

Circular product design

Card set



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Extra information & References

The ⓘ symbol displays additional information on the subject

The 🔍 symbol shows a useful search term

The references on the bottom of each page can be found on the literature card

Two types of cards

Design for variety,

modules give the opportunity to design for a variety of different needs (e.g. different storage size options in phones)

Determine future scenario,

look at trends, cultural behaviour and technical changes.

①
Divide technologies into fast and slow developing. Also divide your parts into fast and slow wearing parts.

The white cards are quick points of attention

The colored cards need to be studied deeper

This set of cards has been developed for the faculty of Industrial Design Engineering to help new product designers to implement the foundations of the circular economy into their design



**DESIGN FOR
UPGRADABILITY
& ADAPTABILITY**



DESIGN FOR UPGRADABILITY & ADAPTABILITY

Design products which can be upgraded to perform different functions and satisfy different user needs in future products generations.

**Design
for easy
attachment
and
detachment** so
modules can be
changed between
platforms

(Gu, Xue & Nee, 2009;
Keoleian & Menerey, 1993)

A decorative graphic in the bottom right corner consisting of a bar chart with three bars of increasing height and a large upward-pointing arrow to the right.

**Design with
standard
cross-platform
connections,**
use standard
connectors so
functions can be
transferred (eg.
USB, HDMI).


A decorative graphic in the bottom right corner consisting of three light green vertical bars of increasing height from left to right, with a large light green arrow pointing upwards on the right side.

(Autodesk, 2011)

Design in modules,

create individually
functioning parts
that can be
interconnected.

(Gu, Xue & Nee, 2009; Lunar, n.d.; Mulder et al., 2012; Taylor, n.d.; Autodesk, 2011)



Make
current parts
compatible with
future products,
make problematic
parts removable
for upgrade

Q Google for:
Forward compatible

(Autodesk, 2011)

A decorative graphic in the bottom right corner consisting of a bar chart with three bars of increasing height and a large upward-pointing arrow to the right.

**Make parts
useful in
earlier
generations,**
enable reuse of
new components
in old products.

Q Google for:
Backward compatible

(Autodesk, 2011)

Build
diagnostic
tools to help
users understand
the components
that are limiting
performance

(Autodesk, 2011)



Design for variety,

modules give the opportunity to design for a variety of different needs (e.g. different storage size options in phones)

(Martin & Ishii, 2002)



**Determine
upgradable
functions,** look at
the functions which
you want to upgrade
for every generation
based on your
scenario.



Divide technologies into fast and slow developing. Also divide your parts into fast and slow wearing parts.

(Gu, Xue & Nee, 2009)

A bar chart with three bars of increasing height, where the tallest bar is an upward-pointing arrow.

Determine future scenario,

look at trends,
cultural behaviour
and technical
changes.



**DESIGN
FOR
RECYCLING**



DESIGN FOR RECYCLING

Design your product to be recycled at the end of its life, so materials can loop back into the technological or biological cycle.

**Reduce
material
variety,** this
can increase
recyclability and
can decrease
manufacturing
energy.

(Gu, Xue & Nee, 2009; Lunar, n.d.; Mulder et al., 2012; Taylor, n.d.; Autodesk, 2011)

Use recyclable materials,
choose materials which can be separated and recycled in a recycling plant.



Sourcing sustainable materials from distant locations can sometimes prove more harmful than beneficial.

(Lunar, n.d.; Autodesk, 2011)

**Label parts
with recycling
codes** or other
permanent
ways to identify
materials.

Q Google for:
identification system for
packaging materials

(Autodesk, 2011; Packaging Council of
South Africa, 2014)

**Make
materials
separable,**
this increases
recyclability
because each
material can be
recycled separately.

(Autodesk, 2011)



Use inherent color, avoid using paints, additives and surface treatments. These lower the recyclability.



Eliminating paint on appearance parts could result in lower yields in the molding process. Discuss this with the part manufacturer to determine acceptable yield rates.

(Lunar, n.d.; Mulder et al., 2012; Autodesk, 2011)

Design products with compatible materials,

the entire
product may be
recycled without
disassembly.

**Q Google for:
metal wheel Reuter**

(Tempelman, Shercliff, & Eyben, 2014).

Reduce size and weight,

lightweight products use less material which reduces emission during production, transportation and recycling.



Don't sacrifice durability in the name of weight savings. Shipping a lightweight item twice, because of product failure, can cause more harm than shipping a heavier one once.

(Lunar, n.d.)

Create durable and high quality designs,

the user will perhaps postpone the discarding of the product when the product still functions.



Not all products should last forever, i.e. foodpackaging. Design temporary items to be absorbed back into the technical nutrients or to be biodegradable.

(Lunar, n.d.; Nes & Cramer, 2006)



Use the system, use the recycling program which is available in the country where the product will be used.



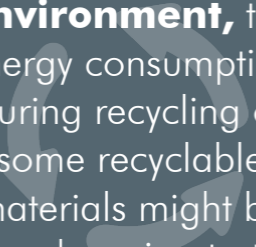
Not all countries work with the same recycling programme. Your business plan might not be compatible in different regions of the world.

(Autodesk, 2011)




**Make recycling
profitable,**
think about
the economic
value when the
materials will be
recycled.

(Tempelman, Shercliff, & Eyben, 2014)



Make recycling beneficial for the environment, the energy consumption during recycling of some recyclable materials might be more harming to the environment than the actual ecological value of the recycled materials themselves.

(Tempelman, Shercliff, & Eyben, 2014;
Lunar, n.d.)



**Think
about easy
take-back
programs**

to ensure proper
disposal of
complicated
products.



**DESIGN FOR
DIS- &
REASSEMBLY**



DESIGN FOR DIS- & REASSEMBLY

Design a product which can be easily disassembled and reassembled without its various components losing their initial function due to damage or deformation.

**Integrate
guiding pins
for alignment,**
to make
re-assembly
easier and less
sensitive to errors.

(Kuo et al., 2001)



No sharp edges on parts, to make sure no injuries occur during dis- or reassembly.

(Kuo et al., 2001)



Design testing points on circuit boards, for quick identification of the problem.



While designing an circuit board it might be useful to discuss this point and other questions with an electrical engineer.

(Kuo et al., 2001)

**Make key
components
accessible,**
so they can easily
be taken out or
modified.

(Mulder et al., 2012; RCAR, 2008)



Use fasteners that endure repeated use, to make sure the product can be dis and reassembled multiple times without failure.


(Tempelman, Shercliff, & Eyben, 2014;
Lunar, n.d.)

A decorative graphic of a wrench, rendered in a light teal color, is positioned in the bottom right corner of the page. The wrench is oriented vertically, with its head pointing upwards and its handle extending downwards.

Design handles for parts

which are difficult to handle or weigh more than 5 kilo.

(Centre for Remanufacturing and Reuse, 2009; Autodesk, 2011)

A decorative graphic of a wrench, rendered in a light teal color, is positioned in the bottom right corner of the page. The wrench is oriented vertically, with its head pointing upwards and its handle extending downwards.

Embed instructions

inside your
product, label and
colour code parts
for easy dis- and
reassembly.

Also see the cards for:
Repair



Make sure the instructions are understood the same around the world.

(Moss, 1985; Autodesk, 2011)

Color code wires for easy identification.



When using colors to label wires, make sure you use standard colors. For example red for Vcc and black for ground.

(Kuo et al., 2001)

Create smooth touch points between the company and users, for easy ways to return a broken product for repair, refurbishing, remanufacturing or recycling.

(Autodesk, 2011)



**Design parts
that can only
be inserted
in one way,**
to prevent
mistakes during
reassembly.

Also see the cards for:
Repair

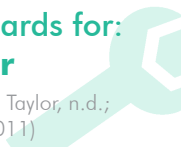
(Taylor, n.d.; Autodesk, 2011)



Use hand-strength press-fits,
so products can
be taken apart
without the need
for tools.

Also see the cards for:
Repair

(Mulder et al., 2012; Taylor, n.d.;
Autodesk, 2011)





**DESIGN FOR
EASE OF
MAINTENANCE
& REPAIR**



DESIGN FOR EASE OF MAINTENANCE & REPAIR

Design products that are easy to repair and maintain.

This prolongs product quality and will postpone the need for product replacement.

**Make
connections
accessible** from
the same axis.
Hold multiple
parts with one
fastener.

(Autodesk, 2011; Sundin, 2004)



Strive for simplicity,
reduce the number
of parts and use
standard components
that are easy to
replace.




Simplicity may lead to overlook opportunities to increase the usefulness of a product without increasing its ecological impact.

(Lunar, n.d.; Taylor, n.d.; Centre for Remanufacturing and Reuse, 2009;

**Allow enough
space for
tooling,** so parts
can be easily
accessed when
they need service
or repair.

(Mulder et al., 2012; Taylor, n.d.; RCAR,
2008; Moss, 1985)

A decorative graphic in the bottom right corner consisting of a stylized orange wrench and a screwdriver, both rendered in a simple, flat design.

**Use hand-
strength
press-fits,**
so products can
be taken apart
without the need
for tools.

Also see the cards for:
Dis- & Reassembly


(Mulder et al., 2012; Taylor, n.d.;
Autodesk, 2011)

Avoid permanent glues, if gluing is necessary, use glues which are easily soluble.

**Design parts
that can only
be inserted in
one way,** to
prevent mistakes
when executing
maintenance.

Also see the cards for:
Dis- & Reassembly

(Taylor, n.d.; Autodesk, 2011;
Mulder et al., 2012)



**Use less
(different)
connectors,**
this decreases the
amount of tools
needed and therefore
makes repair easier.



Don't sacrifice durability in the name of using less connectors. Less durable products need to be replaced more often.

(Lunar, n.d.; Mulder et al., 2012;
Autodesk, 2011)

Embed instructions

inside your
product, label and
colour code
parts for trouble
shooting.

Also see the cards for:
Dis- & Reassembly



Make sure users from around
the world understand your
instructions in the same way.

(Taylor, n.d.; Autodesk, 2011)

**Make
spare parts
available,**
make sure it is
more attractive to
repair than to buy
a new product.

(Autodesk, 2011)



Create trouble shooting tools/support,
so users can easily diagnose problems when a product malfunctions.

(Taylor, n.d.; Autodesk, 2011)



**Guarantee
safety by
design itself**
instead of using
warning labels
and colour codes.

Provide clear documentation

make service
documentation
accessible, easy
to understand,
and open source.

(Autodesk, 2011)



**Provide repair
and service
feedback,**
create prompts
to let users
know when your
product needs
service or repair.

(Autodesk, 2011)



**Combine
connectors for
electronics,**
which will allow
all electronic
components to be
disconnected at
the same time.

(RCAR, 2008)



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