



Artificial Intelligence for Steelmaking: optimizing processes, augmenting workers, blurring accountability

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Coercion, Consent and Conflict in the Labour Process and Beyond**

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Data and de-centralised AI for a competitive and green European Metallurgy Industry

- **EU Horizon 2020 funded interdisciplinary project (2022-2025): ALCHIMIA**
 - Partners – technology development partners, two steel industry corporations, two universities [Alchimia Project | \(alchimia-project.eu\)](https://alchimia-project.eu)
- **Optimization of EAF scrap-mix by means of MACHINE LEARNING:**
 - AI – Federated Learning & Continual Learning
 - Industry 5.0
- **Principles: Human-centered design, Trustworthy AI (ALTAI), compliance with HLEG AI guidelines**
- **ALCHIMIA will be developed for and deployed at 2-3 Electric Arc Furnace plants and within one automotive brake disc manufacturer**
- **Scalability and replicability of ALCHIMIA for more efficient and environmentally friendly metallurgy industry**

Steel Industry Context

- **Steelmaking – two main methods:**
 - Primary: Integrated Blast Furnace / Basic Oxygen Furnace: iron ore to steel
 - **Secondary: Electric Arc Furnace (EAF): recycled steel scrap to new steel**
- **High Carbon Emissions:**
 - Largest single energy related CO₂ emissions globally by industry (Ritchie and Roser, 2016)
 - 3 billion tonnes of CO₂ per year = 8% of global emissions
- **Decarbonisation:**
 - Carbon Direct Avoidance: Hydrogen; Green Electricity
 - Transition to EAF
 - Smart Carbon Usage: Carbon Capture and Storage; Carbon Capture and Use
 - Efficiency innovations e.g. ALCHIMIA
- **Technological innovation and transition = workforce implications...**

Themes: Technology and Work

Set within...

- **Industry 4.0 and Industry 5.0:**
 - From digitalisation of manufacturing (cyberphysical systems, big data, internet of things, etc.) to Industry 5.0 (human centred, sustainable and resilient) [see Leng et al, 2022]
- **Digital Technology:**
 - Highly rewarding for some (Brynjolfsson and McAfee, 2014), technology induced unemployment for others (Frey and Osborne, 2017 *cf.* Autor 2015), end of work (Spencer, 2018)
 - Wacjman (2018: 168] challenges the 'widespread assumption that digital technologies... [are making us]... mere hostages to the accelerating drive of machines'
 - Orlikowski (1992) and Edwards and Ramirez (2016) understanding technology 'effects' offers an opportunity to negotiate technology insertion

Themes: Technology and Work

- **Artificial Intelligence and Human Centred Design (HCD)**

- Artificial intelligence: Things that are *Artificially intelligent* differ from something that is *naturally intelligent*'... artifacts that possess special properties ordinarily possessed by non-artifacts... commonly machines and ability to learn... machine learning (ML) (Fetzer, 1990): 'ML techniques may be so complex that it may be difficult for those who are not AI experts to understand' (Shrestha et al. 2019)
- AI and ML = Big-data revolution: Big-data analytics refers to a mechanism whereby advanced computing and statistical tools are used to process and make use of complex data... integrating big data analytics can introduce quality metrics to monitor each phase of the manufacturing process' (Cerexio, 2022)... Federated and Continual Learning
- AI and HCD: workers not passive recipients of algorithmic results but social actors playing an active role in shaping and appropriating technological systems (Jarrahi et al: 2021: 6)
- HCD = enhanced acceptability of technologies and interactive systems, more efficient and effective use, fewer adverse consequences when users involved during development, implementation and use
- Focus on sustainability and human centric approach aspires to I5.0 (Rada 2017) and places workers well-being at the centre of the production process (Alves et al, 2023)

Themes: Technology and Work

- **ALTAI**

- Artificial intelligence: compliance with EU Ethics Guidelines for Trustworthy AI (EU AI HLEG 2019):
- Seven requirements: 1. Human Agency and Oversight; 2. Technology Robustness and Safety; 3. Privacy and Data Governance; 4. Transparency; 5. Diversity, non-discrimination and fairness; 6. Societal and environmental well-being; 7. Accountability

- **European Trade Union Institute (ETUI)**

- Seven Essential Dimensions: 1. safeguarding worker privacy and data protection; 2. addressing surveillance, tracking and monitoring; 3. making the purpose of AI algorithms transparent; 4. ensuring the exercise of the 'right to explanation' regarding decisions made by algorithms or ML models; 5. preserving the security and safety of workers in human-machine interactions; 6. boosting workers' autonomy in human-machine interactions; 7. enabling workers to become AL literate (Ponce 2020: 2)

- **Questions:**

- Which ethical principles should be prioritised and can the conflicts between them be resolved? (Jobin 2019)
- Are such guidelines out of touch with day-to-day issues faced by workers in their engagement with AI? (Ponce 2020; Metzinger 2019)
- How will AI change work? (Brodner 2018; Brynjolfsson and Mitchell 2017; Webb 2020; Herrmann and Pfeiffer 2022)

Themes: Technology and Work

- **Labour process:**
 - From technologically determinist accounts to recognising, sociologically, the relations of power and control on technology insertion and use (Braverman, 1974)
 - Recognition that 'technology is not deterministic and neutral' (Bélanger and Edwards, 2007: 217) and requires us to reflect on 'technical and human organisation of work' (Thomson 1989: 19)

'Human Factor' Research

- Four Research Sites:
 - Italy (Automotive parts)
 - France, Poland, Spain (secondary steel production)
- Ex-ante surveys and interviews at 4 sites (Italy, Poland, France, Spain)
 - Between May and June 2023
 - current roles, patterns of work and perspectives/awareness of AI and ALCHIMIA
- Ex-post surveys and interviews – 1-1.5 years after ex-ante stage
 - post-insertion perspectives and evaluation of ALCHIMIA
- Deliverables:
 - Guidelines for trust, safety and human use of AI tools in heavy industrial environments, including recommendations for human-centred technology development and insertion
 - Skills development strategy, training, education plan and products



The Ex-Ante Data: Optimisation of Production Processes and Changes to Work Processes

- Some divergence of opinion as to the potential to optimize some production processes through changes to work processes, e.g. in scrap sorting

- **Diverse imaginaries/expectations:**

- intensification of work processes
 - (e.g. sensor maintenance, accuracy of readings, AI training data)
- de-intensification of work processes
 - (e.g. fewer checks, fewer points of intervention)

- **Overall: No or little change to:**

- work processes
- job security

‘No, I don't think workers can be replaced by the system. Certainly not at the production level; at the follow-up level a series of “OK, you can lighten a series of checks, however less frequent”, but still you have to do them. So, I'm having a hard time seeing where it can physically be reduced the number of people as checks still need to be done... they will not get rid of hourly check hourly control because it's mandatory and obligatory’ (AutoCo.IT1).



The Ex-Ante Data: AI and the Augmentation (or not) of Steel Workers' Capacities

- **Range of perspectives on:**
 - the potential for the AI to augment steelworkers' capacities
 - the implications of augmentation in terms of leading to cognitive complacency, de-skilling and diminution of workers' capacities, but also upskilling
- **Consequences for:**
 - the potential for steelworkers to successfully transition to be a Resilient Operator 5.0 i.e. 'human operator resilience and human-machine systems resilience... [for]... future of work in smart resilient manufacturing systems in the emerging Industry 5.0'
*Romero and Stahre 2021: 1089)

'Now we are focusing attention basically on knowledge about artificial intelligence, data management, data engineers and data scientists. So, we think that in the near future we will need more of this...[AI PLATFORM], I think it will make the people increase. I don't think they will lose their job. I mean with [AI PLATFORM], it's more a question, that they will have to deal with new tools, and we have to train them to know these new tools...my view is that we will require less people in production but in the other hand, we will require more people in maintenance, so this is something that we see quite clear that maybe they will move people from production to maintenance because this new computers needs to maintain, need people who takes care of them'
(SteelCo.E57).



Blurring Accountability for Decision-Making



- The AI technology, ALCHIMIA, will be a *partially autonomous system* (Rafsanjani and Nabizadeh 2023)... with distributed agency for decision making between workers and the AI' (Rammert, 2008)
- ALCHIMIA is being designed to holistically optimize processes and be capable of making decisions affecting tasks and whole processes that are currently taken by operators
- Outcome:
 - Will likely reduce agency in the furnace control
- But:
 - Differing perspectives about the potential for the AI to affect workers' autonomy and decision-making:
 - de-skilling around critical thinking and decision-making
 - Blurring accountability for decision-making

Blurring Accountability for Decision-Making



'If [AI PLATFORM] were to automate decisions, the short-term risk is that work becomes duller as operators just need to oversee an automated process. In the long run, there is a considerable risk of de-skilling. So, you are offering to me a system [AI PLATFORM] that provides us with continuous forecasts, and we try to follow along with that. On one side, it diminishes firm's know-how and depletes employees who are supposed to grow [in terms of knowledge acquisition]. When you use this system, you are given pre-digested information. So, you don't have to make any sort of effort to understand it...to understand how you got there'. (AutoCo.IT1).

'They don't see it [AI PLATFORM] as a threat to them because it's basically a support because at the end of the day, they're in charge of making decisions about it. So just another tool to factor in while taking decisions' (AutoCo.IT3, interpreter summary).

'[AI PLATFORM] will be something that supports the worker and doesn't replace them because it's still a suggestion instead of a command. So, it can give you an alert, do this or watch out or there might be a problem, but it's still the worker who makes the final decision on it. It can definitely open further avenues for implementing further AI into their daily routine. However, that might even spark some concerns about is the human still allowed to make decisions, or are we just, should we just follow along what AI says. But [AI PLATFORM] definitely like lies within this safe perimeter of leaving the final decision to the worker' (AutoCo.IT6, interpreter summary).

Data Overview: ALTAI



Acceptance Factors	Issue	Ethics Guidelines	Outcome
Impact on Competences and Skills	Deskilling, Upskilling, Retraining	Human Agency and Oversight Diversity, Non-discrimination and Fairness	Additional skill needs identified. Some risk of deskilling
Impact on Work Flow	Work intensification, changing tasks, 'routinization of work'	Diversity, Non-discrimination and Fairness Human Agency and Oversight	Very limited impact
Impact on Privacy	Surveillance, Dataveillance, Function Creep, Cybersecurity	Privacy and Data Governance Transparency	No surveillance or privacy concerns. Some potential for function creep and cybersecurity issues.
Impact on Agency and Control	Autonomy and discretion Work organisation	Human Agency and Oversight Transparency Accountability	May reduce some agency and control and deskill some tasks.
Impact on Job Security	Job losses, increased precarity, loss of benefits	Diversity, Non-discrimination and Fairness Societal and Environmental Well-being	Unlikely to lead to immediate job losses
Impact on Occupational Health and Safety	Accidents, Ergonomics, Wellbeing	Technical Robustness and Safety	Limited impact on OHS
Impact on Employment Relationships	Conflict Work organisation	Diversity, Non-discrimination and Fairness	No conflict identified at this point (???)

Conclusions



- Optimisation of production processes approach of the project seem to imply minimal impact on workers
- However, positive and negative imaginaries of a future with the AI platform
 - Positive: upskilling, augmenting workers capacities, helping with tasks and decision-making
 - Negative: de-skilling, blurring accountability for decision-making
- Project aims to adopt the principles of ALTAI for ethical AI, HCD, and aspires to the goal of I5.0
- But, negative imaginaries mean there is more to do to meet the guiding principles of the project:
 - ALTAI - human agency and oversight; technical robustness' data governance; transparency; accountability
 - European Trade Union Institute - 'ensuring the exercise of the 'right to explanation' regarding decisions made by algorithms or machine learning models...[and] boosting workers' autonomy in human-machine interactions'

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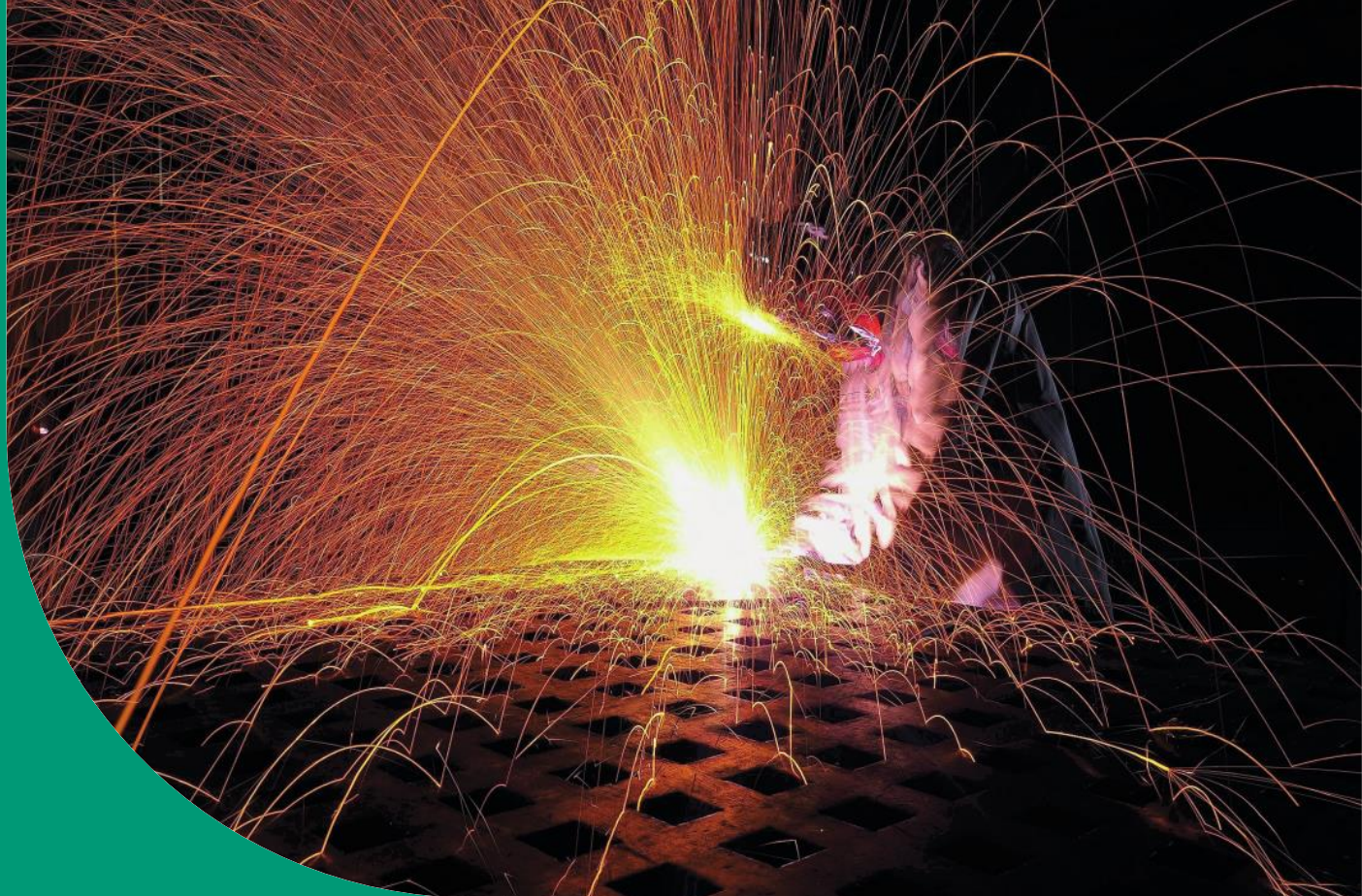
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