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Blueprint “New Skills Agenda Steel”:
Industry-driven sustainable European Steel Skills Agenda and Strategy (ESSA)

Online Mid-term Conference

Technological and Economic Development in Steel Industry

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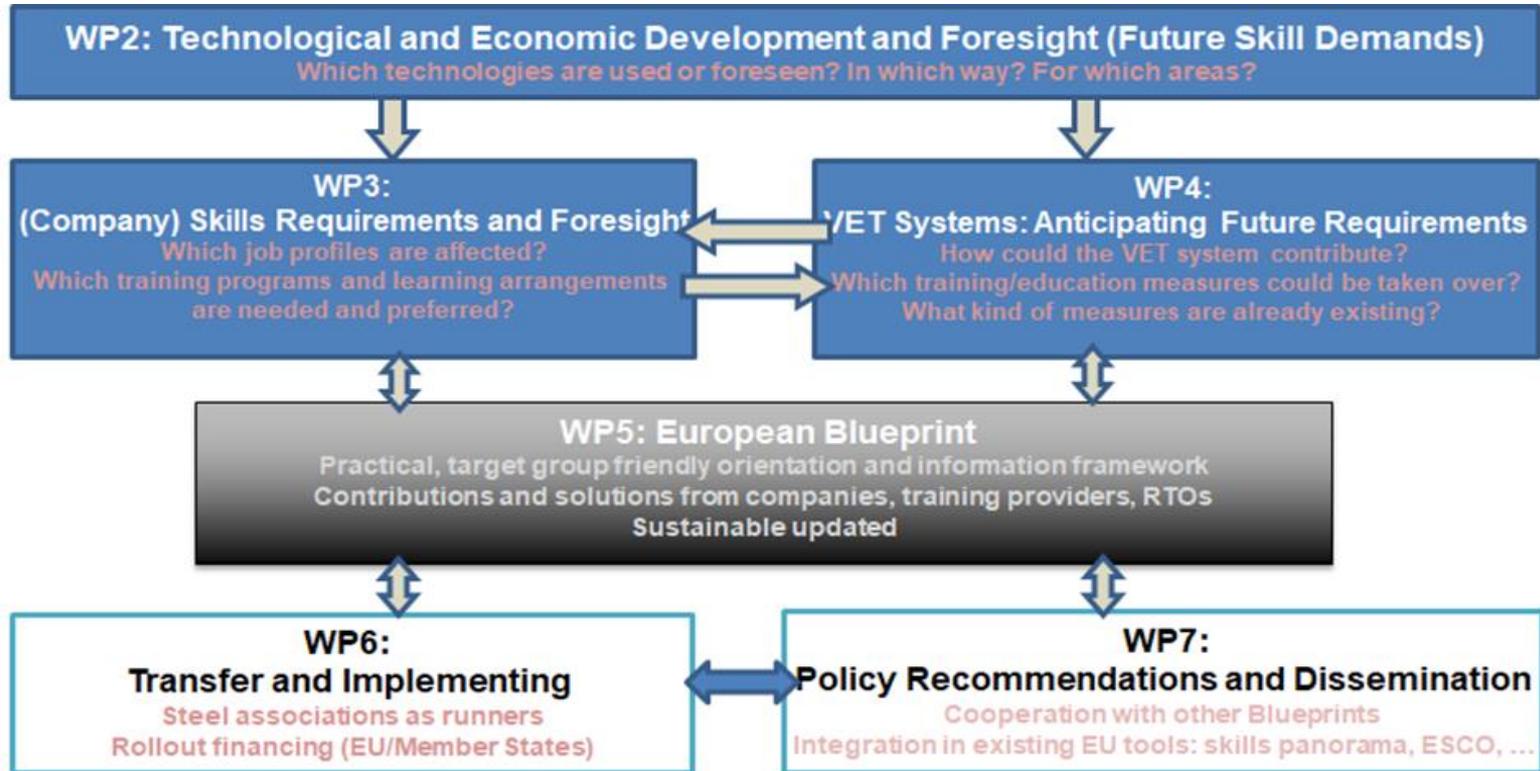
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Technological and Economic Development in Steel Industry



ESSA Approach



Objectives

- **To assess the current state and the future development of the technological transformation**
- **To develop a future scenario of a digitised Steel Factory with economic evaluation and impact on the personnel**



**Base for Company's
skills requirements
analysis**



**Base for support of the
Vocational Education
and Training (VET)**

Methodology overview



Desk Research

- European Innovation Projects (e.g. RFCS, HORIZON 2020, etc.)
- Journal/Conferences Articles, Reports, EC Document
- Best Available Technologies for the Steel Sector
- Technologies for low-carbon steel industry in EU funded project
- Technology for Additive Manufacturing.



Survey

- General information
- Strategy
- Technical information
- Human Resource

First research outcomes

- Current state of digital transformation in steel industry
- Current and upcoming development in digital transformation
- Digitalization and its Economic/Environmental Impact
- Digitalization and Impact on the Workforce

Current state of digital transformation in steel industry

- New **Key Enabling Technologies** (KETs) are represented by new generation of sensors, Big Data, Machine Learning, Artificial Intelligence (AI), Internet-of-Things (IoT), Internet-of-Services, Mechatronics and Advanced Robotics, Cloud Computing, Cybersecurity, Additive Manufacturing, Digital Twins, Predictive Maintenance
- The application of new technologies in the steel sector already supports and can further sustain the optimization of the entire production chain, although the steel production is already automated to a certain extent and often the systems work in an isolated way.
- The steel industry is becoming smart and more agile evolving towards industry 4.0:
 - ✓ The European steel industry has been involved in several policy activities, R&D projects, activities and patents in the field of digitalization.
 - ✓ The **European Commission plays a crucial role** in order to maintain the **competitiveness** of the European steel companies.
 - ✓ The new technologies can really support the **optimization of the entire production chain** through real-time operational data providing better and faster decision-making.
 - ✓ The steel industry expectations from digitalization focus on **quality, flexibility and productivity** through the optimization and the interactions of the individual production units.

Current and upcoming development in digital transformation

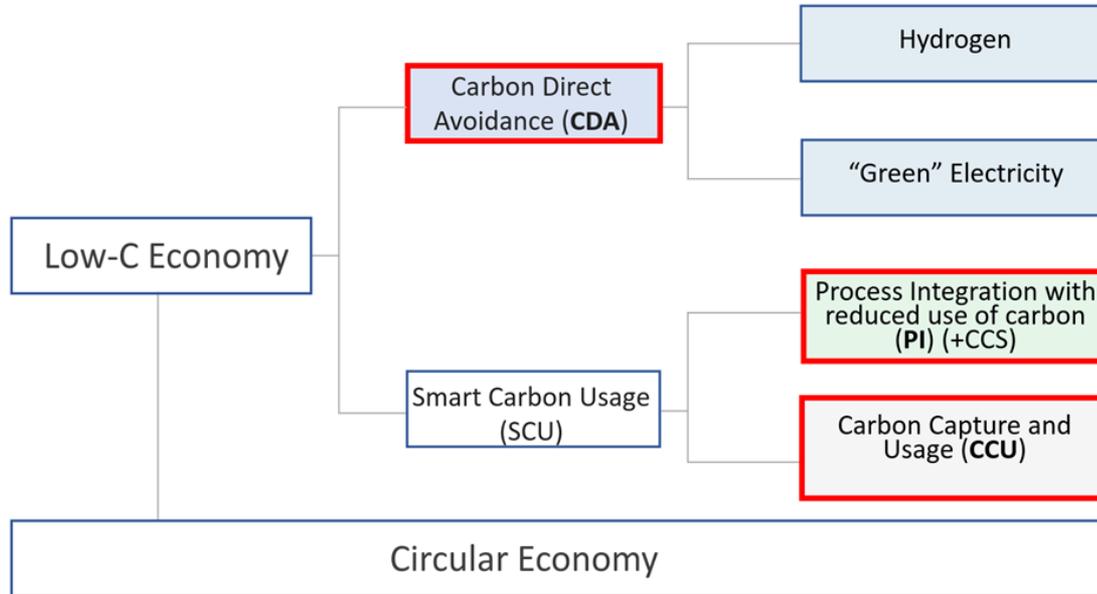
- The challenge of digitalization concerns the integration of all systems (sensors, automation, and IT systems) and production units in different dimensions:
 - ✓ **Vertical Integration** -> Integration of systems across the classic automation levels from the sensor to the Enterprise Resources Planning system;
 - ✓ **Horizontal Integration** -> Integration of systems along the entire production chain;
 - ✓ **Life-cycle Integration** -> Integration along the entire lifecycle of a plant from basic engineering to decommissioning;
 - ✓ **Transversal Integration** -> based on the decisions taken during the steel production chain, considering technological, economic and environmental aspects at the same time. This will only be possible by new IT, automation and optimization technologies and by their combination in an integrated way.
- **Digitalization trends:** adaptive online control, through-process optimization, through-process synchronization of data, zero-defect manufacturing, traceability, intelligent and integrated manufacturing.
- **Knowledge (Data and Human expertise) Management** is a key factor for achieving improvements in the digitalization process, through new approaches based, for instance, on the methodology knowledge-based decision support system.

Digitalization and Economic Impact

- The most important economic factors, related to technological applications - real-time production chain optimization, human robot collaboration, smart energy management, predictive maintenance, analytics – are related to:
 - ✓ reduction of energy and raw material consumption;
 - ✓ lower operational expenditure (OPEX);
 - ✓ reduction of losses;
 - ✓ increased product quality and productivity;
 - ✓ improved flexibility and the reliability of processes.
- New **business models** & organizational structure requiring a stronger networking between business processes, creation of efficient interfaces, integrated data exchange and management.

Digitalization and Environmental Impact

- Monitoring and assessing of the **environmental performance** of processes by **combining digital and of CO₂ mitigation** technologies leading also to new ways of circular economy and industrial symbiosis across different industry sectors.



Source: Project Low Carbon Future

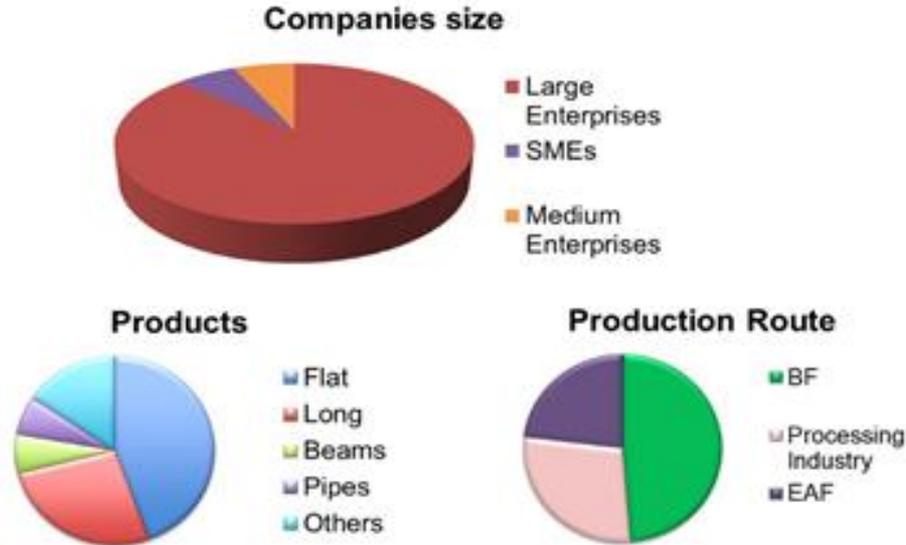
Digitalization and Impact on the Workforce

- Soft-skills as collaboration, communication and autonomy are required for employees in order to be able to carry out their jobs in hybrid operating systems.
- The workforce should increase their ability to be adaptable and to get into the habit of continuous learning in an interdisciplinary perspective.
- The impact of the digitalization on the low skilled workers is an open issue to be faced in different ways, e.g. up-, reskilling, reduction of “middle” workers (polarization), use of external personnel, etc.
- Effects of digitalization on the employment: reduction or increase? Open question to be discussed
- Continuous training activities and updated programs represent the key aspects for the steel companies in order to achieve a successful future and to improve the interdisciplinary skills.

Results from the survey

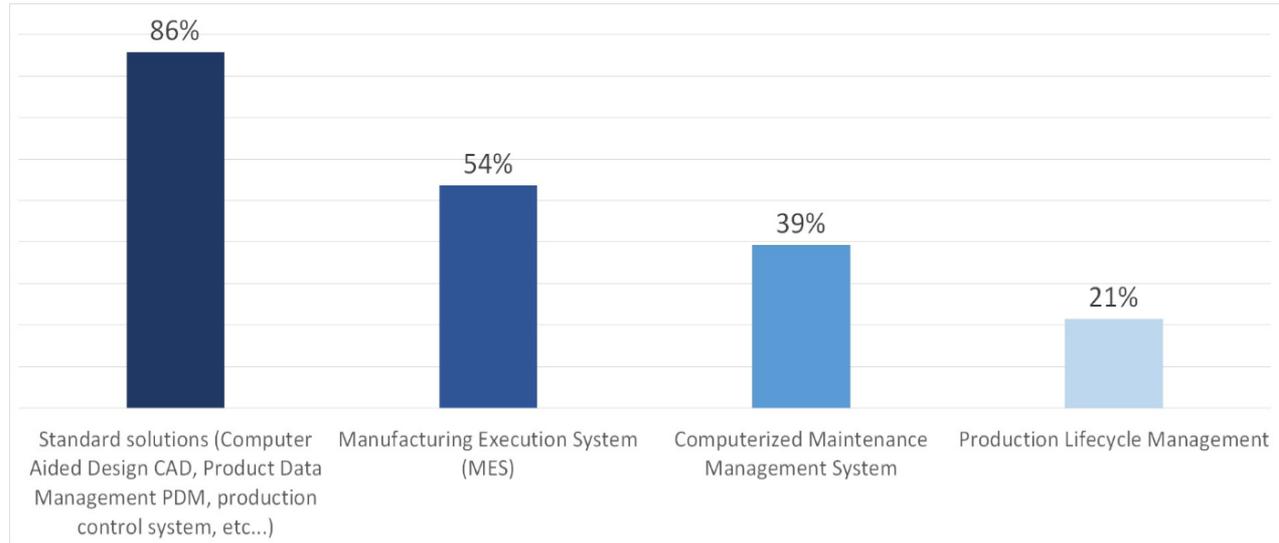
The survey results underline and confirm the desk research results by providing direct answers from Company representatives

Sample characterisation



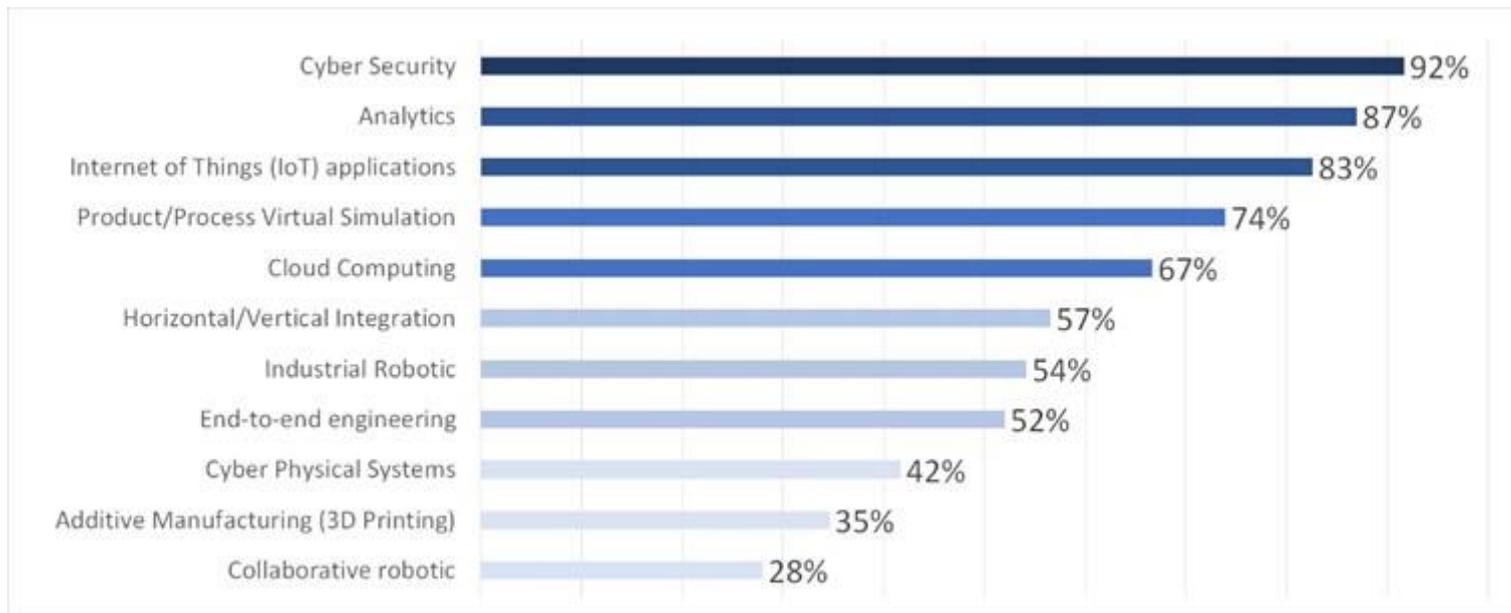
- 28 answers collected up to October 2019
- Steel companies located in several European countries
- Different professional profiles, i.e. board of director, plant managers, ICT, HRs, etc..

Traditional solutions currently applied in the steel companies



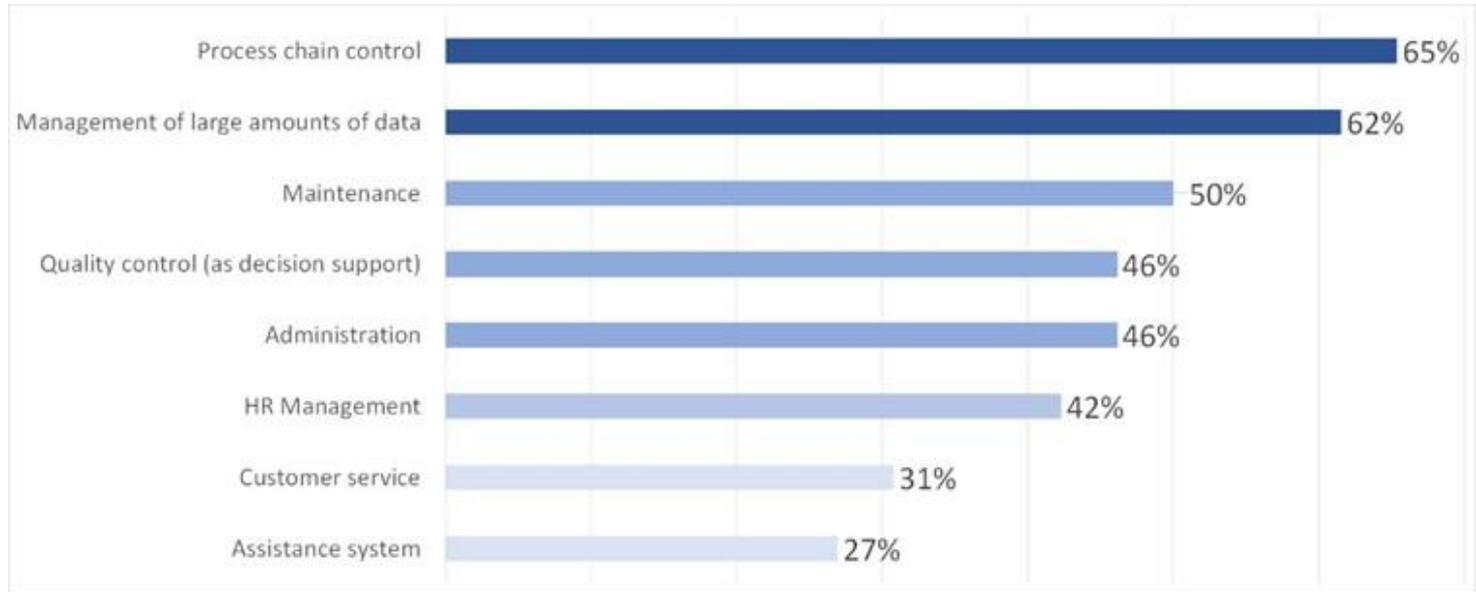
- **Significant levels of automation in the involved steel companies as a starting point to evolve towards a technological improvement**

Planned investments in I4.0 technologies within 3 years



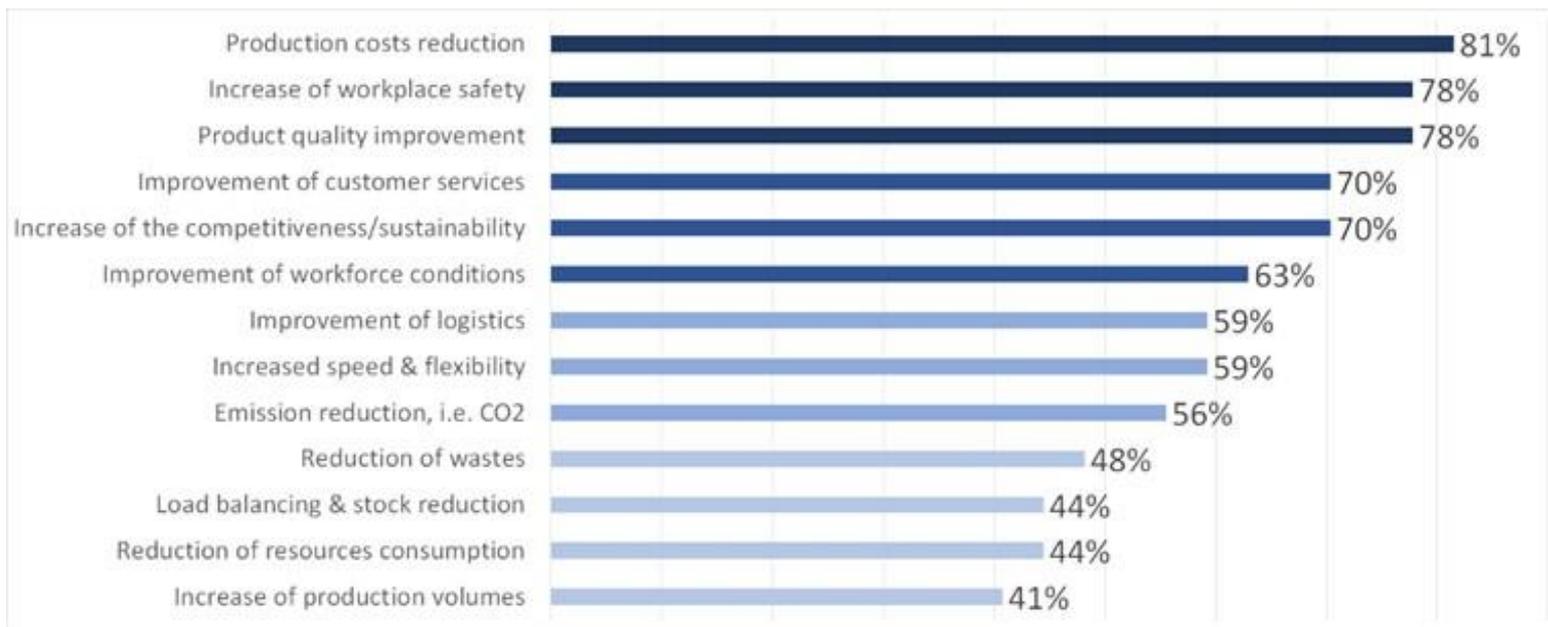
- Industry 4.0 technologies generally widely known
- Major interest and priority on Internet of Things (IoT), Analytics, Cyber Security and Systems Integration (both horizontal and vertical) – the most already applied
- Such technologies also appear in the planned investment mainly within short time (i.e. 3 years)

The level of digitalisation diffusion in the companies' areas



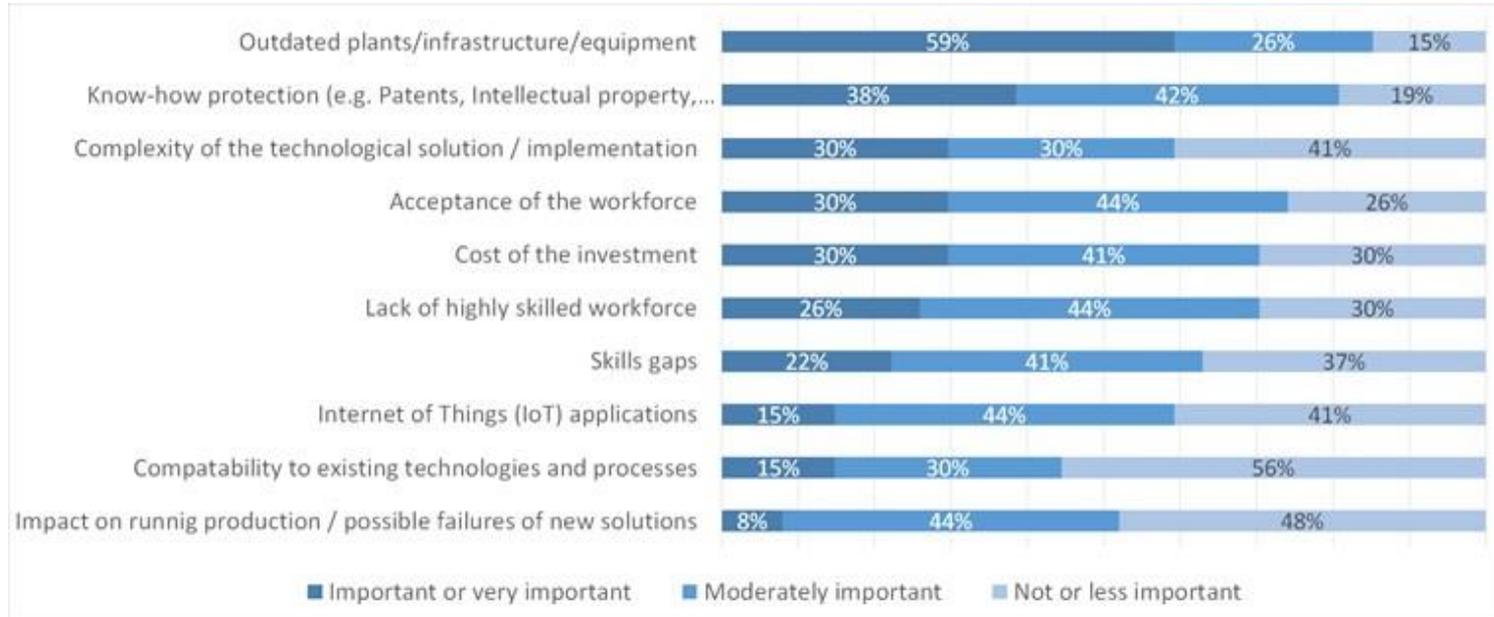
- Digital technologies generally widespread applied in all the company's areas especially in process chain control and where the management of large amounts of data is required, i.e. production, business, etc.
- Maintenance, administration, quality control and HR management are also mentioned among the areas where digitalisation is mostly applied

Main expected benefits from the adoption of the enabling technologies



- **Economic, safety and environmental benefits: production costs reduction & improvement of product quality, increase of workplace safety & improvement of working conditions, increase of sustainability and competitiveness**

Main barriers for the application of the enabling technologies



- **Technical/economic barriers:** compatibility with existing infrastructure and plants status, investment costs
- **Barriers affecting the workforce aspects:** lack of highly skilled workforce, skills gap, lack of confidence in new technologies by some workers

Workforce organisation & digitalisation

- General imbalance of male and female percentage in favours of males in all the three considered areas: operations, administration and services.
- Higher education (i.e. Universities, Occupational Colleges, etc.) is a requisite for most of the production managers and engineers respect to technicians, operators and apprentices/trainees.
- Future evolution of the workforce (in the next 3-5 years): the sample was quite divided about growth in workforce numbers or not (50% yes, 50% no)
- In case of growth, it appears a higher interest to employ more women and **high qualified people, mainly because of the use of new technologies.**
- Production managers and engineers are **the most aware of the needs of digital competences**, while technicians, operators and apprentices/trainees seem less aware.

Next steps



Technological and Economic development & EU climate objectives

Major technological developments in line with the recent European initiatives

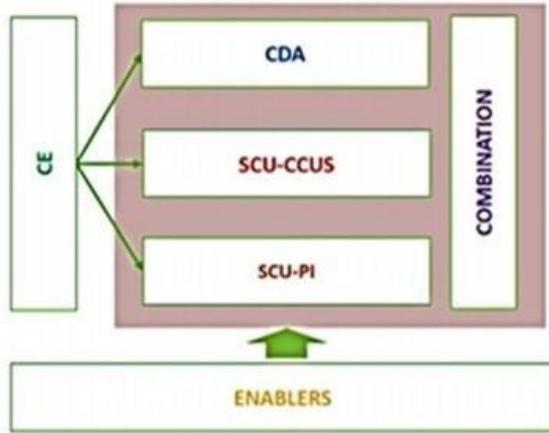


- The **Green Deal** as EU strategy to reach climate objectives and GHGs reduction by 55% by 2030 and climate neutrality by 2050, as a key driver of innovation and growth for industry and to transform the EU into a prosperous, modern, resource-efficient and competitive economy.
- EU initiatives directly affecting the steel industry for a sustainable production in line with the climate objectives:
 - The Green Steel project (2019)
 - The Clean Steel Partnership and Roadmap (2020)

Technological and Economic development & EU climate objectives

- Green Steel project focus on the identification of 1) the most promising technologies for carbon-neutral steel production, 2) the possible barriers, the investment needs, 4) funding strategy
- The Clean Steel Partnership (CSP) Roadmap defines the R&D&I activities for a sustainable production by establishing:
 - six areas of intervention corresponding to the technological pathways and including digitalization as enabler
 - 12 technology building blocks among these digitalization as enabler

CSP Intervention areas & building blocks



Source: Author's elaboration on consultation with ESTEP members



Building Blocks (1-12)	Areas of intervention					
	CDA	SCU-CCUS	SCU-PI	CE	Combination	Enablers
1. Gas Injection	Major	Minor	Major	Minor	Major	Minor
2. Metal oxide reduction	Major	Minor	Major	Major	Major	Minor
3. Melting Technology	Major	NO	Major	Minor	Major	Minor
4. Adjustment production	Major	Major	Major	Major	Major	Major
5. CO/CO ₂ utilisation	NO	Major	Major	Minor	Major	NO
6. Raw materials preparation	Major	NO	Minor	Major	Major	Major
7. Heat generation	Major	Minor	Major	Minor	Major	Minor
8. Energy management	Major	Minor	Major	Major	Minor	Major
9. Steel specific CE solutions	Minor	Major	Major	Major	Major	Major
10. Enablers (Skills, Digitalisation)	Major	Minor	Major	Minor	Major	Major
11. Low CO ₂ emissions downstream processes	Major	Major	Major	Minor	Major	Major
12. Innovative steel applications for low CO ₂ emissions	Major	Minor	Minor	Minor	NO	Minor

Source: Author's elaboration on consultation with ESTEP members.

Digitalisation contribution to the CSP intervention areas

CDA - Major contribution	<ul style="list-style-type: none"> The new CDA techniques need new measurement technologies and digital tools e.g. to handle new safety issues (e.g. handling of hydrogen) and upskill/support of staff regarding the new processes with intelligent scheduling of resources and AI-enabled event management.
SCU-CCUS - Minor contribution	<ul style="list-style-type: none"> Integration of SCU-CCUS in the process systems needs new measuring technologies and digital tools (e.g. for control of gas circuits)
SCU-PI - Major contribution	<ul style="list-style-type: none"> The realisation of SCU-PI technologies needs new measuring technologies and digital tools, this applies in particular for the intermediate transition states (e.g. to handle the influences on gas circuits) PI in its general definition includes also the optimised combination resp. coordination of processes inside the process chain, thus, this area of intervention also considers techniques which are needed across the whole process chain for optimum process integration inside the future carbon-free steel production chains (closely linked to the area of intervention "Combination of technological pathways").
CE - Minor contribution	<ul style="list-style-type: none"> New digital tools are needed to plan, schedule, monitor and control the new material cycles New tools to support life cycle impact assessment are needed
Combination – Major contribution	<ul style="list-style-type: none"> The decarbonisation often includes combinations of techniques which will create several needs for the enablers considered in this building block, e.g. regarding planning, scheduling and automation tools with the extended application of process Digital Twins for in-line and off-line analyses (scenario evaluation, risk assessment etc.)
Enablers & Support Actions - Major contribution	<ul style="list-style-type: none"> There are strong links due to the similar focus of building block and area of intervention

Source: Author's elaboration on consultation with ESTEP members.

Technological and Economic development & EU climate objectives & Digitalisation

- Digitalization and climate change represent the main driver of innovation for the European industry, including the steel sector.
- Digitalisation helps to increase energy and resource efficiency and contributes to keeping materials in use for a longer time.
- The integrated climate industrial policy can allow the EU building up a greenhouse gas-neutral process industry.
- Exploiting the synergies between the different EU initiatives can support the circular economy and companies in their digital transformation

Digital tools in the steel sector to support Industrial Symbiosis

iSlag project: improvement of EAF slag valorization, supporting good practices and exploring new recycling paths by facilitating the implementation of Industrial Symbiosis



- Development of decision support concepts and systems helping to implement smart slag conditioning practices and optimal slag handling for reuse/recycling



Provide operators with easy-to-use tools to support Industrial Symbiosis and Circular Economy practices



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Thanks for your attention

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