Needs of the food industry for ICT and advanced manufacturing solutions to meet food related challenges

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Campden BRI
food and drink innovation

Opportunities

- The **food industry** is the **largest manufacturing sector** in the EU
- Enabling technologies in particular **ICT, advanced manufacturing** and **Industry4.0** provide several **new functions, enabling capabilities, applications** which may **offer new solutions** for the needs, problems of the food processing
- **Knowledge, new functions of the enabling technologies, solutions** developed for other sectors have to be **adapted** to the specific tasks, conditions of the food processing

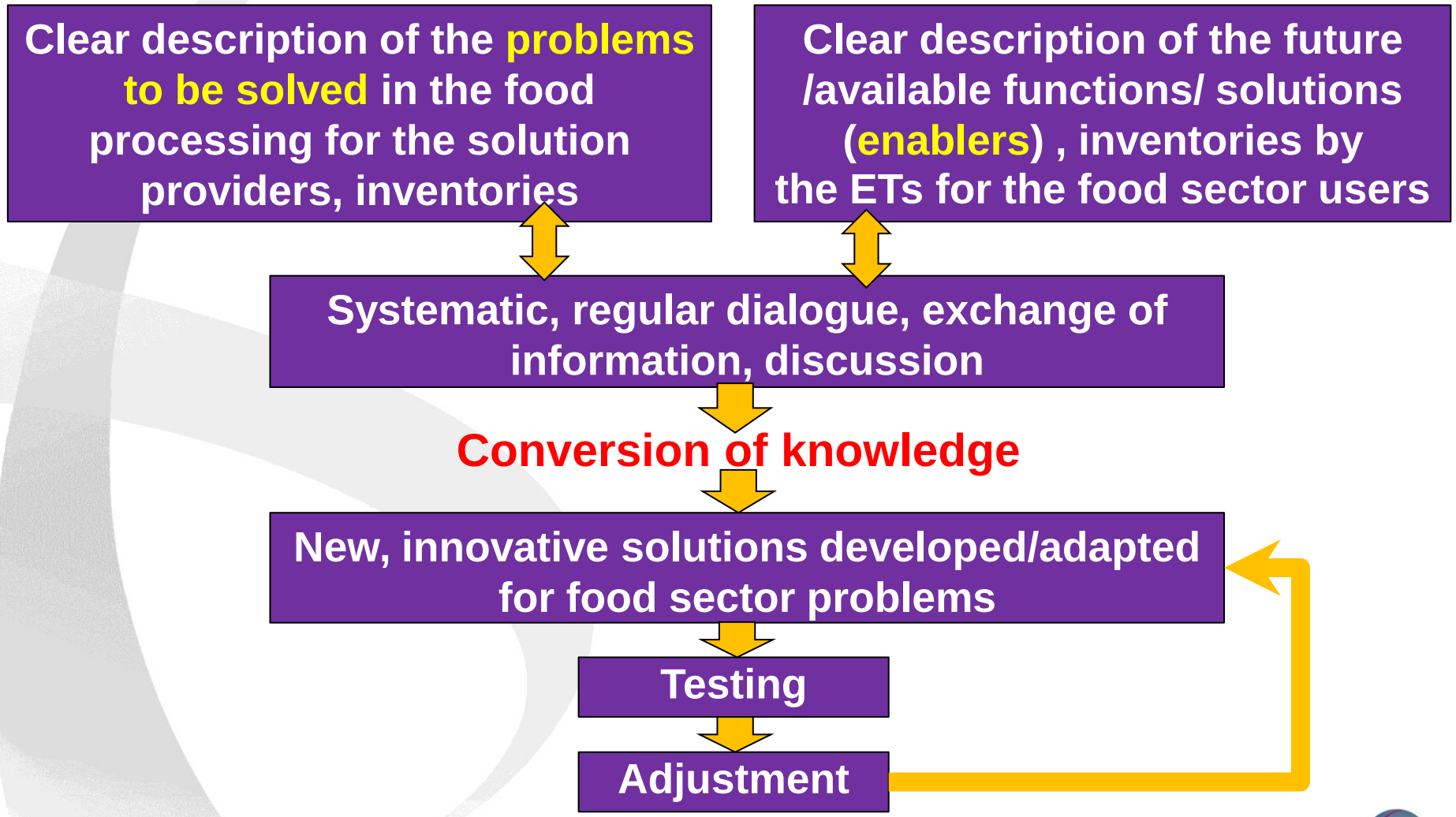
Barriers

- **Food technologists, production managers** and food **R+D experts** are **not aware** of the majority of the **capabilities** and **solutions**, do not know the **enabling functions** available from the technologies (ET)
- **ET knowledge and solution providers don't know the needs, problems** of the **food chain** members, particularly that of the food processors, where their products and services can be used
- There is a **need for systematic exchange of knowledge** and **dialogue** for fostering mutual understanding and collaboration in research and development

Barriers

- **Research** and **pilot testing facilities** are **limitedly available** in the **food sector**, where Enabling Technology enablers and solutions can be tested
- **Such testing facilities limitedly available** in the **ET sectors**, where **food and waste (perishable!)** can be handled in a safe and hygienic way

Method of fostering interdisciplinary collaboration on innovation by networks



Major drivers of food industry needs for research and innovation (Campden BRI 2018)

- **Safety** of the product
- **Quality and Value**
- **Nutrition, health and well-being**
- **Sustainability, resilience and food security**
- **Skills and knowledge**

based on:

- on-line survey of **2400 companies** in 75 countries
- **649** face - to face contributions
- **60** written submissions
- **31** industrial meetings
- **14** member interest groups

source: Campden BRI (2018)

Matrix – drivers for industry needs – at different parts of the food supply chain

Drivers for industry needs	Supply chain			
	Primary production, raw materials and ingredients	Manufacturing and supply	Product and packaging	Food, drink and the consumer
Safety	Minimising contamination in production	Managing product safety hazards and risks in processing, distribution and sale	Delivering products that are safe throughout shelf-life	Protecting the consumer through appropriate guidance
Quality and value	Ensuring suitability for purpose at proportionate cost	Maintaining and enhancing quality through cost-effective process technologies	Maintaining product quality throughout shelf-life	Exceeding consumer expectations
Nutrition, health and well-being	Enhancing nutritional potential	Preserving and enhancing nutritional value in processing, distribution and sale	Delivering nutritious products that meet dietary needs	Responding to nutritional requirements and dietary habits
Sustainability, resilience and food security	Producing and securing 'more with less'	Assuring efficient and resilient manufacturing and distribution	Delivering safe and compliant products that minimise waste	Building consumer trust in the supply chain and its management
Skills and knowledge	Developing and maintaining skills, knowledge and 'tools' in production	Developing and maintaining skills, knowledge and 'tools' in manufacture, retail and food service	Anticipating and responding to regulatory and technical changes and their impacts on product and packaging	Engaging consumers in production, process, product and packaging knowledge

source: Campden BRI (2018)

Managing product safety hazards and risks in processing, distribution, sale

Safety – Manufacturing and supply

- **Detection and removal of foreign bodies** (metal pieces, stones, bone splinters, fish bones, hard plastics, etc.)- (widely used: **metal detection, X-ray, colour sorting**; emerging: **visual systems, laser scanners**)
- **Efficient process control** with **intelligent smart sensor systems** (time, temperature, pressure, pH, water activity, salt, etc.)
- **Cleaning and disinfection** of machinery with **built in automated systems, self-cleaning surfaces, sensors**
- **Antimicrobial surfaces** - **nanotechnology**
- **Monitoring the cold chain** - **sensors, satellite systems**
- Food defence – **protecting production facilities** – **sensors, alarm systems, camera systems**

Delivering products that are safe

Safety – Product and Packaging

- **Analysis of trends** of known and emerging **food safety hazards** -**big data, content based browsing**
- **Predictive food safety modelling** - **big data, simulation**
- **Smart packaging technologies – assuring** and **communicating product safety** and **extending shelf-life** - **sensors, indicators**

Protecting consumers through appropriate information and guidance

Safety – Food and drink and the consumer

- **Enabling informed decision of consumers** – food transparency **-efficient data and information flow, camera systems, digital signals and messages**
- Provision of **web-based guidance for consumer on food safety hazards and preventive measures – web-based tools, content based browsing**

Maintaining and enhancing quality through cost-effective process technologies

Quality and value – Manufacturing and supply

- **Lean, efficient and flexible manufacturing practices** with **increased automation and use of smart technology, artificial intelligence and machine learning** –for **uniform quality** and **less down time for cleaning, maintenance – smart, integrated sensor systems, automation, robots, tele- maintenance**
- **In-line and near line analytical methods** for relevant parameters (protein, fat, moisture, carbohydrate, etc.) – reliable, factory - safe, user friendly, portable – **visual systems**

Maintaining and enhancing quality through cost-effective process technologies (2)

Quality and value – Manufacturing and supply

- **Precise deboning, cutting of** carcasses – **meat and poultry, precise portioning** to enable uniform weight – **visual systems, robots,**
- **Automated assembly** and **precise layering, decoration** of ready to cook meals, pizzas, cakes, etc. – **robots, 3D printing**, **mobile manipulators, little helpers,** etc.
- **Simulation, design and modelling of processes, whole systems, chains and factories**,- **virtual and augmented reality, big data**
- **Improving efficiency and hygiene** - application of **robots, robotic co-workers, "little helpers"** and **mobile manipulators**

Maintaining and enhancing quality through cost-effective process technologies (3)

Quality and value – Manufacturing and supply

- **Better understanding** of **food preparation processes, structural changes inside the product**,- baking, curing, freezing – **CT scanning, X-ray imaging, 3D visualisation**,
- **Real time monitoring and simulation of product and information flow – virtual and augmented reality**

Maintaining Quality and value

Product and packaging

- Methods for **measuring colour, texture, flavour, moisture, maturity, bruising, defects** and **spoilage** of food products to assess quality, authenticity, stability of shelf-life and impact of processes for **improved product uniformity, process control, sorting systems – visual systems, actuators, robots**
- **Predicting and modelling shelf-life – big data**
- **Monitoring compliance of labels, coding, missing ingredients – visual systems**
- **Closing of cups, monitoring proper closing of cups – robots**
- **Monitoring of sealing of cups – intelligent sensors, manipulators**

Exceeding consumer expectations

Quality and value – Food, drink and the consumer

- **Analysis of consumer perceptions** of product quality and sensory properties **consumer preferences** and **behaviour – data analysis, virtual and augmented reality**

Preserving and enhancing nutritional value in processing, distribution and sale

Nutrition, health and well-being - Manufacturing and supply

- **Precise dosing** of **distinguished food ingredients** – **advanced dosing systems, visual systems for monitoring**
- **Restructuring of food products** to enable enjoyable food consumption for people having chewing disabilities – **3D printing**

Delivering nutritious products that meet dietary needs

Nutrition, health and well-being – Product and packaging

- **Substantiation of health claims** by **analysing big data** on claimed effects

Responses to nutritional requirements and dietary hazards

Nutrition, health and well-being – Food, drink and the consumer

- Better **insight into factors** that influence **food, drink and calorie intake** and harnessing this **to tackle non-communicable diseases – data collection, data bases, big data**

Assuring efficient and resilient manufacturing and distribution (1)

Sustainability, resilience and food security - Manufacturing and supply

- **Production systems**, with **built in process- control** considering the complete product and package life cycle (e.g. reduced energy input, reduced water consumption, reduced waste, environmental friendly sanitation methods) with **reduced environmental impact – smart, integrated sensor systems, remote sensing, big data processing, actuators, manipulators, expert sytems, intelligent network of equipment within a processing line and along the food supply chain, flexible, easily reconfigurable, upgradeable equipment and manufacturing systems**

Assuring efficient and resilient manufacturing and distribution (2)

Sustainability, resilience and food security - Manufacturing and supply

- **Technologies, benchmarking systems, modelling tools** and **best practice guidance** for **saving** and/or **recovering water, energy and other resources and reducing, valorising waste** – **integrated sensor systems, sensor controlled robots, tele-maintenance, expert systems for smart process design**
- **Reduction of the cost for investment** for new equipment, maintenance, process control systems – **new business models**
- **Food defence/site security** - **cyber-security, microwave sensors**

Assuring efficient and resilient manufacturing and distribution (3)

Sustainability, resilience and food security - Manufacturing and supply

- **Low friction surfaces** – **Diamond like carbon coating**
- **Local sourcing, short food supply chains** - **technical support to market access** - **improved, standardised data exchange and information flow management, ICT supported logistic solutions**
- **On time delivery, optimised inventory level** - **big data, route management systems**
- **Assembling multi-component packs, pallets, handling heavy loads** - **robots**

Delivering safe and compliant products that meet dietary needs

Sustainability, resilience and food security – Product and packaging

- **Guidance, information, coaching** for **heathy diet** and **specific diet** – **web based tools**
- **Smart refrigerator- shelf life and stock monitoring**- **RFID tags**

Building consumer trust

Sustainability, resilience and food security – Food, drink and the consumer

- **Food transparency information – web based information flow and data management,**

Developing and maintaining skills, knowledge and ”tools”

Skills and knowledge – Manufacturing and supply

- **Training** of **industry staff** – **flipped classes, e-learning, knowledge portals**
- **Practical training, skills** in **virtual and augmented reality,**
- **Expert systems, knowledge transfer** – **web-based tools, virtual and augmented reality**

Anticipating and responding to regulatory and technical changes

Skills and knowledge – Product and packaging

- Improved **databases** to support **food and packaging information provision**(compositional data for new ingredients, reference databases for authenticity tests)

Engaging consumers

Skills and knowledge – Food, drink and the consumer

- **Guidance, information, coaching** for **heathy diet** and **specific diet** for **consumer education** – **web based tools, apps, computer games**
- **Serving consumer's needs, personal profiles** on **information on transparency, authenticity, composition, nutritional value, origin,** etc. – smart food labels/awareness – **RFID tags, personal shopping assistants, smart retail services, web –based food transparency messages, signals, traceability information**
- **Involving consumers to co-creation** of product concepts, recipes – **big data, web-based tools**

Conclusions

- Wide range of **opportunities**
  - **adaptation** of **existing solutions** developed for other sectors
  - **new solutions** developed specifically for the food industry
- **Need** for developing **mutual understanding** and **awareness**
  - regular **transdisciplinary dialogue**
  - **collecting descriptions** of **new enabling functions** and **food industry problems**
- Need for **pilot testing facilities** and **trained staff**

Thank you for your kind attention!

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