

GUIDELINE AND CHECK LIST MANUAL FOR THE DESIGN OF LOW IMPACT PRODUCTS FOR THE ENVIRONMENT

edited by
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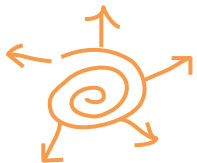
realization
FABRIZIO CESCHIN
CHIARA DEL GAUDIO



PROJECT:

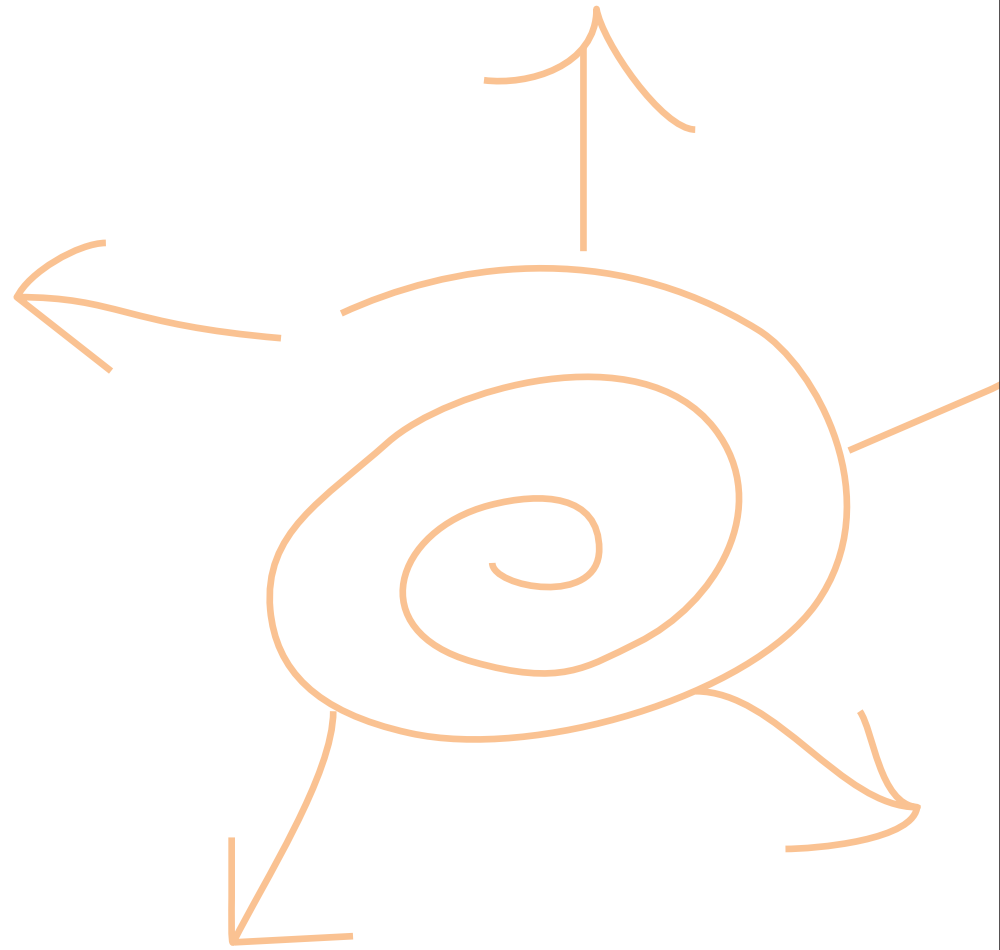
DESIGNER/S:

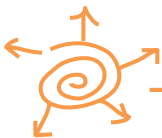
DATE:



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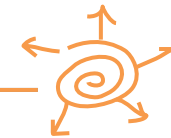


INTRODUCTION

This manual is a practical and simple instrument complied to cooperate with the designer in the design of low impact ecological products. The manual is structured with checklists, control questions that verify if the design has been done properly as stated in the sustainability criteria.

The checklists have been elaborated from Life Cycle Design (LCD) guidelines and criteria developed by the RAPIlabo Laboratory of environmental requirements) of the Polytechnic of Milan (www.polimi.it/rapirete). The principle at the base of the Life Cycle Design approach is that the design process must adopt a systemic vision: the designer should consider the entire life cycle of a product (pre-production, production, distribution, use and disposal); the objective is to minimize the negative effects a product may have on the environment, during its entire life cycle (harmful emissions and consumption of resources). The Life Cycle Design criteria and the relative checklists refer to:

- ***minimizing resources;***
- ***choosing low impact resources and processes;***
- ***optimising the products life;***
- ***extending the life span of the materials;***
- ***facilitating disassembly.***



USE OF THE MANUAL

The manual is divided into five sections (corresponding with the five point criteria of LCD).

Each containing a series of checklists.

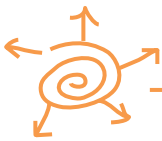
Each control query verifies if a particular strategy has been applied (totally, partially or not at all).

It should be emphasized that some of the guidelines/checklists in the manual are not applicable to all product types. In that case the corresponding query should be left blank.

In conclusion, once all the answers are inserted for each project criteria a total is calculated (expressed in percentages), which in turn gives an indication to the level of sustainability of the product and/or service.

The answers however may be modified in real time and the totals brought up to date instantaneously.

Moreover it's possible to store relative project data.



PROJECT PRIORITY PRINCIPLES

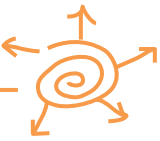
When developing products with a low ecological impact it is important to evaluate intervention priorities aimed at improvement of the project. Not all products necessarily have the same impact on nature nor are the reasons of any given impact the same. In other words every product has a different set of consequences on nature. This fact makes it important to define specific priorities for each project. For example let's consider a vehicle used for transportation and a piece of furniture.

In the first case the major ecologic threat is observed during the usage (consumption of resources/petrol and formation of emissions), so obviously the major intervention should be to "minimize the resources" and "choosing resources with a low ecological impact". However in the second case (in which there is no consumption of resources during the usage), the major intervention would be to "optimise the life of the product". Briefly, depending on the type of product being observed, some criteria are more important than others. These items should be observed more critically.

The process of defining priorities which usually require competitive LCD criteria knowledge is facilitated by Life Cycle Assessment instruments (LCA) (such as [eco.officina, www.polimi.it/rapirete](http://eco.officina.polimi.it/rapirete)). Alternatively they can be based on quantitative valuations (such as SDO-MEPSS, www.polimi.it/rapirete). Finally, even if these operations are recommended they are not compulsory.

Every single criteria may have a level of priority:

A=high;
M=medium;
B=low;
N=none.



PROJECT CRITERIA PRIORITIES

01 MINIMIZING RESOURCES

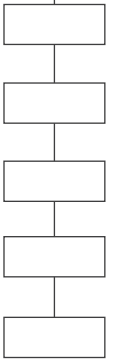
02 CHOOSING LOW IMPACT RESOURCES

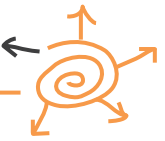
03 OPTIMIZING PRODUCT LIFE

04 EXTENDING MATERIAL LIFE

05 SIMPLIFYING DISASSEMBLY

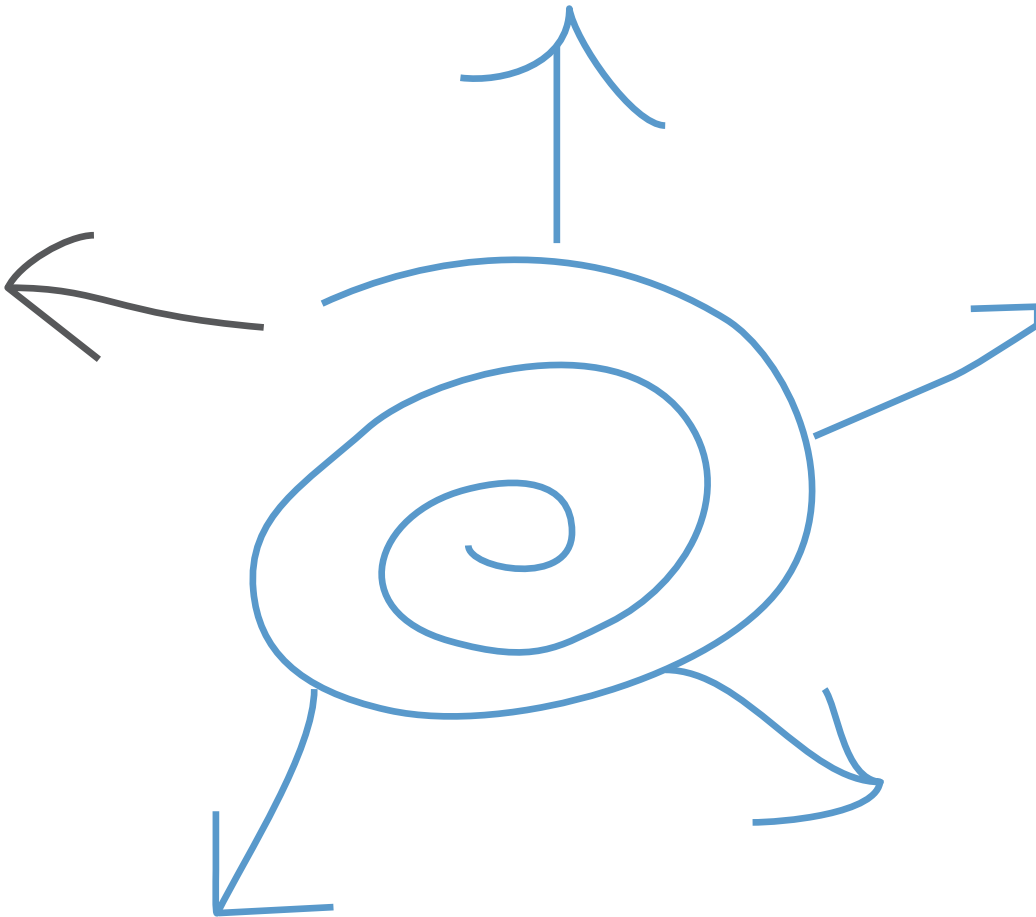
PRIORITY

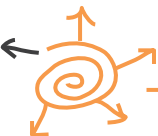




In minimizing or reducing the consumption of materials, the aim is to follow an approach to reduce the consumption of materials in each part of the products life cycle. Using less materials diminishes the ecological impact of a product due to minimising the resources being extracted, but also due to reduction/diminished fabrication processes and produced waist. Apart from their environmental costs products obviously also have economical costs. Less materials mean saving in both contexts. Design indications could be grouped as:

- **minimizing material consumption**
- **minimizing energy consumption**





01/01
MINIMIZING RESOURCES
**MINIMIZING PRE-PRODUCTION
AND PRODUCTION RESOURCES**

**MINIMIZING THE MATERIAL CONTENT
OF A PRODUCT**

Has the product of some of its parts
been dematerialised?

YES	PARTIALLY	NO
☐	☐	☐

Has the product of some of its parts
been digitalized?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Has the product been miniaturized?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Has over dimensioning been avoided?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Have the thicknesses of components
been minimized?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Have nerved structures been used
to rigidify structures?

☐	☐	☐
--------------------------	--------------------------	--------------------------

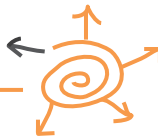
Have non functional parts or components
been avoided?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Given answers

Total answers
Percentage
(Total / Replies X 100) % % %

01/02
MINIMIZING RESOURCES
**MINIMIZING PRE-PRODUCTION
AND PRODUCTION RESOURCES**



MINIMIZING SCRAPS AND WASTE

Have production processes that minimize
scraps and waste been chosen?

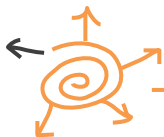
YES	PARTIALLY	NO
☐	☐	☐

Have been used simulation systems to
optimize transformation processes parameters?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Given answers

Total answers
Percentage
(Total / Replies X 100) % % %



01/03

MINIMIZING RESOURCES

MINIMIZING DISTRIBUTION RESOURCES

MINIMIZING THE PACKAGING

Has packaging been avoided?

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
0	0	0
0 %	0 %	0 %

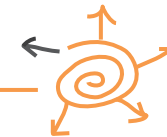
Given answers

Total answers
Percentage
(Total / Replies X 100)

01/04

MINIMIZING RESOURCES

MINIMIZING RESOURCES DURING USAGE



CHOOSING THE MOST EFFICIENT MATERIAL CONSUMPTION SYSTEM

Has the efficiency of consumption of materials been projected or considered?

Have high efficient material supply systems been used?

Has the efficiency of consumption of materials for maintenance been considered?

Have the systems been designed for a passive use of resources?

Have systems been devised that recuperate materials?

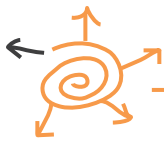
Has the user been facilitated in the saving of materials?

Has the default setting of the product been devised to be the less consuming?

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
0	0	0
0 %	0 %	0 %

Given answers

Total answers
Percentage
(Total / Replies X 100)



01/05

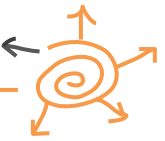
MINIMIZING RESOURCES

MINIMIZING RESOURCES DURING USAGE

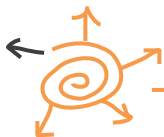
	YES	PARTIALLY	NO
ADOPTING FLEXIBLE MATERIAL CONSUMPTION SYSTEMS			
Has reconfigurable digital support been used?	☐	☐	☐
Have variable consumption systems been devised for different functioning necessities?	☐	☐	☐
Have sensors been employed to adjust the consumption to the needs of the operation?	☐	☐	☐
Has the default setting of the product been devised to be the less material consuming?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %

01/06

MINIMIZING RESOURCES

MINIMIZING PRE-PRODUCTION
AND PRODUCTION RESOURCES

	YES	PARTIALLY	NO
MINIMIZING MATERIAL CONSUMPTION IN PRODUCT DESIGN			
Has been reduced the consumption of stationery materials and packaging?	☐	☐	☐
Has information technology been used in the design, modelling and prototyping stages?	☐	☐	☐
Has information technology been used in the filing, written communication and presentation stages?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



01/07

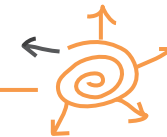
MINIMIZING RESOURCES

MINIMIZING PRE-PRODUCTION
AND PRODUCTION RESOURCESOPTIMISING ENERGY CONSUMPTION
FOR PRE-PRODUCTION AND PRODUCTION

	YES	PARTIALLY	NO
Have less energy content materials been used?	☐	☐	☐
Have less energy consuming production processes been selected?	☐	☐	☐
Have efficient production equipment and devices been used?	☐	☐	☐
Has the dispersed heat from some operations been used as a preheater for other flows of processes?	☐	☐	☐
Have flexible systems been used to regulate the speed of such elements as pumps and other engines?	☐	☐	☐
Have intelligent relays been used to turn off unnecessary equipment?	☐	☐	☐
Has the maintenance of the motors been simplified?	☐	☐	☐
Have tolerances been defined accurately?	☐	☐	☐
Has motor over dimensioning been avoided?	☐	☐	☐
Have the batch acquisitions been optimised?	☐	☐	☐

01/07

MINIMIZING RESOURCES

MINIMIZING PRE-PRODUCTION
AND PRODUCTION RESOURCES

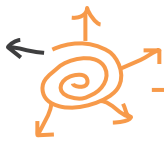
	YES	PARTIALLY	NO
Have stock list control systems been optimized?	☐	☐	☐
Have transfer systems of materials and semi finished products been optimized?	☐	☐	☐
Have efficient heating, air conditioned and light systems for buildings been adopted?	☐	☐	☐

Given answers

Total answers

Percentage
(Total / Replies X 100)

0	0	0
0	0	0
%	%	%



01/08

MINIMIZING RESOURCES

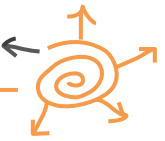
MINIMIZING DISTRIBUTION RESOURCES

	YES	PARTIALLY	NO
MINIMIZING TRANSPORTATION AND STORAGE CONSUMPTIONS			
Have the logistics been optimised?	☐	☐	☐
Has the product been designed to be compact within high density storage?	☐	☐	☐
Has a concentrated product been designed?	☐	☐	☐
Has the product been designed to be compact within high density storage?	☐	☐	☐
Has the product been lightened?	☐	☐	☐
Has the packaging been lightened?	☐	☐	☐
Has transfer activity been avoided managing it by remote control?	☐	☐	☐
Have been used local resources?	☐	☐	☐
Given answers	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %

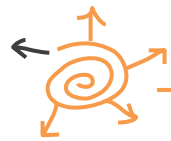
01/09

MINIMIZING RESOURCES

MINIMIZING RESOURCES DURING USAGE



	YES	PARTIALLY	NO
CHOOSING THE MOST EFFICIENT RESOURCES CONSUMPTION SYSTEMS			
Has the product been conceived for collective use?	☐	☐	☐
Has the efficiency of consumption of resources been projected or considered?	☐	☐	☐
Has the efficiency of consumption of materials for maintenance been considered?	☐	☐	☐
Have the systems been designed for a passive use of resources?	☐	☐	☐
Have systems been adopted that transform energy at high efficiency?	☐	☐	☐
Have more efficient motors been used?	☐	☐	☐
Have very efficient energy transmission systems been used?	☐	☐	☐
Have highly insulating technical materials or components been used?	☐	☐	☐
Have punctual insulating and supply systems of energy resources been used?	☐	☐	☐



01/09

MINIMIZING RESOURCES

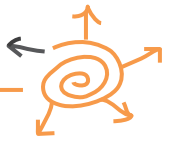
MINIMIZING RESOURCES DURING USAGE

	YES	PARTIALLY	NO
Has the weight of moved products or used to moved been reduced?	☐	☐	☐
Have recovery energy systems been used?	☐	☐	☐
Has the user been facilitated in the saving of energy?	☐	☐	☐
Given answers 0	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %

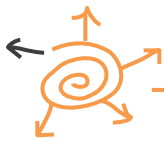
01/10

MINIMIZING RESOURCES

MINIMIZING RESOURCES DURING USAGE



	YES	PARTIALLY	NO
ADOPTING FLEXIBLE ENERGY CONSUMPTION SYSTEMS			
Has reconfigurable digital support been used?	☐	☐	☐
Have variable consumption systems been devised for different functioning necessities?	☐	☐	☐
Have sensors been employed to adjust the consumption to the needs of the operation?	☐	☐	☐
Have switches enabling auto switch off been incorporated into the products?	☐	☐	☐
Has the default setting of the product been devised to be the less energy consuming?	☐	☐	☐
Given answers 0	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



01/11

MINIMIZING RESOURCES

MINIMIZING DISTRIBUTION RESOURCES

MINIMIZING ENERGY CONSUMPTION
IN PRODUCT DESIGN

Have efficient heating, air conditioned and light systems been adopted in the work place?

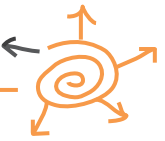
Have telecommunication devices been used for remote activities?

Given answers

Total answers

Percentage
(Total / Replies X 100)

	YES	PARTIALLY	NO
Have efficient heating, air conditioned and light systems been adopted in the work place?	0	0	0
Have telecommunication devices been used for remote activities?	0	0	0
	0 %	0 %	0 %



MINIMIZING RESOURCES

STRATEGIC PRIORITY

01/01 MINIMIZING THE MATERIAL CONTENT
OF A PRODUCT

YES	PARTIALLY	NO
0 %	0 %	0 %

01/02 MINIMIZING SCRAPS AND WASTE

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/03 MINIMIZING THE PACKAGING

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/04 CHOOSING THE MOST EFFICIENT MATERIAL
CONSUMPTION SYSTEM

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/05 ADOPTING FLEXIBLE MATERIAL
CONSUMPTION SYSTEMS

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/06 MINIMIZING MATERIAL CONSUMPTION
IN PRODUCT DESIGN

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/07 OPTIMISING ENERGY CONSUMPTION FOR
PRE-PRODUCTION AND PRODUCTION

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/08 MINIMIZING TRANSPORTATION AND
STORAGE CONSUMPTIONS

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------

01/09 CHOOSING THE MOST EFFICIENT ENERGY
RESOURCES CONSUMPTION SYSTEMS

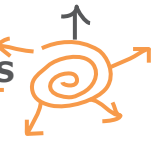
0 %	0 %	0 %
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01/10 ADOPTING FLEXIBLE ENERGY CONSUMPTION
SYSTEMS

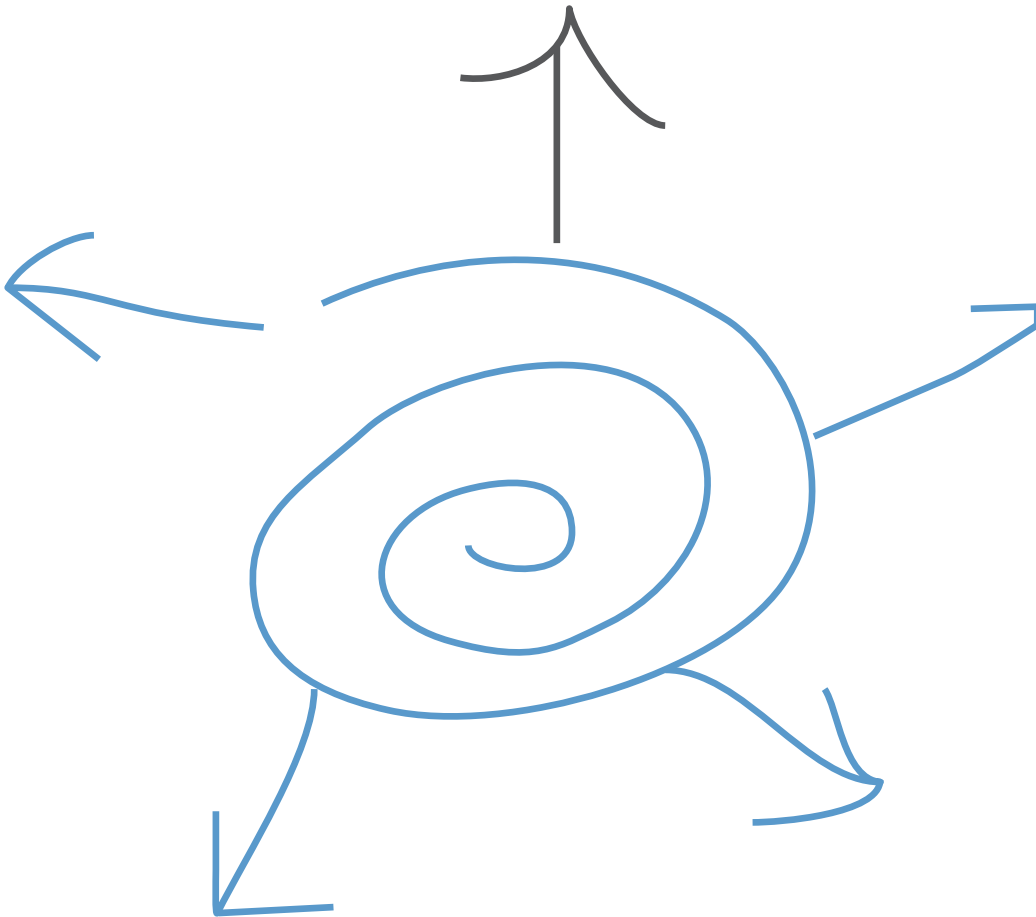
0 %	0 %	0 %
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01/11 MINIMIZING ENERGY CONSUMPTION
IN PRODUCT DESIGN

0 %	0 %	0 %
----------------------------------	----------------------------------	----------------------------------



Design choices tend to favour the resources (materials, energy sources) that relative to the entire life cycle minimise dangerous emissions and all the processes that characterize it. It is required therefore to consider the processing, transporting and emissions of a material during and after its use. However it must be remembered that the cause of toxic or harmful emissions during any stage of the products life cycle might be caused by certain additives to the material rather than the material itself (therefore they are substituted or avoided).





02/01

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

CHOOSING LOW IMPACT MATERIALS AND RESOURCES

	YES	PARTIALLY	NO
REDUCING TOXICITY AND HARMFULNESS OF MATERIALS			
Have toxic and harmful materials been avoided?	☐	☐	☐
Has the risk of toxic and harmful materials been minimized for the product's entire life cycle?	☐	☐	☐
Have materials causing toxic and harmful emissions in pre-production been avoided?	☐	☐	☐
Have additives causing toxic and harmful emissions been avoided?	☐	☐	☐
Have toxic and harmful materials transformation technologies been avoided?	☐	☐	☐
Have toxic or harmful finishing been avoided?	☐	☐	☐
Does the product use toxic and harmful resources?	☐	☐	☐
Have materials causing toxic and harmful emissions during usage been avoided?	☐	☐	☐

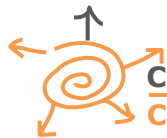
02/01

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

CHOOSING LOW IMPACT MATERIALS AND RESOURCES



	YES	PARTIALLY	NO
Have materials causing toxic and harmful emissions during disposal been avoided?			
Given answers	☐	☐	☐
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



02/02

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

CHOOSING LOW IMPACT MATERIALS AND RESOURCES

REDUCING ENERGY RESOURCES TOXICITY AND HARMFULNESS

Have sources of energy that minimise harmful emissions of pre-production and production been chosen?

Have sources of energy that minimise harmful emissions of distribution been chosen?

Have sources of energy that minimise harmful emissions during use been chosen?

Have sources of energy that minimize rubbish and debris been chosen?

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
0	0	0
0%	0%	0%

Given answers 0

Total answers
Percentage
(Total / Replies X 100)

02/03

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

RESOURCES RENEWABILITY AND BIO-COMPATIBILITY



OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF MATERIALS

Have renewable materials been used?

Has the usage of exhausting materials been avoided?

Have discarded materials originating from other production processes been used?

Have materials originating from dismissed products been used?

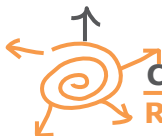
Have recycled materials been used (individually or combined with virgin materials)?

Have biodegradable materials been used?

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
0	0	0
0%	0%	0%

Given answers 0

Total answers
Percentage
(Total / Replies X 100)



02/04

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

RESOURCES RENEWABILITY AND BIO-COMPATIBILITY

OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF ENERGETIC RESOURCES

Has renewable energy been used?

Has a cascade approach been adopted?

Have high efficient second order energy fonts been chosen?

	YES	PARTIALLY	NO
Has renewable energy been used?	☐	☐	☐
Has a cascade approach been adopted?	☐	☐	☐
Have high efficient second order energy fonts been chosen?	☐	☐	☐
Given answers	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0%	0%	0%



CHOOSING LOW IMPACT RESOURCES AND PROCESSES

STRATEGIC PRIORITY

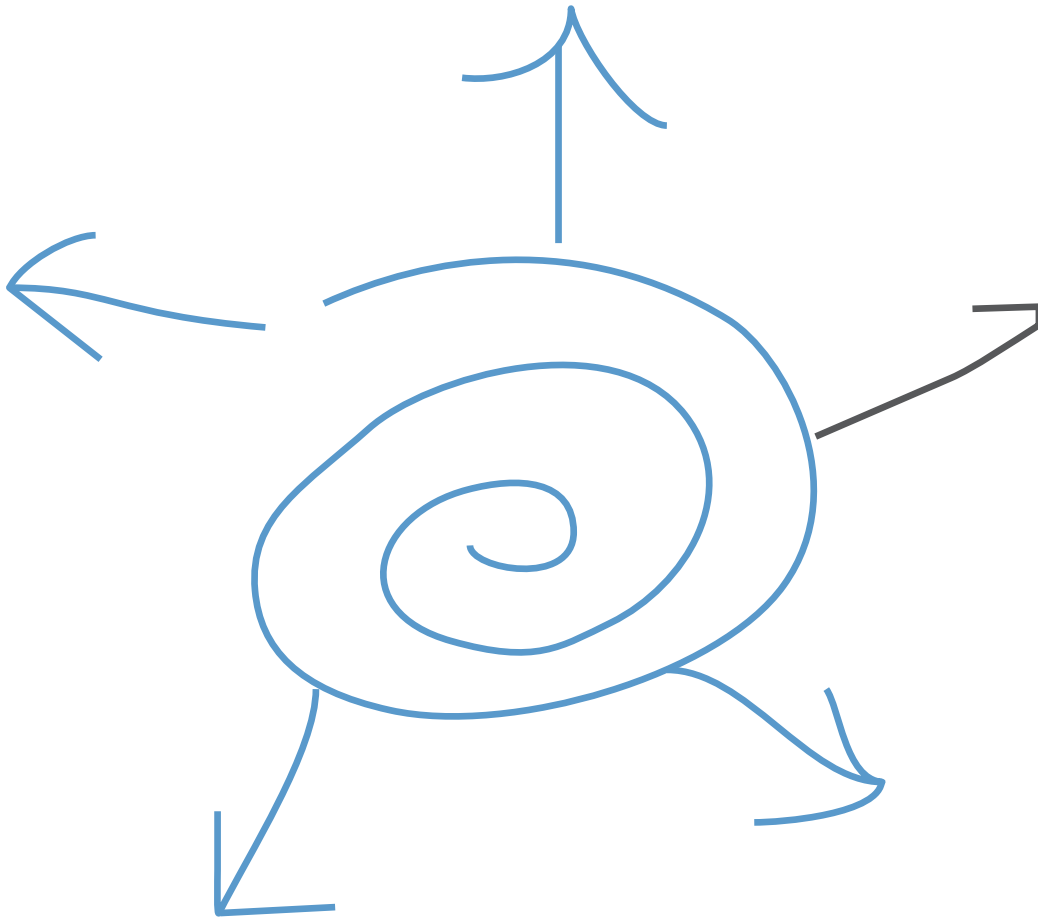
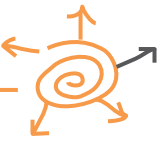
02/01 REDUCING TOXICITY AND HARMFULNESS OF MATERIALS

02/02 REDUCING ENERGY RESOURCES TOXICITY AND HARMFULNESS

02/03 OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF MATERIALS

02/04 OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF ENERGETIC RESOURCES

	YES	PARTIALLY	NO
02/01 REDUCING TOXICITY AND HARMFULNESS OF MATERIALS	0%	0%	0%
02/02 REDUCING ENERGY RESOURCES TOXICITY AND HARMFULNESS	0%	0%	0%
02/03 OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF MATERIALS	0%	0%	0%
02/04 OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF ENERGETIC RESOURCES	0%	0%	0%



There are two possible scenarios applicable to optimise the ecological life of products:

- **extending product life span**
- **intensifying product use**

Extending life span

A product that is more durable but has the same functions as others usually causes less ecological impact.

In fact if such a product possesses a shorter life span it not only ends up generating premature waste, it also creates a necessity to replace it.

In reality considering the duration of use, the extension of life span does not generally decrease the impact of such a product on nature; on the contrary, in such a case where new products are more eco-efficient it may even cause an increase in waste.

As pointed out, the goods that use less resources during usage are the prime candidates for a durable life.

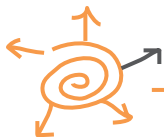
Adversely, products that during their use and maintenance consume a vaster amount of resources are deemed environmentally inefficient and thus are avoided when designing excessively durable products.

Intensifying use

A product that is used more intensely than others in at any given moment and place leads to a quantitative reduction in the presence of such a product; thus reducing the ecological impact.

Moreover if a product is used more intensely it becomes more efficient during it's life span without increasing the total amount of production or dismissal.

In other words a product that is designed for solitary use becomes more quickly obsolete while reducing the total production of items of products for identical purposes.



03/01 OPTIMIZING PRODUCT LIFE EXTENDING LIFE SPAN

DESIGNING AN APPROPRIATE LIFE SPAN

Are all life span identical for all product pieces?

YES
PARTIALLY
NO

☐☐☐

Has the life span of the parts been planned for replacement after a determined time of use?

☐☐☐

Has the division of different span life parts been designed and simplified?

☐☐☐

Do the materials used match the performance required by the life span of the product?

☐☐☐

Have permanent materials been avoided for temporary functions?

☐☐☐

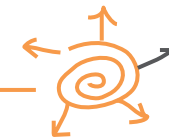
Given answers

Total answers

Percentage
(Total / Replies X 100)

%%%

03/02 OPTIMIZING PRODUCT LIFE EXTENDING LIFE SPAN



DESIGNING RELIABILITY

Have the number of parts been minimized?

YES
PARTIALLY
NO

☐☐☐

Has the product been simplified as much as possible?

☐☐☐

Have weak connections been avoided?

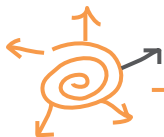
☐☐☐

Given answers

Total answers

Percentage
(Total / Replies X 100)

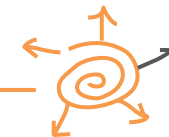
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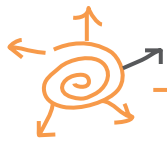
03/03 OPTIMIZING PRODUCT LIFE EXTENDING LIFE SPAN

	YES	PARTIALLY	NO
FACILITATING RENEWABILITY AND ADAPTABILITY			
Has on place replacing, updating software parts been simplified?	☐	☐	☐
Has on place replacing, updating hardware parts been simplified?	☐	☐	☐
Has the product been designed modularly and is it reconfigurable to suit different surroundings?	☐	☐	☐
Has the product been designed to be reconfigurable and/or multifunctional to suit the evolution of individual usage?	☐	☐	☐
Has on place product upgrading and adaptability been simplified?	☐	☐	☐
Are equipment and guide books issued with the product to facilitate upgrading and adaptability?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0%	0%	0%

03/04 OPTIMIZING PRODUCT LIFE EXTENDING LIFE SPAN



	YES	PARTIALLY	NO
SIMPLIFYING MAINTENANCE			
Has the replacement of the part necessary to change been facilitated by simplifying accessibility and removal activity?	☐	☐	☐
Has the accessibility to parts for cleaning been simplified by avoiding slots and narrow holes?	☐	☐	☐
Has the removal and reinsertion of the parts necessary to change been predicted?	☐	☐	☐
Is the product predisposed to use easily available equipment (or are these issued with it)?	☐	☐	☐
Have diagnostics/auto diagnostics systems been predisposed to maintain parts?	☐	☐	☐
Has maintenance been facilitated on the place of usage?	☐	☐	☐
Are equipment and guide books issued with the product to facilitate maintenance?	☐	☐	☐
Have systems been devised to reduce essential maintenance operations?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0%	0%	0%



03/05
OPTIMIZING PRODUCT LIFE
EXTENDING LIFE SPAN

SIMPLIFYING REPAIR

Has the substitution of more damaged parts been predicted?

YES
PARTIALLY
NO

☐☐☐

Have the components been designed to standards?

☐☐☐

Have automatic damage cause identification systems been predicted?

☐☐☐

Has on site product repair been simplified?

☐☐☐

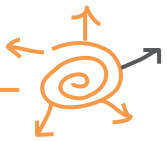
Have tools, materials, guide books been issued for eventual repairs?

☐☐☐

Given answers

Total answers
Percentage
(Total / Replies X 100)

03/06
OPTIMIZING PRODUCT LIFE
EXTENDING LIFE SPAN



SIMPLIFYING RE-USE

Has the resistance of parts subject to more wear and tear been improved?

YES
PARTIALLY
NO

☐☐☐

Has accessibility and the removal of reusable parts been predicted?

☐☐☐

Have interchangeable and modular parts been projected?

☐☐☐

Have standardized components and parts been designed?

☐☐☐

Have reusable auxiliary parts been projected?

☐☐☐

Is it possible to refill or re-use the packaging?

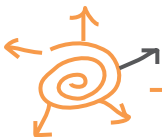
☐☐☐

Has the product been designed for any secondary usage?

☐☐☐

Given answers

Total answers
Percentage
(Total / Replies X 100)



03/07 OPTIMIZING PRODUCT LIFE EXTENDING LIFE SPAN

SIMPLIFYING REFABBRICATION

Has the removal and changing of parts more subject to wear and tear been improved and simplified?

YES
PARTIALLY
NO

☐☐☐

Have the structural parts been designed to be separable from visible parts?

☐☐☐

Has the accessibility to re-tooling parts been simplified?

☐☐☐

Has adequate dimensioning been foreseen for the points more subject to wear?

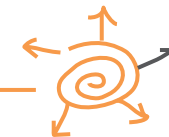
☐☐☐

Has appropriate coating/protection been foreseen in places subject to more deterioration?

☐☐☐

Given answers

Total answers
Percentage
(Total / Replies X 100)



03/08 OPTIMIZING PRODUCT LIFE INTENSIFYING USAGE

INTENSIFYING USAGE

Has the product/service been designed for a shared usage?

YES
PARTIALLY
NO

☐☐☐

Has the product been designed multifunctional with interchangeable shared components?

☐☐☐

Has the product been designed for integrated functions?

☐☐☐

Has the product been or its parts designed for on demand production?

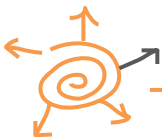
☐☐☐

Has the product been or its parts designed for on supply production?

☐☐☐

Given answers

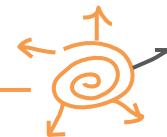
Total answers
Percentage
(Total / Replies X 100)



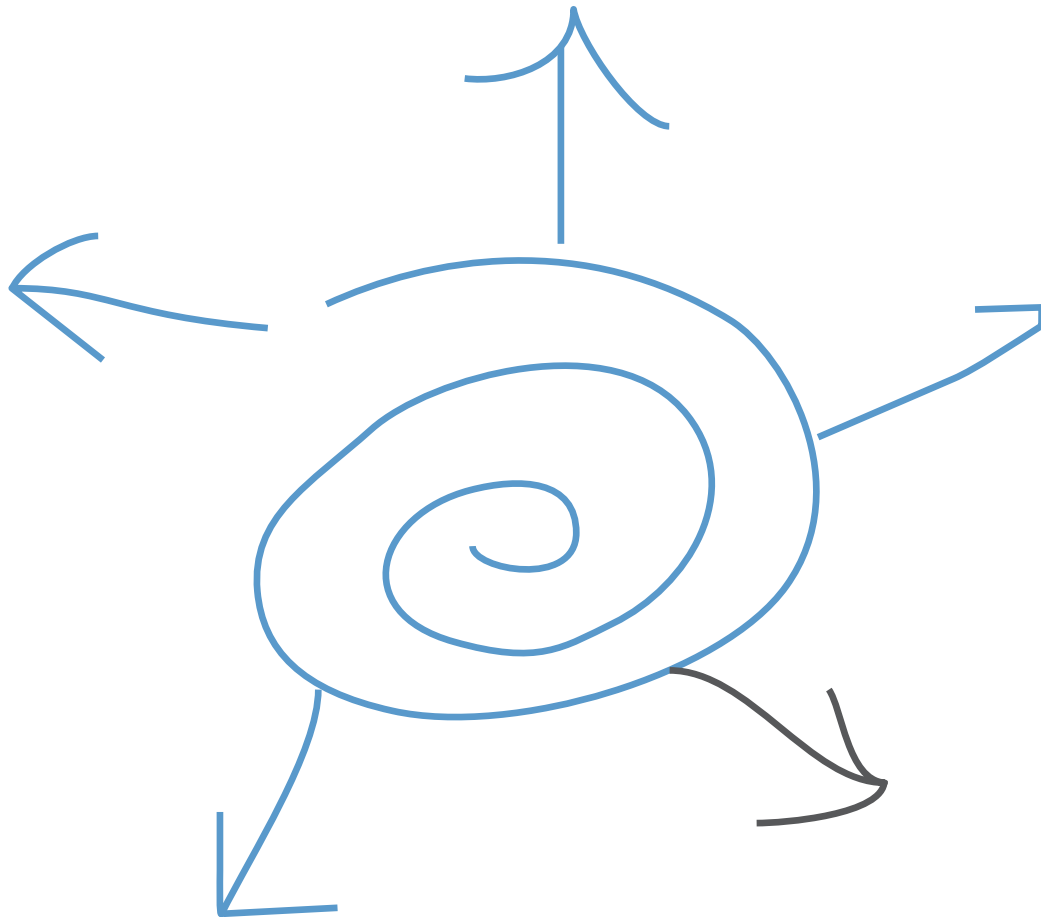
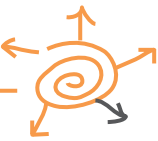
OPTIMIZING PRODUCT LIFE

STRATEGIC PRIORITY

	YES	PARTIALLY	NO
03/01 DESIGNING AN APPROPRIATE LIFE SPAN	0 %	0 %	0 %
03/02 DESIGNING RELIABILITY	0 %	0 %	0 %
03/03 FACILITATING RENEWABILITY AND ADAPTABILITY	0 %	0 %	0 %
03/04 SIMPLIFYING MAINTENANCE	0 %	0 %	0 %
03/05 SIMPLIFYING REPAIR	0 %	0 %	0 %
03/06 SIMPLIFYING RE-USE	0 %	0 %	0 %
03/07 SIMPLIFYING REFABBRICATION	0 %	0 %	0 %
03/08 INTENSIFYING USAGE	0 %	0 %	0 %



OPTIMIZING PRODUCT LIFE



Extending the life of materials means adding ambient and ecological value to them by avoiding premature disposal, by reprocessing them to obtain new prime secondary materials (via recycling or composting) or burning them to recuperate their energetic content.

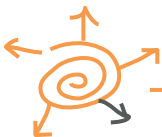
There is a double advantage in the process:

- a) The ecological impact and the cost of disposal of the materials are avoided.
- b) The production and acquisition costs connected with buying virgin materials are avoided.

Naturally the processes of composting, recycling and burning also have their own ecological and economical costs.

In conservatory terms we can adopt a series of measures in relation with all the phases the process of recycling to minimize such ecological and economic costs: collection and transportation; identification and separation; disassembly and/or fragmentation; cleaning and/or washing; pre-production of prime secondary materials.

Generally this principle is followed: the material should be recycled as much as possible before it loses its material properties, then, at that point, the object should be incinerated to recuperate energy.



ADOPTING A CASCADE APPROACH

Have the materials been predicted to be recycled with components having low mechanical properties?

YES	PARTIALLY	NO
☐	☐	☐

Have the materials been predicted to be recycled with components having low aesthetical requisites?

☐	☐	☐
--------------------------	--------------------------	--------------------------

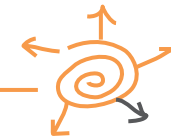
Have the materials been predicted to be burnt to recycle their energetic contents?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Given answers

Total answers
Percentage
(Total / Replies X 100)

0	0	0
0 %	0 %	0 %



ADOPTING HIGH RECYCLABLE MATERIALS

Have materials that retain easily their original characteristics been preferred?

YES	PARTIALLY	NO
☐	☐	☐

Have composite materials been avoided?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Has geometrical shaping such as ribs been applied to reinforce the polymers (instead of using reinforcing fibres)?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Have thermoplastic polymers been preferred over thermosetting ones?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Have certain additives been avoided by choosing temperature resistant thermoplastics?

☐	☐	☐
--------------------------	--------------------------	--------------------------

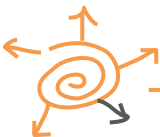
Has the design process foreseen the predicted type of use for each material after recycling?

☐	☐	☐
--------------------------	--------------------------	--------------------------

Given answers

Total answers
Percentage
(Total / Replies X 100)

0	0	0
0 %	0 %	0 %



SIMPLIFYING COLLECTION
AND TRANSPORTATION AFTER USAGE

Has the product been design considering the existing recycling system?

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐

Has weight been minimized optimally?

Has obstruction been minimised and is the dismissed product easy to stack?

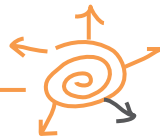
Has the object been designed to be compressed during disposal?

Does the user receive information regarding the type of disposal required for the product?

Given answers

Total answers
Percentage
(Total / Replies X 100)

0	0	0
0	0	0



IDENTIFYING THE MATERIALS

Have the materials been codified to define their type?

Has information been given about the number of recycling processes, and the additives applied to the material?

Have toxic residues and contaminant materials been indicated?

Have standard identification systems been applied?

Have the markings/codifications been clearly visibly indicated?

Have codification processes been avoided after the production of the components?

Given answers

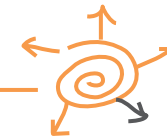
Total answers
Percentage
(Total / Replies X 100)

YES	PARTIALLY	NO
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐
☐	☐	☐

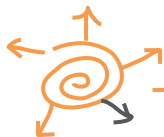
0	0	0
0	0	0



	YES	PARTIALLY	NO
MINIMIZING THE NUMBER OF INCOMPATIBLE MATERIALS			
Have functions been integrated to minimise the usage of materials and components?	☐	☐	☐
Is the product or one of its parts formed from only one material?	☐	☐	☐
Have homogeneous materials been used in joinable structures?	☐	☐	☐
Have compatible materials been used within the product or its parts?	☐	☐	☐
Have the joints been made of materials compatible with those with which they join?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



	YES	PARTIALLY	NO
SIMPLIFYING CLEANING			
Have unnecessary surface treatments been avoided?	☐	☐	☐
Have contaminants difficult to remove been avoided?	☐	☐	☐
Has the removal of contaminants been simplified?	☐	☐	☐
Have surface treatments compatible with underlying materials been used?	☐	☐	☐
Have adhesives been avoided? If not have they been selected to be compatible with the recyclable materials?	☐	☐	☐
Has colouring polymers during the production been preferred over painting them?	☐	☐	☐
Have contaminating printing processes been avoided?	☐	☐	☐
Have materials used to mark and code been avoided?	☐	☐	☐
Have signs and codes been marked during manufacture?	☐	☐	☐
Have the polymers been marked by laser?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



SIMPLIFYING COMPOSTING

Have materials easy to be recycled with the disposal existing system been used?

YES
PARTIALLY
NO

☐☐☐

Have materials been avoided that make composting inefficient?

☐☐☐

Has the separation of non biodegradable materials been simplified?

☐☐☐

Given answers

Total answers
Percentage
(Total / Replies X 100)



SIMPLIFYING COMBUSTION

Have high efficient heating value materials been used in burn down product?

YES
PARTIALLY
NO

☐☐☐

Have materials been avoided that emit dangerous substances during combustion?

☐☐☐

Have additives been avoided that produce dangerous substances during combustion?

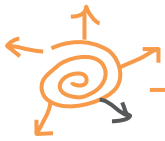
☐☐☐

Has the separation of non combustible materials been simplified?

☐☐☐

Given answers

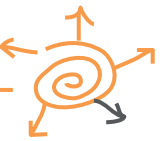
Total answers
Percentage
(Total / Replies X 100)



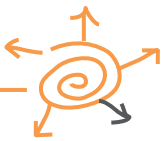
EXTENDING MATERIAL LIFE

STRATEGIC PRIORITY

	YES	PARTIALLY	NO	
04/01 ADOPTING A CASCADE APPROACH	0 %	0 %	0 %	
04/02 ADOPTING HIGH RECYCLABLE MATERIALS	0 %	0 %	0 %	
04/03 SIMPLIFYING COLLECTION AND TRANSPORTATION AFTER USAGE	0 %	0 %	0 %	
04/04 IDENTIFYING THE MATERIALS	0 %	0 %	0 %	
04/05 MINIMIZING THE NUMBER OF INCOMPATIBLE MATERIALS	0 %	0 %	0 %	
04/06 SIMPLIFYING CLEANING	0 %	0 %	0 %	
04/07 SIMPLIFYING COMPOSTING	0 %	0 %	0 %	
04/08 SIMPLIFYING COMBUSTION	0 %	0 %	0 %	



EXTENDING MATERIAL LIFE



Designing easily disassemblable products makes the separation phase faster and more economical (Design For Disassembling, DFD).

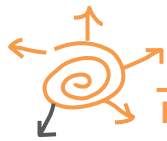
Facilitating the separation of parts also simplifies repairs, upgrades and the re-fabrication of products.

Facilitating separation of the materials as an alternative aids recycling and isolation of materials if toxic or harmful. helps the recycling and their isolation (if the materials are toxic, harmful).

So as indicated this process can extend the life of such a product and in the case of recycling can enable the process to obtain a more satisfactory result.

In other words, the disassembly of incompatible materials must be facilitated, otherwise the value of the secondary material obtained via the recycling processes may not cover the costs of its recuperation.

The same can be said for the recuperation of parts during servicing, repairing, upgrade and re-fabrication.



05/01

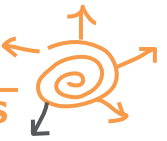
SIMPLIFYING DISSASSEMBLY

MINIMIZING AND SIMPLIFYING THE OPERATIONS
OF DISSASSEMBLY AND SEPERATION

	YES	PARTIALLY	NO
GENERAL ARCHITECTURE			
Has the disassembly of toxic and hazardous materials, parts been prioritized?	☐	☐	☐
Has the disassembly of higher value materials been prioritized?	☐	☐	☐
Has the disassembly of parts more subjected to wear prioritized?	☐	☐	☐
Have modular structures been adopted?	☐	☐	☐
Has the product been divided into smaller pieces which can be manipulated and moved as single pieces?	☐	☐	☐
Has the dimension of the product and its component been minimized?	☐	☐	☐
Have the connections of hierarchic dependence between components been minimised?	☐	☐	☐
Have directions of possible extraction of the components and structures been reduced?	☐	☐	☐
Has maximum uniformity been obtained in disassembly directions?	☐	☐	☐

05/01

SIMPLIFYING DISSASSEMBLY

MINIMIZING AND SIMPLIFYING THE OPERATIONS
OF DISSASSEMBLY AND SEPERATION

	YES	PARTIALLY	NO
Have vertical disassembly sandwich structures been adopted with centre drying parts?	☐	☐	☐
Given answers	0		
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



05/02

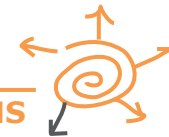
SIMPLIFYING DISSASSEMBLY

MINIMIZING AND SIMPLIFYING THE OPERATIONS
OF DISSASSEMBLY AND SEPERATION

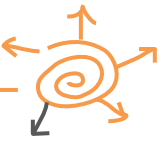
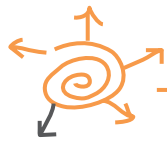
	YES	PARTIALLY	NO
SHAPE OF PARTS AND COMPONENTS			
Have components been avoided which are difficult to move?	☐	☐	☐
Have insignificant asymmetrical parts been avoided?	☐	☐	☐
Have surfaces been designed to grab them in a standard way?	☐	☐	☐
Have grasping points been devised close to the centre of gravity?	☐	☐	☐
Have the components been devised to allow balancing on their base?	☐	☐	☐
Given answers	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %

05/03

SIMPLIFYING DISSASSEMBLY

MINIMIZING AND SIMPLIFYING THE OPERATIONS
OF DISSASSEMBLY AND SEPERATION

	YES	PARTIALLY	NO
SHAPE AND ACCESSABILITY OF JOINTS			
Have fixture systems that require to act in different joining points to allow opening been avoided?	☐	☐	☐
Has the number of fasteners adopted been minimized?	☐	☐	☐
Has the number of fasteners removable with different tools been minimized?	☐	☐	☐
Have fasteners difficult to move been avoided?	☐	☐	☐
Have accessible and recognizable way to disassembly been designed?	☐	☐	☐
Have the separation points been devised to provide good accessibility and facilitate inspections?	☐	☐	☐
Given answers	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



USING REVERSIBLE JOINTS

	YES	PARTIALLY	NO
Have dual way snap-fits been used?	☐	☐	☐
Have snap-fits easy to be opened with obtainable tools been used?	☐	☐	☐
Have snap-fits that can be opened only with special tools been used to eliminate hazardous opening of the parts?	☐	☐	☐
Have joints made of materials that make them reversible only in specific cases been used?	☐	☐	☐
Have screws with hexagonal heads been used?	☐	☐	☐
Have screws been avoided and repositionable clips/cubes used instead?	☐	☐	☐
Have screws compatible with the surrounding materials been used to avoid extraction when recycling material is necessary?	☐	☐	☐
Have auto threading screws been used in polymeric components to avoid adding metal inserts?	☐	☐	☐

Given answers

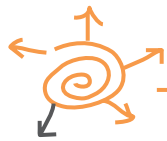
Total answers
Percentage % % %
(Total / Replies X 100)

USING EASILY OPENING PERMANENT JOINTS

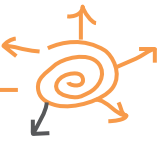
	YES	PARTIALLY	NO
Have rivets been avoided on incompatible materials?	☐	☐	☐
Have pressure systems been avoided on incompatible materials?	☐	☐	☐
Has excess material been avoided during welding?	☐	☐	☐
Have the materials been welded together using appropriate filler?	☐	☐	☐
Has ultrasonic or vibration welding been preferred for thermoplastics?	☐	☐	☐
Has adhesive gluing been avoided?	☐	☐	☐
Have easily removable adhesives been used?	☐	☐	☐

Given answers

Total answers
Percentage % % %
(Total / Replies X 100)



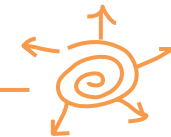
PREDICTING TECHNOLOGIES AND ELEMENTS FOR DESTRUCTIVE DISSASSEMBLY	YES	PARTIALLY	NO
Have fracture areas been predetermined for elimination of incompatible inserts using crushing?	☐	☐	☐
Are the cutting or fracturing paths predetermined so that they pass by the connections between incompatible materials?	☐	☐	☐
Have tools used divide incompatible materials been inserted in the product?	☐	☐	☐
Have physically or chemically destroyable joints been used?	☐	☐	☐
Are the breaking points easy to find, accessible and identifiable?	☐	☐	☐
Have the modalities of breakage been indicated on the product?	☐	☐	☐
Given answers 0	0	0	0
Total answers	0	0	0
Percentage (Total / Replies X 100)	0 %	0 %	0 %



	STRATEGIC PRIORITY		
	YES	PARTIALLY	NO
05/01 GENERAL ARCHITECTURE	0 %	0 %	0 %
05/02 SHAPE OF PARTS AND COMPONENTS	0 %	0 %	0 %
05/03 SHAPE AND ACCESSABILITY OF JOINTS	0 %	0 %	0 %
05/04 USING REVERSIBLE JOINTS	0 %	0 %	0 %
05/05 USING EASILY OPENING PERMANENT JOINTS	0 %	0 %	0 %
05/06 PREDICTING TECHNOLOGIES AND ELEMENTS FOR DESTRUCTIVE DISSASSEMBLY	0 %	0 %	0 %



SINTHESIS INDEX



MINIMIZING RESOURCES

	STRATEGIC PRIORITY			YES	PARTIALLY	NO
01/01	MINIMIZING THE MATERIAL CONTENT OF A PRODUCT			0%	0%	0%
01/02	MINIMIZING SCRAPS AND WASTE			0%	0%	0%
01/03	MINIMIZING THE PACKAGING			0%	0%	0%
01/04	CHOOSING THE MOST EFFICIENT MATERIAL CONSUMPTION SYSTEM			0%	0%	0%
01/05	ADOPTING FLEXIBLE MATERIAL CONSUMPTION SYSTEMS			0%	0%	0%
01/06	MINIMIZING MATERIAL CONSUMPTION IN PRODUCT DESIGN			0%	0%	0%
01/07	OPTIMISING ENERGY CONSUMPTION FOR PRE-PRODUCTION AND PRODUCTION			0%	0%	0%
01/08	MINIMIZING TRANSPORTATION AND STORAGE CONSUMPTIONS			0%	0%	0%
01/09	CHOOSING THE MOST EFFICIENT ENERGY RESOURCES CONSUMPTION SYSTEMS			0%	0%	0%
01/10	ADOPTING FLEXIBLE ENERGY CONSUMPTION SYSTEMS			0%	0%	0%
01/11	MINIMIZING ENERGY CONSUMPTION IN PRODUCT DESIGN			0%	0%	0%

CHOOSING LOW IMPACT RESOURCES AND PROCESSES

	STRATEGIC PRIORITY			YES	PARTIALLY	NO
02/01	REDUCING TOXICITY AND HARMFULNESS OF MATERIALS			0%	0%	0%
02/02	REDUCING ENERGY RESOURCES TOXICITY AND HARMFULNESS			0%	0%	0%
02/03	OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF MATERIALS			0%	0%	0%
02/04	OPTIMIZING BIOCOMPATIBILITY AND CONSERVATION OF ENERGETIC RESOURCES			0%	0%	0%

OPTIMIZING PRODUCT LIFE

	STRATEGIC PRIORITY			YES	PARTIALLY	NO
03/01	DESIGNING AN APPROPRIATE LIFE SPAN			0%	0%	0%
03/02	DESIGNING RELIABILITY			0%	0%	0%
03/03	FACILITATING RENEWABILITY AND ADAPTABILITY			0%	0%	0%

EXTENDING MATERIAL LIFE

	STRATEGIC PRIORITY			YES	PARTIALLY	NO
04/01	ADOPTING A CASCADE APPROACH			0%	0%	0%
04/02	ADOPTING HIGH RECYCLABLE MATERIALS			0%	0%	0%
04/03	SIMPLIFYING COLLECTION AND TRANSPORTATION AFTER USAGE			0%	0%	0%
04/04	IDENTIFYING THE MATERIALS			0%	0%	0%
04/05	MINIMIZING THE NUMBER OF INCOMPATIBLE MATERIALS			0%	0%	0%
04/06	SIMPLIFYING CLEANING			0%	0%	0%
04/07	SIMPLIFYING COMPOSTING			0%	0%	0%
04/08	SIMPLIFYING COMBUSTION			0%	0%	0%

SIMPLIFYING DISSASSEMBLY

	STRATEGIC PRIORITY			YES	PARTIALLY	NO
05/01	GENERAL ARCHITECTURE			0%	0%	0%
05/02	SHAPE OF PARTS AND COMPONENTS			0%	0%	0%
05/03	SHAPE AND ACCESSABILITY OF JOINTS			0%	0%	0%
05/04	USING REVERSIBLE JOINTS			0%	0%	0%
05/05	USING EASILY OPENING PERMANENT JOINTS			0%	0%	0%
05/06	PREDICTING TECHNOLOGIES AND ELEMENTS FOR DESTRUCTIVE DISSASSEMBLY			0%	0%	0%