#WMWeek

#ManufacturingAgenda

Digitalization and Circular Economy as enabling factors in SMEs innovation processes

Confartigianato Imprese Lombardia
on behalf of the partnership of the project “PMI NETWORK”
granted by Interreg V-A Italy-Switzerland 2014-2020 Cooperation

POLITECNICO
MILANO 1863

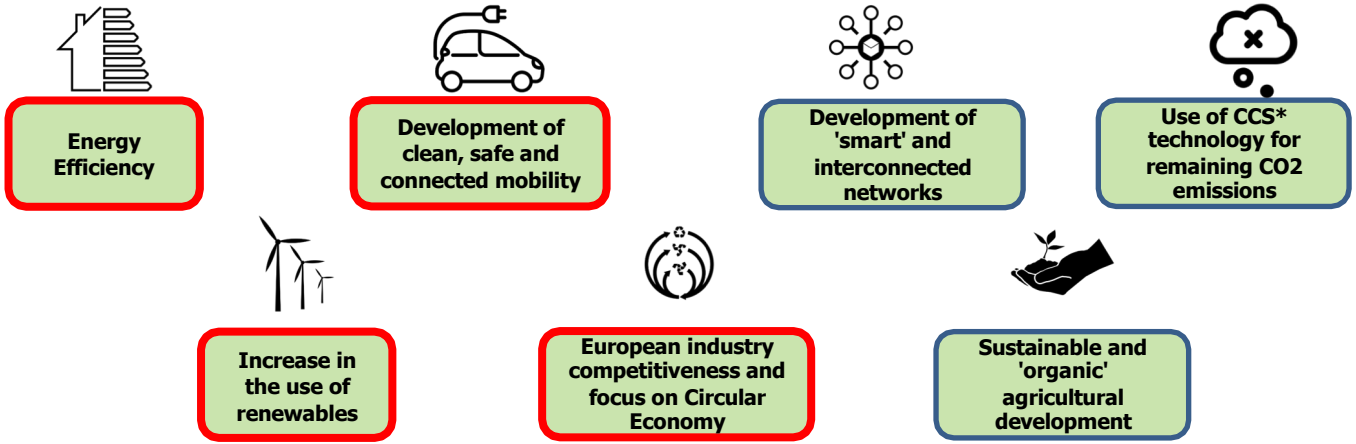
DIPARTIMENTO DI
INGEGNERIA GESTIONALE

The role of digitalization in the Green and Circular Transition

Prof. Davide Chiaroni
davide.chiaroni@polimi.it

The “pillars” of the decarbonised future

The European Commission vision for a **'zero climate impact' European Union by 2050** is expected to take place through joint actions along **7 main "strategic pillars":**

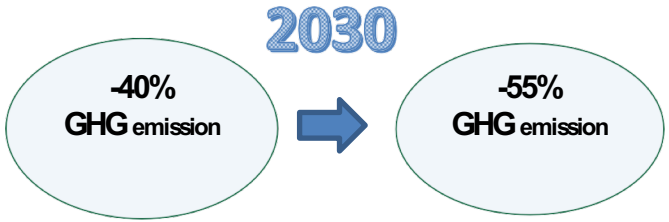


*Carbon capture and storage

The “pillars” of the decarbonised future

As part of the European Green Deal, in September 2020, it was proposed to raise the GHG emission reduction target present within the '2030 Climate and Energy Framework' from 40% to 55%.

At the end of June 2021, following the adoption by the EU of a European law on climate (which inserts the climate neutrality goal by 2050 into European legislation), **the target of reducing emissions by 55% by 2030 became binding.**



The “pillars” of the decarbonised future

… increasingly becoming reality

Climate Capital Climate change

Energy groups must stop new oil and gas projects to reach net zero by 2050, IEA says

Radical move would have to be compensated by huge investment in clean energy

Renewable energy supply forecast to surpass fossil fuels by 2040

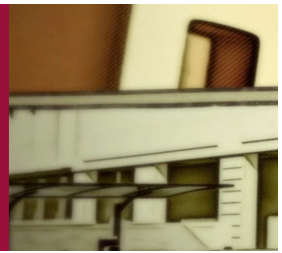
Energy supply (exajoules)

Special Report
How we will live in 2050

Part 3/6: How will we make our stuff in 2050?

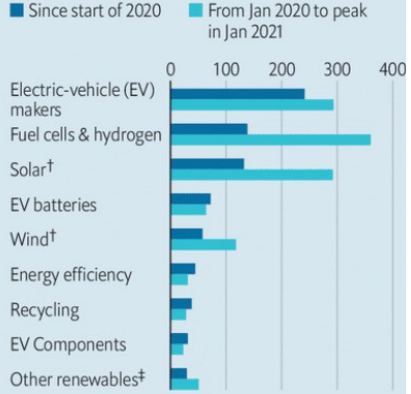
Technology, artificial intelligence and climate concerns are transforming manufacturing.

This third chapter of our 2050 series investigates how we will make and recycle goods. Will humans still work in factories? Will there be a circular economy? And could machines be the inventors of the future?



Shades of green

Green companies*, median increase in share prices, by sub-sector, %



*Based on the companies that are most widely held by roughly 100 clean-energy investment funds †Defined by over 50% of revenues coming from solar or wind, respectively ‡Firms with large revenue streams from many forms of clean energy

Sources: Bloomberg; *The Economist*

The Economist

The “pillars” of the decarbonised future

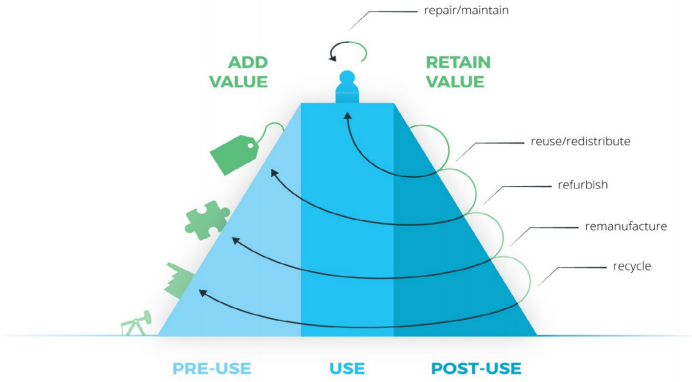
… increasingly becoming reality

The “dark side of the Moon” (1/2)

- We are focusing on new installations / new equipment in a given point in time … but **we are (often) loosing the perspective of the life cycle**

- We are focusing on the design of new circular products /service made for being re-usable, re-manufactured, re-cyclable … but **we are (often) loosing the contact with the customers**

- We are still focusing most on **how to add, rather than retain value**



The “paradox” of digital technologies

The solution of the previous problems are in a different approach

- It requires **a constant** (real time?) **measure of the status**, i.e. of the value, **of resources**
- It implies a **multi-dimensional measure of status** (who is using, what, where, from how long, in interaction with what, at what level of performance, …)
- It requires a definition of **actions related to each measure**, solving the **trade-off between values and costs** and constantly adapted to the **real available opportunities**, i.e. the number of available loops (re-use, re-manufacture, re-cycle, …)

… in other words on the **purposeful use of digital technologies**

It is not a matter of technology ”per se”

CYBER PHYSICAL
SYSTEMS

… but to find the right "business" model

- It requires to **truly "interact" with the sustainable/circular eco-system** and create **"connections" with the actors of the chain**, particularly those in the "during use" phase

- It requires to be **"integrated" in the revenue stream / revenue model**, allowing users as well to benefit from the value "captured"

- It requires to find a **cost/benefit balance in the design phase** and to properly address the problem for "measuring" technologies of **"keeping the pace" of innovation along the life cycle of the main product**

… of which digital technologies are the necessary enabler

The “dark side of the Moon” (2/2)

- We are focusing on big players … but **we are (often) missing the challenge/opportunity of local networks of players**

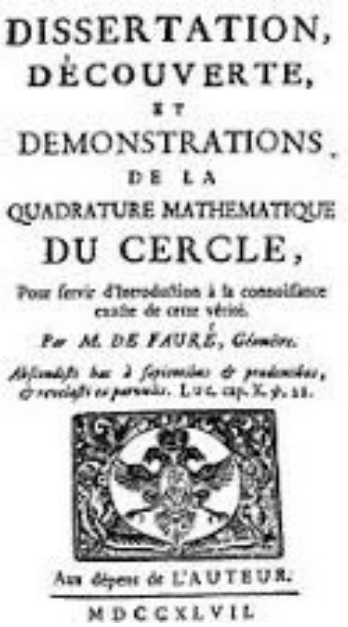
The “next step”

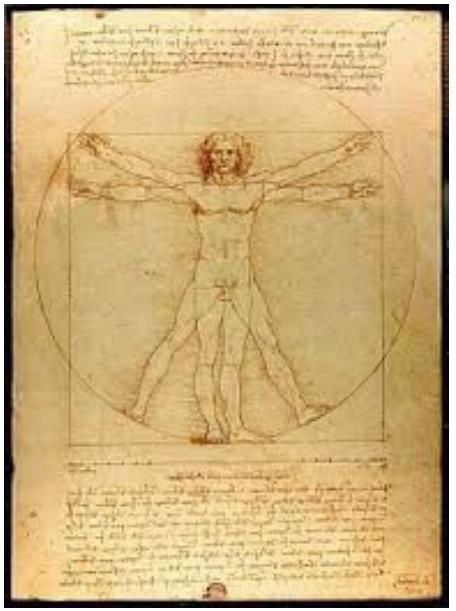
In the **pendulum swing** of Green and Circular Transition it is time to move

from **pre-use**
to **post-use** …

from **“design”**
to **“measure” …**

from **advertising**
to **technology**


DISSERTATION,
DÉCOUVERTE,
ET
DEMONSTRATIONS,
DE LA
QUADRATURE MATHEMATIQUE
DU CERCLE,
Pour servir d'introduction à la connoissance exacte de cette vérité.
Par M. DE FAURÉ, Géomètre.
Abscindit hæc à seminibus & prudentibus, & revelasti ea parvulis. Luc. cap. X. v. 21.
Aux dépens de L'AUTEUR.
MDCCXLVII



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WORLD MANUFACTURING FORUM – Cernobbio 2021 October 21st

DIGITAL PLATFORMS IN THE DEVELOPMENT OF CIRCULAR ECONOMY AND ISSUES RELATED TO THE RECOVERY OF SUPPORTING MATERIALS

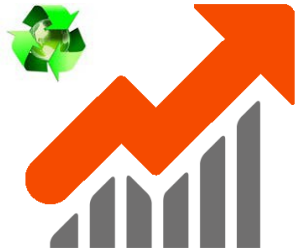
Prof. Maurizio Masi
Politecnico di Milano, Dipartimento di Chimica, Materiali e Ingegneria Chimica "Giulio Natta"

Digital technologies are increasingly pervasive in our society (5G networks, AI, ...) and rapidly developing:

- ***A.I.*** *for mapping and geo-localization of artifacts during their entire life cycle*
- *fast data processing*
- *data accessibility and portability*

Digital technologies are not immaterial (sensors, servers, storage, fibers ….) **and require a sensible amount of energy**. Almost all types of materials are therefore required, from *conductors*, to *ceramics*, to *semiconductors* and *polymers*.

- **Synergy between data networks and energy infrastructure**
- **Immediate availability of materials for technologies**
- **absolutely short life cycles**: need for a more integrated and structured collection and recycling network than the current one.
- **rapidly growing market scenario** (the less affected by the current health crisis)

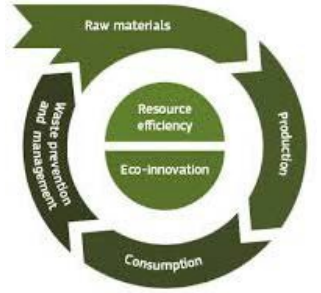


Materials demand of the third millennium will follow the "mega trends" that guide the needs of the population of planet Earth:

- *population growth and urbanization of the population,*
- *sustainable mobility,*
- *digitalization,*
- *health or "well being“ demand*
- …….

Industry has an insatiable appetite for increasingly high-performance advanced materials:

- lightweight HR composites, HTC, LTC, HEC, LEC materials, semiconductors for operation-intensive digital applications, materials for biomedical or energy applications
- request for innovation also for intelligent packaging films (barrier properties + control of the cold cycle or up to indications on logistics).



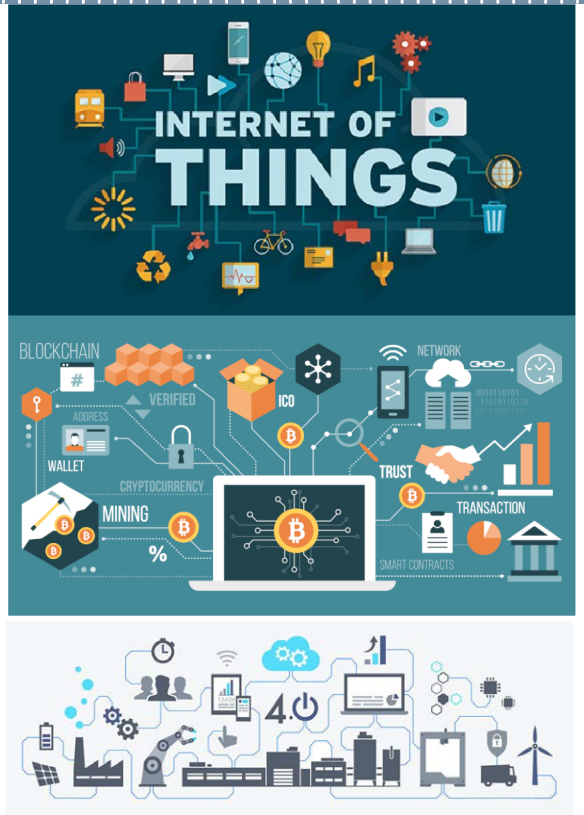
The **matching of the ever increasing demand for products with environmental sustainability** is only achievable through the transformation of production and consumption cycles according to a **circular economy model**

Digitization is an enabling factor for the transition to the circular economy

The connection of products and factories, infrastructural networks, the value chain and users makes it possible to design the manufacturing cycle of the product together with that of its use and reuse in a logic of environmental and economic sustainability.

Digital platforms, **smart devices**, **A.I.**, **IoT** and **blockchain** are already exploited in production processes to improve the use of natural resources by optimizing design, production, consumption, reuse, repair, regeneration, recycling and overall management some waste

This represents a new industrial revolution, usually referred to as **INDUSTRY 4.0** which involves the connection between physical and digital systems, complex analysis through Big Data and real-time adaptations.



EU recognizes the strategic nature of the world of materials as KET @ 2050:

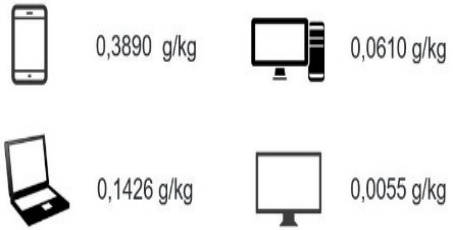
- *materials are the focal point of development for technologies: energy (wind, PV, solar, geothermal, bioenergy, nuclear), electricity and gas grids, energy storage, CO2, H2 and fuel cell sequestration and energy efficiency of buildings*

Recycling processes

In the EU, only about 9% of the materials of the manufactured products that reach the end of their life are intercepted and sent for recycling. Basically in the more consolidated traditional sectors (metals, glass and plastics). Only recently we begun to think about the recovery of materials from the digital and energy supply chains

World TLC Organization highlights that only 20% of the 44.7 Mton of WEEE are recycled (regulatory aspect, organization of supply chains, definition of policies that favor and facilitate the recovery of e-waste……)

WEEE have a complex structure (polymers of the casing and motherboards 50%, the metals of all the circuitry 30% and the "semiconductors" underlying the microprocessors the 20%



%gold in common WEEE

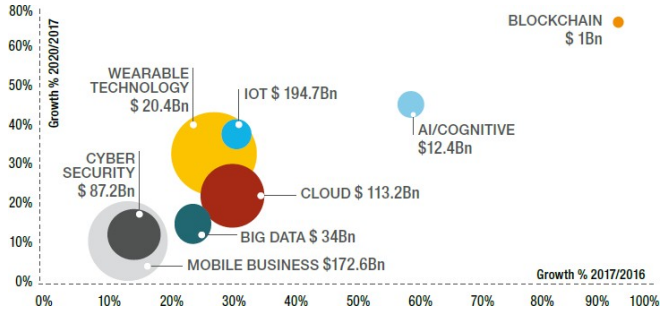
The sectors that can be traced back to the digital sector have a relevant economic values and, more importantly, high growth rates (+2 digits)

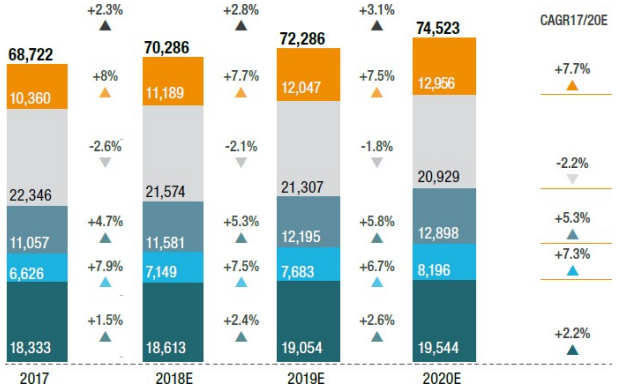
the Italian numbers show a growth of 2.3% for a value of 68.7 Geuro (stagnation)

Digitization has a significant impact on the transformation process of all industrial sectors:

- *Energy*
- *Aerospace*
- *Electronics & telecommunications*
- *Mobility*
- *…….*

All the sectors examined here are accumulated from the use of high-performance materials that can no longer sustain a linear economy.





The contributions that companies in the digital industry sectors can provide to the development of this scenario can essentially be traced back to four lines of action:

- **Introduce virtuous behaviors** within the company's production processes in order to transform the company itself into a "circular enterprise".

- **Encourage the adoption of digital solutions**, to make the use of available resources more efficient (sharing mobility, smart lighting, building automation, paperless economy, e-government services, etc.).

The short life cycle of digital equipment makes it necessary **to coordinate production processes with all the other players in the digital ecosystem** in order to **recover digital waste and reuse the raw materials and materials** used for the production of digital products and tools.

Digital technologies are an **enabling factor** for circular economy products, processes and services

KET

Italy is leader in the enhancement of HI-Tech products, reaching and exceeding the European target of 65% for the collection of WEEE

- Create a robust and competitive plant infrastructure for the Hi-Tech circular economy, with at least **5 new second-level recycling plants** and the upgrading of existing plants, bringing 1,000 jobs to the sector and an increase in turnover of 700 million euros

- Aiming for **100% recycled plastics** (i.e., chemical recycle), with further benefits on greenhouse gas emissions for a saving of at least 1 million tons

- Generate **1,200 million euros in turnover and 3,000 jobs** thanks to **Remanufacturing** and preparation for reuse of which at least 30% for the under 30s and at least 30% in the Southern Regions

- **Create 2,000 jobs and 1 billion euros in turnover** by developing the **circular housing and leasing market** for electronic devices (e.g., *from sell to lease % service*)

Legislation could be an important driver for the transition to the circular economy but it is currently a barrier: the ineffective implementation of the "End-of-Waste" legislation (waste flows not considered), the incidence of long implementation times and bureaucratic complexity of authorization procedure.

- **Lack of key legislative initiatives**: the need for a strategic action plan that leads to innovative legislative initiatives at EU level, financial & support actions
- **Incentives and financial tools for efficient technological production processes and for the recovery of critical raw materials** (CRMs) **but unable to sustain themselves economically** (e.g. implementation of initiatives such as tax credits or sustains for materials subject to market fluctuations).
- **The secondary resource supply chain shows the lack of an engagement / sharing approach between the parties involved** (e.g. producers of secondary raw materials / Recyclers and End-users) and a lack of participation in governance to ensure the presence of all parties to guarantee compliance interest.
- **National and regional initiatives aimed at the traceability of waste** in a coherent way and with digital tools, (e.g. Legislative Decree 135 law 14 December 2018, abolition of SISTRI).

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M. Masi, Innovazione per l'economia circolare: nuovi materiali e digitale, in *"L'Italia sostenibile", opportunità e sfide dell'economia circolare,* M. Caroli et al., Luiss University Press (2021) pp. 221-241. ISBN 978-88-6105-637-4

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World Manufacturing Forum October 21st 2021

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Danilo Bonato – General Manager Erion

erion

About Erion

Erion is the leading Italian **Producer Responsibility Organization** in Italy

- Nonprofit
- WEEE, batteries, packaging compliance and management services
- 2.400 producers (of which 90% PMI)
- > 300.000 tons of hi-tech waste managed in 2020

erion

The evolution of PRO in Europe

- From standardized compliance management service provider to competence “hub”, on behalf of producers, for the transition to a circular economy paradigm
- Requirements: focus on investments new skills, digitalization, economies of scale

erion

Circular Economy: how to move forward

1. Be aware and measure your current investments
2. End of life = business opportunities
3. Eco design is the key
4. Have a role in the new emerging value chains
5. Look for competences and funding

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