

# Freelancers 4.0: the impacts of freelancers on the adoption of Industry 4.0 under a socio-technical perspective

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## Abstract

In this study, we debate the role of freelancers 4.0 as facilitators of the adoption of Industry 4.0 technologies (I40), under a socio-technical lens. I40 production can be seen as a complex socio-technical system that requires various change facilitators to be implemented. After a web search, we found that a considerable number of freelancers are involved in I40 adoption, and could be participating in the adoption process, thus acting as facilitators. We label these workers “freelancers 4.0”. The socio-technical theory does not primarily consider such workers in the technology adoption, even more down the I40 transition. Hence, we suggest two main research avenues to explore freelancers 4.0 in conjunction with the I40 adoption, framed under the socio-technical perspective.

## Keywords

Industry 4.0, Freelancers, Freelancers 4.0, Independent Contractors, Self-employed workers, Knowledge, Absorptive Capacity, Socio-Technical Approach, Facilitators, Operator 4.0, Industry 5.0

## 1. Introduction

The fourth industrial revolution has brought significant changes in the way manufacturing companies operate. These companies are moving towards a renewed vision of the industry, driven by the advanced technologies that are often called Industry 4.0 (I40) [1]. The First Industrial Revolution was born with the generation of mechanical power from water, steam, and fossil fuels in the 1780s. In the Second Industrial Revolution, electrical energy was favoured by manufacturers with assembly lines and mass production in the 1870s. Employing electronics and IT, the Third Industrial Revolution familiarised the production industries with the concept of automation in the 1970s [1]. While the Fourth Industrial Revolution introduces technologies – the internet of things, big data analytics, or robots – that allow integrating the production system and automating both manual and decision-making activities [2]. The successful adoption of I40 technologies delivers more efficient production processes, and safer work environments since most of the manual activities are transferred from human agencies to I40 technologies [2].

In this position paper, we explore the adoption process of the I40 technologies using the socio-technical perspective [3, 4]. This perspective goes beyond prior research grounded on a technocentric perspective that considers adopting I40 technologies by addressing the purely technological stance without considering human agency [4–6]. To reach an effective I40 adoption, various professionals, beyond IT vendors, take part in the process, acting as facilitators [3]. Freelancers can be seen as one kind of worker who may significantly help companies adopt and reach the full potential of I40 technologies. Although such skilled contingent workers have been strongly put forward by practitioners, freelancers are not considered academic considerations [7, 8]. Furthermore, freelancers

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are not studied in conjunction with I40 adoption. We label the term “freelancers 4.0”, referring to such workers who play a key role in the I40 adoption process of companies.

To start exploring this topic, we conduct a web search and explore the presence and roles as part of the I40 adoption. Then, we posit that freelancers 4.0 can be represented as key players in the I40 adoption, acting as facilitators of the adoption process. Subsequently, we present avenues of research using the socio-technical theory. This work contributes to the socio-technical perspective and the I40 literature by providing ways of understanding and analysing the roles of freelancers 4.0 as facilitators during the I40 adoption.

## 2. The Socio-technical theory

The socio-technical theory assumes that an organisation is represented as a work system composed of social – human agencies – and technical systems – technologies. The theory ascribes equal importance to both the technical component and the social component, acknowledging their interdependence. The work system requires the joint optimisation of both social and technical systems to operate successfully: social components, the workers, need to accept the technical components and develop the proper competencies to use them (see Figure 1). The technology adoption achievements for the organisations are both instrumental – better production processes and humanistic – safer workplace, and job enrichment [4]. Figure 1 illustrates the traditional socio-technical framework.

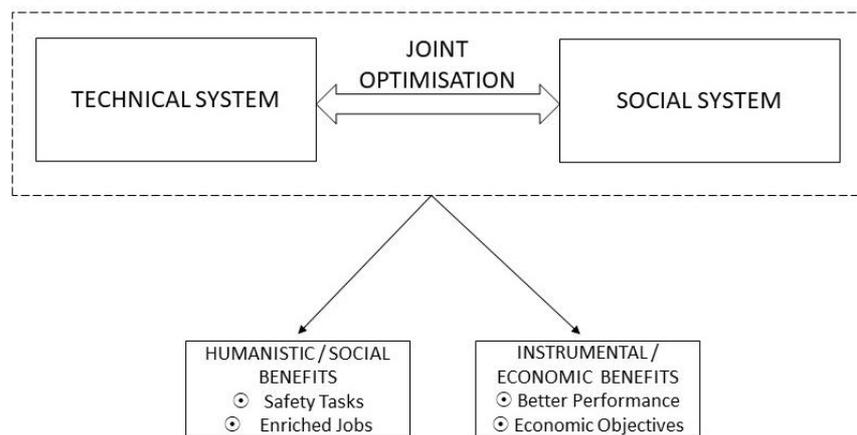


Figure 1: An illustration of the socio-technical theory based on [4]

Our position paper aims to reflect on the facilitator role during the process that leads to the joint optimisation of both systems. This process is traditionally referred to as the adoption process or implementation process. The facilitator(s) is in charge of managing the adoption process of novel technologies and involving workers during such a process – following a participative approach [3]. In this way, technologies can be designed to fulfil organisational needs in conjunction with worker’s needs. In practice, the facilitators are often the technology experts in charge of designing and adopting such technologies in the organisations. Yet, the literature reveals that they can also be external consultants [3]. The facilitator role is increasingly important in complex and automated technologies where the transition from the traditional work system to the novel work system is difficult. In the next section, we suggest that freelancers can be considered facilitators in the I40 adoption process of manufacturing companies.

### 2.1. Freelancers as facilitators in Industry 4.0 adoption

Prior studies related to the I40 adoption process follow a technocentric perspective that considers I40 technologies “rigid” and avoids any consideration of human agencies. However, the literature increasingly understands I40 production as a complex socio-technical system [9–11]. I40 technologies need to be adapted to tailor-made production processes. At the same time, workers need to learn how

to manage such complex I40 technologies to operate efficiently [11]. The extant literature reveals that organisations do not have the competencies to develop I40 technologies. Thus, they resort to IT vendors and technology experts to develop and adopt them. Furthermore, organisations are increasingly resorting to freelancers in conjunction with IT vendors to help this complex I40 transition [12].

Freelancers represent a new form of workers and are part of the contingent workforce that has increased in number in the global labour market [13]. They are used by organisations operating in a highly competitive market because their work arrangements are beneficial for them in a particular situation. Freelancers operate as self-employed workers within one or several companies, during a specific period, in order to carry out projects or assignments that need external specific expertise to be accomplished [14]. In this respect, freelancers 4.0 have considerable potential to play a key role along the I40 adoption process as they may undertake the role of facilitators. However, to date, there is a lack of studies exploring the role of freelancers 4.0 in the adoption process of I40 technologies.

## 2.2. The freelancers 4.0

We conducted a web search analysis as an exploratory method to detect the prevalence of freelancers 4.0 in the Anglo-Saxon labour market, i.e. solo self-employed workers linked to I40, work with client companies, and can potentially be associated with the adoption of I40. In more practical terms, our aim was to grasp the online presence of freelancers 4.0 working with client companies. After several searches, we employed the largest online professional social network and matching platform that may provide companies with freelancers 4.0: LinkedIn [15]. We conducted the websearch in July 2021. We used the following keywords: “industry 4.0“ was matched with “freelancer”, “self-employed”, or “independent contractor. Such keywords can be found in their LinkedIn profile, and have been filtered to “finding persons” only. As no legal tools allow us to scrape data from LinkedIn, we have gathered the number of results related to the multiple searches. Using boolean operators, the searches conducted through the LinkedIn search tool yielded the following results. By combining “industry 4.0” AND “freelancer”, 868 results were found. When combining “industry 4.0” AND “independent contractor”, 98 results were found. When combining “industry 4.0” AND “self-employed “, around 1900 results were found. Finally, when combining “industry 4.0” AND “self employed”, around 1500 results were found (see Table 1).

Keywords	Number of Results
Industry 4.0 + Freelancer	868
Industry 4.0 + Independent Contractor	98
Industry 4.0 + Self-Employed	≈ 1 900
Industry 4.0 + Self Employed	≈ 1500

*Table 1: A LinkedIn search on the number of freelancers 4.0.*

Following this web search analysis, we found a considerable number of freelancers 4.0 related to the I40, therefore linked to both social and technical systems in some way. Such freelancers 4.0 are operating as software or automation developers, project managers, architects, ERP consultants, process engineers, internet of things specialists, user experience consultants, or infrastructure system experts. Apart from project managers, many positions are bounded to more technical systems, as they seem to take part in directly improving the IT processes and infrastructures. The considerable number of workers appearing to be involved as freelancers in the I40 adoption leads us to consider the need for studying this population in the era of the fourth industrial relation. Research avenues to analyse the relationship between I40 and freelancers will be proposed in the following section.

### 3. Freelancers 4.0 and Industry 4.0 adoption under the socio-technical theory

Our web search revealed that freelancers 4.0 are already involved in one way or another within the I40. Such workers may significantly be involved in the I40 adoption as facilitators, and they may impact both the resulting I40 technical and social systems. To illustrate some research avenues between the freelancers 4.0 and the I40 adoption under the socio-technical perspective, we employed the I40 work system proposed by Margherita and Braccini [5]. The I40 work system is composed of two systems: the technical and social systems. The technical system includes the tasks and the adaptive feature of technologies, while the social system consists of the competence and production knowledge of the workforce. The conjoint optimisation of the work system occurs when workers possess proper competencies [9, 16] and production knowledge to manage the I40 technologies in conjunction with the novel production process. The technical system supports to be reprogrammed to incorporate changes in their activities – called adaptive feature – which are proposed by workers who use their knowledge and competence to improve the production process [5]. All these components are interrelated, and the role of human agencies in the work system is essential to the its good functioning. Figure 12 illustrates the I40 work system.

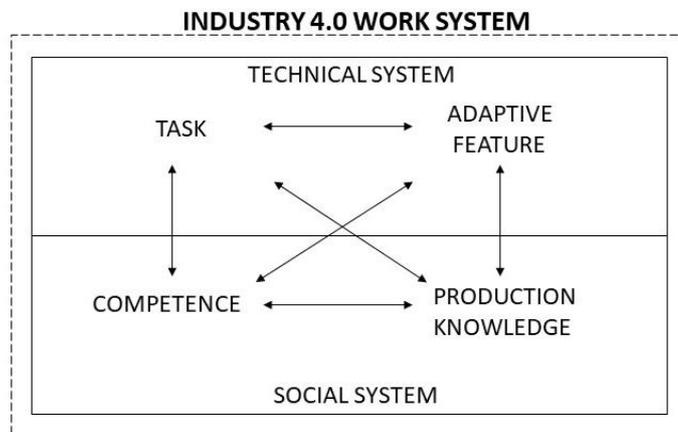


Figure 2: An illustrated Industry 4.0 work system.

#### 3.1. Freelancers 4.0 as facilitators of the adoption process

The first research avenue pertains to using the socio-technical theory to explore and explain the adoption process of I40 technologies as a change process [11] (see Figure 3).

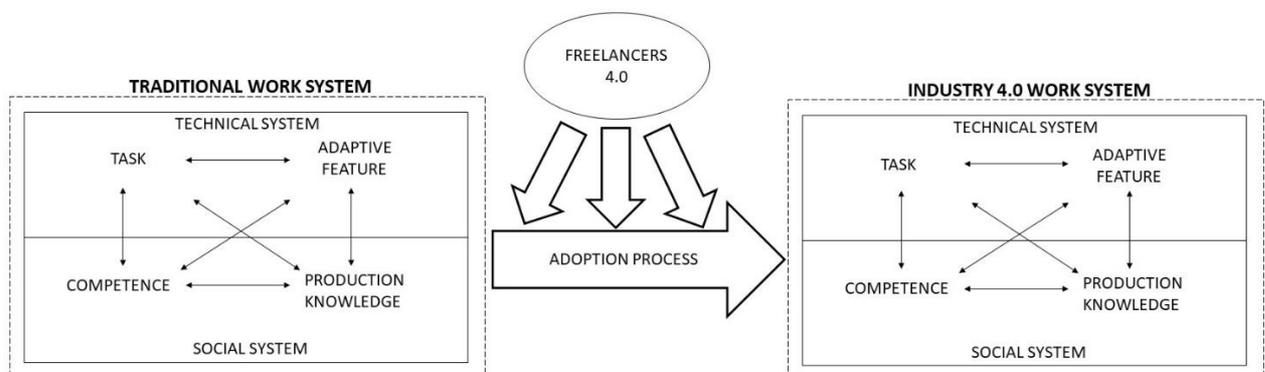


Figure 3: Freelancers 4.0 and socio-technical theory used as a change process.

Under this lens, it is useful to explore the stage where freelancers 4.0 are engaged by organisations and their role in reaching the joint optimisation of technical and social systems. Freelancers 4.0 may be

represented as key players of the change process, bringing their knowledge and expertise down the I40 adoption to the companies passing from traditional work system to I40 work system. By providing know-how and experience, freelancers 4.0 may implement technical components and offer ways of enhancing social systems. They can address adoption barriers by explaining how work practices will change after I40 adoption. Finally, we raise some questions – that remain unanswered at present times and require further academic considerations – to extend this first research avenue:

- Are the freelancers 4.0 involved from the beginning of the change process?
- Are they the key actors of the adoption process within companies?
- Do freelancers work and influence only one system, for instance, the technical one, or are they part of the whole work system change?
- Do freelancers 4.0 bring knowledge, experience, and expertise to enhance only the social systems, or are they upgrading both work systems?

### 3.2. The impacts of freelancers 4.0 on work systems components

A second fruitful line of research could involve studying the impacts of freelancers 4.0 on the components of the two systems (see Figure 4).

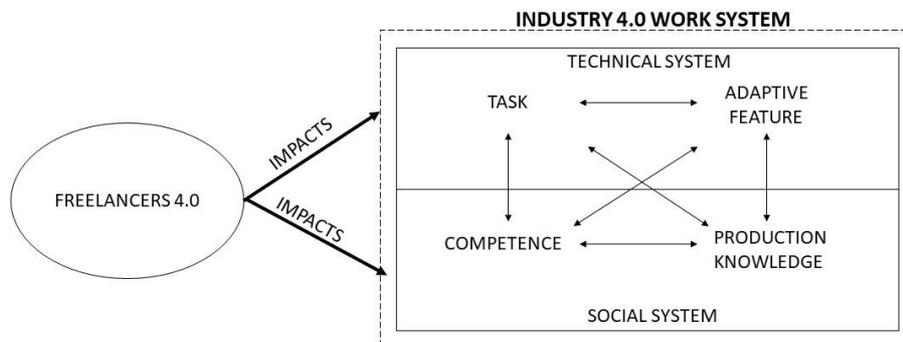


Figure 4: The impacts of freelancers 4.0 on components of Industry 4.0 work systems.

When looking at the technical systems, the main question lies in the contribution freelancers 4.0 could bring towards a more efficient and effective implementation of I40 technologies and their interface, and the support in the choice of I40 technologies for the strategic organisational alignment. With regard to the social systems, various questions can be raised. An interesting investigation can be how freelancers 4.0 help grow digital and I40 related competencies within the organisations, and whether they also conduct job design or they are devoted to developing training paths to enhance workers knowledge on how to use such advanced technologies.

A further reflection is needed on the knowledge component that seems difficult to capture, store, and needs to be transferred within organisations. Since freelancers 4.0 transfer and share knowledge with I40 manufacturers and their workers, we suggest the use of the Absorptive Capacity theory (AC) to study the relationship between freelancers 4.0 and organisational knowledge.

The concept of AC is important when applied to a highly competitive context such as the I40 production [17], and some studies have stressed that the use of external knowledge –represented by freelancer 4.0 – leads companies to adopt I40 technologies, both exploratory and exploitative innovation strategies [18, 19]. More specifically, AC is known as the “ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends” [20]. Two dimensions are constitutive of the theory (see Figure 5).

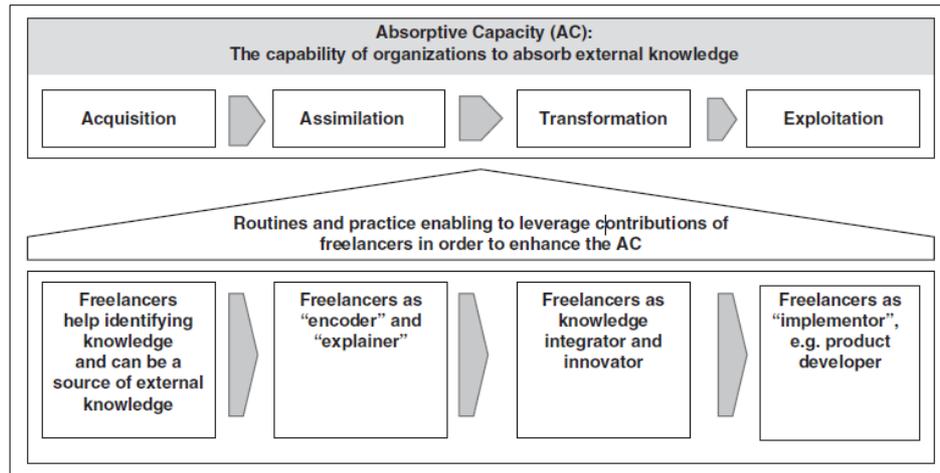


Figure 5: Framework of AC and the contributions of freelancers (Kozic et al. 2014).

First, the transformation and exploitation of knowledge represent the realised absorptive capacity, while the acquisition and assimilation of knowledge are related to the potential absorptive capacity [14]. Acquisition relates to one company's ability "to identify and acquire externally generated knowledge that is critical to its operations" [21]. Assimilation "refers to the firm's routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources" [21]. Transformation "denotes a firm's capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge" [21]. Exploitation "as an organisational capability is based on the routines that allow firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations" [21].

AC could thus strongly help enhance the understanding of the process of using identifying, assimilating, and using knowledge from outside the company, and more specifically, the way companies absorb the knowledge of freelancers 4.0 in order to improve their work system.

Indeed, freelancers 4.0 constitute an important pool of knowledge, as they keep their skills and knowledge up to date through various ongoing projects within several companies and sectors. By doing so, they are able to respond to several issues, drawing on their work experiences that have strengthened their knowledge and skills.

We raise the following questions concerning our second research proposal:

- What is the role of freelancers 4.0 in the knowledge sharing and development of an I40 manufacturing company?
- What components of AC do freelancers 4.0 take part in?
- Through the four components of AC, how are freelancers 4.0 influencing either the technical system or the social systems of an I40 manufacturing company?
- How do freelancers 4.0 support skill development?
- How do freelancers 4.0 support the development of I40 technical systems?

Both research avenues could be investigated under multiple research. Since we suggest studying an emerging and novel topic, an explorative stance is needed to investigate the premises of such research. A case study approach, based on interviews or action research, can be used to embrace and explore the freelancers 4.0 voices. At the same time, researchers can complement the freelancers 4.0 perspective by exploring the narratives of managers and employees on the real impact and value of freelancers 4.0 down I40 adoption. Therefore, it is possible to construct a holistic view related to the freelancers in conjunction with I40 adoption by combining both organisational and external standpoints. Moreover, conducting a longitudinal and case studies study on how freelancers 4.0 actually help companies develop and adopt the I40 technologies and how it impacts I40 work systems could also represent an interesting path. Eventually, and drawing on the research avenues and the models mentioned above, creating a large-scale quantitative study may afterwards represent an important source of knowledge and could strongly improve academic understanding and awareness on the topic.

## 4. Conclusion

This position paper offers a new view of the freelancers, who may act as facilitators down the adoption of novel I40 technologies in manufacturing organisations. In this paper, we conduct a web search to clarify and confirm their potential role in conjunction with I40 adoption. Then, we suggest some research avenues to explore the role of freelancers 4.0 as key actors in the I40 adoption under the socio-technical perspective. To advance the topic study, it is pivotal to investigate and explore the freelancers 4.0 voices. It is also suggested to explore this topic by drawing on the theory of absorptive capacity theory because freelancers 4.0 can be very valuable change agents. They can help companies to adopt I40 technologies with their knowledge and skills. Both research avenues represent the main theoretical implications of the paper. They depict human agencies as important actors in the adoption process of I40, and moderate therefore, the place of I40 technologies. The main practical implication can be found in the value for organisations to resort to and engage freelancers 4.0 in the adoption of I40 technologies to ensure a smooth adoption process through their experience, skills and knowledge.

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