Smart manufacturing and opportunities for Official statistics, a focus on Small and Medium enterprises (SMEs)

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Small and medium-sized enterprises(SMEs)

o SMEs are companies with fewer than 250 employees (yearly average number).

o They include:

- Medium enterprises: 50-249 employees

- Small enterprises: 10 – 49 employees

- Micro-enterprises: fewer than 10 employees

DIMENSIONE D'IMPRESA	NUMERO DI OCCUPATI	FATTURATO in milioni di €	TOTALE DI BILANCIO in milioni di €
MEDIE	< 250	≤ 50 ⟷	≤ 43
PICCOLE	< 50	≤ 10 ⟷	≤ 10
MICRO	< 10	≤ 2 ⟷	≤ 2

o Directive (EU) 2023/2775 of 21 December 2023 also refers to other two parameters: Total balance sheet, Net turnover from sales and services

o For simplicity, here we only refer to the variable 'average number of employees'

Role of SMEs in official business statistics

In Italy the system of business statistics currently includes 44 official direct surveys managed by ISTAT, involving 452.322 companies (legal units).

Type	All direct surveys	%	Structural surveys	%	Short-term surveys	%
Micro and small businesses	430.449	95	373.900	95	111.420	87
Medium-sized businesses	18.425	4	18.135	4	13.036	10
Large businesses	3.448	1	3.418	1	3.026	2
Total	452.322	100	395.453	100	127.482	100

- 99 per cent of companies involved in business official direct surveys are SMEs (97 per cent for short-term surveys)

- In economic terms the weight of large companies is higher as they absorb about 23 percent of employment and create 35 percent of the added value.

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# Average involvement of companies (legal units) in business surveys

Type	All direct surveys	Structural surveys	Short-term surveys
Micro and small businesses	1,53	1,45	1,09
Medium-sized businesses	6,21	4,87	1,94
Large businesses	11,81	8,83	3,08
Totale	1,80	1,67	1,23

9 Non-excessive Burden on Respondents

Statistical authorities request information from respondents only when it is necessary.

- **Burden** required on companies is very high, considering the repeated periodicity of the short-term surveys (quarterly, monthly, weekly).

- Two types of burden emerge, the first characterized by repetitiveness (repeated number of involvements for the same businesses) on medium and large businesses and the second characterized by diffusion across a very large number of micro and small businesses.

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Participation in business surveys

Participation by number of surveys (Q1 and Q4 quartiles).
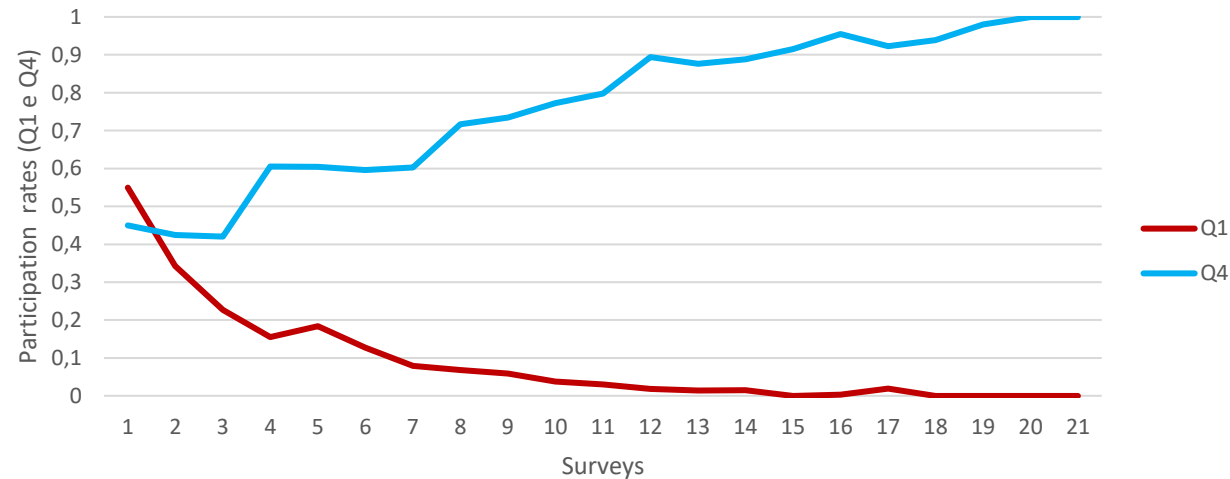
- Participation rates to surveys are low for SMEs pointing out a specific criticality, in terms of sustainability of the required burden and quality of the statistical outputs

- There are effects of the penalty system normally applied starting from the threshold of 100 employees for short-term surveys and 250 employees for structural surveys (also turnover for short-term surveys)

Current trends in official statistical systems

- Progressive shift from a **single source** (direct survey)

  to a set of alternative sources ("multisource" approach):

    a) **Administrative** sources (well-established);

    b) **Alternative** sources falling within the sphere of "big-data" and "data lake"

- Direct surveys **only when necessary** (qualitative variables, inability to access other sources, benchmark for other sources, ecc.)

- The **digital transformation of industrial processes** currently underway multiplies the availability of alternative sources

- **New challenges** for official statistics in terms of TSE measurement, integration of data from different sources, and organization of complex multisource processes

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Digitalization degree of SMEs: the ICT survey

An official source on digitalisation of SMEs is the annual survey on the diffusion of information and communication technologies in businesses (in short ICT survey), conducted within the scope of EC Regulations no. 808/2004 and EC n. 1006/2009:

- criteria and methodologies shared by all European Union countries

- aimed at companies with at least 10 employees

- indications on the degree of digitalisation

- proxy information on the "readiness" for the adoption of smart manufacturing technologies

- indications on the "coverage" and the possibilities
  of extending the solutions identified

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Digitalization degree of SMEs: main results of the ICT 2023 survey

19.3 percent of small businesses have a high or very high level of digitalisation (the share rises to 47.0 percent for medium-sized businesses having 100-249 employee).

38.6 percent of small businesses use ERP software and 14.2 percent use Business Intelligence (72.3 and 46.1 percent respectively for medium-sized businesses having 100-249 employees).

12.2 percent of small businesses practice forms of electronic data sharing with suppliers or customers in the supply chain (30.7 percent for medium-sized businesses having 100-249 employees)

4.5 percent of small businesses (19.6 percent for medium-sized companies in the 100-249 employee range) process data produced by intelligent devices or sensors. The use of such devices is higher among companies in the manufacturing sector.

59.3 percent of small businesses purchase cloud computing services (basic, intermediate or advanced) of which 8.8 concern advanced ERP services.

4.4 percent of small businesses use Artificial Intelligence (AI) technologies, a share that rises to 10.4 for medium-sized businesses belonging to the 100-249 employee range. The prevalent use concerns production processes, in particular for the manufacturing sector (52.5 percent).

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Digitalization degree of SMEs: remarks from ICT 2023 survey

Companies with a high degree of digitalisation represent a significant share of Italian SMEs showing a high "readiness" for the implementation of new technologies, in particular for manufacturing sector

The diffusion of ERP management systems, even advanced second generation, is significant even among small-sized companies.

Weaker among SMEs is the diffusion of AI applications and the use of intelligent devices or sensors.

Further impulse may derive from the incentive policies for the 4.0 and 5.0 transition promoted by Governments.

Smart manufacturing

✓ Definition: Smart Manufacturing consists of creating a highly automated and interconnected production environment where devices, machines, people and systems can communicate with each other and make decisions based on data in real time.

✓ NIST (National Institute of Standards and Technology) defines smart manufacturing as: "fully integrated and collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the factory, supply network, and customer needs."

✓ Smart Manufacturing is based on cloud connectivity. It is a combination of human creativity, digitally connected machines and assets, and artificial intelligence-based systems and analytics.

✓ The goal is to achieve faster, precise and personalized production, reducing waste and increasing flexibility to adapt to changing market needs.

SMART FACTORY

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Enabling technologies

Smart factories are characterized by technologies that make them more efficient:

✓ **Advanced automation**, robots become capable of collaborating with other machines;

✓ **IoT, devices and machines are equipped to send and receive digital data.** Data sent from the device reports its status and activity, while data sent to the device controls and automates actions and workflows. An Industrial IoT (IIoT) network is at the heart of smart manufacturing as it encompasses not only connected assets, but also the intelligent systems and automated processes

✓ **Artificial intelligence (AI) and machine learning**, which automate some actions and, in addition, help to predict possible faults, as well as schedule preventive maintenance;

✓ **Analytics** and machine learning tools for big data analysis.

✓ **Additive Manufacturing/Hybrid Manufacturing**: better known as 3D printing, additive manufacturing increases resilience and agility

✓ **Cloud Computing**: Cloud connectivity and computing offer manufacturers the on-demand availability of system resources such as IIoT data, analytics and process automations. Large clouds can be centrally managed, but distributed across regional or global locations

✓ **Digital simulation/representation (digital twin)**: A digital representation or simulation is created to be an identical virtual copy of a machine or process existing in the real world. It allows production teams to test new ways of producing

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Advantages of the smart factory

Accelerating production processes, but also making them qualitatively more efficient, acting on unexpected events and offering predictive analyses:

- Competitiveness and reduction of time-to-market

- Reduction of human error

- Cost reduction

- Energy efficiency and sustainability

BENEFITS OF "SMART MANUFACTURING"

Environmental Sustainability

Worker Safety

Improved Product Quality

Agility of production

Asset efficiency

Reduced Operational Cost

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New role of statistical data

- Adopting a data-driven approach means using the availability of Big Data in businesses and effectively using them in the decision-making process.

- Data-driven companies consider data management as a strategic element of the business.

- In Smart Manufacturing, every element of the production chain, including products, is connected thanks to the contribution of sensors, measurement and monitoring instruments (e.g. RFID chips). Every element of the supply chain exist simultaneously in both the physical and virtual worlds.

- Other basic concept of Smart Manufacturing is decentralization of control. At each step of the production chain, intelligent control systems allow optimization of the specific phase and communication with the chain in order to make the process more efficient in real time.

- All that is possible by exchanging data and monitoring processes through advanced analysis platforms.
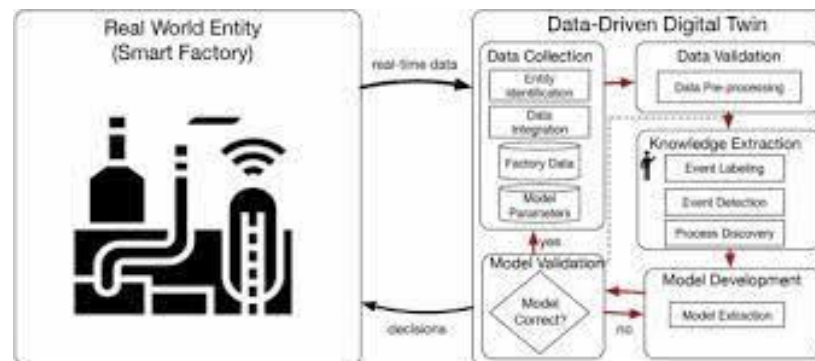
Tools for implementing smart technologies in SMEs production process

✓ A lot of management software (ERP) support SMEs in the transition towards the smart manufacturing.

✓ Second generation ERP software establishes a real-time connection between management processes, including administrative, logistical and commercial ones, and the production and distribution chain.

✓ A relevant functionality for an advanced ERP consists in modularity: for example, it allows establishing a real-time dialogue with industrial production plants.

✓ The Manufacturing Execution System (MES) is software for production control within a manufacturing company with the aim of supervising and monitoring activities in real time and improving the quality of production processes.

✓ Its task is therefore to acquire a large amount of production data in real time and provide useful information to increase the operational efficiency of production plants.

✓ It allows integrated management of all operational areas of the factory: design, supply chain and production. It is thus possible to monitor in real time the process of transformation of raw materials into finished products and control the efficiency and productivity of the systems.

Electronic Data Interchange (EDI)

Benefits of EDI Integration

✓ Electronic data interchange (EDI) is the automatic exchange of predefined and structured data for business purposes between two or more person/organization information systems

✓ Already in 1996 the National Institute of Standards and Technology (Nist) had defined Electronic Data Interchange as "the exchange from computer to computer of a standardized format for exchanging data.

✓ It is a consolidated technology which in the era of the Internet of Things (IoT) and Robotic Process Automation takes on new importance again.

✓ Each EDI transaction is defined by a precise message standard (Indicod-Ecr, Edifact, Ansi X.12, Tradacoms, PEPPOL).

✓ There are also aspects that can generate critical issues, especially for SMEs. In fact, each commercial partner within a B2B network distinguishes itself for a number of specific requirements

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Statistical opportunities for the data collection from SMEs

Main objectives are:

- reducing burden required of respondents;

- Increasing efficiency of DC processes and quality of produced outputs

- development of operational experimental solutions that can be extended to the context of SMEs

In order to enhance opportunities necessary to collect information in the field:

- Analysis of the categories of data made available by the main advanced and integrated management platforms (second generation ERP) through the creation of structured interviews with the suppliers of the most spread platforms and matching with the information needs satisfied, limited in the first phase to short term variables.

- Evaluation of the possibilities of application and acceptability of the new approach among a purposive sample of respondents

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Conclusions

✓ The "single-source" direct survey system presents growing problems of burden and process efficiency

✓ Use of administrative sources, where available

✓ Need to boost alternative sources and automation of DC processes

✓ In business statistics, a promising alternative source may derive from the mass of data produced by smart manufacturing

✓ Advantages: burden, costs, quality

✓ Disadvantages: complexity for NSIs in managing data from different sources, e.g. integration, TSE evaluation

✓ New role of the NIS, no longer monopolists but main actors in the production of official statistics

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Thanks

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