



POLITECNICO
MILANO 1863

M. Sc. – Laurea Magistrale in
Food Engineering
@PoliMI
29 maggio 2019

The Italian Scenario of food industry



More than 3.2 M jobs (13% of national total job positions)

1.3 M Enterprises in Food and Beverage value chain

- ↳ 25% of active companies registered in the Business Register of the Chambers of Commerce

The Italian Scenario of food industry

Food and Beverage transformation companies

	2017
Fatturato	132 miliardi di euro (+1,5%)
Produzione (quantità)	+1%
Numero imprese industriali	6.850
Numero addetti	385.000
Export	31,5 miliardi di euro (+3,6%)
Import	20,9 miliardi di euro (+1,0%)
Incidenza settore Food sul PIL	11,3% (al secondo posto dopo il metalmecanico)



Nota: le imprese alimentari con più di 50 addetti rappresentano il 2% del totale, quando in altri paesi competitor - come la Germania - questa incidenza arriva al 10 per cento

Fonte:
Elaborazioni Centro Studi Federalimentare su dati ISTAT

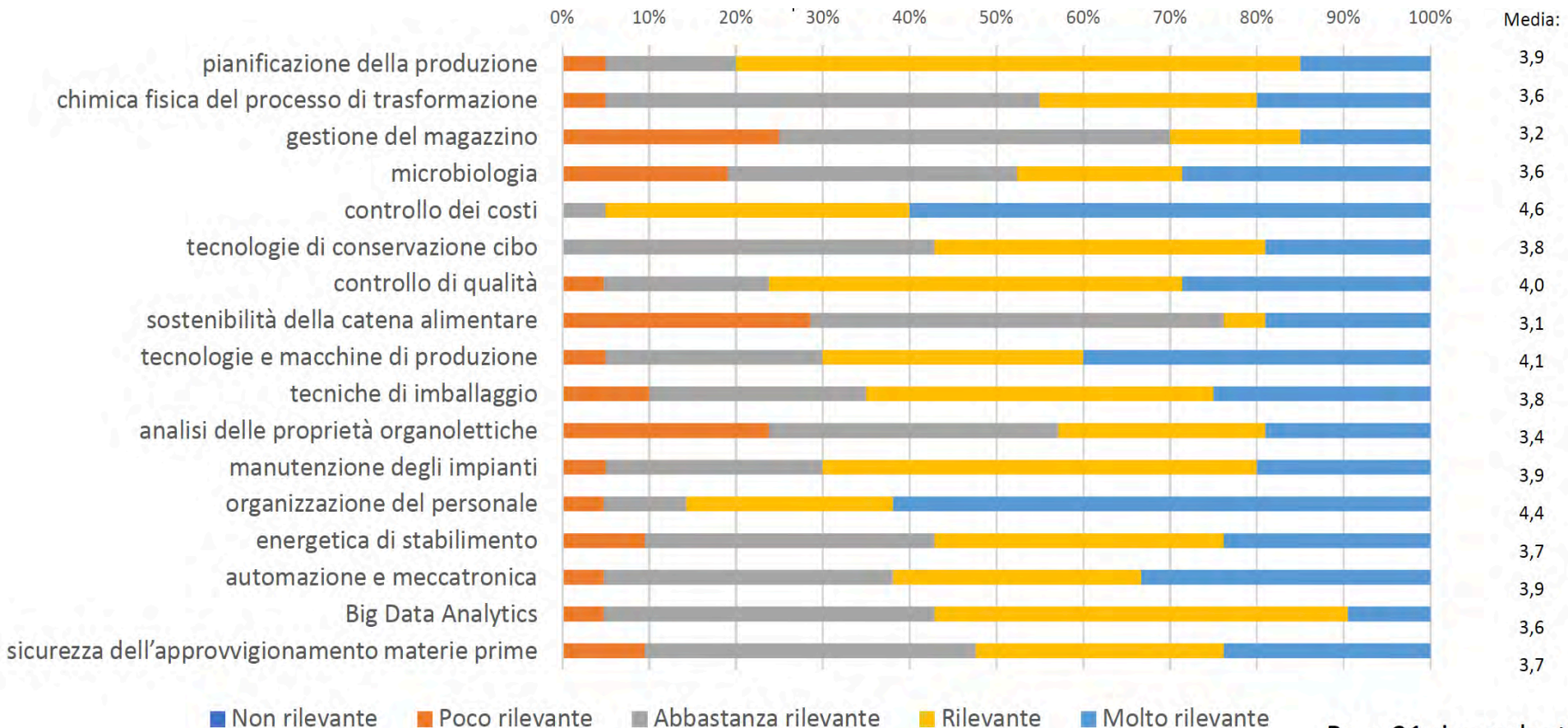


Questionnaire to **21 food industry professionals** from different companies

- Fratelli Beretta
- Barilla
- Oleificio Zucchi
- Marini Alimentare
- Latteria Soresina
- Consorzio padano ortofrutticolo soc. Agricola coop
- Lindt
- Consorzio Latterie Virgilio
- Colussi
- Nestlè
- Ponti S.p.A.
- OROGEL S.p.A. Consortile
- Auricchio
- Cameo
- PLAC
- Cloetta
- Amadori
- Alcass
- + 3 anonymous respondents

Why a Food Engineer?

- All the respondents think is relevant to invest in the creation of this new professional role
- Respondents reported the following as the main competences needed to *hold positions of responsibility in a food production plant*



Base 21 rispondenti

Per la media abbiamo considerato "1 non rilevante", "5 rilevante")

The challenge

A food culture @ Politecnico di Milano

“We are aware that one of humanity's greatest challenges is to feed a constantly growing population without damaging the environment, in order to preserve resources even for future generations”

Carta di Milano - Expo2015

***Develop a new food industry culture
@ Politecnico di Milano***



Food Engineering worldwide distribution



Food Engineering @ Politecnico di Milano

Educational goals



Train master degree-level students to **solve problems** and **innovate the value chain of food and beverage industry**

Engineers who know:

- ↘ The chemical-physical and nutritional qualities of foods and beverages and their components
- ↘ The actors, transformations and trends in the food market and consumer habits
- ↘ The context and the social, economic and environmental effects of production methods, regulatory policies, sustainability

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Educational goals

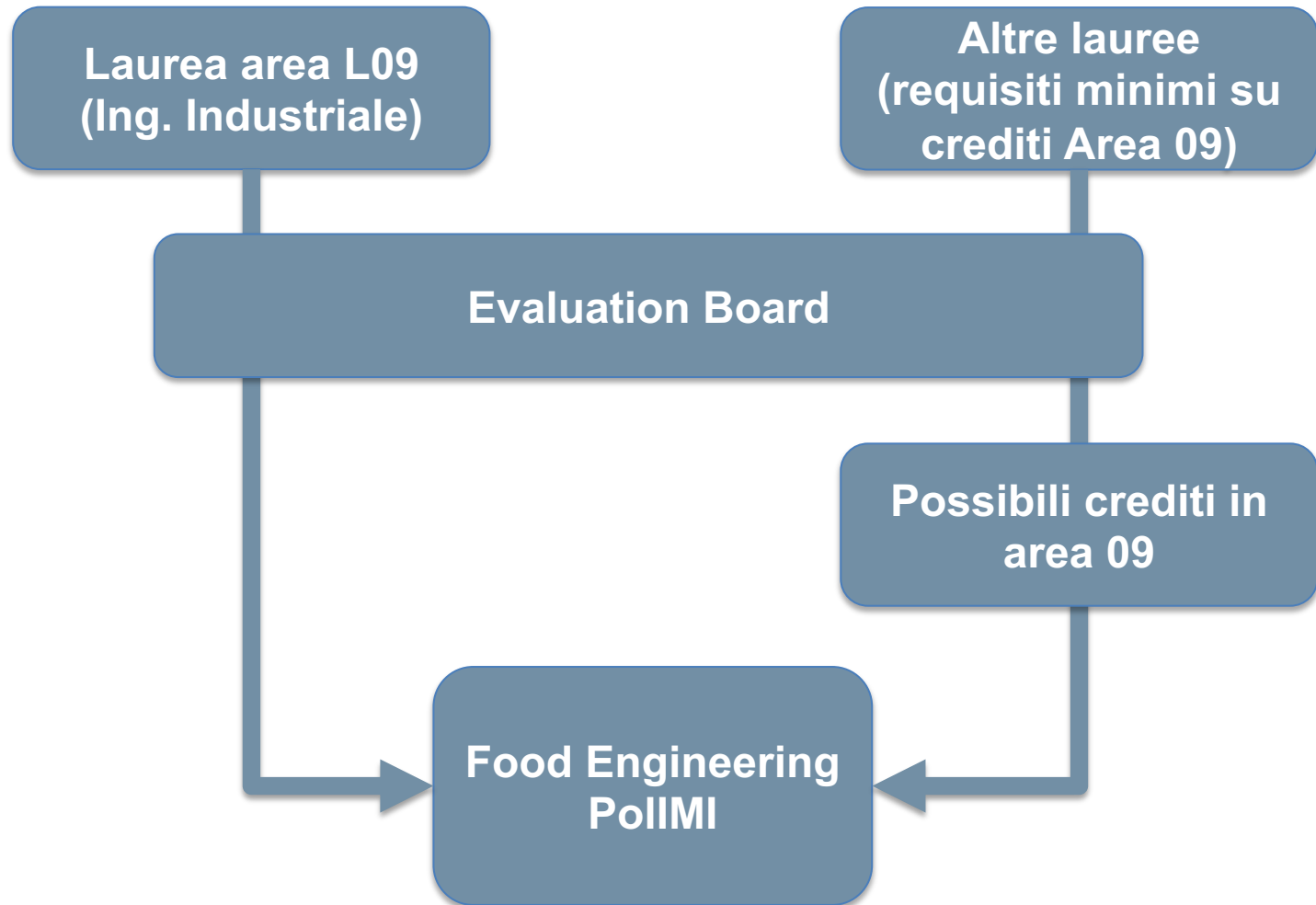


The graduate in Food Engineering @Politecnico di Milano is trained to:

- ↘ Analyze, design and manage the production, transformation and distribution processes in the food sector, mainly related to production technologies
- ↘ Carry out the economic evaluation of the product and process cost structures
- ↘ Manage planning and control methods in a lean perspective
- ↘ Manage food safety and microbiology techniques
- ↘ Quality management techniques
- ↘ Food preservation and packaging technologies
- ↘ Plant energy optimization
- ↘ Logistics chain and food traceability

Food Engineering @ Politecnico di Milano

Programme Admission



Faculty 1st year

Principles of food manufacturing

Maurizio Masi



Trends in food industry lab

Federica Ciccullo,

Luigi De Nardo



Processes and plants in food industry

Laura Capelli



Food Packaging Materials

Luigi De Nardo



Quality engineering

Bianca Maria Colosimo



Logistics management

Claudia Colicchia



Costs and operations management in manufacturing Industries

Irene Roda

Veronica Leon Bravo



Food Engineering @ Politecnico di Milano

Programme structure

4 Semesters of higher education with teachers from different disciplines



I Semester

Food Engineering Laboratory for industrial scenarios (workshops with companies)
Food and beverage production processes
Principles of food preservation

II Semester

Costs and Operations Analysis
Quality
Production chain logistics and distribution

Food Engineering @ Politecnico di Milano

Programme structure

4 Semesters of higher education with teachers from different disciplines



III Semester

- Food Safety and Microbiology
- Energy management
- Sustainability and food and beverage resources
- Aspetti penali della professione d'ingegnere

IV Semester

- Workshop Smart Agri-food
- Big data analysis for food
- Stage in Industry

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Trends in Food industry Lab

Prof. Federica Ciccullo and L. De Nardo



The goal is to provide students with a deep and extensive understanding of the agri-food eco-system

Students will develop an understanding of:

- ↘ demand-related, supply-related and product-related dynamics, trends and global challenges in the agri-food industry



Students will learn the ability to map and analyze the main trends in customer preferences and consumption habits:

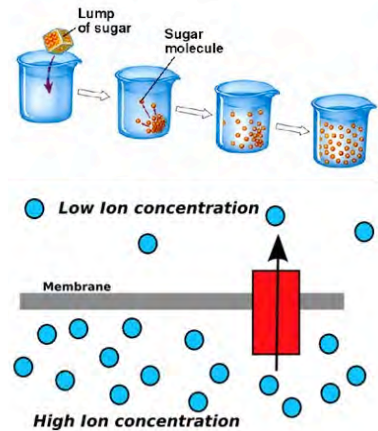
- ↘ Understand and describe the key features of the agri-food supply chain
- ↘ Map and analyze several frontier innovations (process, product, business models innovations)
- ↘ Challenges of Sustainable Development



Students will also develop the ability to interact in a professional, responsible and constructive environment, and to collaborate in a multi-disciplinary perspective to solve present and future challenges of the industry.

Principles of Food Manufacturing

Prof. Maurizio Masi



Food manufacturing is a sequence of operations that obey to physical chemistry rules. All the fundamental conservation laws will be exploited to answer to common questions like:

- ↘ **Physical properties of food:** which are the relevant ones? Density, viscosity, thermal conductivity, diffusivity,
- ↘ **Energy transfer:** how heat is transferred from a pan or an oven to the food? Which are the most convenient way to exchange heat in food processing?
- ↘ **Mass transfer:** how moisture evaporates when cooking bread or seasoning a salami? How a membrane can operate? How many seconds are necessary to homogeneously dissolve a lump of sugar?
- ↘ **Momentum transfer:** liquid raw and semi processed materials have peculiar rheological behaviors: how we can handle them?
- ↘ **Reaction engineering:** which are the chemical reactions occurring during most relevant food manufacturing processes? How to control their rate? How we can avoid unwanted side ones?

Teaching is delivered via a **mix of lectures, in-class discussions and some lab experiments, exercises, and seminars** by experts from the industry, **1-2 company visits**

Principles of food processing and preservation

Materials for food packaging – Prof. Luigi De Nardo



The course aims to introduce students to food packaging technologies, that play a primary role in the modern food industry, processing and preservation:

- ↘ Principles of modern food packaging technologies
- ↘ Industrial products and processes for food packaging materials
- ↘ Materials selection for food packaging and food industry
- ↘ The main regulations for food packaging sector

The course will be divided into 4 modules, organized into lectures, seminars and group-works:

- ↘ Introduction to food packaging technology
- ↘ Materials for food packaging
- ↘ Transport and diffusion phenomena in food packaging
- ↘ Shelf life problems and methods of assessment

Case-studies related to a food packaging materials problem in an industrial context

- ↘ proposed either by the instructor or by invited speakers

Processes of Food Industry

Prof. Laura Capelli



Introduce students to the processes of the food industry through the illustration of the **process unit operations** that are involved in all phases of the food supply chain, which are based on the main principles of the process engineering, such as heat and mass transfer

- ↘ **Food properties:** physical properties and basic concepts of organic chemistry for the food industry
- ↘ **Processes and plants of the food industry:** study of the unit operations that are characteristics of the food industry, with specific references to some food productions
- ↘ **Deepening of some specific processes:** chocolate production, wine dealcoholization
- ↘ **Other related issues:** Environmental impacts and LCA, innovative control techniques (electronic nose)

Teaching is delivered via a **mix of lectures, in-class discussions, exercises, and seminars** by experts from the industry, **1-2 company visits**

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Production Chain Logistics and Distribution

Prof. Claudia Colicchia



The aim of this module is to introduce students to **principles, practices and tools** for **designing, analyzing and managing logistics and distribution processes**, in **food industry**.

If you are new to this subject you will gain an appreciation of the complexity and diversity of it. If you have previous experience of logistics you will further your knowledge and gain fresh insights from current thinking in the new and rapidly expanding topic of logistics, as it relates to the food industry.

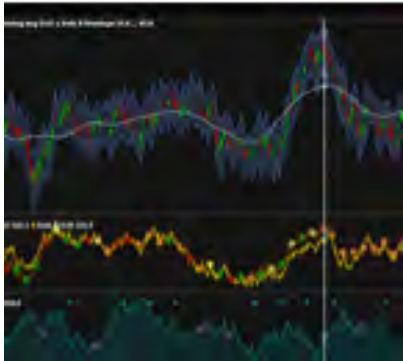
Indicative content:

- ↘ The strategic role of Logistics Management in the food supply chain
- ↘ Design of Logistics and Distribution Systems in the food supply chain
- ↘ Sales and Operations Planning
- ↘ Logistics Execution for food regulation, safety and quality
 - Transportation, Physical Distribution and Materials handling
- ↘ Logistics Performance Measurement
- ↘ Trends, challenges and food logistics innovation
 - Supply chain integration and information sharing
 - Risk and sustainability in food supply chains
 - Logistics 4.0 and omni-channel food logistics

Teaching is delivered via a mix of **lectures, in-class discussions, exercises, and seminars**. We will discuss case studies, journal articles and current thinking from key academic and practitioner texts. **Company visits** will be organized.

Quality Engineering

Prof. Bianca Maria Colosimo



Quality is of paramount importance in food engineering, as it is a highly regulated sector and the customer satisfaction is a key-factor to keep and possibly increase the market share

The course presents solutions for **predicting, monitoring and control the products and process quality** starting from multi-stream data

Statistical engineering approaches for (big) data analysis will be presented and discussed to let the students acquire a suite of tools aiding quantitative decision making in food engineering

Costs and Operations Management in Manufacturing Industries

Prof. Irene Roda, Prof. Veronica Leon Bravo



The objective of the course is to provide students with principles, methodologies and tools to **design, analyze and improve the operations management of manufacturing and service companies in the food sector**, to increase their competitive advantage.



Understand the context variables, functions, processes and decision-making areas essential for the management of operations in the food industry.

Design operations management solutions for different systems in the food sector based on the application of a scientific and engineering approach to face problems and opportunities in a business and industrial environment.



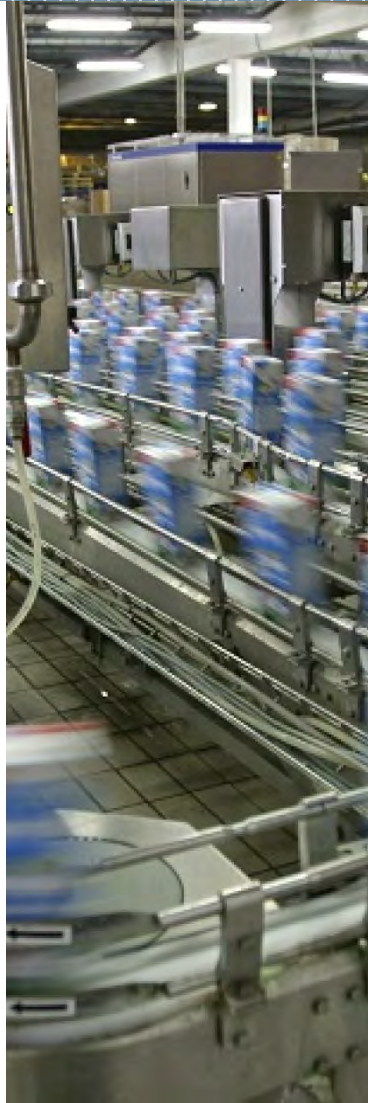
Indicative content:

- ▶ **Operations' objectives and decision areas** in industrial companies and in service companies in the food sector;
- ▶ Development of an **operations strategy** in the broader context of a Business strategy considering the different areas of Operations in an integrated way;
- ▶ **Service Operations Management** in the food sector;
- ▶ Operations improvement through innovative managerial approaches for **operational excellence** (Lean methodology and Systems thinking);
- ▶ Main **trends and innovations** in the operations management of manufacturing companies and service companies in the food industry.



Food Engineering @ Politecnico di Milano

Careers



The graduate in Food Engineering will fit the needs of Food and Beverage industry in different **job positions**:

- ↘ business functions process and/or product development (food and drink)
- ↘ support for the design of plants and equipment for the management of production, service and logistics facilities
- ↘ management of technological services and plant
- ↘ maintenance control and optimization of plants and processes for the technical management of safety and environmental protection functions

Professional opportunities:

- ↘ Food and beverage industries (production, processing, packaging, distribution and marketing)
- ↘ Engineering companies related to the food industry
- ↘ Technical structures of the public administration and consultancy companies for the environment and safety

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Careers



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Industrial Advisory Board



The graduate in Food Engineering is trained by the Politecnico professors, supported by an Advisory Board with the top players in the Food Industry

Advisory Board members

- ↘ Provide **advise** on the **educational aims** of the course
- ↘ Support **group projects**
- ↘ Offer and supervise **internships and degree theses**
- ↘ Are involved in the **mentoring** of the most deserving students and the activation of innovative educational activities
- ↘ **Fund scholarships**

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Advisory Board members

- ↘ **Granarolo**
- ↘ **Unitec**
- ↘ **Number1**
- ↘ **Esselunga**
- ↘ **Goglio**
- ↘ **(Barilla, Nestlè, CocaCola, Unilever, Cereal Docks, Siemens)**