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The Italian clustering approach to ‘intelligent’ factories and industrial sustainability

Warwick, September 2017
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Selected publications on the topic:

2013 *Industrial sustainability: challenges, perspectives, actions* F Tonelli, S Evans, P Taticchi
International Journal of Business Innovation and Research 7 (2), 143-163

The 32nd International Conference of the System Dynamics Society

2015 *Investigating Resource Efficiency and Environmental Policy in an Agent-Based Macro-Economic Framework (EURACE)* G Fadiran, S Cincotti, M Raberto, F Tonelli
27th EAEPE 2015 - A New Role for the Financial System

2015 *Where does the capital for eco-innovation and resource resilient growth come from? A balance sheet-based approach to analyse systemic resource risk in the new financial system* I Monasterolo, E Lauretta, F Tonelli
27th EAEPE 2015 - A New Role for the Financial System


2016 *Approaching industrial sustainability investments in resource efficiency through agent-based simulation* F Tonelli, G Fadiran, M Raberto, S Cincotti
Service Orientation in Holonic and Multi-Agent Manufacturing, 145-155

International Conference on Sustainable Design and Manufacturing, 98-108
Industrial Policy Innovation in Italy
A realistic analysis

- Small size of the factories
- Difficult relationships with the banks -> reduced credit
- Need of effective industrial policies
- Poor innovation capacity of SMEs
- Political instability
- Frequent and unattended legislation changes
- Low R&D investments
Small Medium Enterprises: Weak points

- Poor coordination between enterprises in the same area/sector (research but also synergy)
- Few relations with the research entities
- Reduced knowledge of the newest horizontal technologies (mostly ICT) and clea technologies
- Application oriented (rapid return)
- Lack of mid-long-term plans to sustainability pathway
The Clusters initiative (2012)
https://www.researchitaly.it/cluster-tecnologici-nazionali/

National Technology Clusters are **broad and inclusive networks** made up of the major public and private entities operating throughout the country and focused on industrial research, training and technology transfer: enterprises, universities, public and private research institutions, start-up incubators and other players active in the field of innovation. Each aggregation focuses on a **specific technology and application area** of strategic interest to Italy, of which it represents **excellence** in terms of skills, knowledge, facilities, networks and potential.

**Aerospace**  
**Agrifood**  
**Green chemistry**  
**Smart factory**  
**Life Sciences**  
**Technologies for living environments**  
**Technologies for Smart Communities**  
**Transport and mobility systems of land and ocean surface**

2017 addition of:  
**Cultural heritage**  
**Design and Made in Italy**  
**Sea Economy**  
**Energy**
The Clusters targets

The National Technology Clusters are permanent coordination, consultation and reference tools for the development of proposals and strategies to be adopted to accelerate innovation processes and improve the Country’s industrial competitiveness. Each National Technology Cluster is aimed at one of the following areas considered of strategic interest to the national industry.

• **Lead** the process of strategic positioning of our production system in the international technology landscape;
• **Welcome**, in a coordinated and organic way, the best experiences and skills existing both at local and national level, promoting the inclusion of all the organizations operating in the specific sectors wishing to join in;
• create **synergies** between different industrial sectors on the same types of technology;
• promote **stable connection and interaction** between fields, policies, measures and tools at national, regional and local level;
• **enhance strategic programs of research, technological development and innovation** in line with national and international programs, in particular the National Smart Specialization Strategy (NSSS) and the EU Program Horizon 2020;
• create the conditions for **improving the capacity to attract** investment and talent.
Energy and decarbonization


  – What are the key challenges and uncertainties?
  – What will the impacts be on the energy system, the economy, and society? What will the related investment costs be?
  – What will the impacts be on income and employment?
  – What policy support will need to be established?

  – Frequent legislation modifications and variations led to uncertainty in investors behavior

Manufacturing and decarbonization

• Why?
  – Italy is in the top 3 manufacturers of EU and one of the main manufacturers (PIL/population) in the world
  – Italy is in the top 5 industrial machinery builders

• How?
  – Private Funds / EU Funds / ...

• When?
  – On the mid-long term for its industrial system having to operate mainly in the brownfield domain
  – Immediately (already started) in providing more efficient machineries

• Who?
  – Mainly large companies capable to afford such a important investment and cash-flow radical change (i.e. PSS)
  – Some SME providing innovative/disruptive technology to favour that process

• What?
  – Operating on its own industrial system and favouring refitting and new investment in industrial plants and components
  – Developing innovative industrial machineries capable to reduce the consumption of resources (energy, materials, ...)
  – Providing Product-Service-Systems for durable functional goods
The challenges for Manufacturing

**Climate Change**
- Reduce pollution in air, ground and water through improved environmental sustainability
- Increase the resilience of industry to global warming and climate change (on production, procurement and markets)
- Manage environmental changes due to exploitation of farmland, the construction of infrastructure and urbanization

**Scarcity of resources**
- Reduce energy consumption
- Use of alternative energy sources in manufacturing
- Need to recycle components and products
- Exploitation of energy from waste and scrap
- Reduce consumption of resources through recycling and reuse
The INTELLIGENT FACTORY CLUSTER represents a national platform for advanced manufacturing

The INTELLIGENT FACTORY CLUSTER is an official association created in September 2012 sponsored by the Ministry of University and Research.

The target of the CFI is to promote research and innovation in the area of production systems, and to support the Italian factories.

Members of the CFI are:

- Large and Small-Medium enterprises
- Universities and research centers
- Associations and public
≈380 companies
+50 universities
+20 associations
6 technological districts
Cluster involvement in Innovation and Industrial Policy at Italian level

- Synergy between complementary skills
- Sharing of research infrastructures
- Access to international knowledge
- Internationalization of the Italian manufacturing companies
- Technological partnership
- Support for the access to research grants
- Possibility of proposing new ideas
- A direct communication link with national/regional institutions
1. Four large research project 2014-2017
(10 M€ each)

Project 1: SUSTAINABLE MANUFACTURING
Low impact technologies during the Life Cycle of the product

Project 2: ADAPTIVE MANUFACTURING
Innovative mechatronic solutions for rapid adaptation of the factory

Project 3: SMART MANUFACTURING 2020
Digital technologies for virtualization and preventive maintenance

Project 4: HIGH PERFORMANCE MANUFACTURING
HP machinery and processes for efficient production

- Priorities for research and innovation in the Italian manufacturing
- State-of-the-art R&D
- Sharing the targets with the Ministry of Industry and other international entities

“...the national Technological Clusters are the main instrument to achieve a good coordination between public-public (national-regional-local administrations) and public-private. The Clusters have the task of defining the research strategies and the national roadmaps for technological advancement.”
Long term innovation programs (15 yrs)

- High efficiency innovative production processes for industrial sustainability
- Evolutionary and adaptive production systems for personalized production
- Innovative and eco materials
- Technologies for biomaterials and bio-based products and bio-refineries
- Systems and technologies for site remediation and nuclear plant decommissioning
- Systems and technologies for water and waste treatment
- Technologies for smart grid, renewables and decentralized distribution
Cluster interactions with National Public Institutions

Tavolo strategico MISE su Fabbrica Intelligente, Sostenibile, Energia e Ambiente

MIUR

MISE

Regioni

Italian Regions
GTTS = Scientific Technical Thematic Group

GTTS are permanent structures that have the goal of defining the activities for each Line of Intervention:

- LI1: Customized production systems
- LI2: Strategies, methods and instruments for industrial sustainability
- LI3: Systems for improving the working environment in the factories
- LI4: High efficiency production lines
- LI5: Innovative productions systems
- LI6: Adaptive production systems
- LI7: Strategies and management of next generation production systems
GTTS Targets

- Creation of a community of experts in a specific area
- Definition of the research areas to propose to the Ministries (Industry and University & Research)
- Strategies for founding specific research projects
- Coordinate the Italian activities with similar European activities
- Collect and coordinate activity proposals from the members
- Every member of the Cluster can participate the GTTS on a voluntary base
- Every GTTS has a Steering Committee for the coordination of the activities
Research and Innovation Roadmap

- Enabling Technologies
- Industrial sector
- Intervention Lines
- Projects
Enabling technologies mapping
The Lines of Intervention (LI)

- LI1: Customized production systems
- LI2: Strategies, methods and instruments for industrial sustainability
- LI3: Systems for improving the working environment in the factories
- LI4: High efficiency production lines
- LI5: Innovative productions systems
- LI6: Adaptive production systems
- LI7: Strategies and management of next generation production systems
2.1. Integration of design and development processes in integration lifecycle management
2.2. Product energy footprint monitoring
2.3. Product-process-system integrated modelling for energy and resources eco-efficiency
2.4. Technologies and processes for re-use, re-manufacturing, and recycling of products, components, and materials end-of-life and maintenance interventions
2.5. Technologies and tools for intelligent de-manufacturing systems
2.6. Modelling and Simulation for economical and environmental sustainability analysis of production processes based on LCA/LCC
2.7. Business Models for “Circular Economy”
National Industry 4.0 Plan

• The Plan is an opportunity for a smart and innovative industry for an even more competitive Made in Italy to be future ready

• **Key Points**
  – a public investment of about 20 billion euros
  – a super and hyper amortization of 140% and 250%
  – a 50% tax credit on R&D investments
  – incentives on investments in start-ups and innovative small businesses

• [https://youtu.be/y-2GfHhMLSU](https://youtu.be/y-2GfHhMLSU)
Some interesting Industrial Projects in the area of Industrial Sustainability

  - Human-mimetic approach to the integrated monitoring, management and optimization of a symbiotic cluster of smart production units. SIEMENS – ITIA (application to Italy)

- Regional project FIDEAS [http://www.fideas.industries/](http://www.fideas.industries/)
  - De-manufacturing plant for high tech electronics products
    ITIA – Regione Lombardia
Some interesting Industrial Projects in the area of Industrial Sustainability

**Active Projects:**
- **Zero-Waste PCBs:** Integrated Technological Solutions for Zero Waste Recycling of Printed Circuit Boards (PCBs).
  - **PCB-ID Prototype Project:** In-line automated device for the identification of components and the characterization of materials and value in waste PCBs
  - **ShredIT Prototype Project:** Self-optimizing shredding station for demanufacturing plants
- **FIDEAS:** Fabbrica Intelligente per la Deproduzione Avanzata e Sostenibile.
- **WEEE ReFlex:** Highly Evolvable E-waste Recycling Technologies and Systems.
  - **WEEE Reflex CPS Prototype Project:** Cyber-Physical System (CPS) for reconfigurable e-waste recycling processes
- **National Cluster: Intelligent Factory** – Project 1.3 – Demanufacturing.
- **RobustPlanet EU Project:** Use case – remanufacturing of mechatronic components at Knorr Bremse.
- **Cyber-Sort:** Identificazione in linea e sorting automatizzato per soluzioni di circular economy ad alta efficienza.
- **FiberEUse:** Large scale demonstration of new circular economy value-chains based on the reuse of end-of-life fiber reinforced composites.
To sum up...

- The Cluster Fabbrica Intelligente is the natural and official mediator between Italian stakeholders and the International Entities driving the evolution of the Digital Factory.
- Normative activities are of primary importance for the industrial members of the Cluster.
- Italian companies are more interested in the application of the new technologies than in their definition.