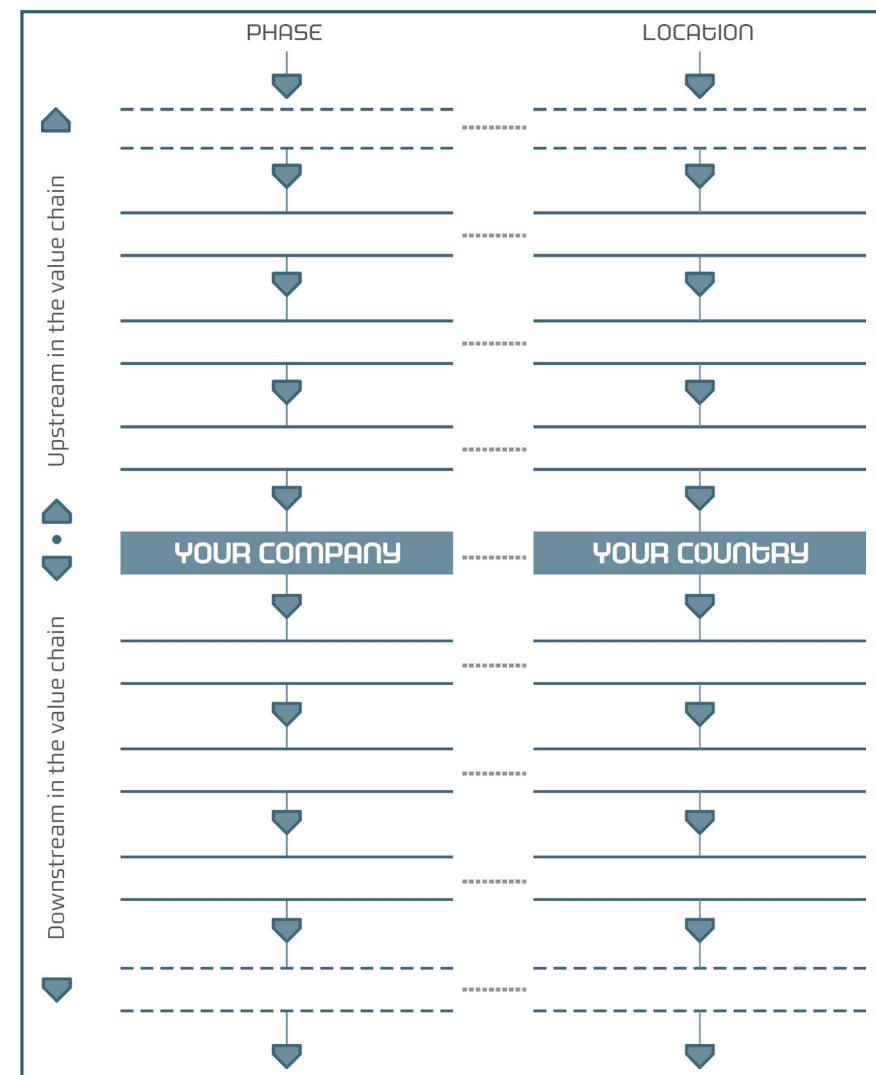
5_

R5

WORKSHEET

D4S ASSESSMENT

1> Outline the phases of the product process tree and write them down (left column). Indicate for these phases their physical location (right column).



2> Define the user scenario and functional unit of the product.

The functional unit is the combination of the function of the product and the user scenario of the product.

FUNCTION

What is the main function of the product as perceived by the user?

Describe in a qualitative and quantitative way

USER SCENARIO

On average the product will be used in:

Mode_during

Hours a day

Days a week

Weeks a year

Location of Use:

Make sure that the functional unit is taken into account when filling in the following worksheets.

3> Identify the D4S criteria that should be included in the D4S Impact Matrix:

- 1_ Materials use
- 2_ Energy use
- 3_ Solid waste
- 4_ Toxic emissions
- 5_ Social responsibility
- 6_
- 7_
- 8_

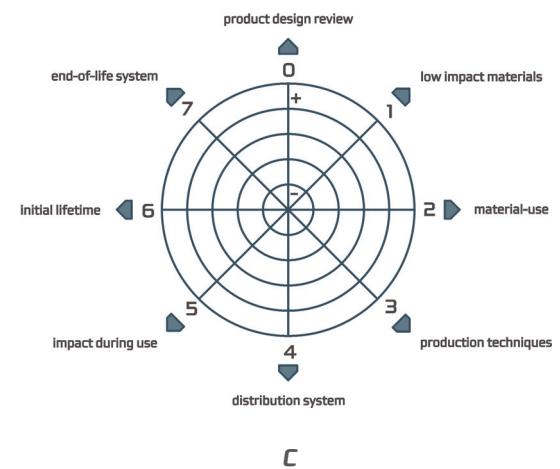
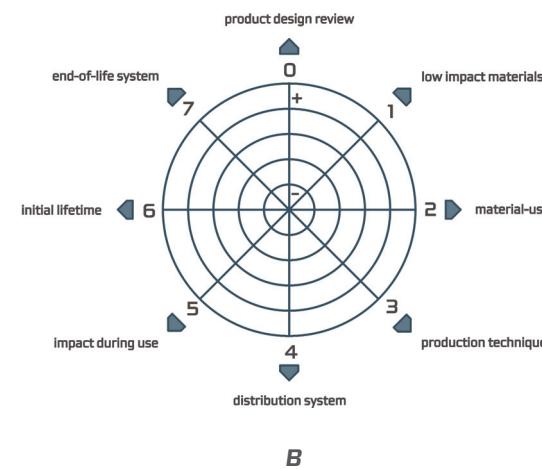
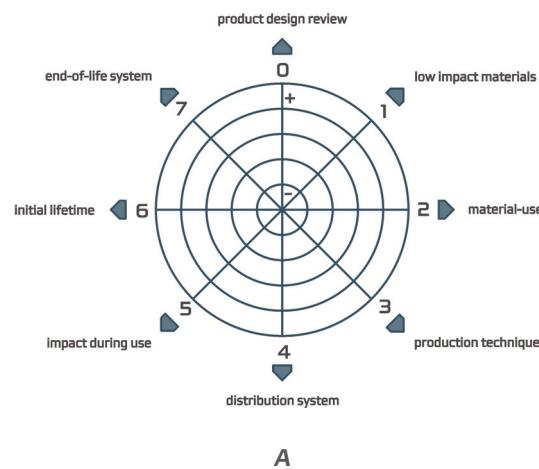
> Write the above D4S criteria into the first column in the D4S Impact Matrix on the right.

> Write the earlier identified life cycle process tree stages into the first row.

> Fill in the D4S Impact Matrix and highlight the cells or activities with relatively high impact(s).

	MATERIAL EXTRACTION					
Material use						
Energy use						
Solid waste						
Solid emissions						
Social impacts						
....						
....						
....						

- Based upon the results of the D4S Impact Matrix, what are the 'top two' D4S strategies for improvement options? Indicate them in D4S wheel A.
- Based upon the results of the D4S drivers selection, what are the 'top two' D4S strategies for improvement options? Indicate them in D4S wheel B.
- What D4S strategies will the company and project team focus on in the idea generation and concept development stages? Indicate them in D4S wheel C.



> Work out the D4S Design Brief.



WORKSHEET

IDEA GENERATION AND SELECTION

> Collect the obvious improvement options during analysis of the D4S Impact Matrix and D4S drivers.

	IMPROVEMENT OPTION
1_	
2_	
3_	
4_	
5_	
6_	
7_	
8_	
9_	
10_	
11_	
12_	
13_	
14_	

> Organize a creativity session (see Chapter 9) and come up with D4S improvement options using selected D4S strategies.

> Check the D4S rules of thumb (see Chapter 8) to see if they stimulate other improvement options

1_Select low impact materials

2_Reduce the use of materials

3_Optimization of production techniques

4_Optimization of distribution system

5_Reduction of impact during use

6_Optimization of initial lifetime

7_Optimization of the end of life system

> Cluster all the generated improvement options according to the D4S strategies

1_Select low impact materials

2_Reduce the use of materials

3_Optimization of production techniques

4_Optimization of distribution system

5_Reduction of impact during use

6_Optimization of initial lifetime

7_Optimization of the end of life system

> Which criteria should be included to prioritize improvement options?

IDEA	D4S CRITERIA 1	D4S CRITERIA 2	D4S CRITERIA 3	D4S CRITERIA 4	D4S CRITERIA 5	D4S CRITERIA 6	ACTION PLAN ST OR LT	NOTES
	Environmental benefit	Social benefit	Economic benefit	Technical feasibility	Market opportunities		
1_								
2_								
3_								
4_								
5_								
6_								
7_								
8_								
9_								

> List the options and rate each one based on the time implications – short (ST) or long-term (LT)

R8

WORKSHEET

CONCEPT DEVELOPMENT AND SELECTION

› Determine which criteria should be included to select the best concept

› List the concepts and rate them according to the criteria

R9

WORKSHEET

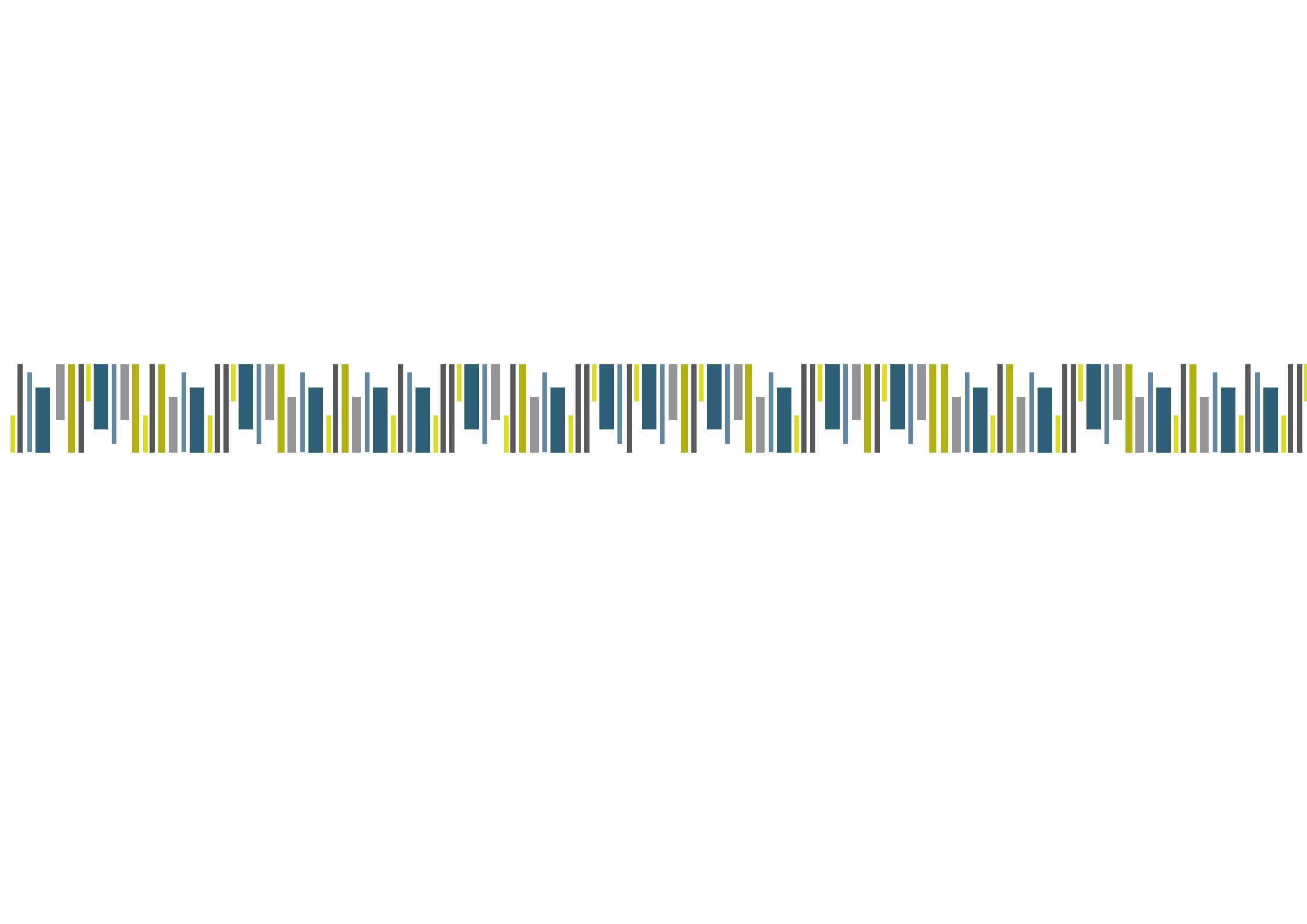
D4S EVALUATION

> Compare the profile of the new design with that of the old product, using the criteria from worksheet R7 and R8.

> Evaluate the benefits of the new design in relation to the drivers and goals identified in worksheet R2.

PRIORITY INTERNAL AND EXTERNAL DRIVERS SELECTED IN R2			BENEFITS OF NEW DESIGN ON THIS ASPECT
1_			
2_			
3_			
4_			
5_			

PROJECT GOALS AS FORMULATED IN R2		RESULTS OF THE PROJECT IN RELATION TO THE GOAL
1_		
2_		
3_		



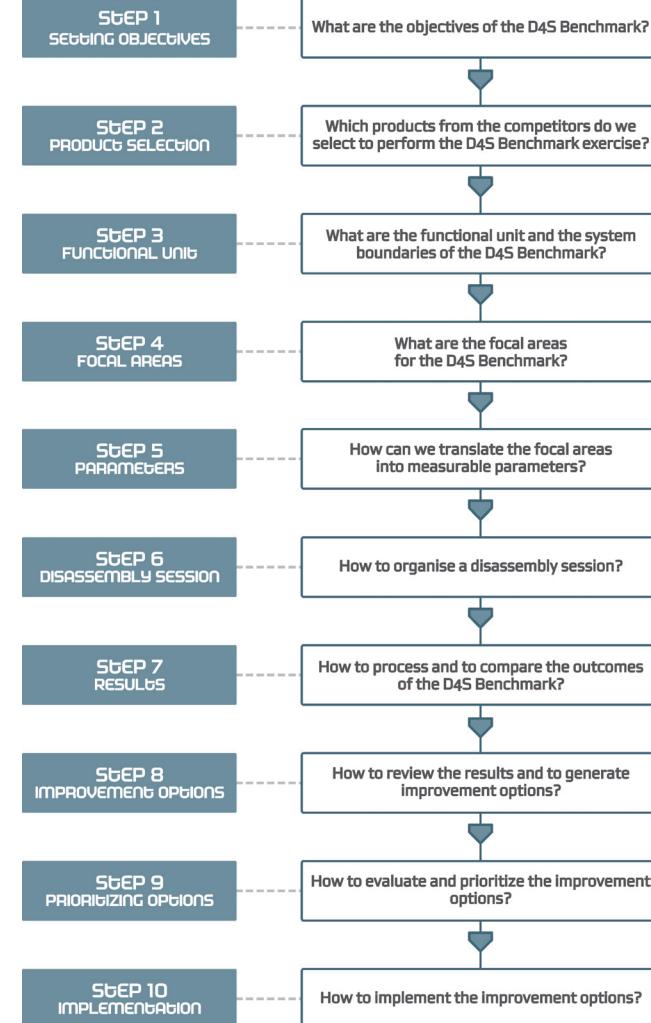


WORKSHEETS

ACCOMPANYING CHAPTER 6

D4S BENCHMARKING

D4S BENCHMARKING WORKSHEETS



LIGHT VERSION

ALL-IN-ONE WORKSHEET

EXTENDED VERSION

WORKSHEET 1

WORKSHEET 2

WORKSHEET 3

WORKSHEET 4

WORKSHEET 5

WORKSHEET 6A+6B

WORKSHEET 7

WORKSHEET 8+8B

WORKSHEET 9

"ALL-IN-ONE" WORKSHEET

LIGHT VERSION D4S BENCHMARKING

> Use this worksheet if benchmark version A or B (see Chapter 6.4 and Worksheet B1) is chosen or once it is understood how a D4S Benchmarking exercise is done. It contains the most relevant information from the separate worksheets combined into one.

PRODUCTS IN THE BENCHMARK (FILL IN: BRANDS AND TYPE)	FOCAL AREA 1	FOCAL AREA 2	FOCAL AREA 3	FOCAL AREA 4	SMART SOLUTIONS	SILLY SOLUTIONS
1_						
2_						
3_						
4_						
.....						

IMPROVEMENT OPTION	ENVIRONMENTAL BENEFITS	COSTUMER BENEFITS	COMPANY BENEFITS	TECHNICAL FEASIBILITY	FINANCIAL FEASIBILITY	MANAGERIAL FEASIBILITY
1_						
2_						
3_						
4_						
5_						
.....						

SHORT TERM OPTIONS WITH HIGHEST PRIORITY	LONG TERM OPTIONS WITH HIGHEST PRIORITY

B1**WORKSHEET****BENCHMARKING OBJECTIVES**

**Specify
the company's product
to be benchmarked:**

Brand and type
Functionality description
Main market description (Market share/market segment)
Description of competition

**What are the main objective(s) for executing
this benchmarking exercise:**

A_ To learn from competition in general (worldwide)
B_ To know how the product scores in comparison to local competition
C_ To get inspiration for environmental improvements
D_ To know where it stands in relation to (specific) upcoming legislation
E_ To see if performance is improving over time
F_ Any other reason that may be important (specify):

If A_ In the next worksheet, make sure to include 2-3 products from global competitors, preferably from 'A-brand' multinationals.

If B_ In the next worksheet, make sure to include 2-3 products from local competitors, preferably those that have the largest market share in the market segments that are most important to the company.

If C_ In the next worksheet, make sure to include 2-3 products from competitors that are known to produce products with good environmental performance, that have a good environmental image, and/or that operate in an environmental niche market.

If D_ In the next worksheet, make sure to choose products from brands that will be affected by the same legislation.

If E_ In the next worksheet, make sure to choose products from the company's own brand's previous generations. Also, several products of the main competitor can be included in order to benchmark the rate of improvement .

> Determine the appropriate type of D4S Benchmark for the company - light version versus extended version and information versus physical version. Indicate the selected type in the table below.

	BASED UPON INFORMATION OF PRODUCTS OF COMPETITORS	BASED UPON PHYSICAL PRODUCTS OF COMPETITORS
Light version (All-in-one worksheet)	A	B
Extended version (10 worksheets)	C	D

Arguments for this selection_

1_

2_

3_

4_

B2

WORKSHEET

SELECTION OF PRODUCTS

> Choose the products for the benchmark and describe their features following the selection criteria_

	OPTION: BRAND AND TYPE	FUNCTIONALITY	YEAR OF MARKET INTRODUCTION	PRICE	AVAILABILITY	MOTIVATION	OTHER COMMENTS
	Write in this column (options for) the products that will be compared with the environmental benchmark exercise	Describe briefly the main and specific features of the product, and make sure that products do not differ too much	Check if the products are more or less from the same product generation	Check if the products have (a more or less) similar retail prices	Commercial availability in terms of good, average or poor and make sure there is not too much difference	Describe motivation include product like i.e. local or international competitor, best practice, etc.	
1_	(Company's Product)						
2_							
3_							
4_							
5_							
6_							
7_							
.....							

Result of this worksheet a set of products upon which the D4S benchmarking exercise will be performed.

B3

WORKSHEET

DEFINITION OF A FUNCTIONAL UNIT

> Determine the functional unit (this is a combination of the function of the product in combination with the use scenario of the product)...

FUNCTION

What is the main function of the product as perceived by the user?

Describe in a qualitative and quantitative way

USER SCENARIO

On average the product will be used in:

Mode_during

Hours a day

Days a week

Weeks a year

Location of Use:

Make sure that this functional unit is taken into account when filling in the following worksheets.

B4

WORKSHEET

IDENTIFICATION OF FOCAL AREAS FOR A BENCHMARK

> Determine the focal areas for the benchmark process.

Relevant focal areas will depend on the product to be benchmarked and the objectives of the benchmark. Relevance is reflected by product characteristics that are important

- 1> from an objective, **scientific perspective**, e.g. causing a relatively large environmental impact;
- 2> from a **government perspective**; e.g. (upcoming) legislation;
- 3> from a **customer perspective**;
- 4> **other** reasons (which can include aspects other than sustainability).

Use this worksheet to determine the benchmark variables that are most applicable for this exercise.

FOCAL AREA	PERSPECTIVES				MOTIVATION
	Scientific	Government	Customer	Other	
1_					
2_					
3_					
4_					
5_					
.....					

B5

WORKSHEET

DEFINITION OF BENCHMARK PARAMETERS

> Describe measurable parameters for the focal areas.

In many cases it will be necessary to use more than one parameter to express a single focal area.



WORKSHEET

DISASSEMBLY SESSION

- > Organize a disassembly session.

A disassembly session is often a good idea to learn more about the target product and competitors' products and to get ideas for environmental improvement. Use this worksheet to structure the disassembly session.

BASIC REQUIREMENTS

A product(s) to be disassembled (preferably the company's products and some of the competitors' products)

- > A balance (0.1 g precise),
- > A stopwatch,
- > Simple tools (to pry, cut, screw),
- > A magnet,
- > Pen and paper,
- > (Digital) camera (to make pictures).

OTHER USEFUL TOOLS

Multimeter (to measure energy consumption).

STEPS BEFORE THE START

- > Make a work plan,
- > Make a list of evaluation criteria for the disassembly session,
- > Weigh the complete product before dismantling it,
- > Measure energy consumption before dismantling it, and
- > Do not forget to analyze packaging.

Product to be disassembled	Weight of the packed products (product+packaging)	Volume of the packed products (product+packaging)						
Goals of the disassembly session								
Evaluation criteria for the disassembly session								
Total disassembly time								
Amount of general and specific tools needed to dismantle the product								
Composition and amount of different kind of materials								
Amount of (different kind of) connections								

PACKAGING

MAIN MATERIALS (PAPER, MOULDED PULP, EPS, ETC.)		WEIGHT
1_		Grams
2_		Grams
3_		Grams
4_		Grams
.....		Grams
Total Weight		Grams

**VOLUME RATIO
(VOLUME PACKAGING/ VOLUME PRODUCT)**

**WEIGHT RATIO
(WEIGHT PACKAGING/ WEIGHT PRODUCT)**

ENERGY

Take in mind the Functional Unit / User Scenario as determined in worksheet B3

MODE I.E. STAND-BY, FULL POWER	ENERGY CONSUMPTION	HOURS/DAY ACCORDING TO FUNCTIONAL UNIT/USER SCENARIO:	COSTS OF 1 kWh=
Mode 1_	W	X	Wh
Mode 2_	W	X	Wh
Mode 3_	W	X	Wh
Mode 4_	W	X	Wh
		Total energy consumption per day	kWh/day
		Total energy consumption per year	kWh/year
		Total energy cost per day	Cost/day
		Total energy cost per year	Cost/year

PRODUCT

MAIN PARTS (IN ORDER OF DISASSEMBLY)	PARTS THAT NEED TO BE REMOVED FIRST	MAIN MATERIAL	TYPE OF CONNECTIONS TO BE BROKEN	AMOUNT	SECONDS
1_					
2_					
3_					
4_					
5_					
.....				Total Seconds	

B6B

WORKSHEET

PRELIMINARY LIST OF IMPROVEMENT OPTIONS

During the disassembly session and the other steps of the benchmark “smart solutions” of competitors and “silly solutions” in the company’s own product will be encountered. It is very useful to write these observations directly down!

ISSUES THAT ARE OBVIOUS

Smart solutions (for example smart fastening, integration of functions, smart architecture, good material choice)

Silly solutions (incompatible materials joined, superfluous parts, glues, messy architecture, coatings, no marking of plastics)

B7**WORKSHEET****REPORT OF BENCHMARK EXERCISE DATA**

> Summarize all benchmark findings with the help of the following table:

FOCAL AREA	BENCHMARK VARIABLE	DIMENSION	PRODUCT A	PRODUCT B	PRODUCT C	PRODUCT D	PRODUCT E
Focal Area 1 Topic_____							
Focal Area 2 Topic_____							
Focal Area 3 Topic_____							
Focal Area 4 Topic_____							
Focal Area..... Topic_____							

Using a marking or a color code can help identify which product scores best for a particular focal area or from an overall perspective. For example the best scores green and the bad ones red.

B8

WORKSHEET

IDENTIFICATION OF IMPROVEMENT OPTIONS

> Review all benchmark results and identify improvement options

One of the aims of performing a D4S benchmark exercise is to identify green improvement options. There are several ways to get triggered when identifying green improvement options. In addition to solutions that the redesign module of this manual may yield, one can think about.

- 1>** Using worksheet B6 (Issues that are obvious) to identify smart solutions from competitor's products that may be improvements for the company's products.
- 2>** Using the same worksheet to identify silly solutions that need improvement in comparison to a competitor's products. The competitor shows that these solutions are feasible in his case, so they are likely to be feasible in the company's product as well.
- 3>** Trying to obtain a perspective on technological advancements; these could yield improvements as well. One can think about:
 - a>** alternative energy sources
 - b>** use of materials, such as plastics, with less environmental impact
- 4>** Trying to look for alternatives that have not been considered before, such as:
 - a>** components and subassemblies from other suppliers
 - b>** changes in product architecture that result in less material use (wiring, integration of functions, sharing of connections)

IMPROVEMENT OPTIONS

B9

WORKSHEET

EVALUATION AND RANKING OF IMPROVEMENT OPTIONS

> Select the best improvement options by evaluating them against the potential benefits and feasibility.

Each option is evaluated based on a number of criteria listed below. Criteria can be split in:

- (i) Benefits
- (ii) Feasibility

BENEFITS

Let it be noted that:

- (i) Most benefits can in principle be quantitatively assessed, but in general, various aspects will play a role in the evaluation of a single criterion, including issues that can not be enumerated using a single dimension.
- (ii) Benefits can be of a tangible as well as of an intangible nature.

> General environmental benefits (from a societal perspective). If applicable, for this environmental perspective it may be useful to discriminate between different environmental impact categories (for example, resource perspective, emissions perspective, toxicity perspective, or for example CO₂ generation, (cost for cleaning up) waste generation) when improvement options affect more than one stage of the product's life cycle.

> Benefits from the customer perspective can include_

- _ Money saved because of lower power consumption,
- _ Less hassle,
- _ More comfort,
- _ Lower purchase price, or
- _ More fun.

> Benefits from the company perspective can include_

- _ Reduction in assembly costs,
- _ Reduction in material use/costs,
- _ Reduction in transportation costs,
- _ Image improvement,
- _ Beneficial in terms of (future) legal compliance,
- _ New market potential, or
- _ Higher profit margins for the product,

FEASIBILITY

Apart from benefits, the feasibility of implementing improvement options is also important when choosing which options to implement. Improvement options may show great environmental benefits, but many practical reasons may exist why feasibility could be a problem. In general these can be divided as:

(i) Technical feasibility

- a**_ Technology might not be present,
- b**_ Knowledge might not be present in the company,
- c**_ Reliability may be a problem,
- d**_ Testing procedures might take too long, or
- e**_ Existing company standards might be out-of-date but unlikely to change.

(ii) Financial feasibility;

- a**_ Too big an investment is needed (changes to a production line, new facilities, new moulds too expensive, general budget limitations),
- b**_ Existing contracts may prevent use of new materials/components, or
- c**_ Transportation/distribution might yield problems.

(iii) Managerial feasibility:

- a**_ Solutions might not fit in company's product development process,
- b**_ Sales and Marketing departments might not want to cooperate,
- c**_ Company culture might be too big an obstacle, or
- d**_ Solutions can be generally perceived as too risky.

EVALUATION MATRIX

The next worksheet can be used to get an overview of both benefits and feasibility. There are a few issues to take into account:

- > Remember that filling in the worksheet is not a matter of absolute truth, but rather of relative scores.
- > Remember that the main objective is to select improvement options that have the best chances to be implemented and yield benefits. This can be accomplished without exact scores.
- > Remember to evaluate each improvement option against each criterion separately. For example, do not let the evaluation of company benefits be clouded by the financial feasibility of that particular solution.

IMPROVEMENT OPTION	ENVIRONMENTAL BENEFITS	CUSTOMER BENEFITS	COMPANY BENEFITS	TECHNICAL FEASIBILITY	FINANCIAL FEASIBILITY	MANAGERIAL FEASIBILITY
1_						
2_						
3_						
4_						
5_						
.....						

RANKING IMPROVEMENT OPTIONS

The next issue is to select improvement options that have the best chance to be implemented and yield benefits. When this is accomplished, in principle the company can start working down the list as long as resources to do so remain available. For selection of the most promising improvement options it may be relevant to differentiate between short- and long- term options.

> Short-term options are only likely to be successfully implemented when practical considerations are sufficiently addressed. Therefore, in order for improvement options to be feasible in the short-term, the criteria 'company benefits' as well as all three feasibility criteria should be given sufficient weight. In this case, consideration of customer and environmental benefits is relevant.

> Long-term options: For selection of feasible long-term options, the environmental and customer benefits can be given more weight.