Decision making methodology for the design of emulsion-type chemical products during early design stages

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Decision making methodology for the design of emulsion-type chemical products applicable to early design stages

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Contents

Introduction: Trends in chemical products engineering

Chemical Industry

- Competitiveness
- Towards high added value products
- Know-how, staff experience

Customers and public opinion

- Innovative products
- Environmental and safety issues
- New regulations

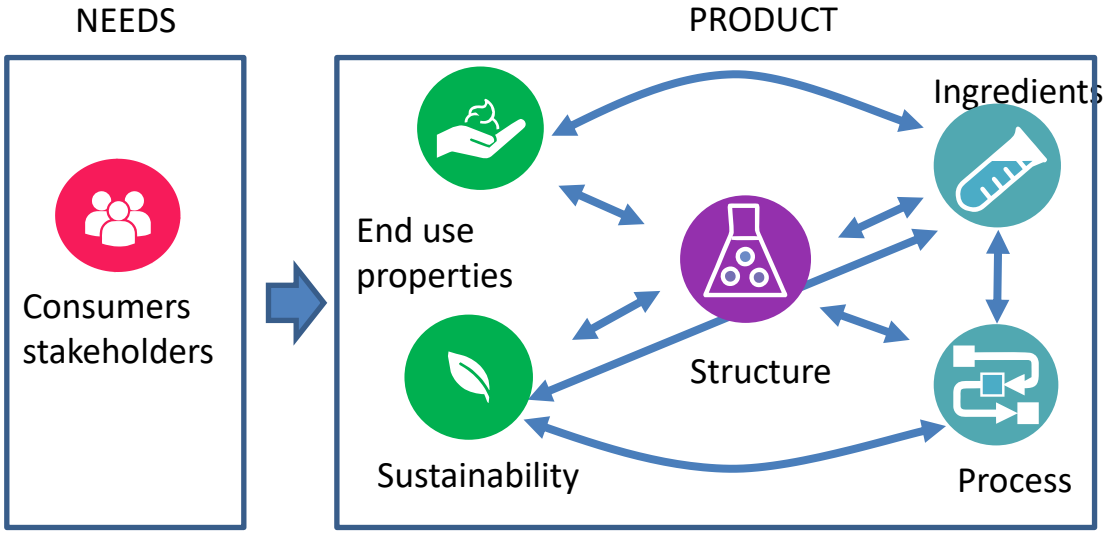
Research in Chemical Engineering and Academia

- Chemical product design
- Courses and graduate programs

(Charpentier, 2010)(Cheng et al. 2009) (Kind 1999)

Introduction: Emulsion - micro-structured product

- ✓ Micro-structure
- ✓ End use functions



(Cussler and Moggridge, 2011)

Problem statement

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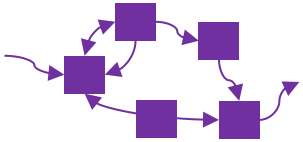
- Deal with **complex systems** – as emulsions



- **Early design stages**

75% costs. - few information.

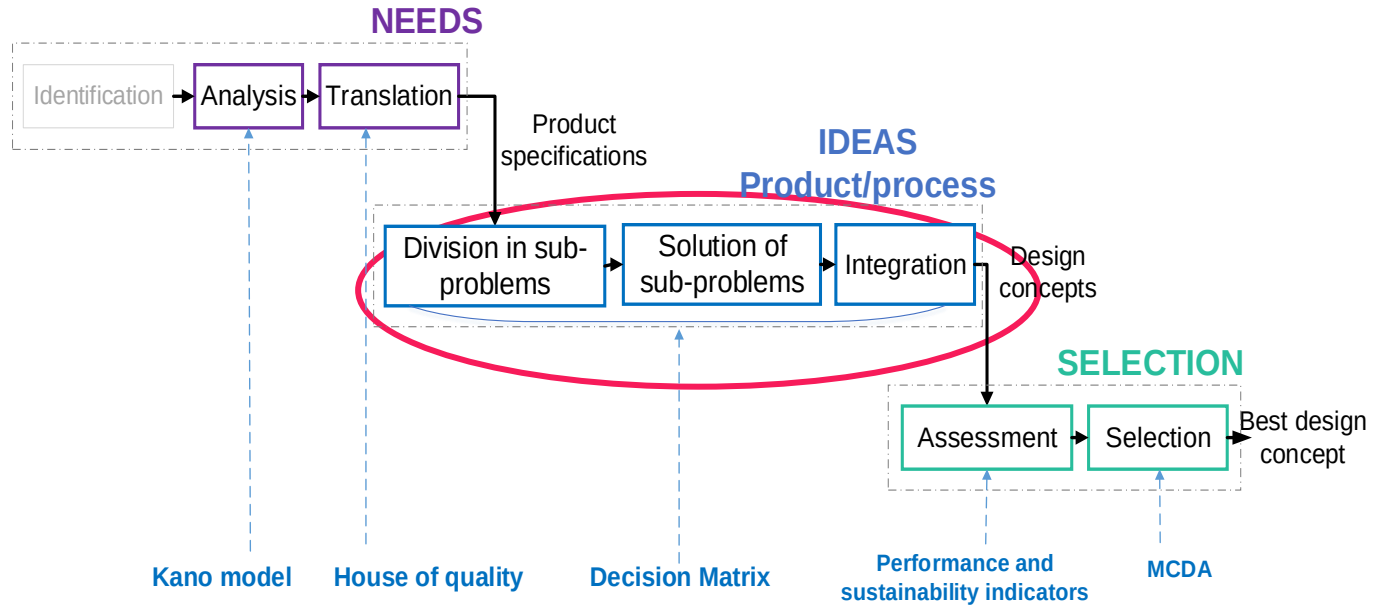
- **Usability**: engineers may understand the methodology and **re-use it autonomously**

(Chandrasegaran et al. , 2013)

Proposal

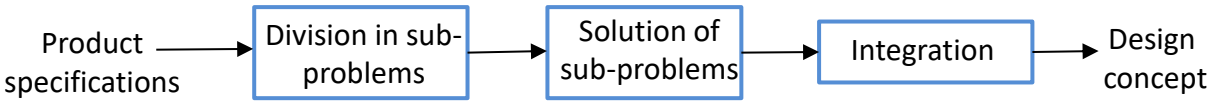
- Global vision
  - ✓ Methods **from need** analysis to the **selection - interdisciplinary**
- Holistic vision
  - ✓ Identification of interrelation between design variables
- Knowledge base
  - ✓ Emulsion science
  - ✓ Expert knowledge

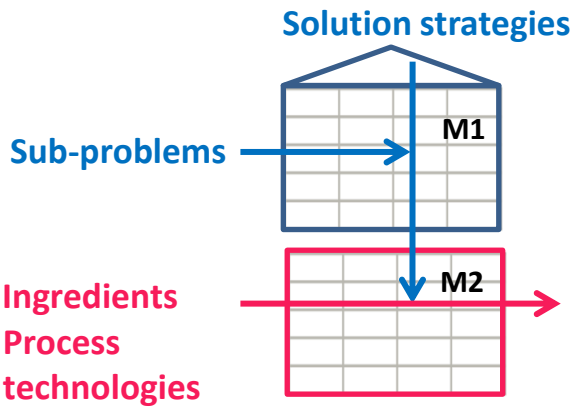
Methodology



(Cussler and Moggridge, 2011) (Ulrich and Eppinger, 2004) (Hauser & Clausing 1988) (Ishizaka & Nemery 2013)
(Rejeb et al. 2011) (Commenge & Falk 2014) (Govers 1996) (Serna et al. 2016)

Ideas generation: Decision matrix



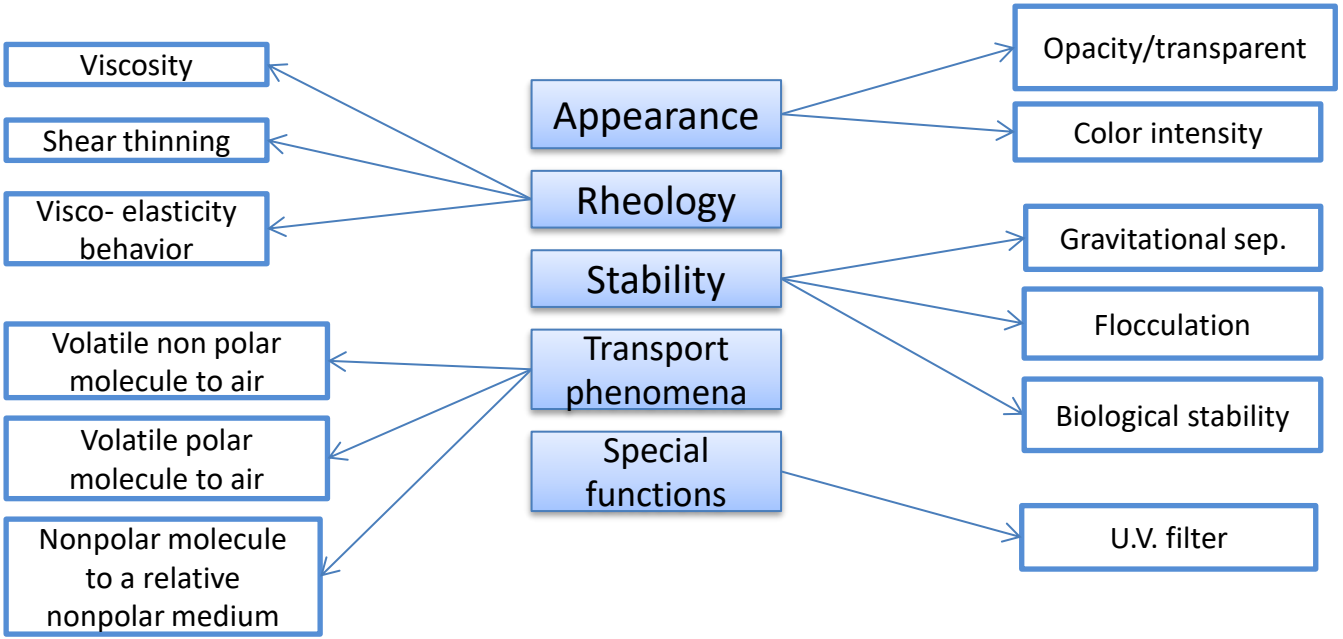


- ✓ Based on emulsion science principles
- ✓ The connection between them is done with expert knowledge

Based on method proposed by (Commenge & Falk 2014)

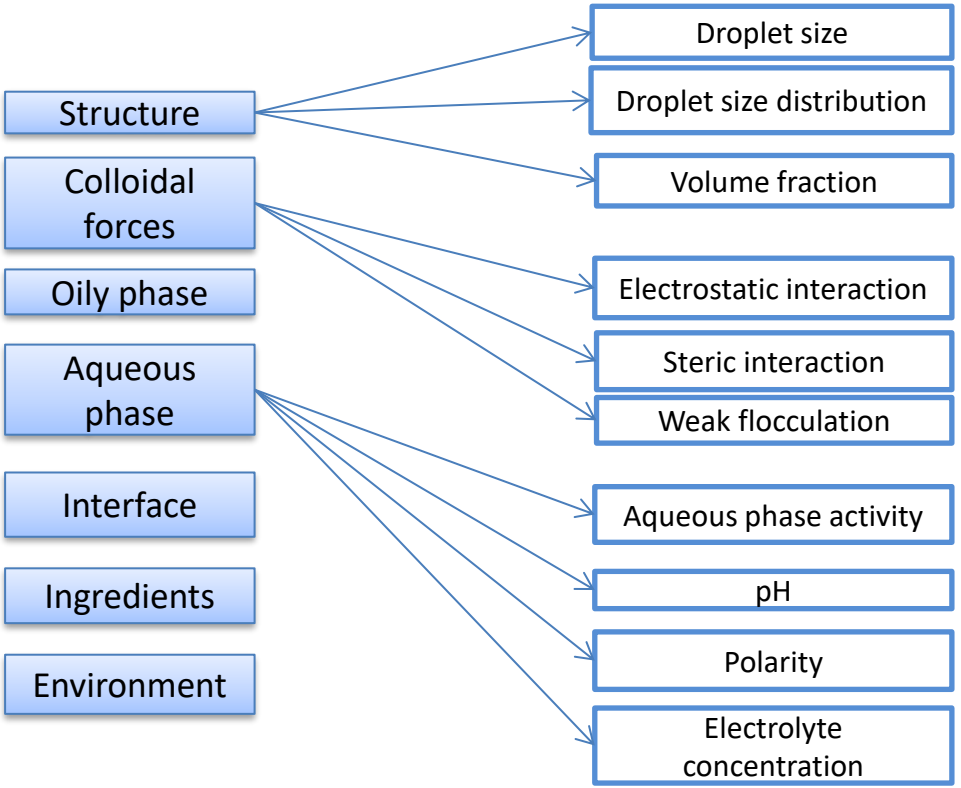
Decision matrix: M1 sub-problems

Identified from emulsion science - 22 + generic sub-problems



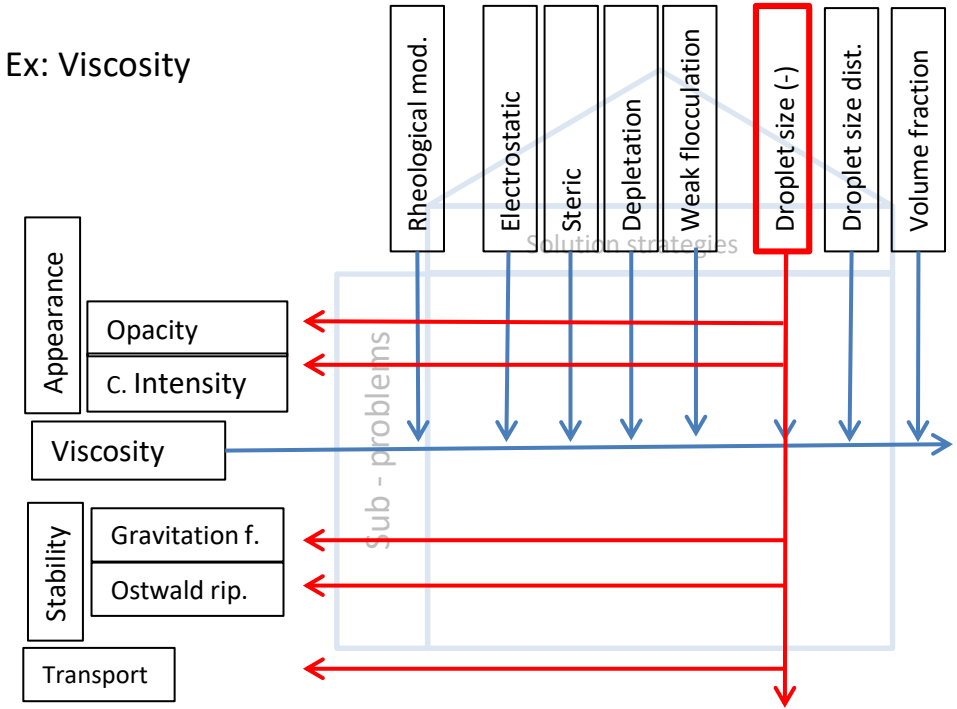
Decision matrix: M1 solution strategies

Identified from emulsion science 36 general solution strategies



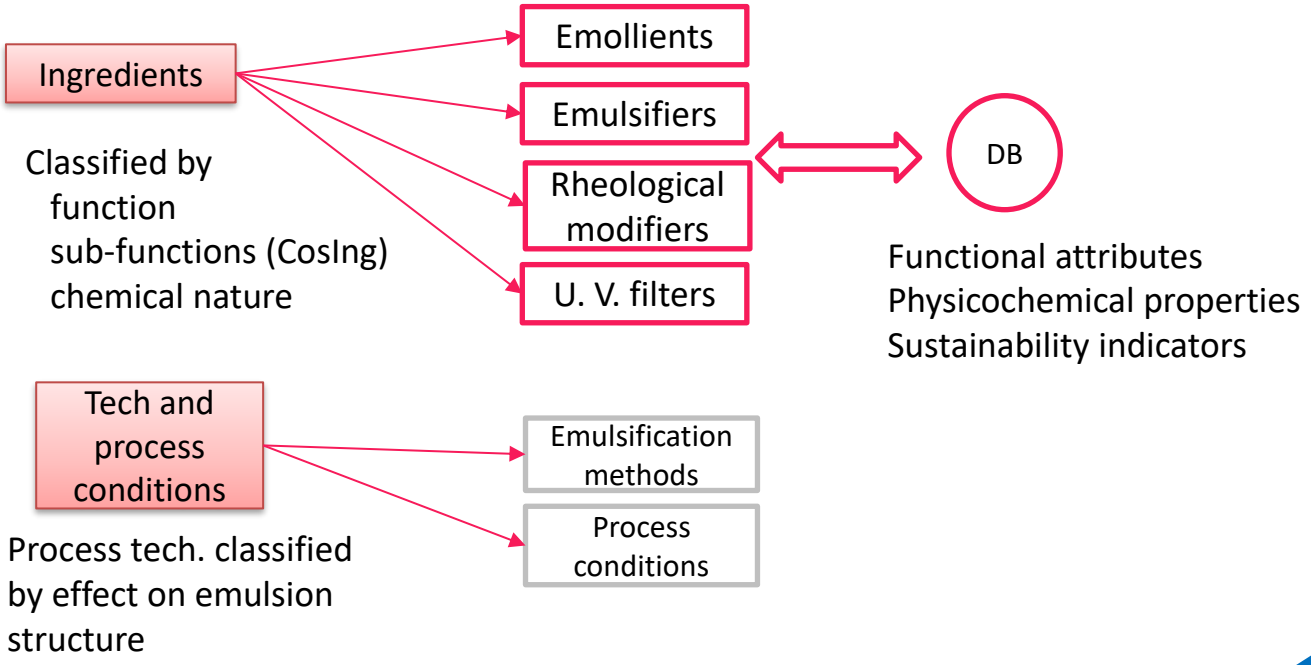
Decision matrix: M1 interrelation

Interrelation of sub-problems and solutions strategies – experts knowledge (O/W emulsion, low concentration of the oily phase (<20%))

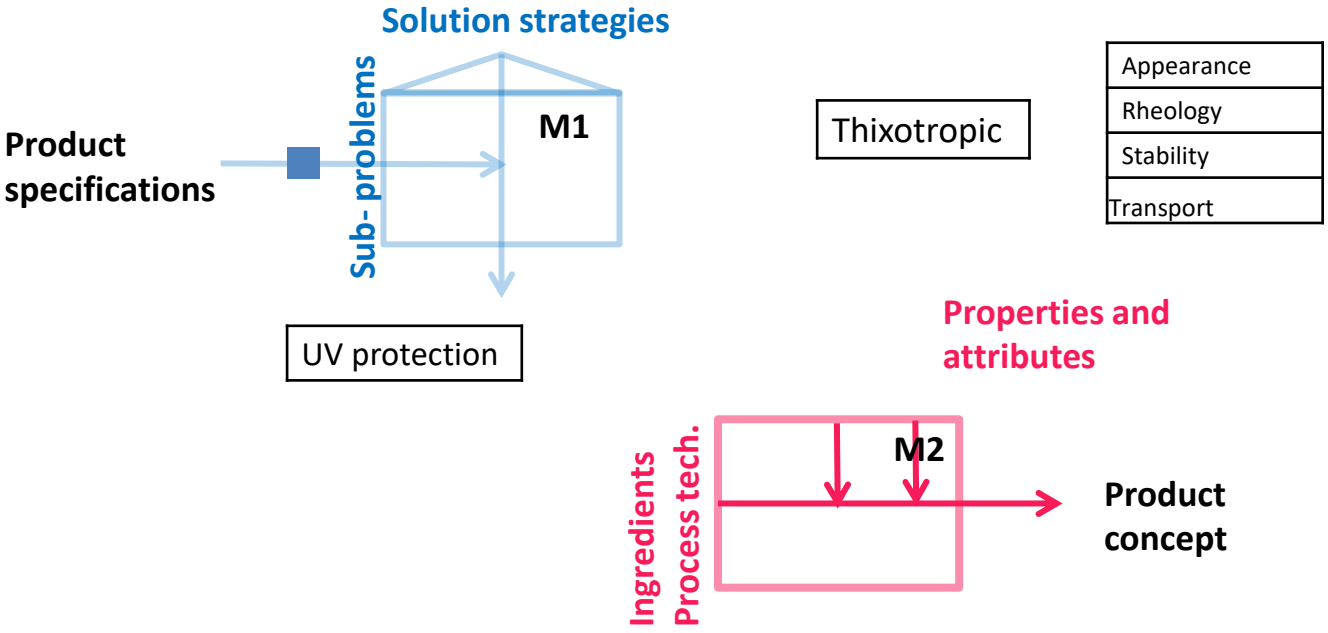


Decision matrix: M2 ingredients and technologies

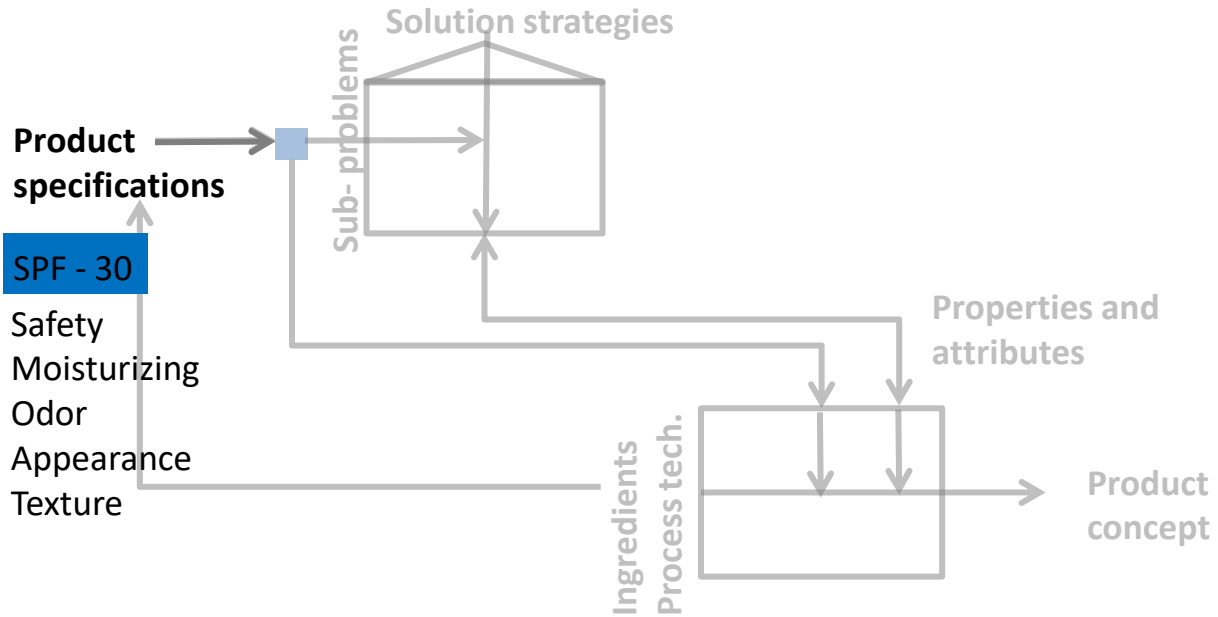
Structure of second matrix of the decision : Cosmetic emulsion – skin care



Decision matrix: Information structure



Example: Sunscreen



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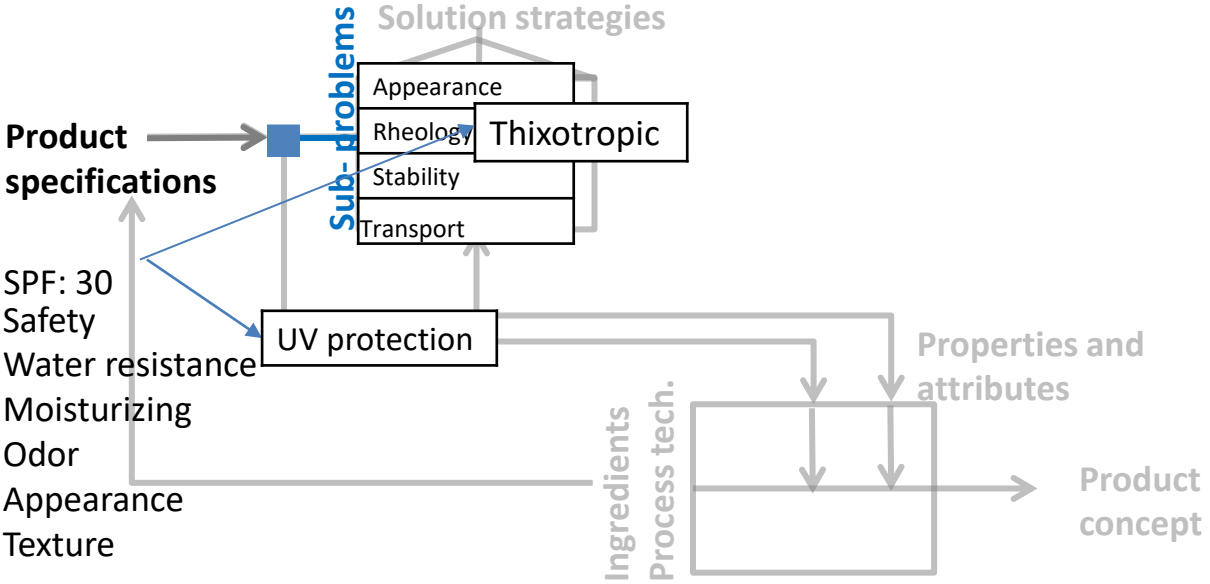

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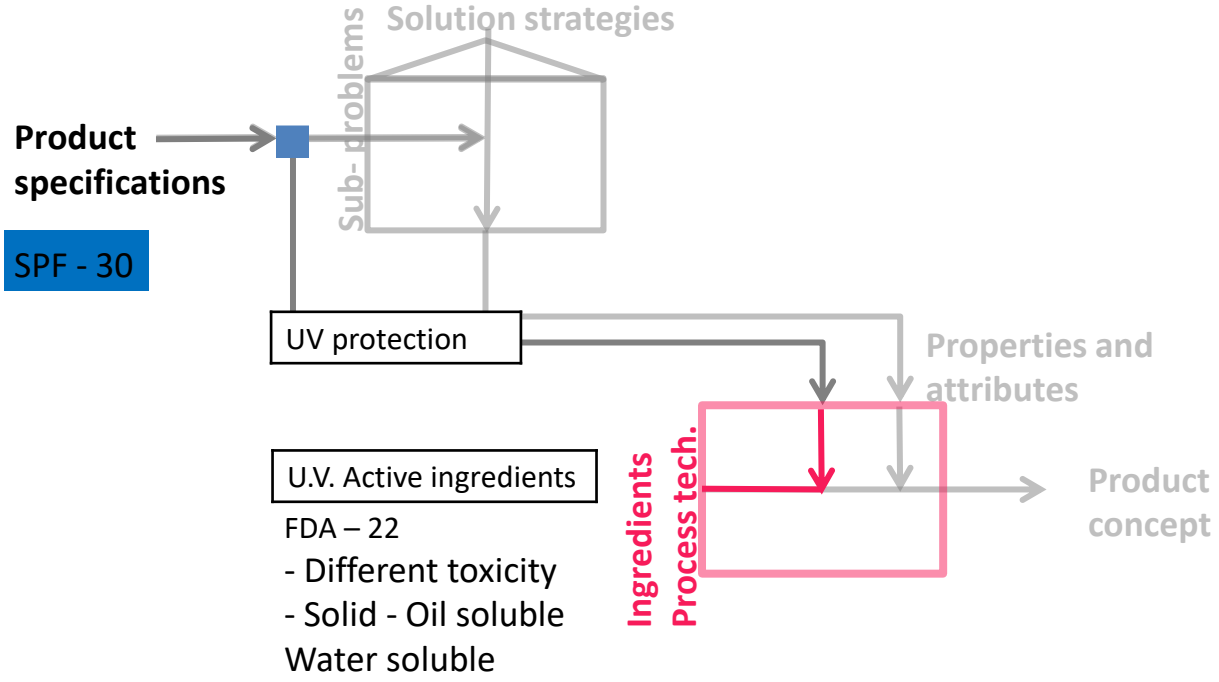

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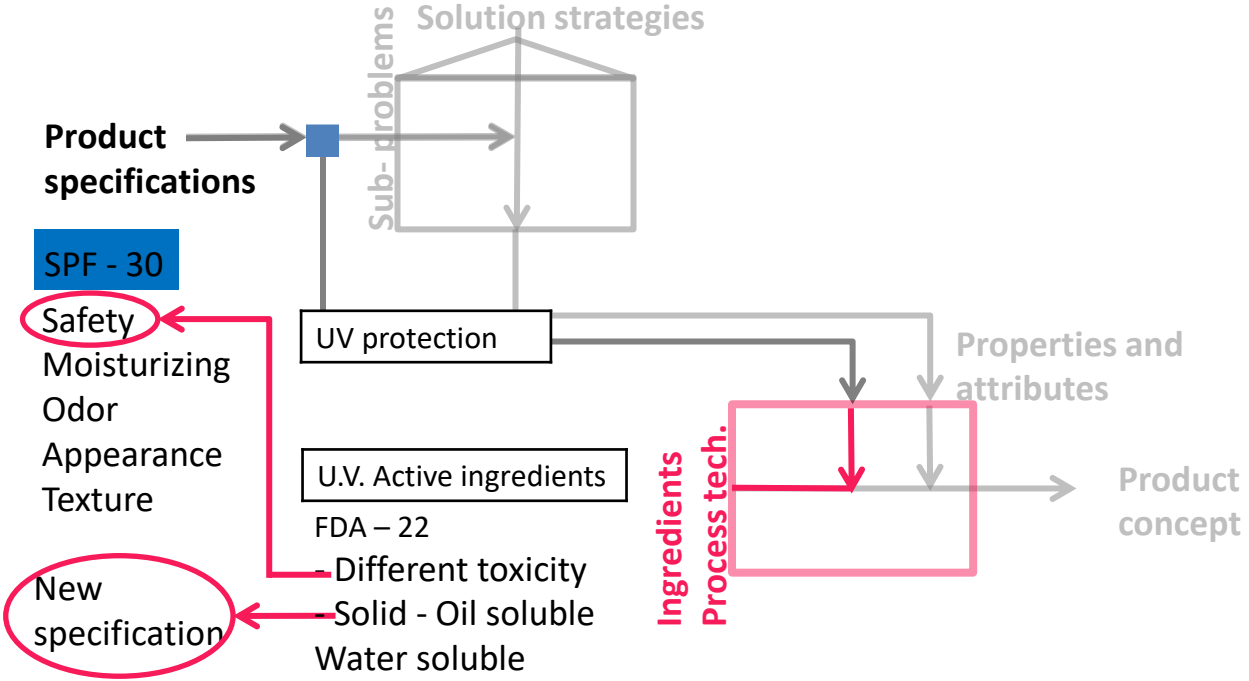

Conclusions

- ✓ The base of our methodology for decision making during early stages of chemical product design is presented.
- ✓ A method for ideas generation based on emulsion science principles and expert knowledge is proposed.
- ✓ The information structure of the decision methodology is exemplified with a case study of the cosmetic sector: a sunscreen
- ✓ This methodology will be taught to last year chemical students in order to evaluate its usability.

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Thank you

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