INNOVATION RELOADED – THE SOCIAL CHARACTER OF DIGITALISATION IN INDUSTRY

In the very core of digitalisation, there is social innovation: experiences of digitalisation processes in the production industry show that combining technological and social innovation makes technological development and implementation processes more effective and efficient – changing social practices in the sense of social innovation.

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It might be hard to imagine that digital products of engineers, software developers and other technical disciplines are subject to social innovation. However, we argue that successful digital solutions are changing ***social practices.*** Working activities, organisational and business procedures will change when people and organisations are going digital. That´s in fact what is called a social innovation: *new or reconfigured social practices that solve problems in a better way than existing practices* [1].

Digital solutions that have a real impact on business and society are usually the result of a *social innovation process*. Developing and implementing new (digital) solutions in an effective and efficient way stems from initiating co-creation processes. In these processes, users and stakeholders are consequently integrated with their knowledge and competences, right from the beginning. This is not only done to ensure acceptance of the solution but also to improve its applicability and quality. For example, artificial intelligence might create an optimisation of production processes based on math. However, these theoretical solutions become meaningful when combined with the knowledge of process experts and the practical knowledge of operators. Therefore, in many cases, it is the power of co-creation and complementarity – and thereby a social innovation process – that makes a *mere* digital solution smart.

If an industrial revolution will take place, as suggested by the term 'Industry 4.0', it will materialise as a combination of technological and social innovation. The following paragraphs present the development of digital technologies in the production industry within social innovation processes transforming the production and working environment and leading to new social practices at the workplace.

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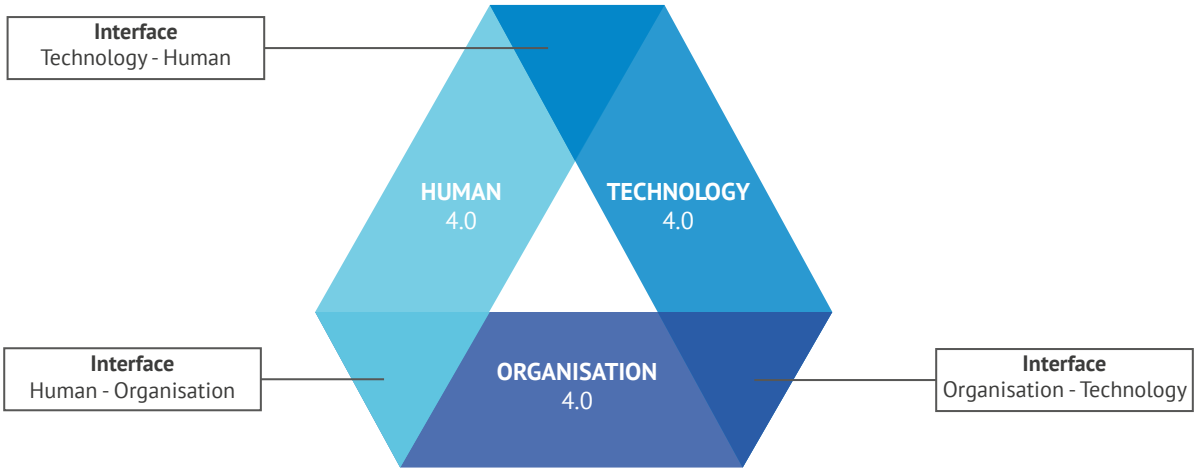
(SOCIO-)DIGITAL TRANSFORMATION IS GENERATING NEW SOCIAL PRACTICES

The usage of digital technology in itself does not change production processes. For this purpose, skilled workers have to use technology implemented in an organisational framework. Thus, the so-called digital transformation is indeed a socio-digital transformation. Otherwise, transformation will not really take place or fail. The way to design that socio-digital system will make the difference. If it is not consciously designed, a socio-technical system might emerge, which is dominated by technology reducing people and organisations to residual categories (see the article of Pot et al. in this chapter).

However, to unfold the full potential of digital transformation, a joint optimisation of people (human), technology and organisation has to take place by placing great importance on the interfaces between them. For instance, intelligent assistance systems, new division of tasks between human and robot as well as related human-robot interfaces exemplify the human-technology interface. Consequently, not only technology but also working practices and needed skills, are changing while using new technologies: beside generic digital skills, for instance holistic and interdisciplinary tasks, decentralisation of decision making, problem-solving, team- and networking, as well as T-shaped skills combining transversal with specialised skills are needed. Those changes in social practices will increase effectiveness and (sometimes



Interfaces of human, technology and organisation in Industry 4.0

in the end) efficiency of industrial processes with a positive impact on employees and the environment (e.g. in reducing energy and heavy and hazardous work).

Kohlgrüber et al. [2] applied this framework in several research and consulting projects in process and manufacturing industries – raising user requirements related to human, technology and organisation as dimensions of a socio-technical system. Examples are provided by the plant-wide digital optimisation project COCOP (Coordinating Optimisation of Complex Industrial Processes) and an aircraft manufacturing project dealing with the impact of digitalisation on employees.

Further projects, such as ESSA (www.estep.eu/essa) and BEYOND4.0 (www.beyond4-0.eu), focus on future skills needed for digitalisation. Again, the interface between people and technology is highlighted as a key factor for a successful digital transformation. Several steel companies have developed digital strategies that are strongly connected to identifying needed qualifications and trainings in time in a forward-looking anticipatory way.

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(SOCIO-)DIGITAL TRANSFORMATION AS A SOCIAL INNOVATION PROCESS

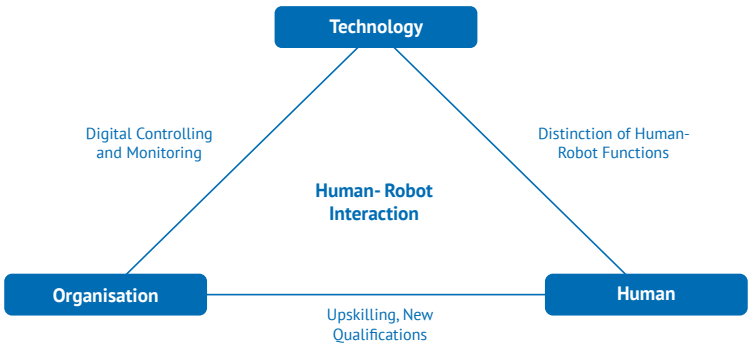
Without a social innovation process, implementation of digital solutions is lacking acceptance and knowledge of users and stakeholders. To achieve the joint optimisation of people, technology and organisation, participation of users and stakeholders is key. As far as companies only take technology as *acceptance object* into account, two other necessary aspects are neglected: people and teams as *acceptance subjects* and the regional/historical/social/company *acceptance context*. Not considering this perspective might be the reason why a high number of new software systems are not crossing the threshold of industrial implementation.

The only way to increase this small share of used technologies is a co-creation process solving a specified demand where users/stakeholders are involved in the development and implementation of new solutions. Getting people from human resources departments, work councils, representatives of employees, and workers themselves involved in the project team, will create better solutions than project teams only consisting of engineers, software developers, etc. With their explicit experiences, employees are the experts for their workplaces and processes. If they are seriously involved in development processes, they will provide feedback and suggestions on new technologies based on their experience, expertise and needed requirements. This participation will not only create acceptance but will make the new solution more suitable and valuable.

However, even if project leaders are open for participation of users and stakeholders, they are often facing the problem of different cultures and languages between technical developers and human resources experts. Feedbacks of users/stakeholders are usually not formulated as requirements – they are expressed as statements, general descriptions, needs or questions. However, their feedback has to be translated into precise human requirements: clear, measurable and validatable. If defined in another, more open manner, technical designers take notice of the users' and stakeholders' needs, but they are not capable to process this information into their further work.

ROBOHARSH: Robot – Human – Interface development leading to new practices / a new role for operators

Developing a Robotic Workstation in Harsh Environmental Conditions to Improve Safety in the Steel Industry (ROBOHARSH) needed a new allocation of tasks between the human operator and the robot activities. Done in a close co-creation between workers and technicians the new division of work did not only improve the acceptance of the end users, but clarified also the new required skills. In this case, low skilled heavy and dangerous work is substituted by high skilled computer-controlled activities. Taking the interfaces between technology, organisation and human into account the work of the operator changed from "operator to supervisor" [3].



GT VET: User related learning arrangements
https://www.estep.eu/estep-at-a-glance/involvement/gt-vet/

Greening Technical Vocational Education and Training (GT VET) for maintenance in the steel shop floor is of high relevance to reduce waste, energy, noise and emissions [4,5]. To sensitise workers and apprentices for "greener" working practices, not only the content but also an effective, efficient and accepted way of learning / training became relevant. Starting the development of a training module as a social innovation process by integrating all the relevant stakeholders and future learners it became evident in the very beginning that the planned eLearning module would not be appropriate and used. Instead, apprentices and workers stressed workplace and action oriented learning. In the end, a common training module was developed, reflecting the main requirements of the companies concerning the training modules (energy, waste, noise, and raw material reduction) and the didactical requirements of the learners (starting with basic information and understanding background and coherences but then focusing on practical exercises and projects linked to the concrete workplaces). The test phase of the training module showed not only the high engagement of the trainees but led also to new energy saving, emission and noise reduction practices: not only via new "greener" maintenance practices but also by changing some elements of the production process (in the sense of workplace innovation).

This setting of involved parties within a digital transformation could also be seen as a social innovation process, involving all relevant stakeholders and considering impact in a broader sense (social, organisational, environmental, regional and others), right from the beginning of technological development. Within a common co-creation and implementation process representatives of employers and employees, end users and beneficiaries, technical and human factors experts are collaborating together to achieve better results than former practices. The outcome of this new practice of co-creation could lead also to formal negotiations between management and employee representatives (within a company or at a national level). The advantage for employees and their representatives is that their requirements are considered in an early project stage when there still is a wide range of design options, creating a win-win situation with advantages for all involved parties.

CONCLUSION

Digitalisation is not only about technology, it is much more a social innovation process and a socio-digital transformation leading to new practices. Only if the solution of a given economic, societal challenge (e.g. reduction of hazardous work and energy, improved competitiveness) is leading technological developments (and not the technological possibilities as such) implementation, usage and impact are to be expected. Against this background the configuration of the interfaces between human, technology and organisation are crucial for the innovation process. All three elements are affected, but especially the interface between human and technology is often neglected or considered when the technology is already developed (leading sometimes to collateral damages and high follow up costs for adjustments). Integrating the end users, customers, beneficiaries and other relevant stakeholders in a common innovation process is therefore key for developing effective and usable solutions and the implementation of new (digital) technologies, leading to new social practices enabled or supported by new technologies.

Digitalisation can not be reduced to social innovation but it is much more social as frequently assumed; it is both technological and social. The best results and outcomes will be achieved, if both technicians and human resources perspectives, competences and skills will be combined right from the beginning in a common innovation process, co-creating socio-digital transformation of existing practices to new practices solving given economic, societal challenges in a better way than before.

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