QUESTIONNAIRE – USE OF MATHEMATICAL MODELS IN THE FOOD INDUSTRY

Introduction

This questionnaire is developed by the COST Action "FoodMC", which aims at supporting the European food sector in adopting modelling and optimization methods from mathematics and computer science. The questionnaire will be given to a broad range of food companies across Europe. The answers will be used to review the current use of computational tools for various applications such as product and process development, process control, food safety, decision support and environmental impacts.

What is a COST action? COST is a European framework supporting trans-national cooperation among researchers, engineers and scholars across Europe. COST funds networking projects called Actions, with the objective to create a community around emerging topics. For more information, see the COST website: http://www.cost.eu. The full name of COST Action "FoodMC" is "Mathematical and Computer Science Methods for Food Science and Industry": https://www6.inra.fr/foodmc.

QUESTIONNAIRE

Country: _____

Number of employees:

☐ Small company (≤ 50)	☐ Medium company (51 – 250)	☐ Large company (≥ 250)

Type of industry - Please indicate your company's position(s) in the supply chain and the product categories

Position in supply chain: / Type of product:	Primary production	Food processing	Storage/distribution	Retail and wholesale
Meat and poultry	☐	☐	☐	☐
Dairy	☐	☐	☐	☐
Fruits and Vegetables	☐	☐	☐	☐
Grains and cereal products	☐	☐	☐	☐
Fish and seafood	☐	☐	☐	☐
Eggs and egg products	☐	☐	☐	☐
Oils and fats	☐	☐	☐	☐
Confectionaries	☐	☐	☐	☐
Convenience food (e.g. ready-to-eat meals)	☐	☐	☐	☐
Spices, seasoning and condiments	☐	☐	☐	☐
Food additives	☐	☐	☐	☐
Beverages	☐	☐	☐	☐
Feed	☐	☐	☐	☐
Others	☐	☐	☐	☐

Implemented certified management systems (regardless of type of standard):

☐ Food safety management system (e.g. FSMS – ISO 22000, BRC, IFS, GlobalGAP)	☐ Quality management system (e.g. QMS - ISO 9001)	☐ Environmental management system (e.g. EMS – ISO 14001)

Respondents position in the company

☐ Top management	☐ Research and development	☐ Quality control	☐ Production	☐ Sales and Communication

Mathematical models & computational tools in your company

Rules for scoring: "1" - Strongly disagree; "2" – Disagree; "3" - Neither agree nor disagree; "4" – Agree; "5" - Strongly agree

Modelling technique	**I have knowledge of this technique**					**This technique is routinely used in our company**				
	"1"	**"2"**	**"3"**	**"4"**	**"5"**	**"1"**	**"2"**	**"3"**	**"4"**	**"5"**
Physics-based modelling										
• Transport phenomena and mechanics (fluid dynamics, solid mechanics, heat and mass transfer)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Molecular modelling/Multi scale modelling	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Flowsheeting	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Data based (empirical) modelling										
• Response surface modelling	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Multivariate data analysis	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Data mining and machine learning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Automation and control										
• Production planning	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Real time process control	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Business models										
• Supply chain models	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Decision support	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
• Productivity analysis	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Need for models

Rules for scoring: "1" – There is no need for mathematical models in my company; "2" – I would like to some mathematical models; "3" – There is some (limited) use, we would like to expand our knowledge in this area; "4" – We have an extensive use of models in this area; "5" – Not applicable in our company (N/A)

Application areas for modelling	**"1"**	**"2"**	**"3"**	**"4"**	**"5"**
Product development	☐	☐	☐	☐	☐
Process development	☐	☐	☐	☐	☐
Real-time process optimisation and control	☐	☐	☐	☐	☐
Food storage optimisation and control	☐	☐	☐	☐	☐
Food quality control	☐	☐	☐	☐	☐
Microbial growth modelling	☐	☐	☐	☐	☐
Food safety and pest control	☐	☐	☐	☐	☐
Characterizing food quality	☐	☐	☐	☐	☐
Value chain management	☐	☐	☐	☐	☐
Decision control	☐	☐	☐	☐	☐
Productivity analysis	☐	☐	☐	☐	☐
Life cycle assessment	☐	☐	☐	☐	☐
Carbon footprint	☐	☐	☐	☐	☐
Water footprint	☐	☐	☐	☐	☐
Energy footprint	☐	☐	☐	☐	☐
Waste management	☐	☐	☐	☐	☐

Barriers for using computational tools in your company

Rules for scoring: “1” - Strongly disagree; “2” – Disagree; “3” - Neither agree nor disagree; “4” – Agree; “5” - Strongly agree

Statements	**“1”**	**“2”**	**“3”**	**“4”**	**“5”**
We lack competence on mathematical modelling	☐	☐	☐	☐	☐
We lack sensors/instrumentation to collect data	☐	☐	☐	☐	☐
We lack infrastructure for data/model management	☐	☐	☐	☐	☐
Our product/process is too complex for modelling	☐	☐	☐	☐	☐
Our product/process is too simple to gain from modelling	☐	☐	☐	☐	☐
We have problems with upscaling our models	☐	☐	☐	☐	☐

Awareness and documentation of environmental impacts

Rules for scoring: “0” - There is no analysis of this environmental impact; “1” - Company analyses basic environmental data; “2” – Company calculates specific environmental indicators for this impact; “3” - Company converts basic data to calculate environmental impacts per process / functional unit; “4”- Company calculates environmental footprints related to this environmental impact. Data are presented per process and/or functional unit (kg of final product). N/A – Not applicable

Your company is aware of its…	**“0”**	**“1”**	**“2”**	**“3”**	**“4”**	**N/A**
Electric energy consumption	☐	☐	☐	☐	☐	☐
Thermal energy consumption	☐	☐	☐	☐	☐	☐
Sources of energy consumption	☐	☐	☐	☐	☐	☐
Water consumption	☐	☐	☐	☐	☐	☐
Impact on air pollution (atmosphere)	☐	☐	☐	☐	☐	☐
Impact on water pollution (hydrosphere)	☐	☐	☐	☐	☐	☐
Impact on soil contamination (lithosphere)	☐	☐	☐	☐	☐	☐
Impact on the ecosystem (biosphere)	☐	☐	☐	☐	☐	☐
Impact on climate change	☐	☐	☐	☐	☐	☐
Impact from waste generated in our company	☐	☐	☐	☐	☐	☐

Documented environmental targets / indicators for...

Rules for scoring: “1” - Strongly disagree; “2” – Disagree; “3” - Neither agree nor disagree; “4” – Agree; “5” - Strongly agree

We have documented numerical targets / indicators for……	“1”	“2”	“3”	“4”	“5”
Energy savings on a company basis	☐	☐	☐	☐	☐
Energy savings for all processes	☐	☐	☐	☐	☐
Water savings on a company basis	☐	☐	☐	☐	☐
Water savings for all processes	☐	☐	☐	☐	☐
Decreasing air pollution	☐	☐	☐	☐	☐
Decreasing water pollution	☐	☐	☐	☐	☐
Decreasing impact on the ecosystem	☐	☐	☐	☐	☐
Decreasing greenhouse gas emission	☐	☐	☐	☐	☐
Decreasing amount of hazardous waste	☐	☐	☐	☐	☐
Decreasing amount of all types of waste	☐	☐	☐	☐	☐
Improving my product	☐	☐	☐	☐	☐