The future of Food Engineering: Education

P. Pittia, C. Silva, D. Knorr, G. Trystram

CATÓLICA
UNIVERSIDADE CATÓLICA PORTUGUESA
ESCOLA SUPERIOR DE BIOTECNOLOGIA

AgroParisTech

INRA

EXISTING EDUCATION PROGRAMMES

Education: Food related-study programmes in EU

Bachelor degree: > 210

Leading countries (n.): DE, ES, IT, PT

Master degree: > 200

Leading countries (n.): IT, PT, UK, DK, BE, F

PhD: > 70

Only a few number of places where Food Engineering is developped

(Track_fast & ISEKI_Food collection data, 2012)

Education: Food related-study programmes in EU

- **Bachelor programmes:**
- **FST, FS, FT, FE, Biotech, Viticulture & Oenology, Processes of Animal products, Nutrition & FS, Process Eng – FT, Engineer Agronomist,…**
- **Food Innovation Management, Food Innovation, Food Service, Gastronimic Sciences, Food & Business….**
- **Master programmes:**
- **FS&T, FS&Eng, Industrial Biotech, Innovative Enology, Food microbiology, Food chemistry, Life science Technology, Agrofoodchain**
- **Food enterprise development, Food Business,…**

(Track_fast & ISEKI_Food collection data, 2012)

Definition of Food Engineering
from EAFE project, 2013

- *Food Engineering covers the study, modeling and design of ingredients and foods at all scales using technological innovations and engineering principles in the development, manufacturing, use and understanding of existing and emerging food processes, food packaging and food materials from food production to digestion and satiation enabling development and design, production, and availability of sustainable, safe, nutritious, healthy, appealing and affordable supply of high quality ingredients and foods.*

Fundamental	Details
▪ Characteristics of raw food material	▪ Understand the source and variability of raw food material and their impact on food processing operations.
▪ Principles of food preservation including low and high temperatures, water activity, etc.	▪ Know the spoilage and deterioration mechanisms in foods and methods to control deterioration and spoilage. ▪ Understand the principles that make a food product safe for consumption.
▪ Engineering principles including mass and energy balances, thermodynamics, fluid flow, and heat and mass transfer	▪ Understand the transport processes and unit operations in food processing as demonstrated both conceptually and in practical laboratory settings. ▪ Be able to use the mass and energy balances for a given food process. ▪ Understand the unit operations required to produce a given food product.
▪ Principles of food processing techniques, such as freeze drying, high pressure, aseptic processing, extrusion, etc.	▪ Understand the principles and current practices of processing techniques and the effects of processing parameters on product quality.
▪ Packaging materials and methods	▪ Understand the properties and uses of various packaging materials.
▪ Cleaning and sanitation	▪ Understand the basic principles and practices of cleaning and sanitation in food processing operations.
▪ Water and waste management	▪ Understand the requirements for water utilization and waste management in food and food processing.

Fundamental	Details
▪ Communication skills (i.e., oral and written communication, listening, interviewing, etc.)	▪ Demonstrate the use of oral and written communication skills. This includes such skills as writing technical reports, letters and memos; communicating technical information to a nontechnical audience; and making formal and informal presentations.
▪ Critical thinking/problem solving skills (i.e., creativity, common sense, resourcefulness, scientific reasoning, analytical thinking, etc.)	▪ Define a problem, identify potential causes and possible solutions, and make thoughtful recommendations. ▪ Apply critical thinking skills to new situations.
▪ Professionalism skills (i.e., ethics, integrity, respect for diversity)	▪ Commit to the highest standards of professional integrity and ethical values. ▪ Work and/or interact with individuals from diverse cultures.
▪ Life-long learning skills	▪ Explain the skills necessary to continually educate oneself.
▪ Interaction skills (i.e., teamwork, mentoring, leadership, networking, interpersonal skills, etc.)	▪ Work effectively with others. ▪ Provide leadership in a variety of situations. ▪ Deal with individual and/or group conflict.
▪ Information acquisition skills (i.e., written and electronic searches, databases, Internet, etc.)	▪ Independently research scientific and nonscientific information. ▪ Competently use library resources.
▪ Organizational skills (i.e., time management, project management, etc.)	▪ Manage time effectively. ▪ Facilitate group projects. ▪ Handle multiple tasks and pressures.

Example of one Web Site Master Food Engineering

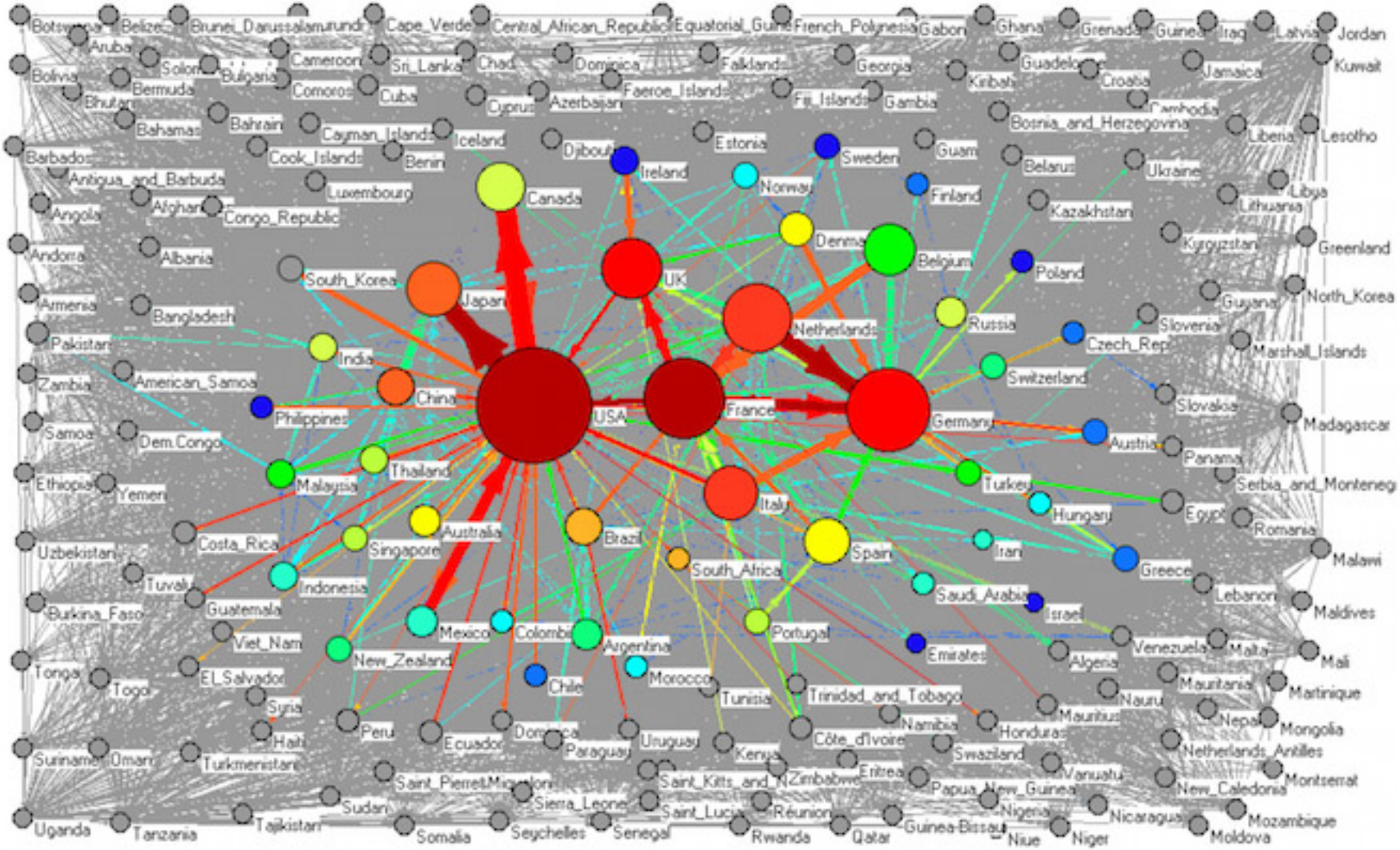
- Effect of Food Processing on Bioactive Compounds in Foods, Muscle and Meat Biochemistry, Poultry Meat Technology, Thermal Processing of Foods, New Developments in Fruit and Vegetable Industry, Water in Foods and Food Industry, Spectroscopic Methods in Food Analysis, Contaminants in Foods, Chelates Antimicrobials and Antioxidants in Food Industry, Advanced Heat Transfer, Aseptic Packaging, Energy in Food Processing, Developments in Vegetable Oil Processing Techniques and Quality Control Methods, Microbial Polysaccharides, Wine and Spirit Technology, Numerical Methods for Food Process Operations, New Dairy Product Development, Rheological Properties of Foods, Special Topics in Food Chemistry, Egg and Egg Products Technology, Sensory Test Techniques, Cold and Frozen Storage of Foods, Special Topics in Food chemistry, Drying Techniques, Food Marketing Research, Interactions of Food Components, Quality Assurance Principles in Food Analysis Laboratory, Cheese Defects and Prevention Methods, Water Treatment Systems in Food Industry, Nanotechnology Applications in Functional Food Science, Deep-fat Frying Process and Oxidation, Olive Oil Chemistry and Technology, Bioreactors Used in the Biotechnological Processes, Food Process Analysis And Modeling, Electrical Heating Methods in Food Engineering, Pickles and Vinegar Technology, Technical Problem Solving in Food Industry, Design of Nutritious and Healthy Foods, New Developments in Food Packaging Technologies, Heat Transfer Technologies of Fruits and Vegetables, Food Industry, Nutrition and Health.

Other input in Food Engineering

- Reaction Engineering, kinetics, …
- Biotechnology
- Bio Engineering
- Microbiology, enzyme processing, ..
- Process control, PAT, sensors, automation, robotics, …
- Modelling
- …
- Management, nutrition, sensory evaluation, .. appear as topics
- Legislation, Law, reglementation, ..

NEW CHALLENGES AND APPROACHES FOR FOOD ENGINEERING EDUCATION

Exchanges of products, raw materials, ..



Ercsey-Ravasz M, Toroczkai Z, Lakner Z, Baranyi J (2012)
Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810

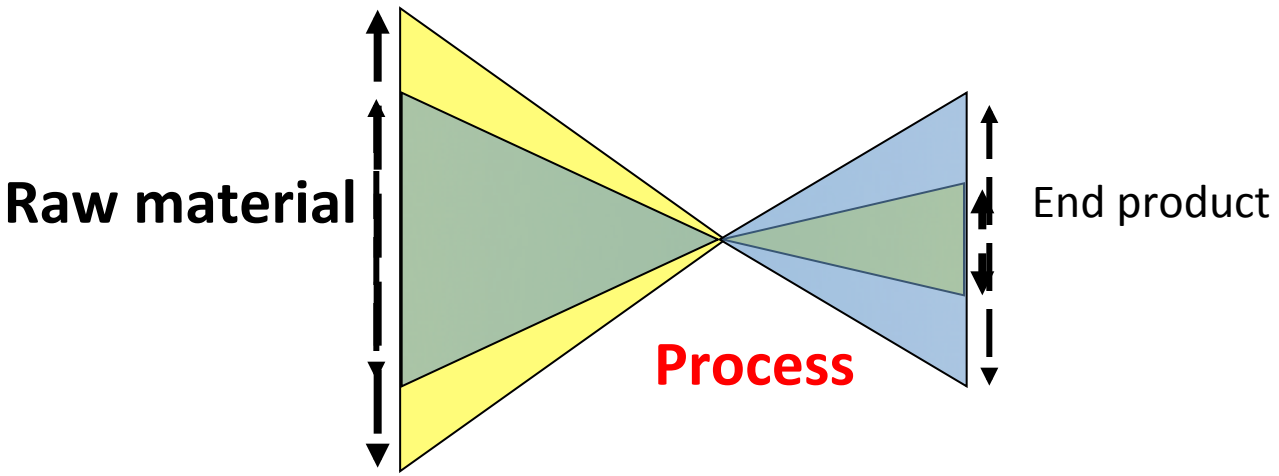
Identified future stakes for Education in Food Engineering

- Challenges for the food industries
  - Food security, Population Growth
  - Food safety, Changing eating behaviour
  - Globalization, climate change
  - Energy cost and change in value chain, fossil fuel prices
  - Sustainability and other emerging challenges
- Fundamental change in economical competition: acceleration of technological innovation, increase with information exchanges, quick evolution of consummation centres, urbanisation..
- **New answers**: competition, intensive innovation, innovation based competition, open innovation, …
- New theory emerge on design and engineering of products
- New ways of cooperation's between companies are available
- New skills are necessary, **more cross disciplinary** approaches are expected
- New students with new ways of working and expectations

CHALLENGE 1: DIVERSIFICATION

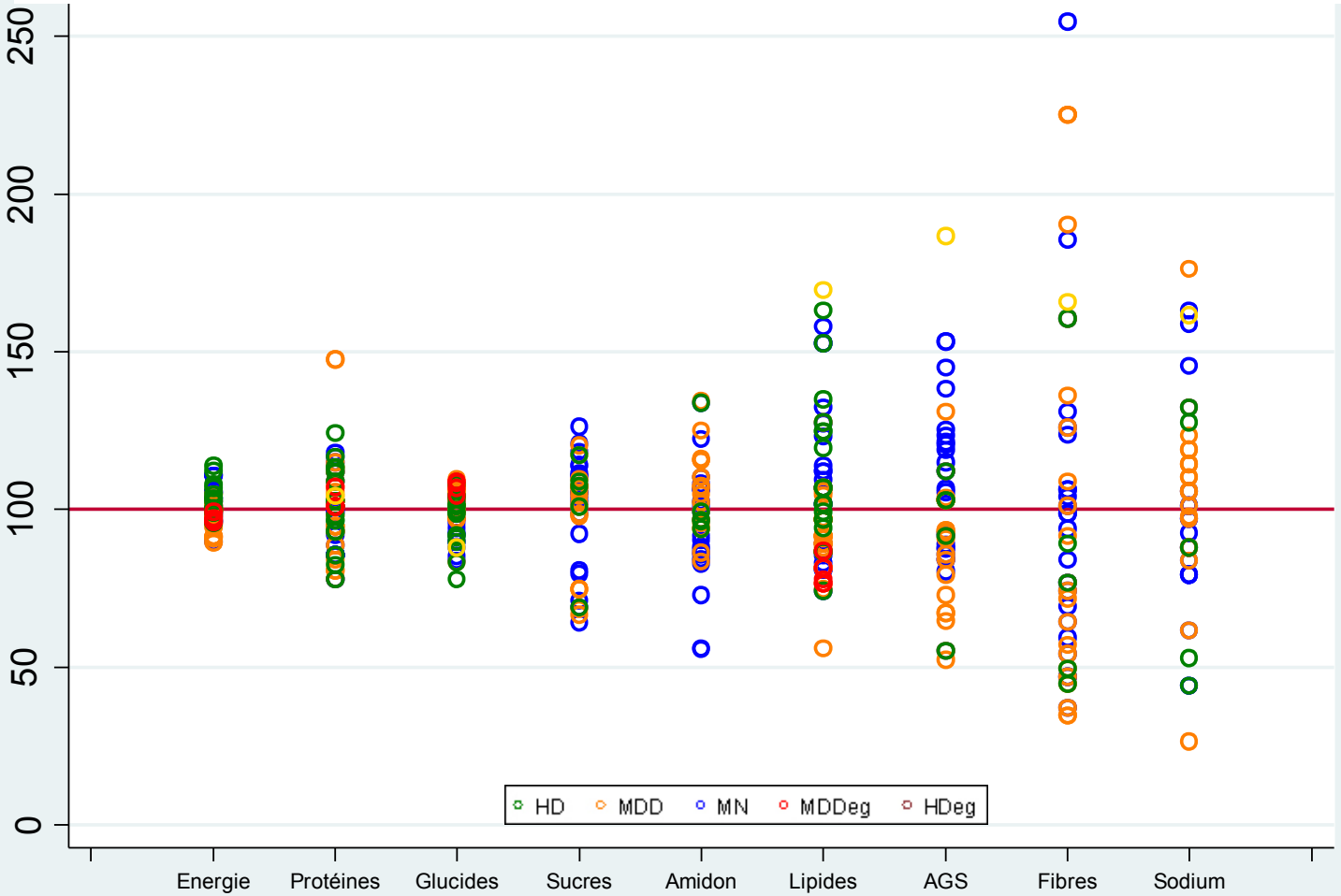
Industry has built delayed diversification for food

- The industry, by seeking efficiency and regularity, shifted diversification to downstream
  - **Gradual reduction of the diversity of raw materials (variety, culture, ..)**
  - **Control the variability of ingredients and additives**
- A food industry built in 2 or 3 steps



Industry has built delayed diversification for food

Example of the variety developed by the process: exemple of cookies



Data from OQALI project

CHALLENGE 2: EXPECTED SKILLS FROM COMPANIES

Training Requirements And Careers for Knowledge-based Food Science and Technology in Europe

TRACK_FAST

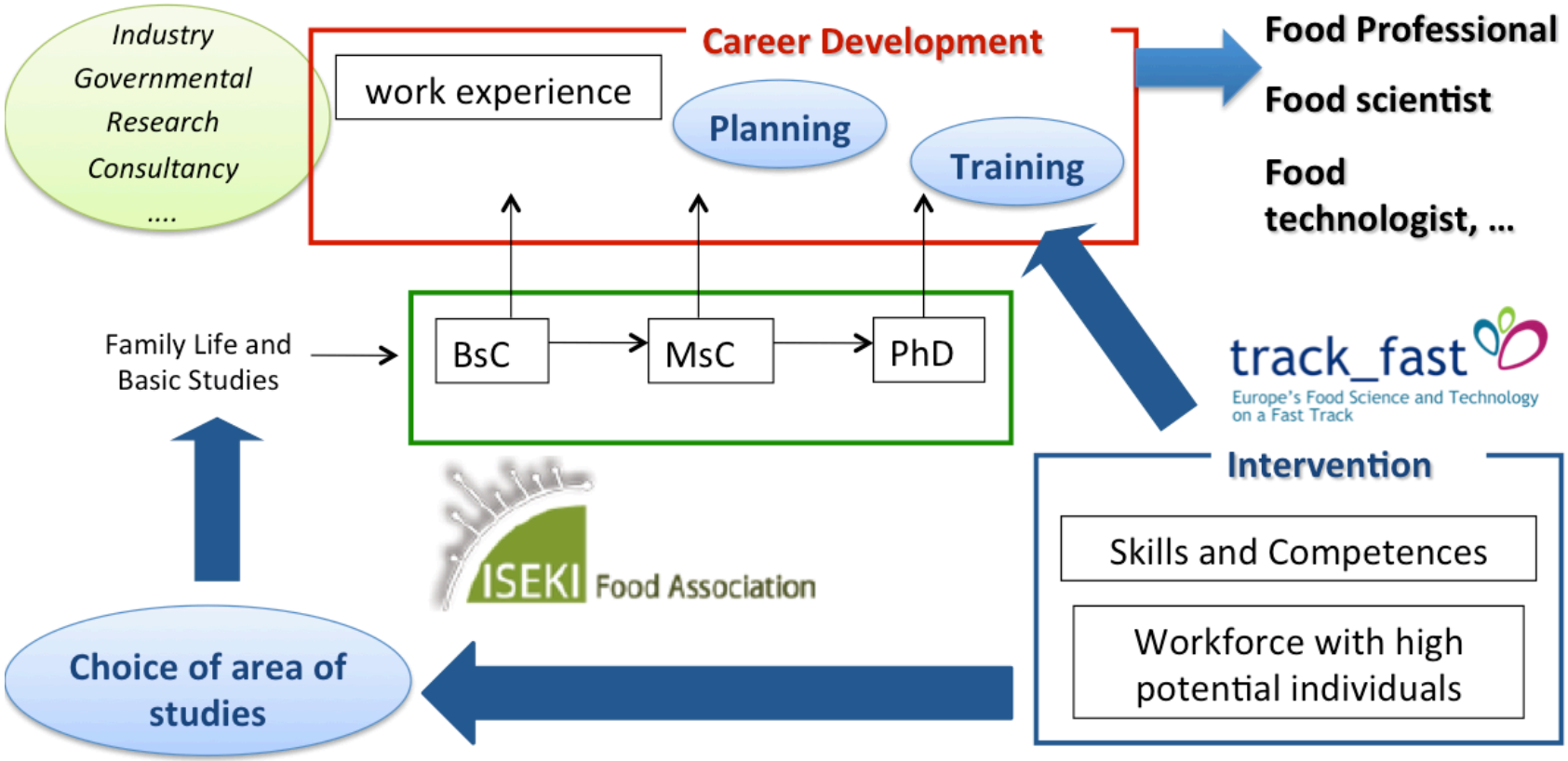
FP7 KBBE 227220

Project Coordinator
Prof. Cristina L. Silva
Escola Superior de Biotecnologia
Universidade Católica Portuguesa
Porto Portugal

Consortium

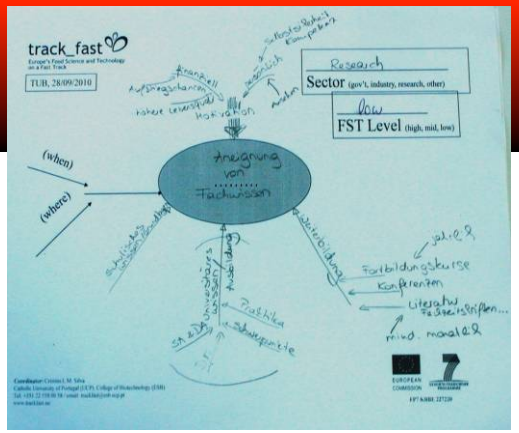

SIK, Sweden
EFFoST, The Netherlands
KI, Sweden
Unilever, The Netherlands
ASIIN, Germany
FEVIA, Belgium
TUB, Germany
SAFE, Belgium
UGent, Belgium
KTU, Lithuania
BOKU, Austria
ISEKI FOOD Assoc. Austria
UL, United Kingdom
UL BF, Slovenia
CUB, Hungary
Agroparistech, France
UG, Turkey
FIPA, Portugal
ESAC, Portugal
AINIA, Spain
UNIBO, Italy
USAMVB, Romania
ESB-UCP, Portugal
IPVC, Portugal
UPV, Spain
UNITE, Italy
NTUA, Greece

“Life cycle” of a Food Professional

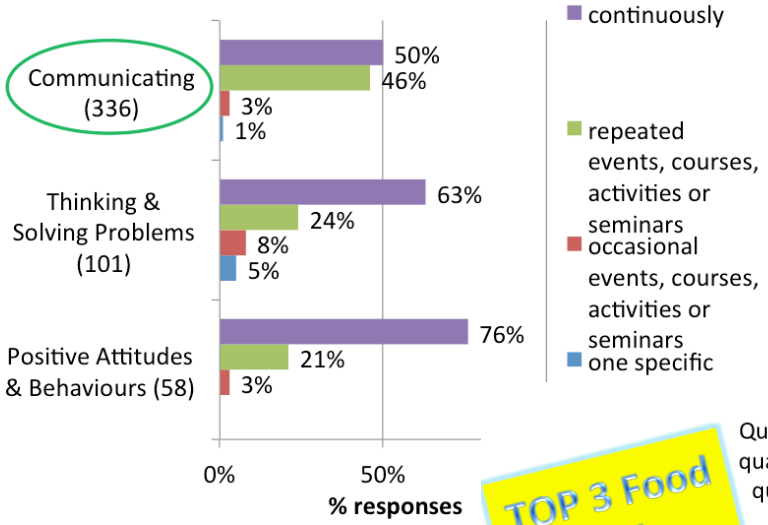


track_fast
Europe’s Food Science and Technology on a Fast Track

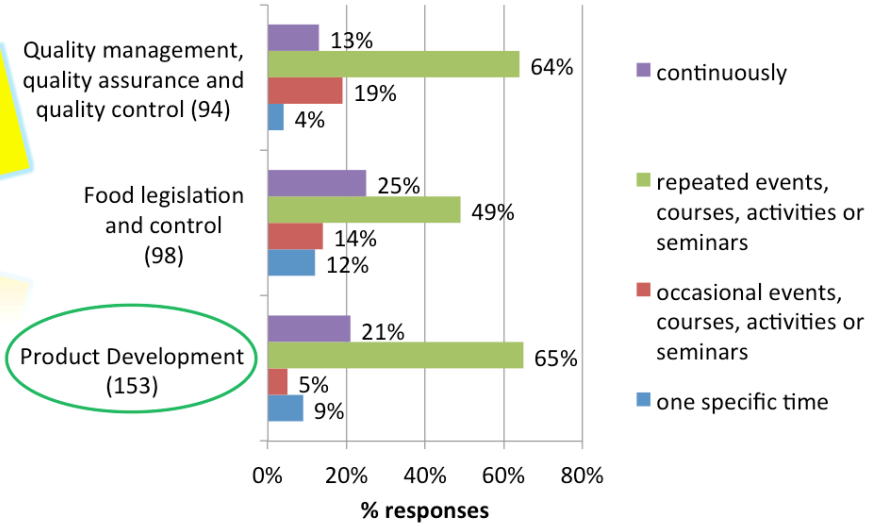
Which competences ? Where, when, how, how often?



TOP 3 Soft Skills

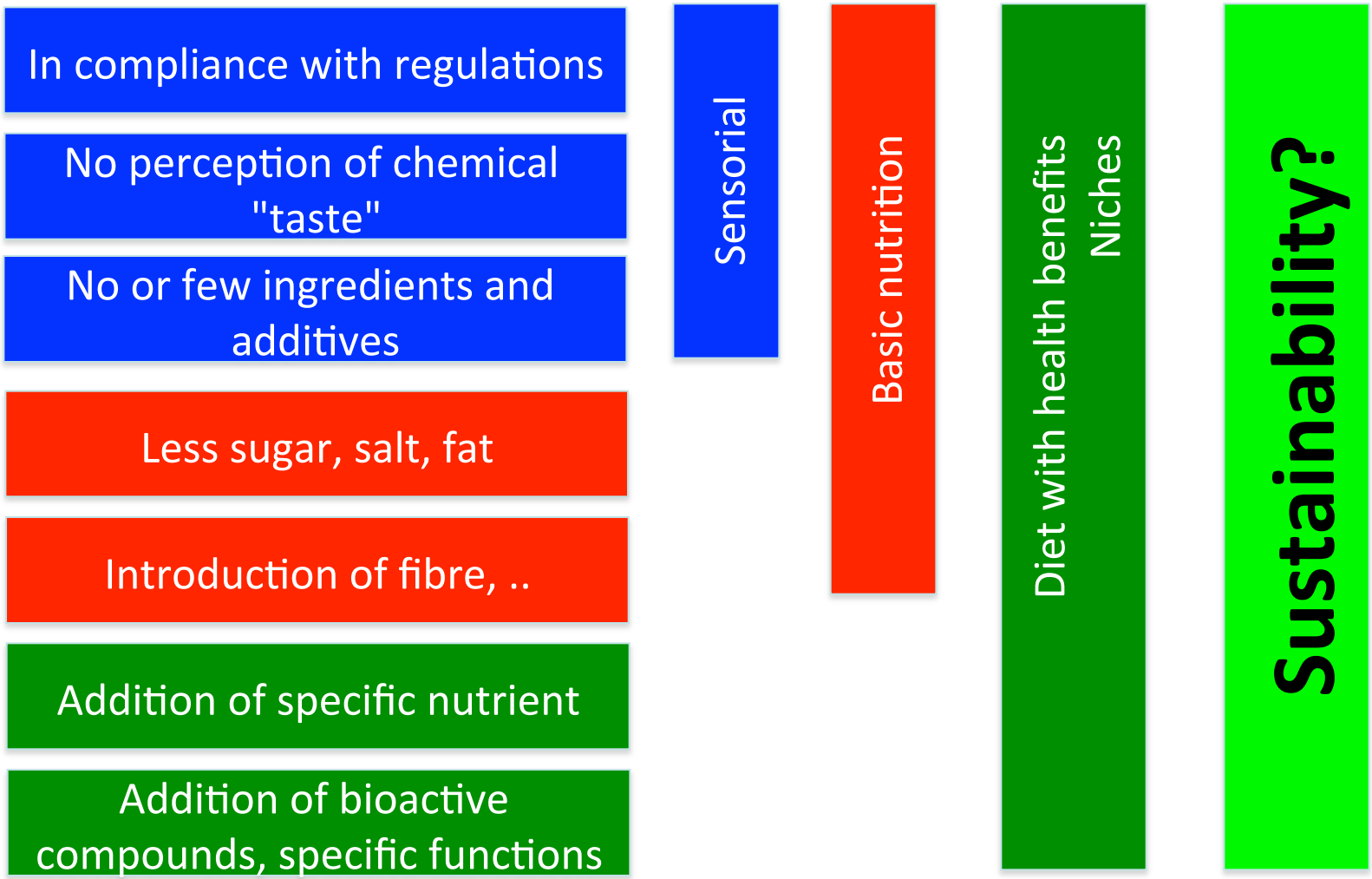


TOP 3 Food Skills



CHALLENGE 3: WHAT IS SUSTAINABILITY ?

Drivers behind the creation of variety in supply



Food systems: major questions

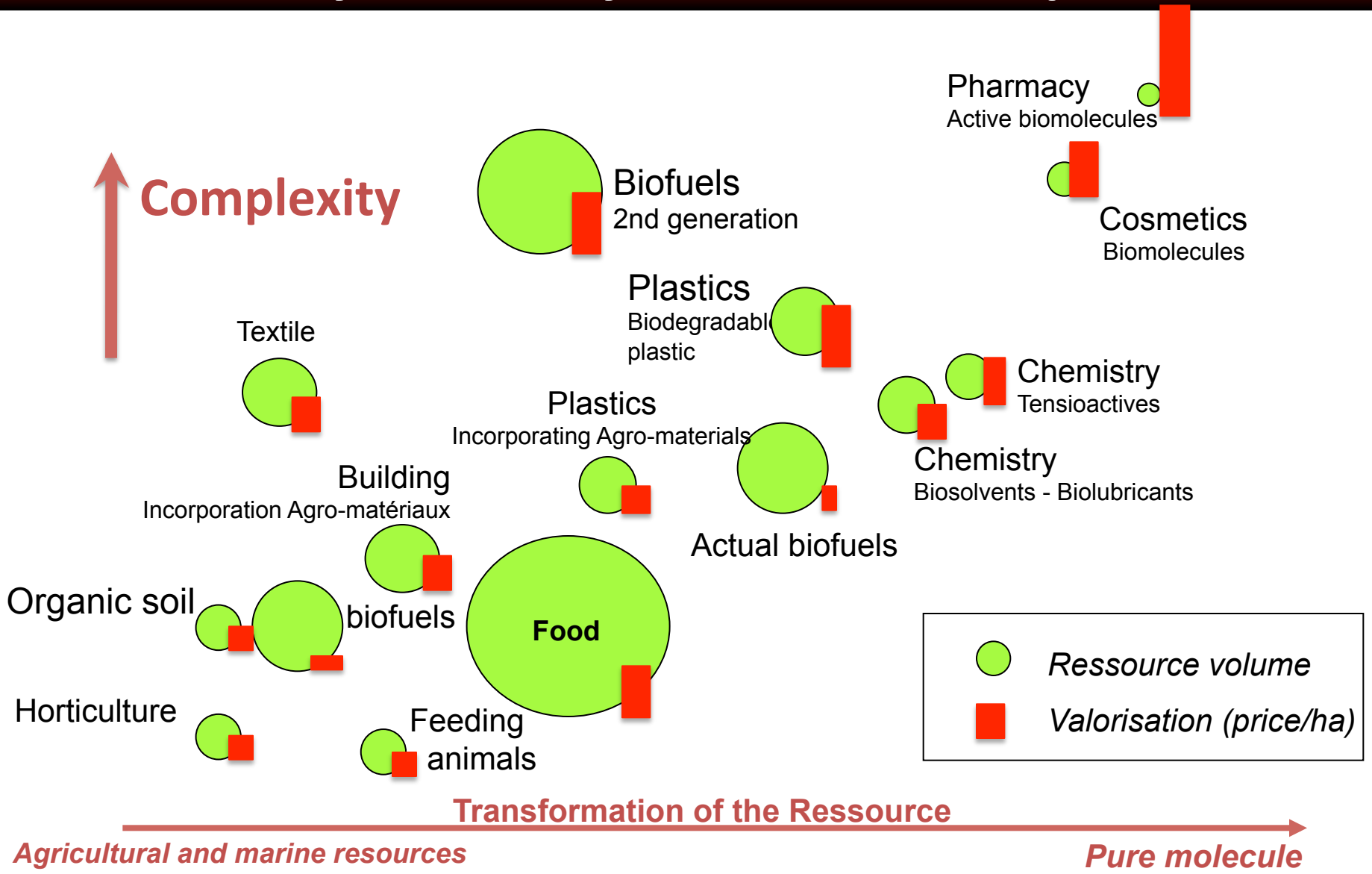
Food process conception and sustainability

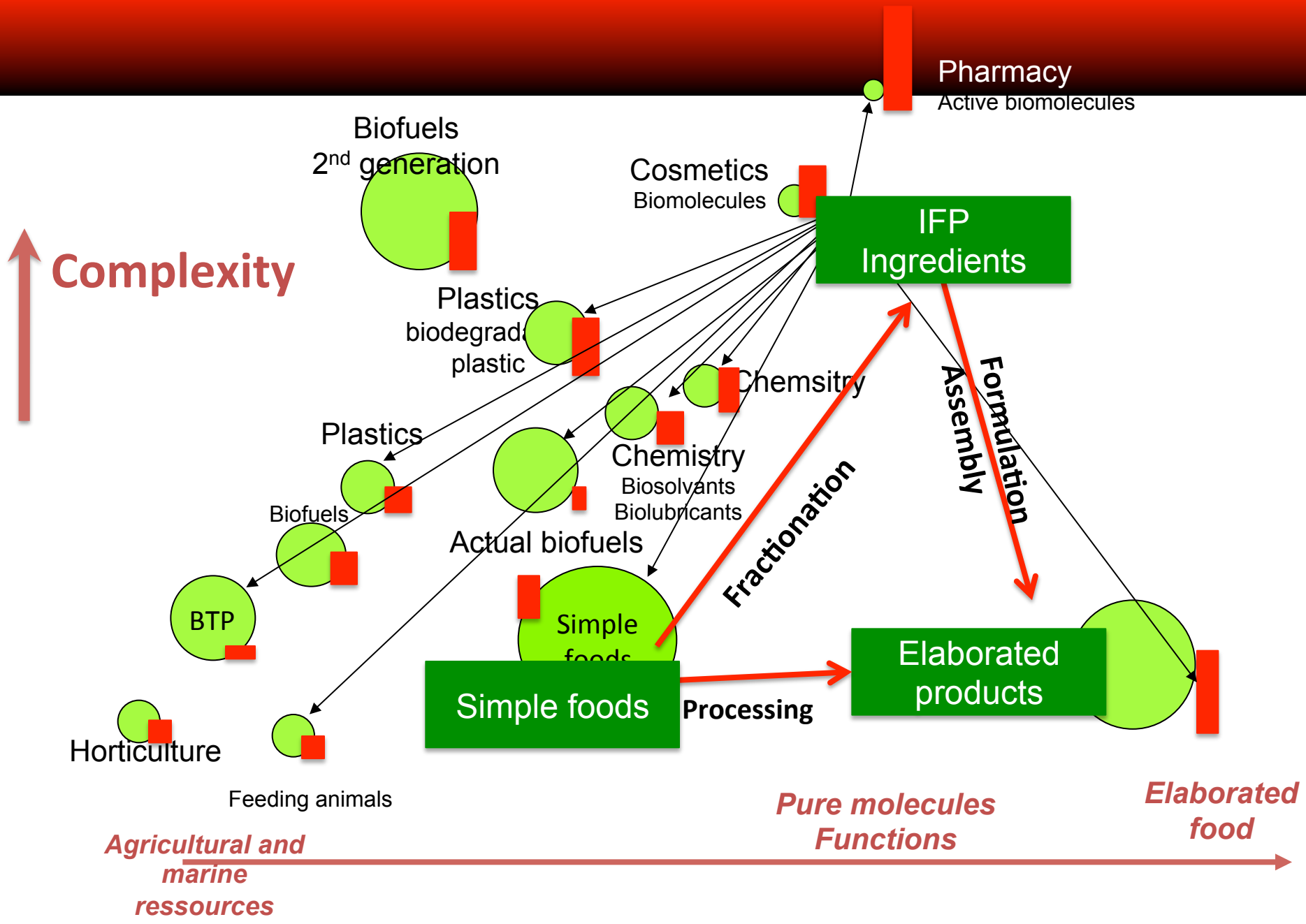
Over time, gradual integration of multiple constraints (cost, microbiological safety, sensory aspects, chemical safety, nutritional value... and environmental constraints)

Will it be possible to comply with the constraints of sustainability without having to go back on some of the constraints previously integrated?

Is it possible to respond by optimising existing technologies, or is it necessary to fundamentally redesign food processing methods, the relationship between agriculture and industry, and the organisation of food chains?

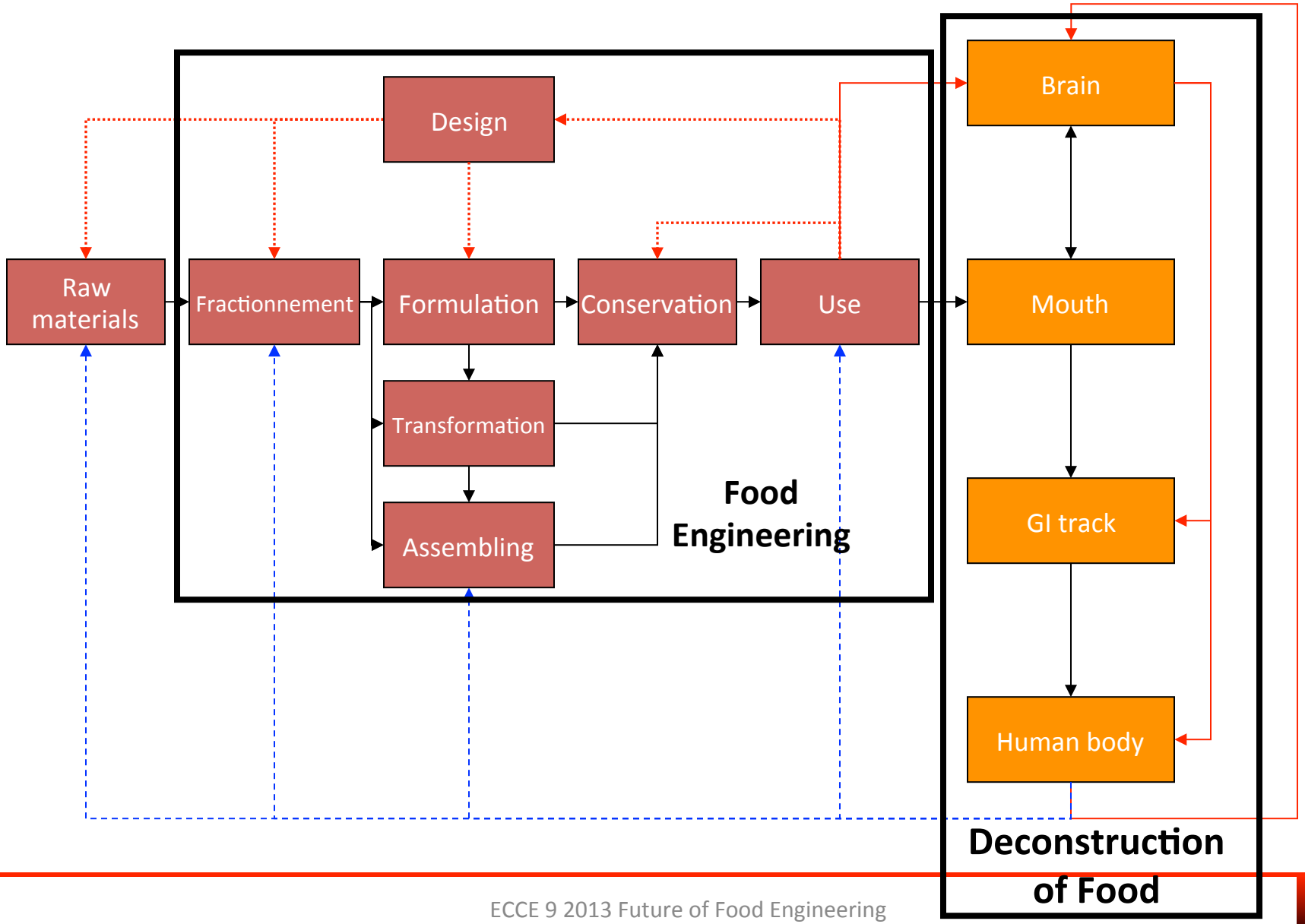
Sustainability is it really a food limited question?




Pharmacy
Active biomolecules
Biofuels
2nd generation
Cosmetics
Biomolecules
IFP
Ingredients
Complexity
Plastics
biodegrad
plastic
Chemsitry
Plastics
Chemistry
Biosolvants
Biolubricants
Biofuels
Actual biofuels
Fractionation
Assembly
Formulation
BTP
Simple
foods
Simple foods
Processing
Elaborated
products
Horticulture
Feeding animals
Pure molecules
Functions
Elaborated
food
Agricultural and
marine
ressources

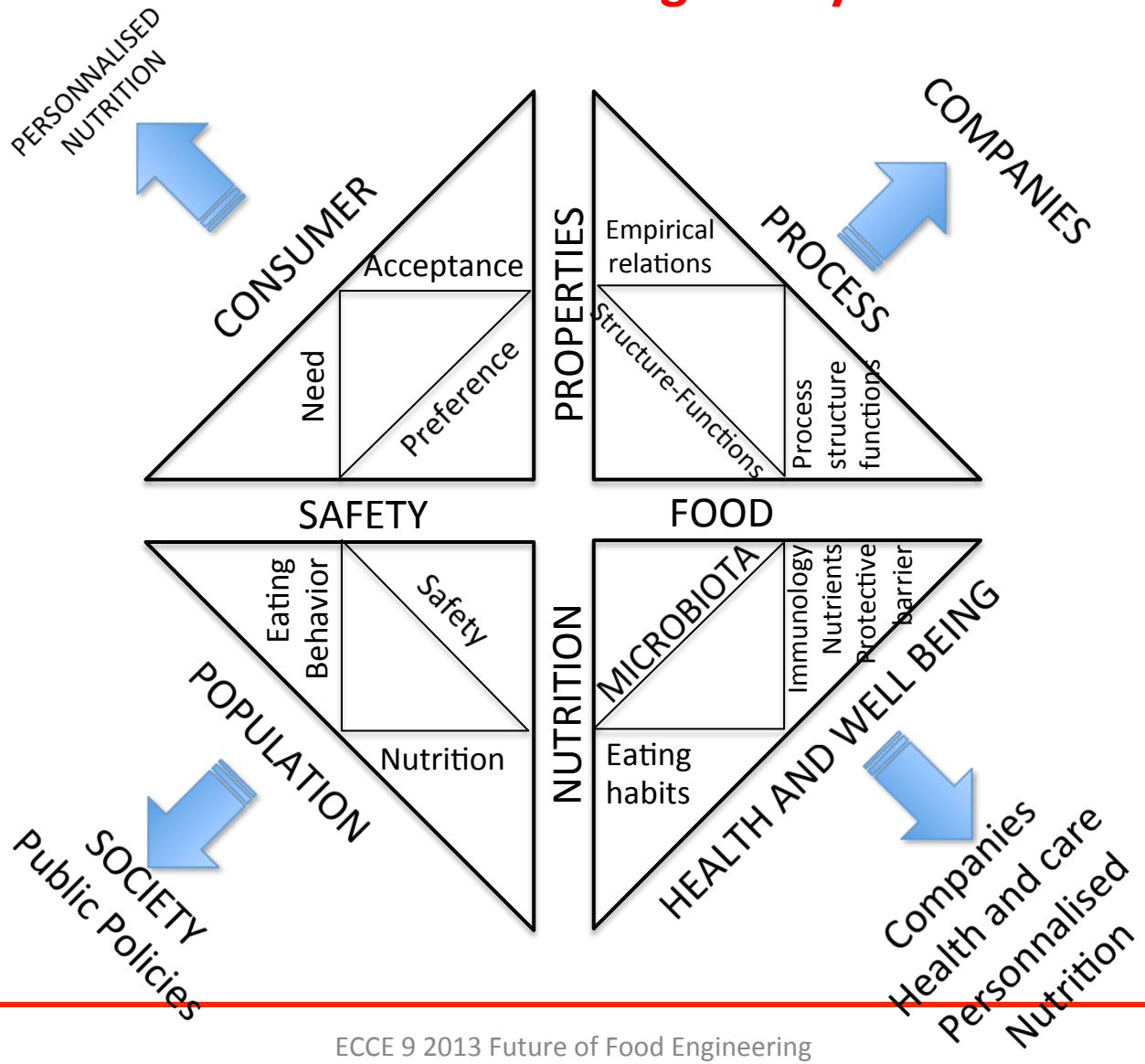
CHALLENGE 4: MORE COMPLEX OBJECTIVES

Food Engineering in a more complexe objective



Food Engineering in a more complexe objective

A reverse thinking ability becomes important



EXAMPLES OF EDUCATION INNOVATIVE APPROACHES

To promote new education ways

- Education by doing:
  - Innovation hubs
  - Living labs
  - Projects with companies
- Competition in order to foster innovation
  - Students contest (Ecotrophelia, …)
  - Awards (EFCE PhD, …)
    - Highly qualified young European scientists who will finish their PhD in Food Engineering and Technology soon or have recently received a PhD are invited to present their work. The candidates should be less than 35 years old.
- Collaboration with others
  - Create new cross-disciplinary content
  - Network of projects across Europe

SOME COMMENTS FOR A CONCLUSION

Main training and educational goals of HE institutions

- To be able to introduce in **courses and programs** entrepreneurships and innovation dedicated content
- To promote **new teaching methods** and pedagogy
  - New generation of students
    - Internet-social network
    - Web 2.0 generation
  - Lower financial support to HE
  - Resistance to changes
- To boost **industry's participation** in Education
- To Develop a **quality framework in education:** Quality standards (certification, label)
- New skills for new jobs: To be aware of the **skills that industries** expect from our graduates and follow how they evolve over time.
- To Motivate and accompany **young students** interested by a career in the food industry because of **lower importance of Food Science and Technology studies/curricula and Competition from other scientific fields**

IFOOD 4 - Main objectives and expected outcomes

- ***Modernising and upgrading*** *the education and training of Food studies*

- ***Implementing the labour market role*** *of the* ***third level of education*** *(PhD programmes, in particular) in promoting the employability and entrepreneurship of the graduated FS&T and Food professional*

- ***Lecturing qualification*** *of university teaching staff*

Toolbox for modernisation and internationalisation of curricula in Food studies

Innovative teaching tools

Virtual platform for PhD students networking and training

Teaching staff framework and pilot summer school

Thank you for attention