

Responsible Innovation for the Acceptance of AI in the Process Industry

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Wageningen University: M.W.
Vegter & R. Wesselink



Institute for
Sustainable
Process Technology



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1. Industry 4.0 is changing the workplace

Artificial Intelligence (AI) particular and digitalization more general are said to give rise to the fourth industrial revolution; Industry 4.0. This ongoing change is characterized by the introduction of the Internet of things (IoT) and Internet of services concepts into manufacturing, which enables smart factories with vertically and horizontally integrated production systemsⁱ. Cath and colleagues suggest the renewed focus on AI is likely to boom because of four self-reinforcing trendsⁱⁱ:

1. Ever more sophisticated statistical and probabilistic methods
2. The availability of increasingly large amounts of data
3. The accessibility of cheap, enormous computational power and
4. The transformation of ever more places into IT-friendly environments

Industry 4.0 entails the promise of a paradigm shift from automated manufacturing toward an intelligent manufacturing concept. Although this shift is technology-driven it seems to be constraint by people-related aspects such employees' involvement and active participationⁱⁱⁱ.

In 2019, A.SPIRE a European public-private partnership that represents process industry, published their perspective on Artificial Intelligence building on the contribution of their digital working group highlighting the importance of company culture. According to this report improvements are said to be made possible because AI technologies in process industry will improve decision making, make better use of existing data, replace repetitive transactional and judgment-related tasks, reduce human involvement in dangerous working environments and overall improve the operators' working conditions while at the same time transferring and formalizing operators' knowledge and best practices^{iv}.

Building on this report the perceived threats and hurdles when it comes to AI concern on the one hand the more technical and legal worries considering safety, transparency and accountability; while on the other hand we find the more societal issues such as a limited willingness to adopt to new technologies, described in terms of (company) culture, hype, and the training of staff. We will focus on the latter. Since I4.0 technologies and its sociocultural environment are highly interdependent, technological innovation should be complemented by thinking about the changing workplace and the preconditions to involvement and participation of all employees involved, including the end-user. In this white paper we want to share important considerations about the 'soft' side of innovation and pose four questions based on our research into these more sociocultural aspects of AI-related innovations. These question might contribute to the successful adoption of new technologies. So first of all ask yourself;

How does your company keep an eye on the changing work environment?

2. Training

The success of Industry 4.0 is said to depend on suitable training and life-long learning^v. So far, process technology in the Netherlands has been committed to develop AI, Data Analytics and virtual reality (VR)/ augmented reality (AR) applications. Yet until now this industry has had trouble to successfully scale up ongoing projects. While some plea to consider data-analysis as a company asset, it is also a given that for many data analysis is only one of many complementary tasks. The development of field labs provide



an interesting opportunity to learn about the importance of skill developments for employees^{vi}. However there are some difficulties when it comes to training. Beane & Brynjolfsson studied AI-enabled robotics in manual work throughout the U.S. and found that successful adaptation is rare; *'anything from punch-card-driven looms to automated call patching — organizations spend much more time and money than anyone expected to find productive uses for that technology.'* This phenomenon is called the Productivity J-Curve: Radical new technologies require investments in business process redesign, worker reskilling, and organizational transformation. For these investments to pay off 'eventually', productivity and performance can take a discouraging dip and the company needs stamina and dedication^{vii}. Such a dip might hold companies back to invest in skill. Adding to the former, Beane and his colleagues show that it is exactly training that seems to be under threat because of AI; trainees are being moved away from their "learning edge", and that on-the-job learning (OJL) risks a downfall^{viii}. Indicating that in the successful adoption of technology adequate skill development is a pressing issue that is easily overlooked.

Additionally, we have to face an important bias if we want to take away hurdles rather than further constrain innovations; The Skill-Bias in technical change. This entails the phenomenon that a shift in production technology favors skilled over unskilled labor by increasing its relative productivity and, therefore, its relative demand. Berkers and colleagues showed in their research into the effects of automation and robotization in logistics that its mostly higher educated management that are able to seize the opportunities of smart innovations while lower educated employees have to deal with the threats of automation^{ix}. When AI-optimists suggest that Industry 4.0 will give employees; managers and operators, greater freedom and responsibility (A. SPIRE report) this skill-bias is yet another argument to offer training and develop skill to get employees on board.

Given that successful innovations need investment in training, ask yourself;

What has been your company's most recent initiative to promote skill and training for lower educated employees?

3. End-user involvement

New technologies have both 'hard' and 'soft' impacts, in general we are biased to focus on the seemingly more objective and quantitative notions of risks rather than the societal and political questions which are often considered 'soft' and therefore negligible^x. The MIT- scholar Daron Acemoglu and his colleagues highlight the importance of investing in the 'right kind' of AI in terms of labour demand^{xi}. AI can automate tasks or create new tasks in which humans can be productively employed. Recent technological change has been biased towards automation, resulting in rising inequality and lowering productivity growth. The current tendency to develop AI in the direction of further automation might mean missing out on better economic and social outcomes. When it comes to the success of Industry 4.0, Dregger et al address the digitization of manufacturing and its societal challenges as a balancing act between what is technologically feasible and labor-politically desirable^{xii}. Currently research is being done that addresses



how such a balancing act should take place. The field of Responsible Research and Innovation (RRI) addresses this problem through the development of an anticipatory and responsive innovation process so that stakeholders are involved and public interest is safeguarded^{xiii}. Though the idea of participation resonates in process industry more general in terms of end-user involvement; examples like LEAN and AGILE methods tie into this idea that one also has to strategize work bottom-up. Nevertheless do companies have very little ways to 'monitor' those soft impacts. So take a look at the following question;

What organizational infrastructure does your company have to give voice to people who have concerns about the 'soft impacts' of technological change i.e. their jobs and labor demand? And in what ways does the company provide answers to these concerns?

4. Resistance to Change

The unsuccessful uptake of new technologies within a job routine is often explained in terms of 'resistance' towards this technology; however this is often grounded in a certain idea about ones job and protecting a sense of dignity either in the content of work or in the way change is being managed^{xiv}.

Highlighting the importance of recognition for jobs in production i.e. process industry, a recent news article about manufacturing jobs in the US tells the story of how despite the pandemic pushing millions out of work, most from service industries, many factories have had trouble finding workers^{xv}. This report ties in with the observation by Micheal Sandel who argues that meaningful work in production has become a problem in our day of age; there is a need for recognition of work in production. A lack of a sense of purpose constrains the improvement of these industries. What Sandel underscores is the importance of recognition for our share in terms of production, recognition for the work that is being done^{xvi}. Purpose is not merely translatable in terms of a paycheck, it is very much about the acknowledgement of the worker within his respective role. Therefore, the concept of meaningful work has recently received increased attention in the context of robotization and AI and is especially valuable to process industry^{xvii}. Digital technologies may further obscure the role workers play as producers. Which applies, for example, to operators in process industry. The operator-job that traditionally has had a fairly unambiguous 'task identity' is now subject to change. For example; working in a hazardous environment such as a chemical factory plant means having to follow 'scripts' and protocols to keep production going. Keeping the factory running safely weighs up against the lack of flexibility one has while working as an operator. Task identity, simply put, means it is clear to the employee what his contributions adds up to in terms of production and/ or safety. When part of the job is being pulled 'behind the wallpaper', a common phrase to refer to automation within these industries; task identity becomes fairly less perceivable. Where before a clear task identity would provide purpose; being able to see what you contributed to production adds meaning to one's job; after parts of that job are being concealed it means the loss of a clear task identity and thus a loss of (self) acknowledgement in the production process^{xviii}. Resistance to these new digital technologies becomes a way to safeguard a sense of dignity in one's respective job. Having employees involved in the innovation process could help



foster a new sense of task identity; being able to contribute to and understand in what ways one adds to the production AND the innovation process and help determine one's new role. This adds up to the following question;

What does your current innovation process look like and whose involved?

5. Conclusion - Change means Inclusion

If Process Industry wants to become 'smart' its innovators should be keen to develop skills and to safeguard meaningful work. This is done by creating a work environment that fosters involvement and participation. Let's be real - inclusion in the innovation process doesn't mean everybody has to agree; inclusion means employees need to be heard and given an answer. So let's stop talking about adoption and start talking about inclusion and co-creation!

ⁱ Thoben et. al. 2017 <https://zenodo.org/record/1002731#.YHVt0egzY2w>

ⁱⁱ Cath, Watcher et al 2018, <https://link.springer.com/article/10.1007/s11948-017-9901-7>

ⁱⁱⁱ Tortorella 2018, <https://www.tandfonline.com/doi/pdf/10.1080/00207543.2017.1391420>

^{iv} <https://www.spire2030.eu/news/new/artificial-intelligence-eu-process-industry-view-spire-cppp>

^v Thoben et. al. 2017, p 6, <https://zenodo.org/record/1002731#.YHVt0egzY2w>

^{vi} https://nptprocestechnologie.pmg.be/nl/dossier/EIMbe2110W04_00?project=EPTbe2114E01&email=

^{vii} <https://sloanreview.mit.edu/article/working-with-robots-in-a-post-pandemic-world/>

^{viii} Beane, 2019 <https://hbr.org/2019/09/learning-to-work-with-intelligent-machines>

^{ix} Berker et. Al. 2020. https://www.gedragenorganisatie.nl/inhoud/tijdschrift_artikel/GO-33-4-4/Robotisering-en-betekenisvol-werk-in-distributiecentra-bedreigingen-en-kansen

^x Swierstra & te Molder, 2012. https://link.springer.com/referenceworkentry/10.1007%2F978-94-007-1433-5_42

^{xi} <https://academic.oup.com/cjres/article-abstract/13/1/25/5680462> &

<https://www.nature.com/articles/d41586-018-07501-y>

^{xii} Dregger et. Al. 2016. <https://ieeexplore.ieee.org/abstract/document/7560045>

^{xiii} Owen et. al. 2013 <https://www.sciencedirect.com/science/article/pii/S0048733313000930>

^{xiv} Hodson 2001

<https://pdfs.semanticscholar.org/919c/723e7b9952c3444c3852d136e255c8f8a638.pdf>

^{xv} <https://www.reuters.com/article/us-usa-economy-jobs-manufacturing/u-s-factories-desperate-for-workers-even-as-ranks-of-jobless-remains-high-idUKKBN2BP0ZI>

^{xvi} <https://www.theguardian.com/books/2020/sep/06/michael-sandel-the-populist-backlash-has-been-a-revolt-against-the-tyranny-of-merit>

^{xvii} Smid et al 2019, <https://link.springer.com/article/10.1007/s13347-019-00377-4>

^{xviii} Berker et. Al. 2020. https://www.gedragenorganisatie.nl/inhoud/tijdschrift_artikel/GO-33-4-4/Robotisering-en-betekenisvol-werk-in-distributiecentra-bedreigingen-en-kansen