

FRAUNHOFER ITALIA - INNOVATION ENGINEERING CENTER IEC

SUSTAINABLE DIGITAL TRANSFORMATION

Fraunhofer Italia approach and applied research activity

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A cura di



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1 Fraunhofer Italia Research Scarl

Fraunhofer Italia Research Scarl - Innovation Engineering Center is the first independent foreign company in Italy of the Fraunhofer-Gesellschaft, the largest applied research organisation in Europe with a total of around 29,000 employees generating a total volume of research projects amounting to 2.8 billion euros. Fraunhofer is present in Germany with 75 research institutes and worldwide with offices in 19 countries. Fraunhofer Italy was founded in Bolzano in December 2009 as a non-profit research organisation and has a workforce of around 40 employees, operating since 2017 in the new headquarters at the Bolzano Technology Park (NOI Techpark). Fraunhofer Italy consists of three research departments (Automation and Mechatronics Engineering, Process Engineering in Construction, Robotics, and Intelligent Systems Engineering) and the application centre ARENA (Area for Research & innovative Applications). The activities carried out by Fraunhofer in Italy aim to support small and medium-sized enterprises in industrial automation projects in the manufacturing and construction sectors, as well as to develop management models capable of combining technologically advanced production processes, digitalisation, and sustainability.

Specific research focuses of the Bioeconomy and Sustainability thematic area are - without prejudice to the overall objective of sustainability - mainly the circular economy, the bioeconomy and sustainable digital transformation. As these issues are cross-sectoral in nature and influenced by a wide range of global factors, understanding, and addressing them requires an integrated multidimensional approach. This includes analytical and methodological tools to assess, monitor and develop business models and action plans for achieving industry-integrated sustainability goals.

2 Sustainable digital transformation: approach and competences

Our idea of sustainable digitalization agrees with the path to the digital transformation identified by the European Union:

"A European way to digital transformation that enhances our democratic values, respects our fundamental rights and contributes to a sustainable, climate and resource neutral economy."¹

Sustainable digitalization puts technology at the service of sustainable development and responsible design of digital services. Thanks to these fundamental principles, digital sustainability is the mean through which digital transformation can foster sustainable development. Digital transformation requires responsible actions: *understanding how to successfully drive the change through an approach based on shared sustainability values*.

Today, technological transformation represents a fundamental drive for economic growth, significantly impacting all sectors of production and services. It can be considered a powerful catalyst that can help accelerate different trends within our society: it is an important (non-renewable) resource that contributes to the transition towards sustainability. However, digital transformation is truly sustainable when, in addition to supporting the economy, it does not create new environmental and social pressures. Digital sustainability can ultimately be seen as the way in which technology is used to deliver sustainability.

An increasing number of companies are turning their gaze towards the Net Positive Approach: a new way of doing business that introduces more into the society, the environment and the global economy than it takes. In this process, companies are moving away from simply eliminating internal problems and towards an approach whereby providing sustainability through their products and services becomes an integral part of their core business.

Despite being a formidable vector of economic and social progress, digital technology is not exempt from any reproach: it is estimated that today, on a global scale, digital uses have double their environmental footprint on Earth. Most of the research conducted so far has focused on the positive impacts of technological progress and digitalization as supporting means alleviating the pressure on the economy (e.g., increase in efficiency), on the society (e.g., connection and

¹ EU, 2020. SHAPING EUROPE'S DIGITAL FUTURE

exchange of information) and on the environment (e.g., dematerialization). However, it emerged that the term digitalization is so broad that it requires individual aspects' analysis in order to verify its actual impacts. It is therefore not possible to define digital as a positive or negative impact tool: there are several factors at play, such as the nature of the digital solution (e.g., hardware or software), the size of impact made (e.g., construction, use, disposal, entire life cycle), the categories of impact generated (e.g., a specific aspect or all sustainability's aspects) and the scale on which it operates (micro, meso, macro).

Furthermore, considering the ethical and the social dimensions become fundamental when it comes to digital transformation. In this context, some ethical / social challenges related to digital technologies are analyzed, such as the externalization of human willpower (e.g., technological tools become a source of human disqualification), the influence of ICT on the information flow (e.g., algorithmic bias) or the loss of user autonomy when dealing with digital tools. The goal is to bring the people back to being the protagonist of their own actions, promoting knowledge of social and ethical problems associated with new technologies and contributing to public and industry awareness.

This is our vision and general approach on the issue, which is transformed into applied research projects and tools aimed at companies and institutions. By its nature, sustainable digitalization has to deal with complex systems, which we tackle mainly by adopting an approach with the following characteristics:

- interdisciplinary, as digital is connected to all Fraunhofer Italia's research areas;
- *systemic and specific*, capable of supporting the sustainable digital transition of companies, collaboration and sharing solutions at the level of industrial symbiosis or value chain, and the management of a digitally sustainable territory;
- connected to decision-making processes, considering the fact that the computer data intervenes in local policies, as in those of companies and individuals, the area of digital ethics acquires importance and as it helps to define the invisible limit often crossed by decision-making activities;
- *quantitative*, where possible, since it is necessary to know the starting point and the amount of the impact, the objectives to be achieved are measurable and have the ability to monitor and track the transition towards these objectives;
- shared, digital is the means that connects and facilitates the creation of new synergies by sharing skills and resources, in this context we participate in research projects, organize and participate in seminars, conferences and workshops, we publish in popular magazines

and scientific journals, and we participate in local, national and international working groups.

Specifically, the activities are carried out performing applied research projects directly commissioned by companies or by participating as scientific partner in research consortia in the context of national and European calls.

3 Themes and reference projects

The assessments concerning sustainable digital can be traced back to three main aspects:

- 1. *Hardware:* direct and indirect impacts deriving from the production, use and disposal of ICT components, following their entire life cycle;
- 2. *Software:* effects, often hidden, deriving both from the functionalities of the electronic devices to guarantee the results expected from their use, and from the data-information cycle active in every sector of work and leisure;
- 3. Management and awareness: impacts' management through awareness and culture.



To analyze digitalization's impact, it is necessary to be able to analyze all its aspects, understood as a set of physical components that must be produced and disposed of at the end of their life, and software components that allow the hardware to meet the functions and objectives set. Both, whatever use is made of them, have positive and negative impacts at every stage of their cycle. For this reason, projects on the topic of sustainable transformation are very transversal: from studies on theoretical frameworks for evaluating systems and identifying indicators and metrics, up to feasibility studies for very specific cases, in different sectors of production and services.

Sustainable production

Evaluation of the sustainability of decentralized and parametric approaches to production

Description

Within the SMART-Pro project, one of the lines of activity will deal with the definitions of indicators and indices capable of measuring the sustainability performance of decentralized and reconfigurable production system. The indices will have the characteristic of being able to be used:

- in the design phase, to estimate the performance of the various configurations;in the optimization phase as support for the algorithms that will manage the distributed
- In the optimization phase as support for the algorithms that will manage the distributed system;
- in the monitoring phase of the implemented system.

The approach will be based on the concept of urban production, to allow for the evaluation of design alternatives for production according to the logic of territorial distribution and mass customization. All of these technological and organizational alternatives have great potential to achieve circular goals.

Level

Micro, meso, macro

Duration

11.2020-06.2022

Partner

Fraunhofer Italia

Financing

As part of the FESR 1135 SMART-Pro [CUP: B52F20001530009] – European Regional Development Fund of the Autonomous Province of Bozen / South Tyrol – Investiments in favor of growth and employment. FESR 2014-2020

Sustainable digitalization

Systemic approach to assess digital impacts related to sustainability objectives

Description

The digital revolution has transformed our lives and society with unprecedent speed and scale, offering immense opportunities and challenges. New technologies can make a significant contribution to achieving the Sustainable Development Goals of the Agenda 2030, but positive outcomes cannot be taken for granted.

By means of a systematic literature review, the project intends to reflect on the key issues for a transition towards a responsible and sustainable digital. It aims to present, in an exhaustive and coherent manner, the impacts generated by IT equipment: from metals' extraction, to the use of electronic device itself (e.g., energy consumption), up to its dismantling (e.g., waste management / recovery; pollution; exhaustion of non-renewable resources; etc.). The detailed study of the factors that allow us to identify the impacts (whether positive or negative) of digital transformation, permit us to better understand how digital tools can support companies and territories to grow sustainably. These issues are addressed to foster practice-oriented sustainable digitalization assessments regarding ethical and ESG consideration. The main project objectives are:

- to define digital and to create a classification framework for digitalization's tools;
- to address how to measure the positive and negative impact of digital into the economic, social and environmental domain;
- to list existing solutions to solve digital's impacts;
- to understand where and whether digital's impact changes from negative to positive and vice versa.

Duration

01.2021-31.12.2021

Partner

Fraunhofer Italia

Financing

Internal project

I4.0 Roadmap

Development of a roadmap to assist local SMEs in the manufacturing and construction sector in the technological and organizational planning of industry 4.0

Description

The fourth industrial revolution represents a necessary path that companies must take if they are to survive in rapidly and constantly evolving markets. An increasing number of industries are adopting integrated Industry 4.0 solutions to adapt to this trend which will revolutionize the way of producing, but also of conceiving the dynamics between producers, suppliers and final consumers. Big data, internet of things, augmented reality, advanced automation, are just some of the possibilities that companies have at their disposal to increase their productivity

Duration

01.06.2017- 30.11.2018

Partner

Fraunhofer Italia

Financing

FESR 1054 I4.0 Roadmap [CUP: B53D07000290008] European Regional Development Fund of the Autonomous Province of Bozen / South Tyrol – Investiments in favor of growth and employment. FESR 2014-2020. Secondo call – Axis 1 Research and Innovation

4 Scientific publications on the subject (selection)

Brozzi, R., Forti, D., Rauch, E., Matt, D., T. The Advantages of Industry 4.0 Applications for Sustainability: Results From a Sample of Manufacturing Companies. *Sustainability* 2020, *12*, 3647. DOI:/10.3390/su12093647

Sacco P, Rangoni Gargano E., Cornella A., 2021. Sustainable digitalization: a systematic literature review to identify how to make digitization more sustainable. TFC21, the ETRIA World Conference "TRIZ Future" 2021 "Creative solutions for a sustainable development". Accepted