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‘Smart manufacturing and tasks automation. Reflecting routine work and the importance of transversal skills in shifting to industry 4.0’

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Industry 4.0

- I4.0 relies on key innovations, such as ICT and robotics and more recent concepts, such as the Internet of Things, Cyber-Physical Systems, Cloud Computing, Big Data and Artificial Intelligence.
- I4.0, aims to achieve a thorough interconnection of all the elements taking part in the value-added process, transforming analogue data into digital data and using cloud computing and data science to improve efficiency and competitiveness (Schroeder 2016).
- The technological and organisational transformations that stem from I4.0 will influence the kind of skills, competencies and qualifications that are needed in the future.

Industry 4.0 in the Steel Industry

- The steel industry is progressively moving towards Industry 4.0 (Estep, 2017) with firms starting to make use of IoT models, sensors and big data analytics to improve energy efficiency and resource management, as well as quality monitoring and defects detection.

- Robot-assisted production is increasingly allowing workers to supervise, instead of perform, dangerous and labour-intensive processes and tasks e.g. drones.

- Extensive generation, storage and analysis of data will help steel companies to improve processes and plan recurring intervention on machinery based on sensor data and computer simulation.

Approaches to the Issue (1)

- Reflecting on the relationship between technology and work is nothing new in social sciences

- The 'digital workplace' has brought special attention to this area in the last decade.

- Little agreement has been reached on likely future scenarios:
  - Negative relationship between technology and employment (e.g. Susskind & Susskind 2015, Frey & Osborne 2017)
  - Optimistic perspective (e.g. Autor 2015, Lloyd & Payne 2019, Stroud and Weinel, 2020).

Approaches to the Issue (2)

- The distinction between routine and non-routine tasks (Autor et al. 2003) has played an important conceptual and methodological role in many influential labour market forecasting studies:
  - routine tasks ‘can be accomplished by machines following explicit programmed rules’;
  - non-routine tasks as those for which ‘the rules are not sufficiently well understood to be specified in computer code and executed by machines’;
  - further combined with a distinction between manual and cognitive tasks.

- Two arguments maintained:
  a. technology substitutes for workers in carrying out routine cognitive and manual tasks;
  b. technology complements workers in carrying out problem-solving and complex communication activities (cognitive non-routine tasks).

Approaches to the Issue (3)

- Frey and Osborne (2017):

  - with the improvement of sensing technologies and with the rise of Big Data and Machine Learning, a wide range of non-routine cognitive tasks is now in the reach of technology. Similarly, advancements in robotics are widening the range of non-routine manual tasks that robots can take over from human workers.

- Susskind (2019):

  - the distinction between routine and non-routine tasks is undermined by the most recent technological developments and does not hold anymore: the inability of human beings to articulate their thinking is no longer a constraint on automation, what counts is whether or not a task is 'routinisable' from the standpoint of a machine.

Approaches to the Issue (4)

- Pfeiffer (2015; 2016; 2018) has also criticised the routine/non-routine dichotomy, her argument is rooted in a reflection on the absence of clear boundaries between the two when contextualised in the practice of real industrial settings:

  - The more automated, digitalised and complex a production environment becomes, the more human experience becomes important in ensuring that all the processes run smoothly.

  - while in highly complex and digitized production environments the significance of living labour may be quantitatively decreasing, its role in maintaining these complex production processes is becoming ever more important.

The Research

- European Steel Skills Agenda (ESSA)
  - Explores futures skill needs of the European steel industry – digital and green
    - ➢ Erasmus+
    - ➢ Four Years and €4M: January 2019 – December 2022
  - Five case study countries
    - Germany, Italy, Poland, Spain, United Kingdom
  - Interviews with trade unions and steel producers = 41
  - Supplementary questionnaires = 12 (Poland and Spain)

ESSA
EUROPEAN STEEL SKILLS AGENDA

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Main Arguments

- We maintain that the relationship between technology-induced transformation at the level of the I4.0 workplace and replacement by automation for low- and mid-skilled workers is a non-linear one.
- Our data suggests that, even in highly digitalised and automatised settings, soft skills (e.g. problem-solving, leadership, communication, autonomy) are important to use the new technologies and perform the assigned tasks.
- We argue that jobs labelled as ‘routine’ may entail a range of tasks that current technology remains unable to entirely automatise and that human supervision, intervention and coordination is crucial to ensure that automatised processes run flawlessly.
- We contend that the most evident development in labour markets is the prominence acquired by soft skills at every occupational level.

A Few Examples from the Field (1)

- Decision making….

  ‘*you need someone who understands the phenomenon and makes the machine understand what it has to do. […] it is very important that the person using the system has a technological concept. And that he understands that if I continue to show it a certain defect, which in reality is not important to me, the system begins to think that that defect is important, and therefore spends much more energy of calculation on that defect compared to another thing that was perhaps important’* (Italy)

A Few Examples from the Field (2)

- Data Analysis….

  ‘*in the rolling mill or in the smelting furnace, everything is automated and what the worker has to do is a good analysis of the data. And then, with this data analysis, he has to transfer the solutions to unforeseen events and problems by modifying these data, these parameters, to how they should produce in practice* ’ (Spain)

A Few Examples from the Field (3)

- Quality control….

‘the lamination will be almost completely automatized. And it will be supervised by technical operators there in the line. However, the quality control part of the final product will not be automatized. As I said, we produce high quality special steel, so if we will find some problem in the final part of the product, this is going to be reworked and this part is not going to be automatized, this will still be manual’ (Spain)

Deteministic vs. Probabilistic Technological Approaches

- An aspect that requires consideration is the particular character of I4.0. We propose a distinction between a 'deterministic' approach, which characterises earlier forms of automation and a 'probabilistic' one:

Industry 3.0	Industry 4.0
Deterministic (one lane of operation)	Probabilistic (multiple lanes)
Automation is designed and programmed to perform in a unidirectional way	Digital and robotic systems are designed to interact with one another and with their environment, generating, processing and acting upon data
Linear programming/operating sequence	Algorithms programmed to learn, interact and offer alternative lines of action
Supervision to avoid failure, general understanding of the process	Supervision to avoid failure, general understanding of the process, general understanding of technology, capacity to read data and translate into real-word situations, act upon data, refuse machine suggestions

Reformulation of Autor et al. (2003) dichotomy

- We propose the following reformulation of Autor et al. (2003):

  - (a) Technology can substitute for workers in tasks that entail computation, pattern recognition and sequential (codified) action. This broad category includes in our view everything that has been previously defined as ‘routine’ or ‘routinisable’ tasks.

  - (b) Technology complements workers in carrying out any other task that deals with non-linear, non-deterministic behaviours or events. This corresponds in our view to ‘non-routine’, ‘unroutinisable’ tasks and includes any task that requires interaction, complex communication, situational interpretation (knowledge and experience), problem solving and so on.

Some Concluding Thoughts

- The more digitalised, interconnected, multi-layered systems derived from the Industry 4.0 paradigm are integrated in the different areas of steel production, the greater the need for human understanding, evaluation and supervision.

- In such a context, soft skills play a crucial role as these are properly those skills that allow human beings to perform all those non-routine, unroutinisable actions that require a great deal of interpretation, critical thinking, problem solving, communication, negotiation etc..

- While, as Susskind has noted, new technologies make a higher number of tasks routinisable thanks to their capacity to compute, recognise patterns and generate rules of action, it should not be overlooked that such technologies cannot manage complexity and unpredictability, and would fail where scenarios and lines of actions are not pre-defined (Pettersen 2019).

Thank You

For Your Attention

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