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



MSc. Juliana Serna
Prof. Paulo César Narváz Rincón
Prof. Vincent Boly
Prof. Véronique Falk

Barcelona
October 03, 2017

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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



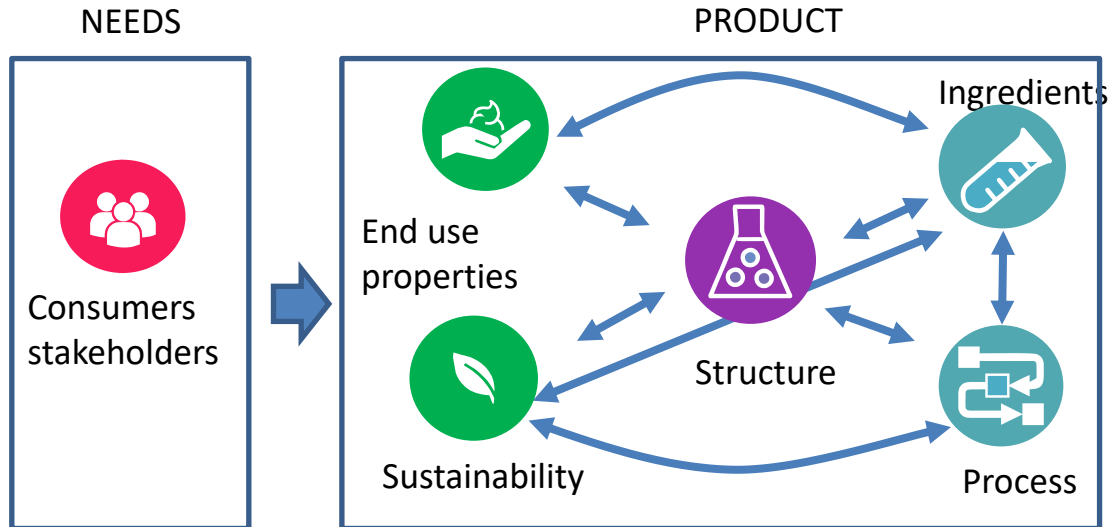
Research in Chemical Engineering and Academia

- Chemical product design
- Courses and graduate programs



Introduction: Emulsion - micro-structured product

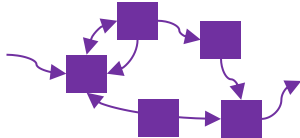
- ✓ Micro-structure
- ✓ End use functions



Problem statement

Problem statement

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



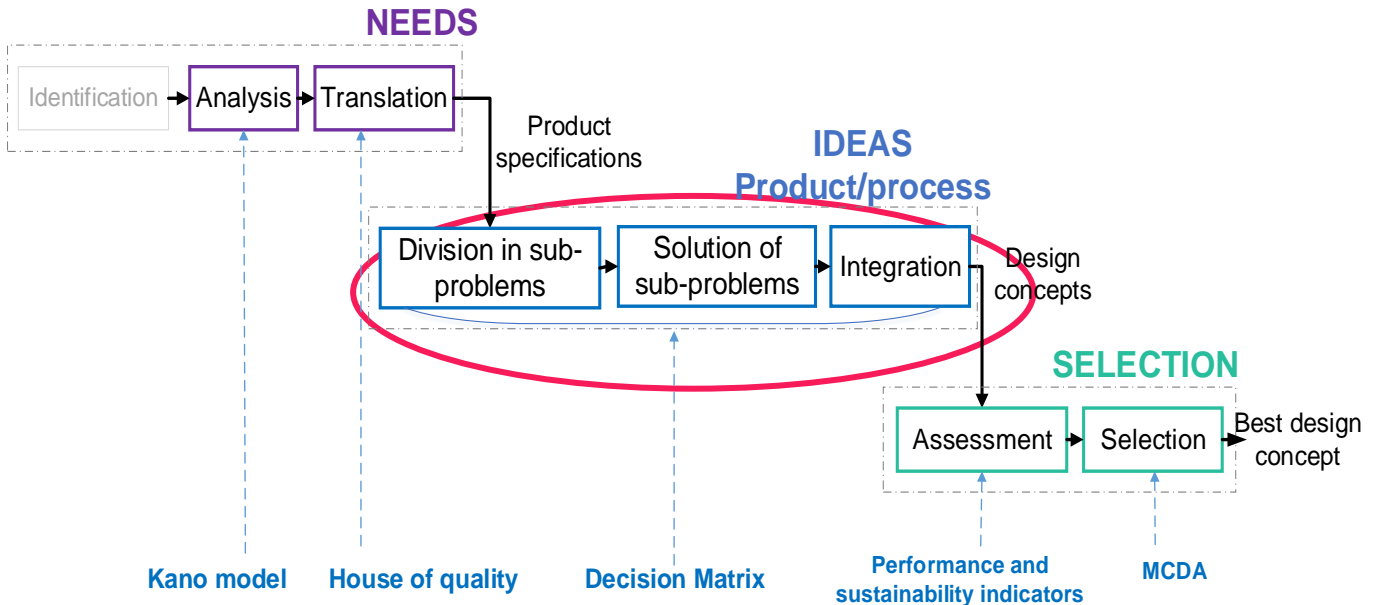
- **Early design stages**
75% costs. - few information.
- **Usability:** engineers may understand the methodology and **re-use it autonomously**

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



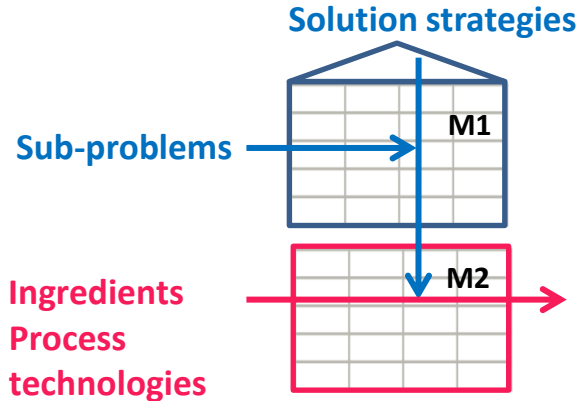
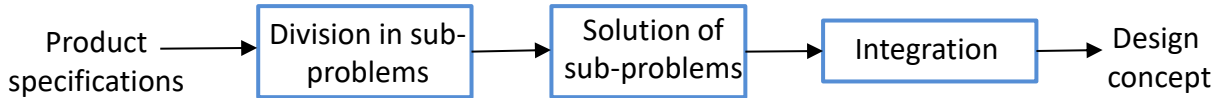
Methodology



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



Ideas generation: Decision matrix

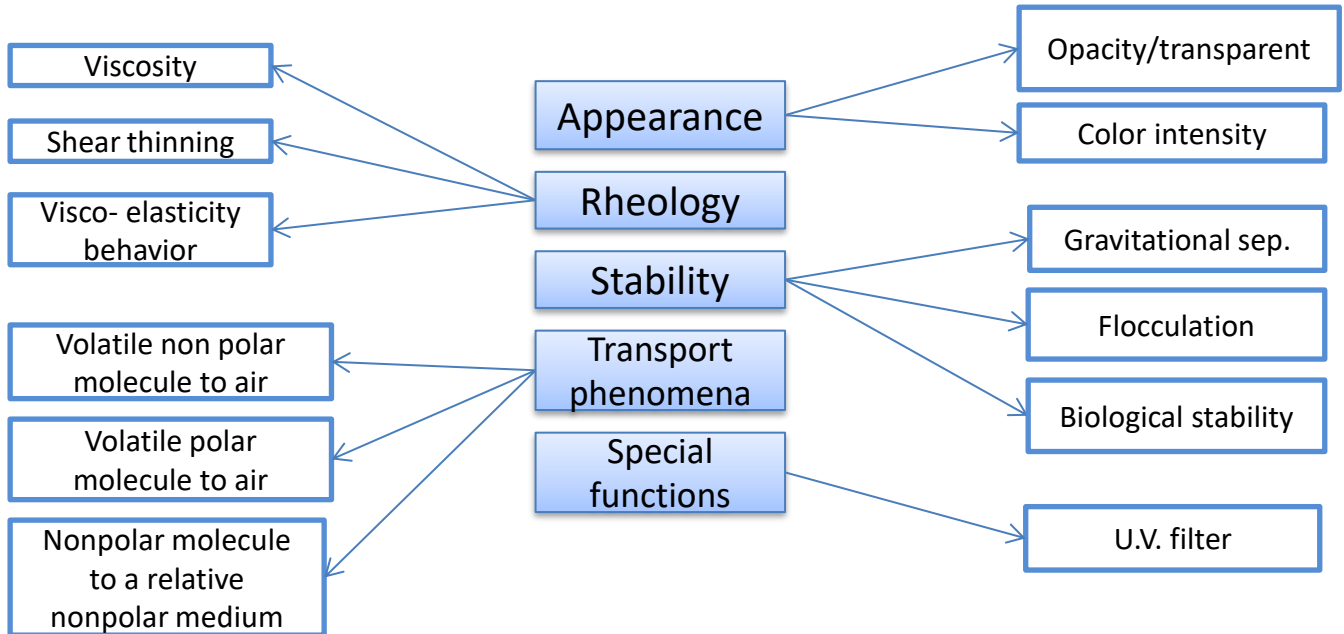


- ✓ Based on emulsion science principles
- ✓ The connection between them is done with expert knowledge



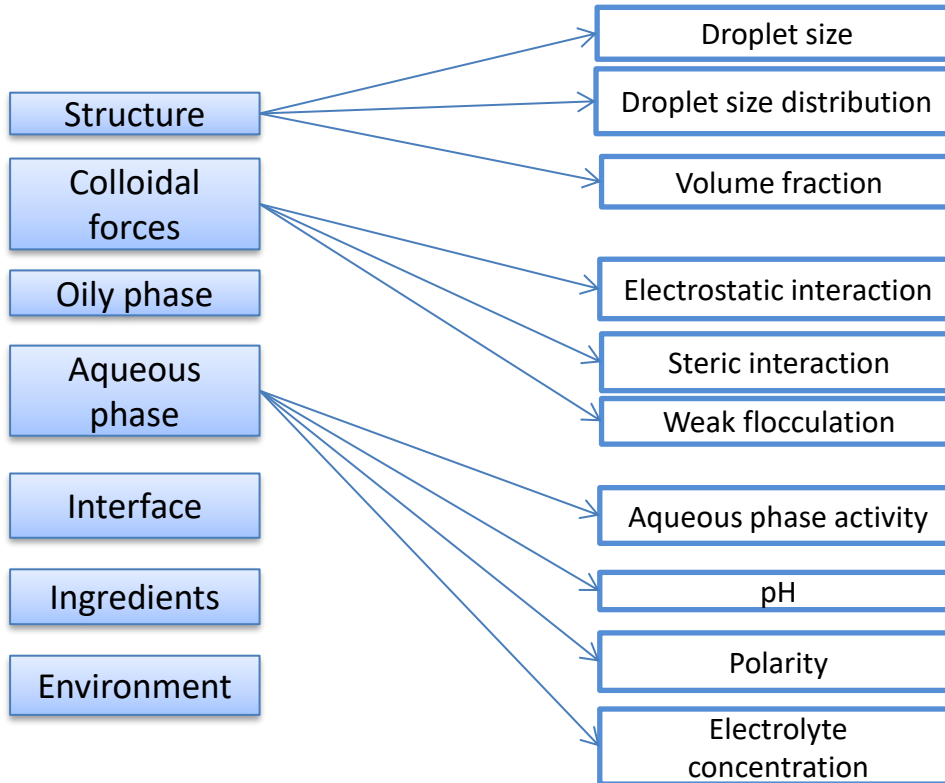
Decision matrix: M1 sub-problems

Identified from emulsion science - 22 + generic sub-problems



Decision matrix: M1 solution strategies

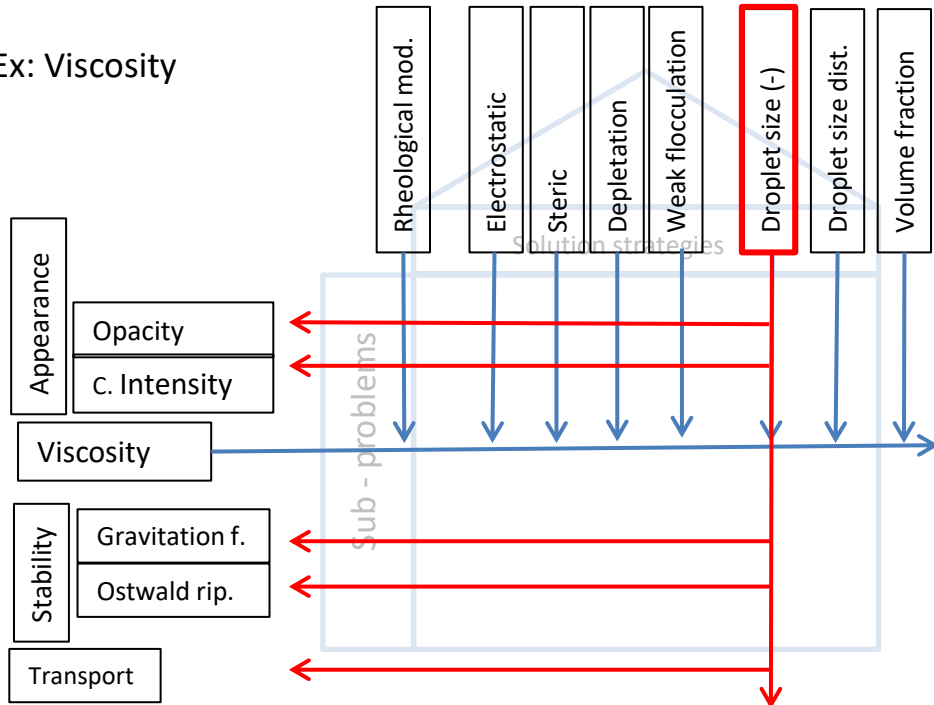
Identified from emulsion science 36 general solution strategies



Decision matrix: M1 interrelation

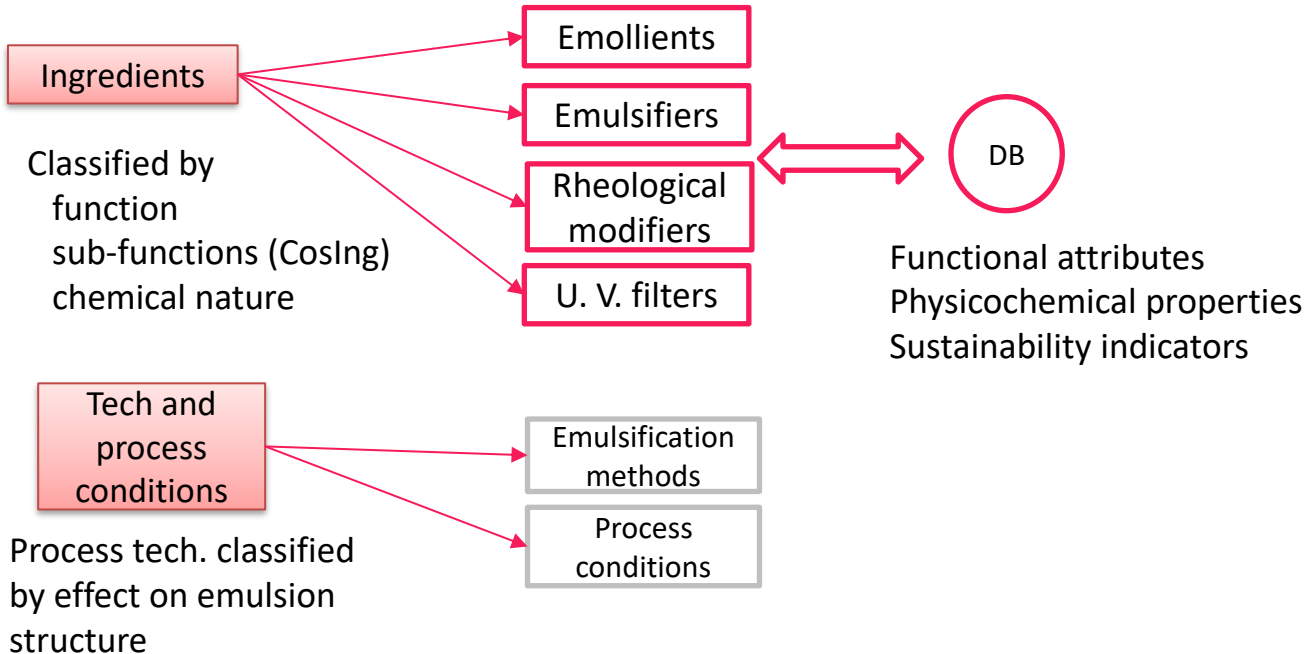
Interrelation of sub-problems and solutions strategies – experts knowledge (O/W emulsion, low concentration of the oily phase (<20%))

Ex: Viscosity

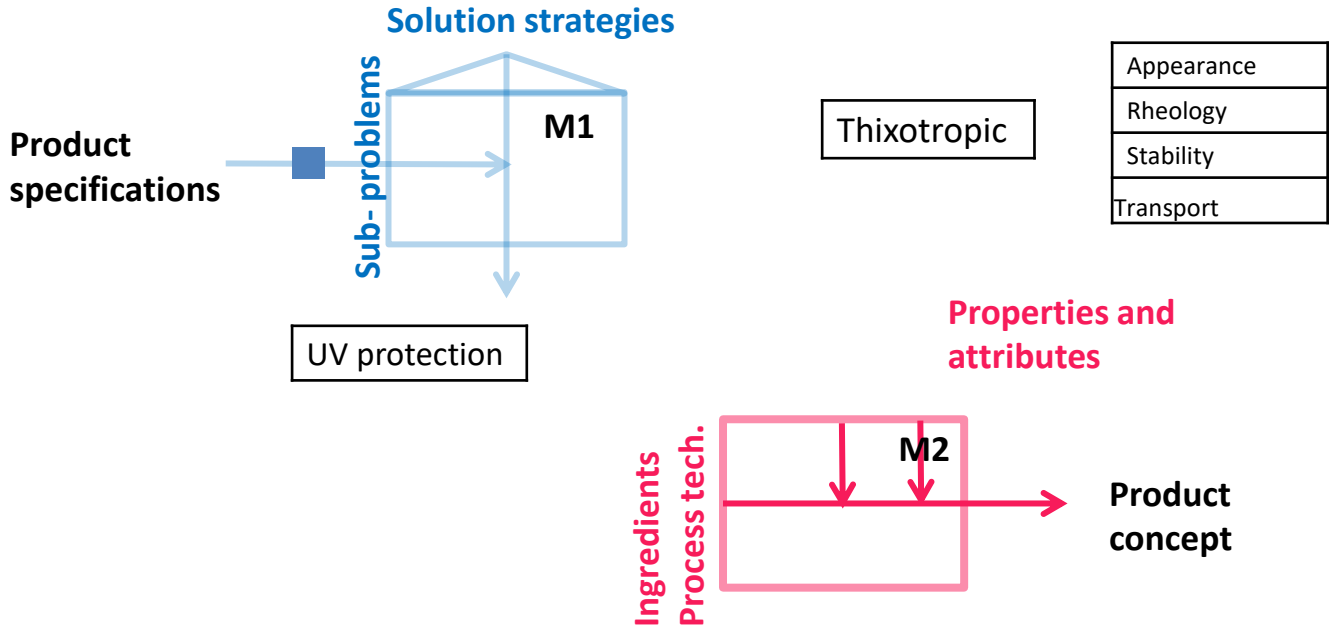


Decision matrix: M2 ingredients and technologies

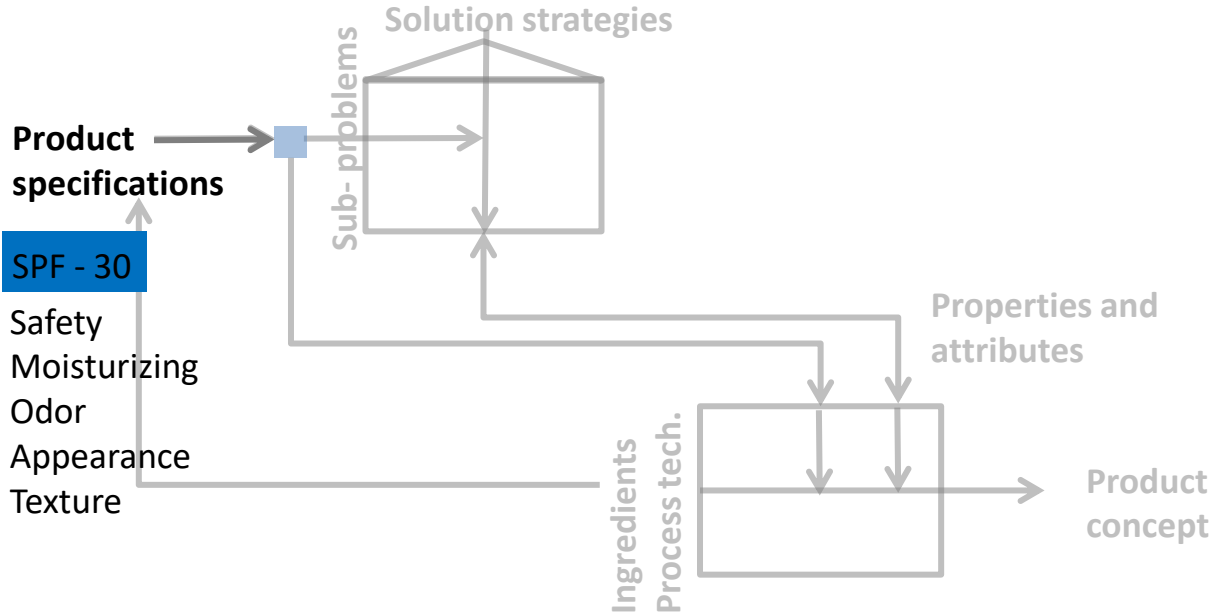
Structure of second matrix of the decision : Cosmetic emulsion – skin care



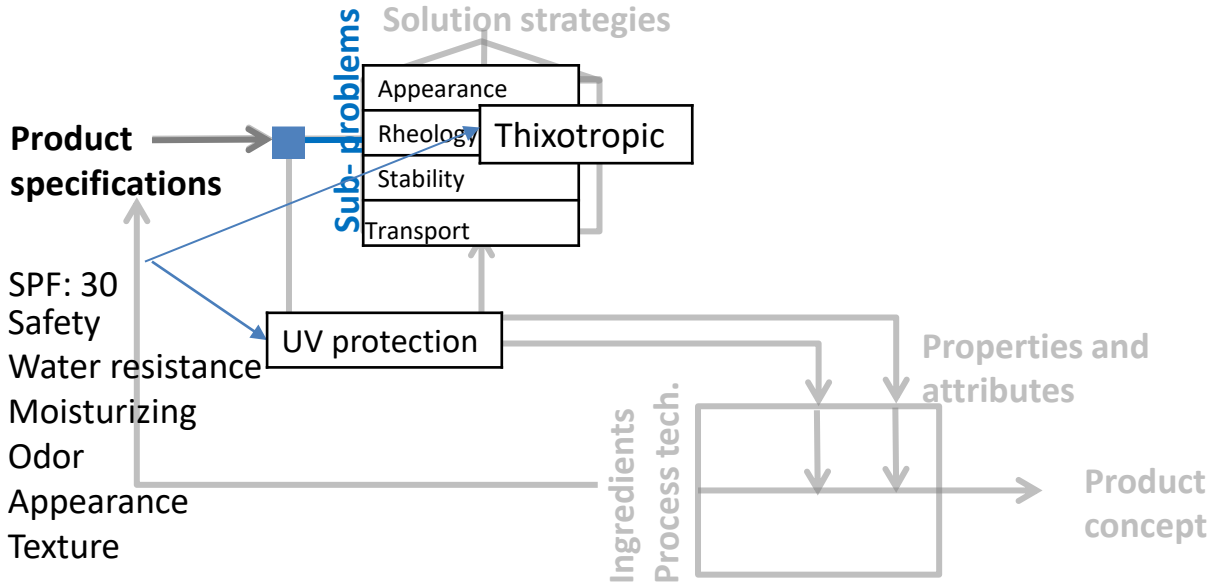
Decision matrix: Information structure



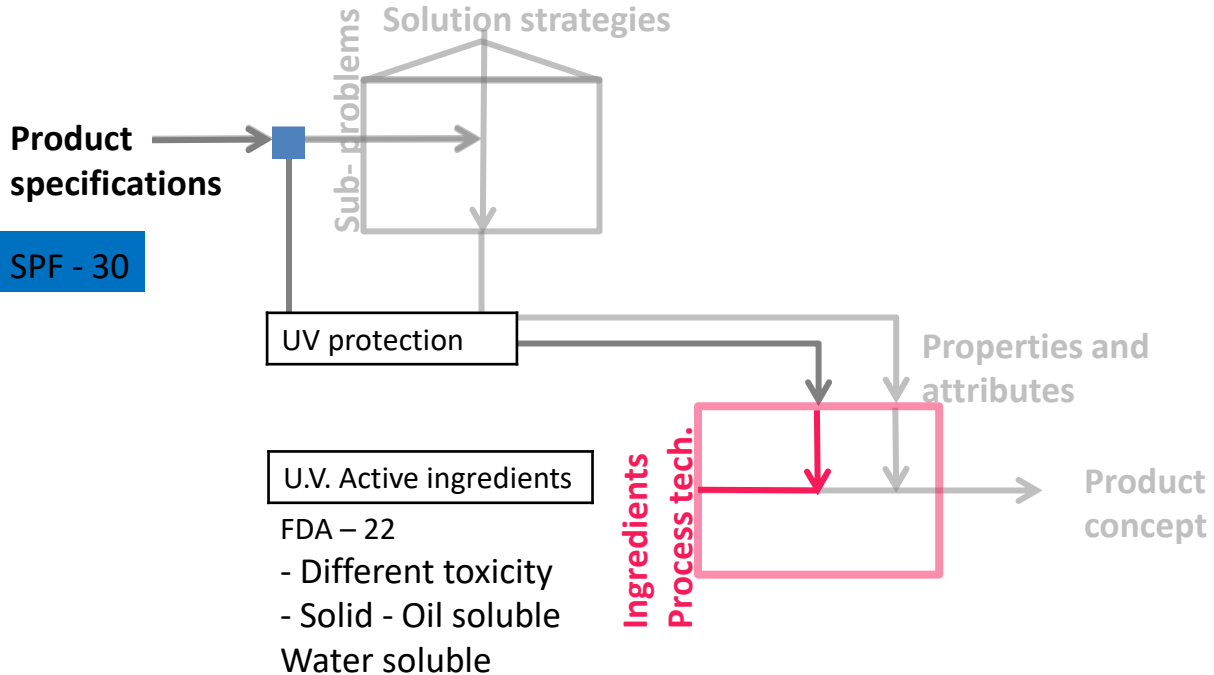
Example: Sunscreen



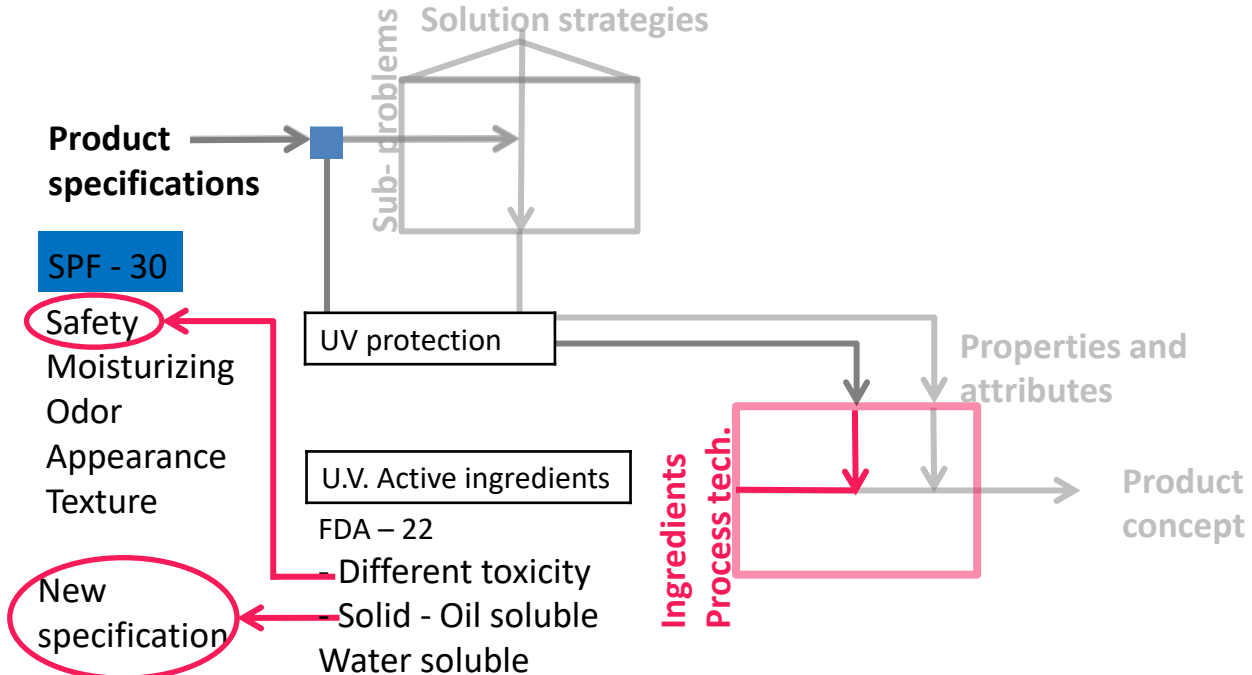
Example: Sunscreen



Example: Sunscreen



Example: Sunscreen



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.





Thank you



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