A user centred ecodesign approach to support the design of upgradable products

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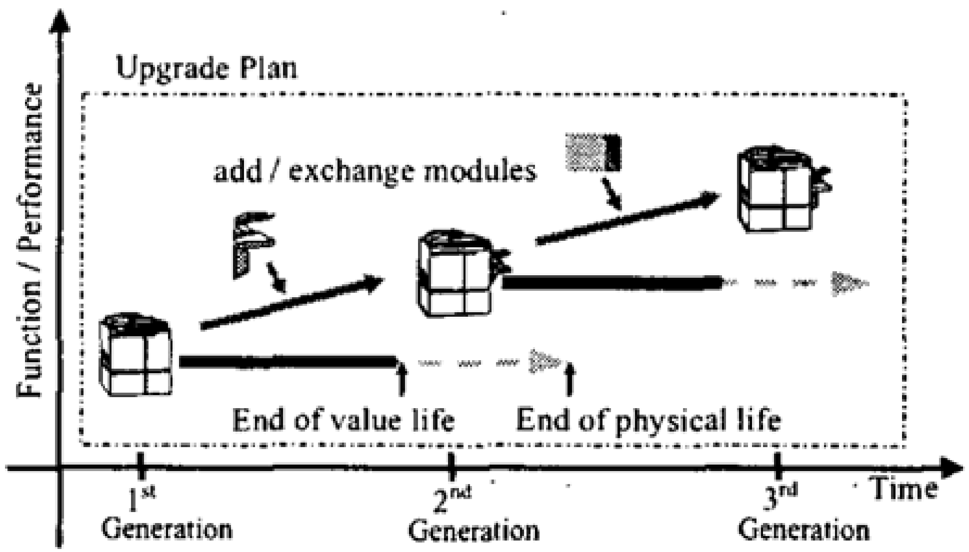
Context of the research work

Current challenges related to ecodesign for upgradability



The concept of upgradability [Umeda, 2007]

Environmental interests of upgradability:

- Avoid accelerated obsolescence
- Material rationalization
- Improvement of environmental performance in use

[Pialot et al., 2015]

Ecodesign for upgradability

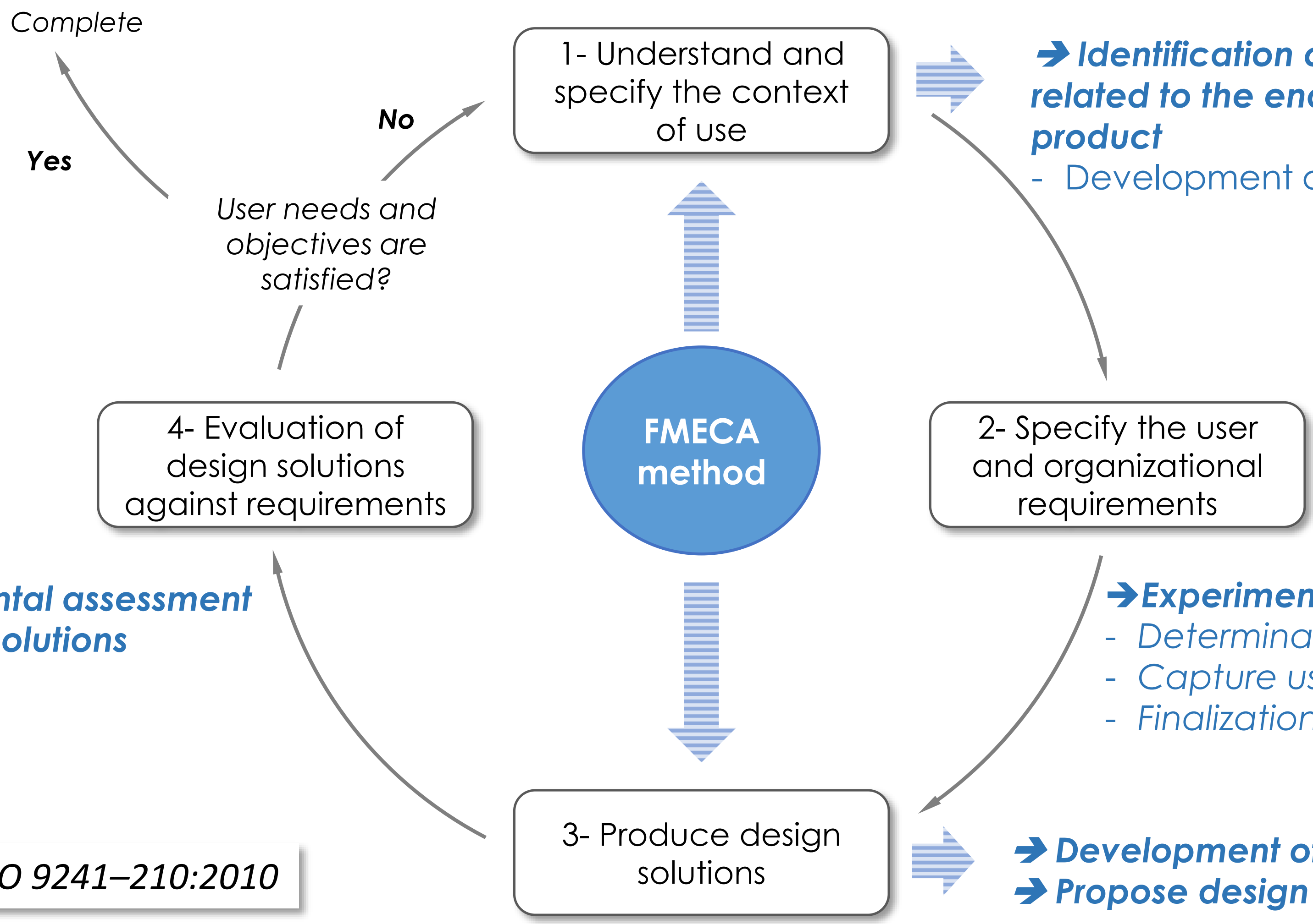
Ensure **environmental performance** of upgradable products compare to conventional products all along the design process

Anticipate upgrade planning through **the integration of users needs** and expectations into design processes

Ensure **efficient integration of DfUp principles** into design processes

Proposition

A user centred ecodesign approach to support Design for Upgradability



➔ Identification of potential failures modes related to the end of PLT and VLT of the product
- Development of usage scenarios

➔Experimental protocol and user observations
- *Determination of users' profiles*
- *Capture users' behaviour*
- *Finalization of usage scenarios*

➔ Development of an upgrade plan
➔ Propose design solutions

➔Environmental assessment
➔Compare solutions

Adapted from: EN ISO 9241–210:2010

Case-study

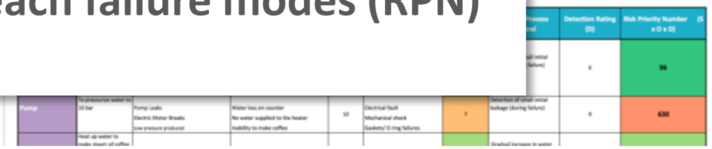
Redesign of a coffee maker using the methodology

FMECA

Identification of Potential Failure Modes in use that can:

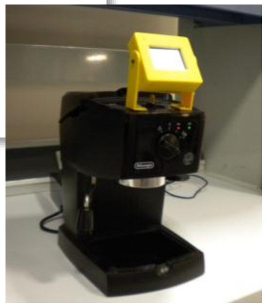
- Shorten the Physical Life time of the coffee maker
- Shorten its Value Life Time
- **Decrease its environmental performance in use through usage drifts**

Risk Priority Number for each failure modes (RPN)

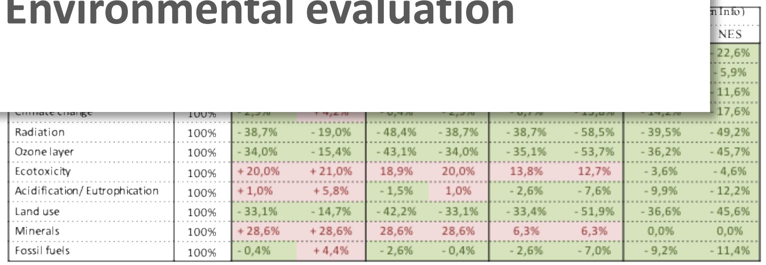


Product in use observations

- Identification of users' profiles
- Product's prototyping
- Test of prototypes in a "as in home" environment



- **Indicators on users' perception regarding design solutions**
- **Environmental evaluation**



Radiation	100%	- 38,7%	- 19,0%	- 48,4%	- 38,7%	- 38,7%	- 58,5%	- 39,5%	- 49,2%
Ozone layer	100%	- 34,0%	- 15,4%	- 43,1%	- 34,0%	- 35,1%	- 53,7%	- 36,2%	- 45,7%
Ecotoxicity	100%	+ 20,0%	+ 21,0%	18,9%	20,0%	13,8%	12,7%	- 3,6%	- 4,6%
Acidification/ Eutrophication	100%	+ 1,0%	+ 5,8%	- 1,5%	1,0%	- 2,6%	- 7,6%	- 9,9%	- 12,2%
Land use	100%	- 33,1%	- 14,7%	- 42,2%	- 33,1%	- 33,4%	- 51,9%	- 36,6%	- 45,6%
Minerals	100%	+ 28,6%	+ 28,6%	28,6%	28,6%	6,3%	6,3%	0,0%	0,0%
Fossil fuels	100%	- 0,4%	+ 4,4%	- 2,6%	- 0,4%	- 2,6%	- 7,0%	- 9,2%	- 11,4%

Perspectives

- Challenges and difficulties in the approach:
  - Implementation into design process

    Access to users' information, to user panel for observations and prototyping

    ➔ **Upgradability facilitate the access to users' information over time**

- Perspectives:
  - Development of the **dedicated FMECA approach**
    - Identification of the different generic "failure modes" regarding the environmental performance of upgradable products (support the identification of usage drifts)
    - Definition of a classification scale of the failure effects severity regarding environmental performance (PLT, VLT, performance in use…)
    - Development of a modeling method for upgradable systems to support a good identification of failure modes
  - Test of the methodology to evaluate its efficiency and **development of specific tools** to support designers in its deployment, in companies

Thank you for your attention

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