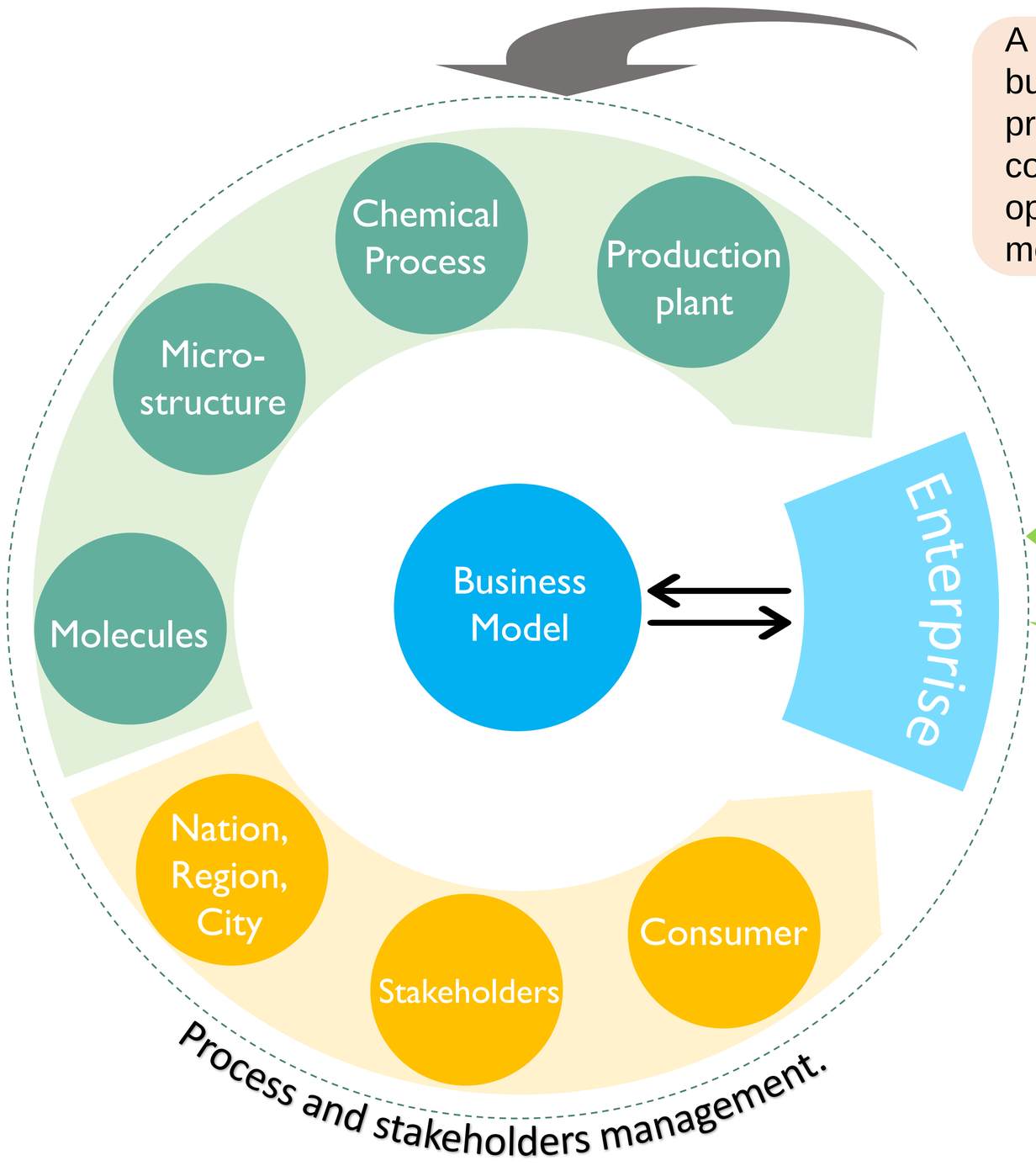
TOWARDS A HOLISTIC FRAMEWORK FOR COSMETIC FORMULATION 4.0

Jose L. Rivera Gil[1,2], Javier A. Arrieta Escobar[1], Juliana Serna Rodas[1], Fatima Hamdani[1], Paulo Narvaez[2], Vincent Boly[1], Veronique Falk[1], Fernando Bernardo[3].

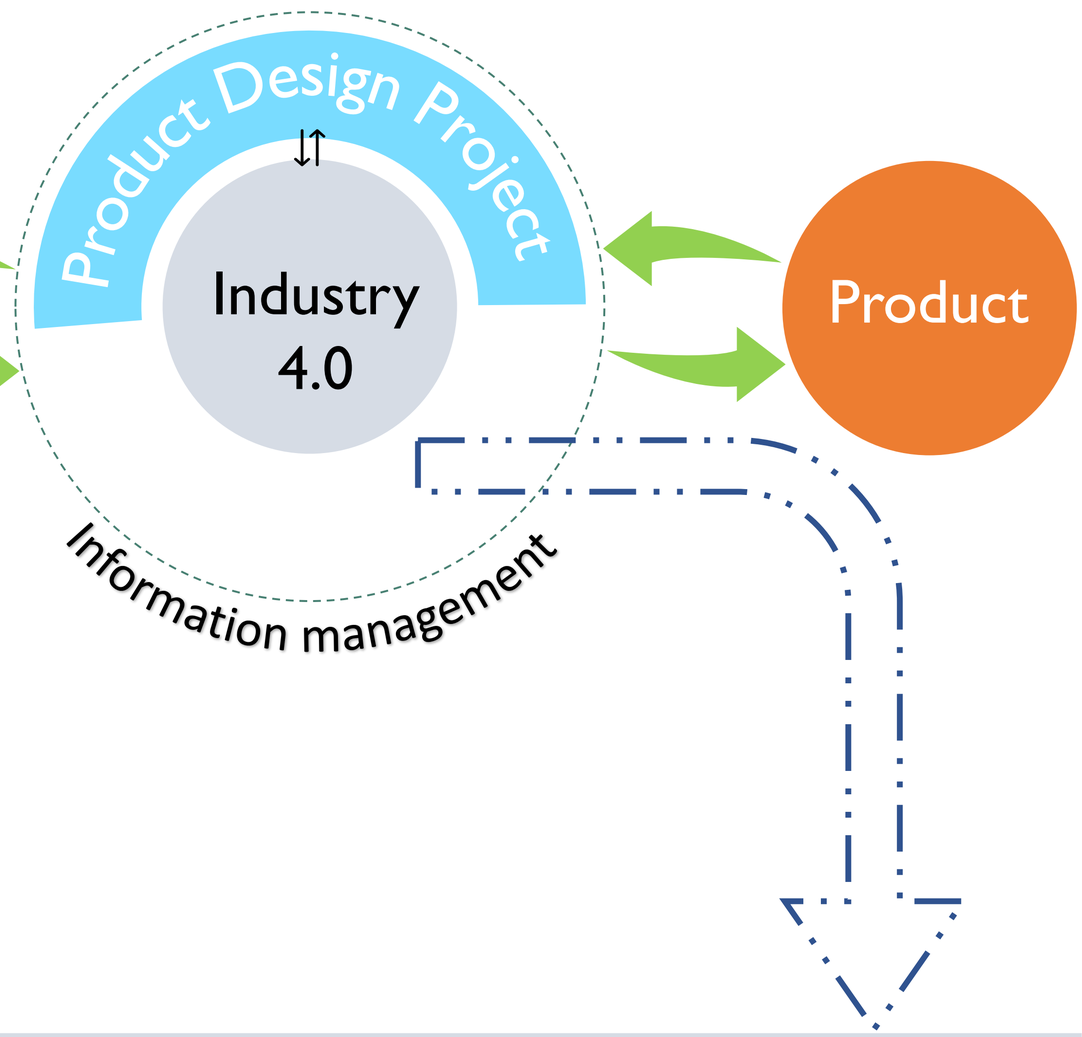
(1) Université de Lorraine, Nancy, France (2) Universidad Nacional de Colombia, Bogotá (3) University of Coimbra, Portugal

*jlriverag@unal.edu.co

Formulated consumer products design is a major challenge in many industrial sectors. Desired product properties depend on its application and usually are conferred by a synergistic action of ingredients, composition, and production process. Product design projects must manage aspects such as the study of consumer needs and their translation, technical requirements, product conceptualization, selection of suppliers and raw materials, environmental objectives; marketing characteristics; quantitative sales and distribution goals.

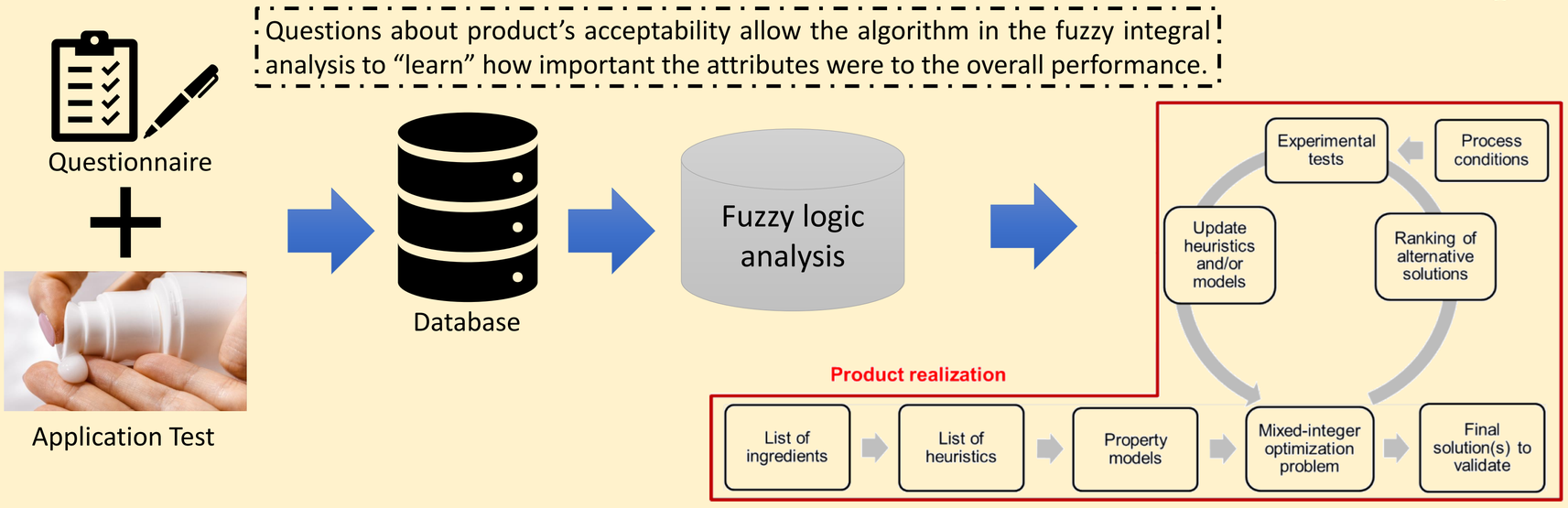


A decision-making context is proposed based on the company business model for finding plausible formulations of cosmetic products. The framework uses a comprehensive fuzzy analysis of consumer preferences integrated into a mixed-integer optimization tool that incorporates available heuristic and property models.

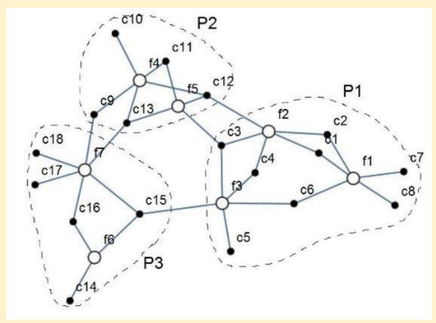


Consumer Assessment and Product modelling

Questions about product's acceptability allow the algorithm in the fuzzy integral analysis to "learn" how important the attributes were to the overall performance.

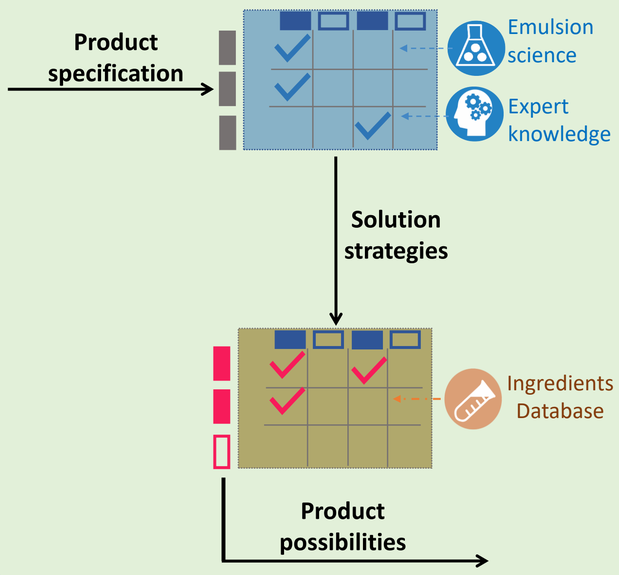


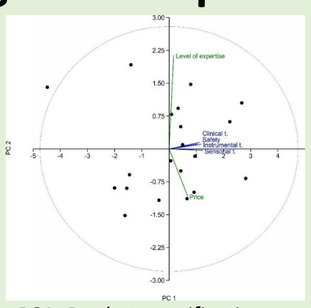
Possible formulations Clusters



An automated exploratory design of experiments is generated, including at least one instance from each cluster.

Decision making tool - Expert system





PCA: Product specifications groups according to experts

Rule based expert system

A matrix database for the interrelation of variables based on QFD and multivariable statistical data analysis methods are proposed as tools for the formalization of experts' knowledge.

Perspectives

In a further development, a similar approach should also be applied to the analysis of the other variables in the new product formulation process considering product sustainability, as well as supply chain analysis, to build a holistic framework for formulation. In this sense this research represents a contribution to Industry 4.0 in the cosmetic sector where the digitalization of product design, should be a major trend in a short term.

References

Bernardo, F. P., & Arrieta-Escobar, J. A. (2019). Clustering alternative product formulations using graphs. *Computer Aided Chemical Engineering*, *46*(i), 511–516. https://doi.org/10.1016/B978-0-12-818634-3.50086-2

Escobar, J. A., Camargo, M., Morel, L., Bernardo, F., Orjuela, A., & Wendling, L. (2020). Integrated Methodology for the Design of Formulated Products Incorporating Consumer Preferences and Heuristic Knowledge. *Authorea Preprints*, 1–19. https://doi.org/10.22541/au.158879155.54817449

Serna Rodas, J., Arrieta Escobar, J. A., Enjolras, M., & Hamdani, F. (2020). Exploring the relationship between customer needs and product target specifications for cosmetic emulsions. *International Association for Management of Technology*.