SERVICE PUBLIC FEDERAL
DE PROGRAMMATION
POLITIQUE SCIENTIFIQUE

PROGRAMMATORISCHE
FEDERALE OVERHEIDSDIENST
WETENSCHAPSBELEID

Sustainable Employment in the Age of Digitalisation:

challenges, obstacles and opportunities

CONTRAT N° B2/191/P3/SEAD

SEAD Working Paper 2021.1

INTRODUCING THE SEAD PROJECT

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1. General introduction[1]

From existing research it has become evident that digitalisation can have a profound and even disruptive impact on most domains of life. The "Sustainable Employment in the Age of Digitalisation" (SEAD) project focuses on one domain in particular: the world of work. The project has two main aims: (1) to assess the nature and impact of technology-related change in existing and developing labour market segments in Belgium and (2) to identify the potential for sustainable employment and for limiting the vulnerability of workers in the context of digitalisation.

This first section of the working paper provides an introduction to a state-of-the-art review of the literature considering the four main topics addressed in the SEAD project:

- Macro-economic insights about how digitalisation is affecting labour market dynamics, the occupational structure and job quality in Belgium (WP1).
- The role of organisational characteristics in shaping the impact of technology on the work experience, with specific attention for organisational models and managerial practices that promote sustainable employment in a context of technological innovation (WP2).
- How the skills composition and job quality of occupations in the Belgian labour market are changing as a consequence of the introduction of new technologies (WP3).
- The platform economy as an emerging employment phenomenon: job quality, perspectives for collective action and the socio-demographic profile and employment trajectories of those workers engaging in digital platform work (WP4).

Within the project, the topic described in each of the induction papers is the central study objective of a separate work package. Before taking a closer look at the state-of-the-art for each of these topics, we will introduce the main ideas and concepts shaping the SEAD project.

1.1. The concept of digitalisation

The central concept in the SEAD research project, digitalisation can be defined as *"the process that converts information from a physical format into a digital format"* (Jakosuo, 2019, p2). Since the end of the 20th century, a wave of new digital technologies in computing, information networks, robotics and artificial intelligence has emerged. This process of digitalisation has been described in different ways. Brynjolfsson & McAfee (2014) refer to the adoption of digital technologies as 'the second machine age', following the 'first machine age' that was based on technologies such as steam engines, electricity and railroads. Schwab (2017) launched the concept of the '4th Industrial Revolution', following the 1st Industrial Revolution (driven by steam power), 2nd Industrial Revolution (driven by electrification and railroads) and 3rd Industrial Revolution (driven by computers and communication technologies). According to this description, the 4th Industrial Revolution is supposedly driven by the integration of information technology in machines and products of all types. Although both largely

[1] Parts of this introduction draw heavily on Deschacht, N. (2021). The digital revolution and the labour economics of automation: A review. *ROBONOMICS: The Journal of the Automated Economy, 1*, 8.

depend on the same (type of) technologies, the difference between the 3rd and 4th Industrial Revolution thus lies in the fact that the latter is driven by the intelligent interconnection of complex machinery and computing devices (Lu, 2017; Agostini & Filippini, 2019). By building sensors and computers into objects that are not computers themselves (such as cars or industry robots), machine-to-machine communication improves and things and processes can become "smart". Digitalisation thus encompasses a large range of technologies.

A number of studies throughout the literature have further characterised relevant digitalisation processes and their effects, one notable example being the description of digitalisation processes a 'digital revolution' (Brynjolfsson & McAfee, 2014). However, the question that remains is to which extent the use of the term 'revolution' is appropriate when describing the recent and ongoing wave of digitalisation. In fact, the disruptive character of digitalisation processes has to be put into question in light of a more nuanced approach accounting for the complex interdependent processes at work. On one hand, the increase in the use of information technology and digital tools is evident and has taken place rapidly. The real cost of performing a standardised set of computations is estimated to have fallen by a factor of over one trillion in the six decades after 1945, which implies a productivity growth far larger than that for other technologies (Nordhaus, 2007). Over this same period, the share of information processing equipment in private investment is estimated to have risen from about 8 percent to more than 30 percent (Autor, 2014). On the other hand, the use of the term 'revolution' points to a sudden and discontinuous quantitative and qualitative leap over a relatively short time span, which is debatable from a techno-economic perspective (Valenduc & Vendramin, 2017). Moreover, the impact of digital technologies on the world of work is not solely determined by the performance of technology, but will be shaped by other factors such as management strategies, power relations and social processes (Valenduc & Vendramin, 2017; Fleming, 2019). Therefore, we will continue to use the more general term 'digitalisation' in the context of the SEAD project.

1.2. Technologies of digitalisation

The previous paragraph makes clear that digitalisation can be described as a remarkably fast process of generalisation, amplification and intensification of the use of many digital technologies. For the purpose of the SEAD project, both information and communication technologies and more advanced, interconnected digital technologies will be considered. In this section, we provide a description of the main technologies that can be conceived as key factors of change in the world of work and that are thus eligible to be studied in het context of the project. Although such an overview is useful to guide the reader throughout the content of this report – and the SEAD-project at large – this should not be regarded as an exhaustive or binding list of technologies that will be included in the project. As the project progresses, the exhaustiveness of this list and the relative importance of the different types of technologies will be evaluated through empirical work.

<u>Information and Communication Technologies (ICT)</u>

The term "Information and Communication Technology" (ICT) refers to a collection of different technologies that are said to characterise the 3rd Industrial Revolution. This category of technologies includes – but is by no means limited to – the internet, e-mail, chat systems, mobile applications, laptops, mobile phones and social networks. Information and Communication Technologies do not

facilitate machine-to-machine communication, but they do facilitate the sharing and discussion of ideas independent of location and time.

Internet of Things (IoT)

The "Internet of Things" (IoT) refers to the entire network of physical objects that are equipped with software and connected with other devices or applications over the Internet, for the purpose of exchanging data and communicating with each other. The IoT allows for real-time connectivity and interconnection between objects, which means that machines can generate content and more things can become a (monetised) service.

Robots and Robotic Process Automation (RPA)

Robots are programmable devices that interact with the physical world. Originally, robots were only used on the shop floor to replace muscle-power and more specifically to execute repetitive, non-ergonomic or physically demanding tasks. In manufacturing and logistics, some blue-collar occupations (for instance assembly line work, order picking or parcel sorting) have been automated using industrial robots. This type of technology is also eligible for study in the context of the SEAD project.

When robots are used to automate a business process through software capable of following a graphical representation of said process, this can be described as "Robotic Process Automation" (RPA) (Col, 2017; Lacity & Willcocks, 2016; Makkonen, 2017; Moreau, 2018). This type of technology is increasingly used in the services sector (Canals, 2020) to automate time-consuming tasks with low added value (such as data entry, data consolidation, information extraction and compliance verification). In that context, RPA is for example used by customer advisors (e.g. e-mail analysers and virtual assistants) and by recruiters (e.g. the automated sorting of CVs and automated hiring systems). When the scope of action of RPA is extended to complex processes or the handling of unstructured information, this can be described as "cognitive automation" or "intelligent automation" (Moreau, 2018).

Artificial Intelligence (AI)

Whereas RPA concerns robot software that mimics human actions and thus aims to act, "Artificial Intelligence" (AI) concerns the actual simulation of human intelligence by machines and thus aims to think (CFB Bots, 2018). Marvin Lee Minsky, who is considered one of the pioneers of AI, defined it as "the science of making machines do things which would require intelligence if they were done by humans" (Whitby, 1996). In other words, artificial intelligence is the development of machines or computer programs that can mimic human cognitive functions. This means that AI tools have the potential to map out data and identify patterns of behaviour from this data (Canals, 2020). An example of the introduction of AI in the world of work is the use of screening software in recruitment (Levy, 2018).

Machine learning

"Machine learning" is a branch of artificial intelligence in which computer algorithms are automatically improved by a set of learning protocols to give machines the ability to perform tasks, instead of being explicitly programmed for these tasks (as is the case in conventional programming). The learning protocols involve training algorithms and reinforcement of pattern recognition (Naugès, 2016). This type of technology is increasingly used in the financial sector to assess investment risks and compliance with regulations, in recruitment to assess job applicants and in legal departments to detect errors in contracts. Machine learning can even be applied in the medical world. Recent advances in pattern

recognition have led to systems that, in terms of accuracy, are close to doing the work of radiologists, whose job it is to use medical imaging to diagnose diseases such as breast cancer by screening mammograms (Nature, 2019).

Big data

According to Laney (2001), "big data" can be defined by three criteria: it concerns (1) large volumes of (2) extremely varied data that are generated, collected, processed and stored (3) at high speed. These data are created both through explicit data production and secondary data generation and come from different sources: the Internet of Things, social networks, digital surveillance, cookies and IP addresses gathered on the internet, businesses, governmental and social security institutions, etc (Lupton, 2014; Menger & Paye, 2017). As such, big data are not a technology in itself but rather a by-product of the use of technology. One of the interests of big data is to find correlations and associations between data that could, at first glance, not have any links between them. Of course, this requires the development of intelligent algorithms aimed at massive, self-learning and autonomous use of these large volumes of data (Constantiou & Kallinikos, 2015; Lafrate, 2018).

IBM postulated in 2012 that we generate 2.5 trillion bytes of data every day and that 90% of the data in the world had been produced over the previous two years (Bhambhri, 2012). According to the McKinsey Global Institute (2016), this global volume of data doubles every three years. In the world of work, the use of big data is increasing in Research & Development (R&D) for example, with the goal of improving tasks of strategic planning processes (Bauer & Schimpf, 2018). Customer service workers also increasingly work with cloud services and big data to manage and share files (Jantti & Hyvarinen, 2018).

1.3. Digitalisation and the world of work

From a historical perspective, predictions about the disruptive impact of technological innovations on work and employment are not new - see Marx, Smith and Ricardo (Woirol, 1996) and later Keynes (1930) and Rifkin (1995). Today, the increased use of digital technologies is widely considered to be the main (but not necessarily the only) source of automation in contemporary labour markets. Recent studies have fuelled the fear that digitalisation and the resulting processes of automation are threatening many jobs and occupations (Frey & Osborne, 2017; World Economic Forum, 2018). Paradoxically, the amount of people formally engaged in employment only grew – and even faster in technology-intensive firms (Koch, Manuylov, & Smolka, 2019). Critics of the thesis of technology-induced job destruction argue that various mechanisms compensate for labour-saving technologies: employment in the design of new technologies, increased demand because of increasing productivity and falling product prices, extra profits and increased investments (Autor & Salomons, 2018; Caselli & Manning, 2019; Vivarelli, 2015).

Either way, it is clear that digitalisation has substantial but contradictory effects on labour markets and more precisely on the allocation, the nature and the quality of jobs. The adoption and implementation by organisations of the enormous technological potential results in a restructuring of the world of work: some sectors grow and others decline, some occupations disappear, others emerge and the job content and/or task requirements of still other occupations change (Autor, 2015; Acemoglu & Restrepo, 2019). The reallocation of workers from declining sectors and occupations to growing (or

even new) ones also means that skill mismatches tend to occur (Aghion & Howitt, 1994). Recent evidence suggests that jobs done by lower educated workers have become substantially less skilled (Autor, 2019; Kunst, 2019), while on the other end of the skills-spectrum new opportunities for intrinsically rich jobs are created (Cascio & Montealegre, 2016). This process could thus lead to job polarisation between the most and the least qualified, which could in turn result in threats to employment sustainability for those in a less powerful position, increased income inequality and rising levels of poverty (Goos et al., 2014; Hurley et al., 2015).

According to the Future of Jobs Survey, activities that are generally present across industries – e.g. 'communicating and interacting', 'coordinating, developing, managing and advising' and 'administering' – are likely to undergo important changes due to new technologies (World Economic Forum, 2018). A striking example of this phenomenon is the occupation of secretaries. The number of secretaries has been declining rapidly since executives started to use their personal computers and smartphones to write correspondence, answer calls and organise their calendars. On top of this, software for business operations is automating much of the back-office work in both the private and the public sector. As a result, since the year 2000, over 2 millions of such jobs in "administrative and office support" have been lost in the US (Bureau of Labor Statistics, 2020). Of course, this also means that the occupation of remaining secretaries has received another interpretation over time, involving important changes in task content.

Digitalisation is also affecting both the type of products we buy and the way we consume (in other words, the demand side of the product market), which in turn affects the demand for labour in specific occupations and/or the job content associated with these occupations. As consumer demand shifts, companies in more traditional industries struggle. Traditional retailers such as supermarkets, book shops and fashion stores are declining in numbers because of the rise of e-commerce, a trend that has accelerated during the 2020 Covid-19 health crisis. Even before this crisis, the share of e-commerce in total turnover in the EU-28 increased from 12% in 2008 to 18% in 2018 (Eurostat, 2020). In the remaining shops, the shift towards self-service by consumers is threatening jobs as well: supermarkets and libraries are introducing self-checkout machines, fast-food restaurants use self-ordering machines and self-banking has become the norm for most customers to manage their bank accounts and to transfer money. This evolution in turn opens a niche for more specific shops and services.

The development of digital technologies has also facilitated the emergence of novel business models, mainly characterised by the externalisation of assets and means of production, as well as value extraction from otherwise non-intermediated transactions. An important evolution in this regard is the rise of the platform economy, in which the digital platform acts as an intermediary between clients, producers, service providers, etc. (Srnicek, 2017). Platform-mediated work is « *[…] increasing and is now the main source of income for as many as 2% of adults across 14 EU member states […]* » (European Commission, 2019).

While freelance work and other new forms of digitally mediated employment cultivate an image of success, autonomy and both opportunity and flexibility maximisation, many aspects of platform work are characterised by insecurity and unpredictability, low career progression, unsustainable incomes and low bargaining power (Lenaerts & Smits, 2019). Moreover, (partial) exclusion from the systems of social protection is a real threat to employment sustainability (Goods, Veen & Barratt, 2019). Similar concerns are also valid when it comes to occupational health and safety (OHS) protection and collective representation (Brugière, 2018). Moreover, the emergence of the platform economy has consequences for more traditional industries as well. Uber, the largest platform for taxi rides, had 5 million drivers by the end of 2019 who do about 6 monthly trips on average (Uber, 2020). The rise of

Uber is disrupting the traditional taxi industry, with falling prices for taxi licenses (The Economist, 2015). Protests of traditional taxi drivers against Uber have occurred in many places, amongst which Brussels (Brusselstimes, 2020).

Finally, digitalisation also affects the supply of labour and the institutions that govern labour markets. One aspect is that the rise of internet-based job search and recruiting is reported to have increased worker mobility and to have improved job matching quality (European Commission, 2019). Another aspect is related to the emergence of new employment phenomena such as platform work, which seems to have reduced entry barriers into the labour market for workers that otherwise face discrimination, thereby capitalising on an already segregated labour market. Freelancing platforms of the gig economy, such as Freelancer.com or Amazon Mechanical Turk, may also increase the labour supply by allowing employers to disaggregate certain jobs into separate tasks (Cook et al., 2019; European Commission, 2019) and thereby both delocalise and accelerate the execution of these jobs.

While it is often (implicitly) assumed that changing employment patterns and job characteristics are inevitable consequences of technological innovation, caution towards such a technological deterministic view is warranted. It is in fact at the level of organisations that the impact of technology on the characteristics of jobs takes shape. Fleming (2019) advances the concept of "bounded automation" to describe how effects of digitalisation are dependent on organisational forces rather than being determined by technology alone. The emergence of new technologies tends to unlock complex relations between (pre-existing) organisational designs and new possibilities and requirements (Lall et al., 2016). In other words: organisational choices regarding the selection, the implementation and the specific use of technological features will for a large part determine the impact of digitalisation on workers' jobs (Fabbri, 2018). Therefore, contextual factors such as supporting HR-practices, organisational culture, managerial climate and leadership styles are crucial (Chivaka, 2018). They determine how organisational design is translated into specific job features, affecting job quality and thus influencing employee well-being and performance (Aryee et al., 2012; Van de Voorde, Veld, & van Veldhoven, 2016).

1.4. Sustainable employment

As the introduction of new technologies is deemed to profoundly affect the world of work, several consequences for workers might be expected. It is one of the central aims of the SEAD project to study these consequences, which will be grasped using the umbrella term "sustainable employment". In this part of the introduction we will elaborate on the meaning and use of this concept in the context of our project. Our definition of sustainable employment draws heavily on the Eurofound framework (Eurofound, 2015; Eiffe, 2021).

It is important to mention that the idea of sustainability originated from an ecological perspective, referring to the ability "to meet the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). This strong longitudinal focus is also essential when the concept of sustainability is used in relation to work. Sustainable employment can thus be described as "working and living conditions that support people in engaging and remaining in work throughout an extended working life" (Eurofound, 2015). In other words, a clear life course perspective is adopted: sustainable employment allows for workers to age in their job/career (van Dam et al., 2016; Vendramin & Parent-Thirion, 2019).

Drawing on the concept paper by Eurofound (2015), two main components are distinguished within the broad concept of sustainable employment. The first component, "job quality", refers to the nature and quality of objective job characteristics and the work environment. However, to be able to meet the needs of the worker in the present without compromising his/her ability of future work requires more than the mere presence of high quality working conditions in the current job (Eiffe, 2021). Therefore, a second component is distinguished – i.e. the "quality of working life". This term refers to a broader (and for a part also more subjective) set of individual work outcomes such as social protection, job satisfaction, willingness and motivation to stay in (current) employment, opportunities for personal growth, health, well-being and the compatibility of work with other life spheres (Eiffe, 2021; van Dam et al., 2016). In other words: the "job quality" component is mainly related to the characteristics of the current job, whereas the "quality of working life" component is broader and relates to the fit between job characteristics and individual characteristics/circumstances now and in the future (Eurofound, 2015). The distinction between both components also relates to the distinction between objective and subjective dimensions of work. In what follows, each of the two components will be discussed more in detail.

1.4.1 Job quality

This first component of sustainable employment concerns the nature and quality of job characteristics. According to Eurofound (2015), job quality can be considered as the most direct and obvious determinant of employment sustainability, since good job quality is a precondition at every career stage.

The quality of a job is determined by an entire package of objective job features, in turn affecting the sustainability of employment. Conceptually, a distinction can be made between two main categories of job characteristics (Munoz-Bustillo et al., 2009; Vandenbrande et al., 2012). The first category is the **"work"** dimension, refering to job features that are strongly related to the performance of work tasks and thus represent the "intrinsic quality of work". This dimension contains both characteristics inherently linked to the nature of work tasks (job content) and the ergonomic, environmental and psychosocial exposures or demands related to these tasks (working conditions). The second main category of job characteristics is the **"employment"** dimension. This dimension is concerned with those job features that surround the actual performance of work tasks. Two subcategories can be distinguished: the mutual agreements between employee and employer about the organisation of employment (employment conditions) and the formal as well as informal relations between worker, colleagues and employer (employment relations or social relations at work) (Vets et al., 2009). Table 1 shows examples of the corresponding job characteristics for each of the job quality dimensions.

Table 1. Job quality dimensions and corresponding job features

Work		**Employment**	
Job content	*Working conditions*	*Employment conditions*	*Employment relations/ Social relations at work*
Work task intensity Workload Work task type Work task variation Work task complexity Work pace Worker autonomy Learning opportunities Skill requirements Work task flexibility Role clarity/ambiguity	Ergonomic exposures Physical exposures Environmental exposures Psychoscocial demands	Contractual arrangements Working time arrangements Social rights Training opportunities Training policies Career o pportunities Career policies Renumeration and benefits	Collective representation Power relations Relationship of authority Worker involvement Worker participation Social support at work Social contacts at work Discrimination Adverse social behaviour

1.4.2 Quality of working life

This second component of sustainable employment is concerned with individual work outcomes that transcend the nature and quality of job features. The central idea is that, in order to create sustainable employment situations, job characteristics and the work environment in general have to be adapted to the needs and the abilities of an individual throughout his/her life course. This also means that the same objective job features can have different consequences in terms of employment sustainability, according to the individual's characteristics/circumstances. The fit between both has an important impact on whether or not a job is considered sustainable and will thus positively affect the (continued) participation of individuals in the current job or in the labour market more generally. In the Eurofound conceptual framework, this aspect is described as the "availability for work" (Eurofound, 2015).

The "quality of working life" concept contains several individual work outcomes that are shaped by the fit between job characteristics and individual characteristics/circumstances. A first important element is the reconciliation between work and other life spheres. It is easily understood that things going on in other domains of life (e.g. family or care responsibilities) can facilitate or hamper the availability for (certain types of) employment or can result in a different impact of certain job characteristics on workers. An important question in this regard is to which extent the fit between job features and the broader context of the individual provides opportunities for social integration. The nature and the development of individual skills and competencies is a second element of the quality of working life, with an important effect on the (type of) attachment to the labour market. Still another element of the quality of working life is the health and well-being of workers, because it is at the same time an important determinant of the availability for work and a clear outcome of labour market participation and job quality. A fourth aspect is the motivation to work or, otherwise said, 'work engagement'. This refers to the intention to actively engage on the labour market, but also to the willingness and motivation to stay in the current job. In that regard, it is key that workers are satisfied with (the characteristics of) their job, can enjoy their work and have the feeling of doing useful/meaningful work. A last important element is social protection. During the course of their life, many individuals will be confronted with difficulties when it comes to their availability for work at one point or another. Support for workers to make transitions between jobs or between employment and other activity

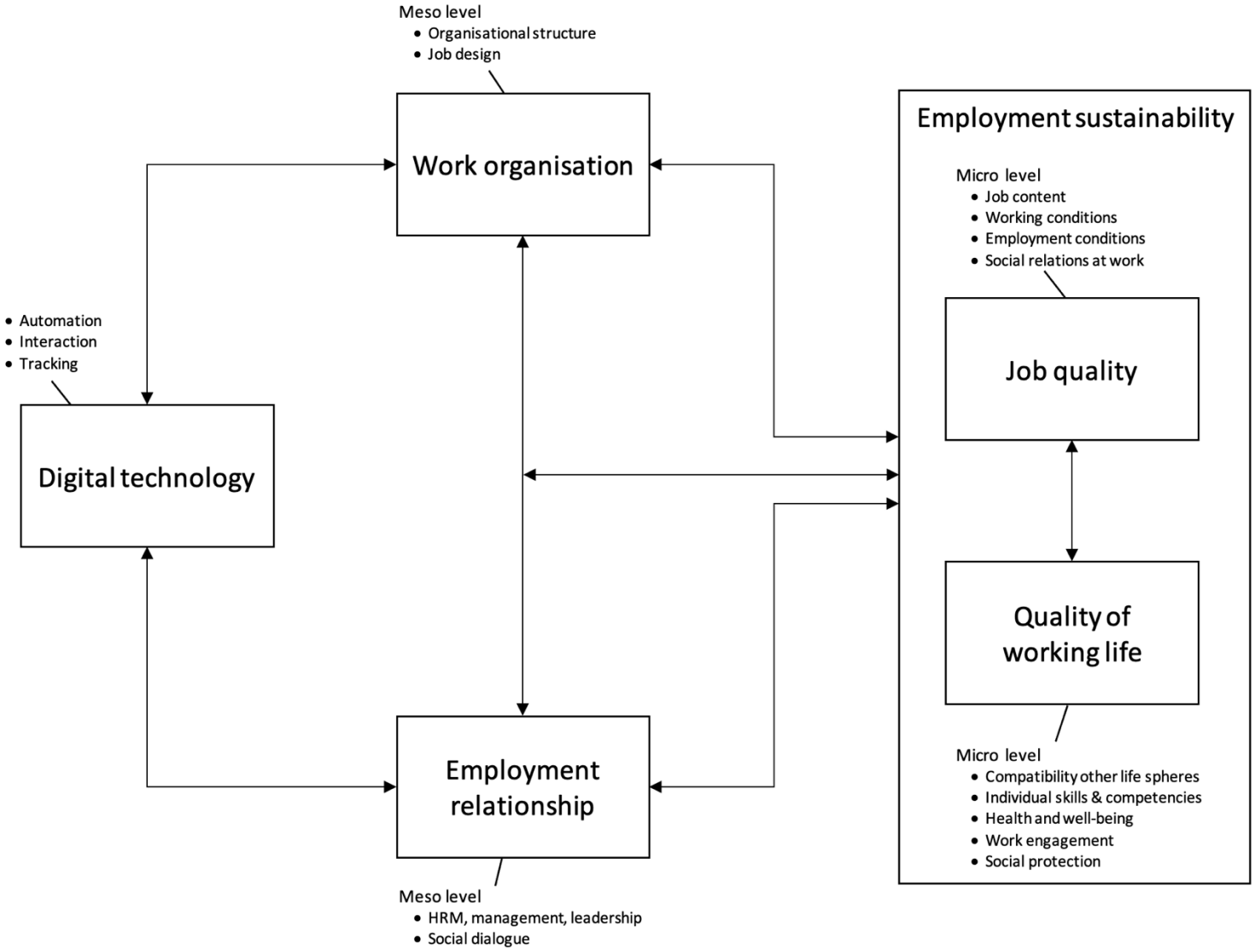
statuses (unemployment, illness, caring responsibilities, education,…) is crucial to safeguard their ability for future work (Eurofound, 2015; Eiffe, 2021).

1.5. Overall conceptual framework

Figure 1 shows the overall conceptual framework that is used in the SEAD project. On the left-hand side of the model, we can find the **digital technology**. It was mentioned earlier in this introduction that different types of digital technologies will be studied in the context of this project. Each of these technologies has a potential influence on the world of work. The organisational level is positioned in the centre of the conceptual model. It is through the process of adoption in a specific organisation that a technology will be able to actually influence the jobs and individual work outcomes of workers. Two meso-level characteristics will have an impact on the selection of technologies to be introduced in the organisation and on the way they are used related to the organisation of work. The **work organisation** refers to organisational choices regarding the division of labour, resulting in a certain organisational structure and job design. The **employment relationship** refers to the way in which the organisation deals with the workers assigned to the different jobs and includes aspects such as HRM practices, leadership styles and social dialogue at the level of the organisation (Huys et al., 2013; Van Hootegem, 2000). In turn, these two organisation-level characteristics will be impacted by the adoption and the use of new digital technologies (Van Hootegem, 2000). Both aspects are discussed more elaborately in the literature review on the role of the organisational level.

The digital technology and the specificities/results of its adoption in an organisation then have an impact on the sustainability of employment for individual workers. As was mentioned in the previous section, two components of **employment sustainability** are distinguished. The position of the first component, **job quality**, in the overall conceptual model indicates that it will be treated both as an outcome and as a determinant in the SEAD project. Job quality is conceived as an outcome in the sense that job features depend (at least partly) on the use of certain (digital) technologies in the organisation. It is also conceived as a determinant, in the sense that job characteristics in turn are related to the second component of sustainable employment: the **quality of working life**. Within the concept of sustainable employment, we thus acknowledge that the nature and quality of job characteristics (job content, working conditions, employment conditions and employment relations) have an impact on workers' ability to engage and remain in work throughout an extended working life, either directly or in an indirect manner through the influence on individual work outcomes such as work motivation, health and well-being, work-life balance, etcetera.

Figure 1. Overall conceptual framework adopted in the SEAD project



1.6. Overview of the working paper

The preceding overview concerning the impact of digitalisation on the world of work shows that the emergence of digital technologies (and more specifically the way they are implemented in organisations) involves challenges for and threats towards the sustainability of employment. However, the process of digitalisation and the accompanying changes in the labour market can also provide opportunities to advance the ideal of sustainable employment (Peña-Casas et al., 2018). This working paper is composed of four literature reviews, each related to one of the four content-related work packages in the SEAD research project and thus concerned with a particular aspect of the relationship between digitalisation and sustainable employment.

The first review presents the literature and main economic theories concerning the effects of the digitalisation on the labour market. The consequences for labour demand, the occupational structure and work task composition are discussed, but attention is also paid to the consequences for labour market outcomes such as inequality, job quality and unemployment. This means that in the first work package, sustainable employment will mainly be studied from a macro-perspective. The second review is concerned with the meso-level and focuses on the role of organisational practices in shaping the relationship between the implementation of (new) digital technologies and sustainable employment. This is also the second work package in the SEAD project. The third literature review is related to the third work package and deals with the effects of digitalisation on the job quality and individual work outcomes in five transversal occupations: assembly line workers, customer advisors, middle managers, recruiters and R&D managers. The fourth work package is concerned with the platform economy. Therefore, the fourth review in this working paper discusses the characteristics of the platform economy, its historic and societal context, but it also provides insights regarding workers' demographic profiles and the employment sustainability challenges associated with platform work. The working paper is concluded by an overview of the next steps that will be undertaken in the SEAD project with regard to each of the four main topics.

2. Digitalisation and labour markets

2.1. Introduction

This part of the working paper reviews the literature about the effects of digitalisation on the labour market. Section 2 presents the main economic theories and the empirical evidence of how technological change affects labour demand, the occupational structure and the work task composition of occupations. Section 3 discusses the main consequences of this occupational change for labour market outcomes such as wages, inequality, job quality and unemployment. The final section discusses the need for a comprehensive research on the effects of digitalisation in Belgium.

2.2. The economics of digitalisation and occupational change

There is a growing literature on the effect of digitalisation on labour markets (Autor et al. 2003; Frey and Osborne, 2013; Arntz et al. 2016; Acemoglu & Restrepo, 2019). Most studies focus on *automation*, which is the substitution of human labour by machines in the production process. As technology improves and machines become capable of performing certain occupations more cheaply than humans do, these occupations tend to be automated. History shows many examples of such obsolete occupations. A dramatic example in Belgian history is the rapid decline of the linen industry during the 1840s, which employed a substantial part of the population in occupations such as weaving and spinning. The mechanisation of the textile industry during the First Industrial Revolution created competition from cheaper textile products. By 1850, the linen industry, that only 10 years earlier had still employed over 20% of the active population in Flanders, was almost completely wiped out. As the crisis unfolded, the Belgian Parliament launched an inquiry and put forward various initiatives to save the industry – but none were successful (Winter & Deschacht, 2015). The process of digitalisation has made various occupations obsolete as well. For example, before the arrival of digital photography, people brought their analogue photographs to shops to have their film developed and printed to photo paper: this job has almost completely disappeared. Kodak, the company that had dominated the market for analogue photography during the 20th century, went bankrupt in 2012. Video rental stores, where people rented movies on VHS tapes, largely disappeared as technology created more efficient ways of delivering movies to homes. Digital payments and ATM machines have eliminated the need for cash withdrawals with bank tellers.

But the effects of automation on the occupational structure are much broader than is suggested by these examples of occupations closely related to technologies that have been replaced. An influential study by Oxford academics Frey and Osborne (2017) concluded that 47% of all US jobs have a high probability of being automated over a period of a decade or two. The study received an enormous amount of press coverage and it has led to fears of substantial job losses and unemployment in the near future. However, the study has been misunderstood. The authors asked a group of experts which occupations would surely be automated and which jobs would surely not be automated. The experts came up with 70 occupations they thought they could confidently assign to one of both categories. Next, the authors constructed a model that classifies all the other occupations in the economy based on the characteristics of these occupations, such as the level of creativity or social intelligence required

in the occupation. The result is, for each occupation, a predicted probability to be in the category of the occupations that are likely to be automated. The occupations with a predicted probability greater than 0.7 represent 47% of all US jobs. The aim of the analysis was to study which occupations are more susceptible to automation and not to estimate how many jobs will actually be automated – a subtle but important difference. In a reaction to the press coverage and the discussion that followed the publication of their study, one of the authors stated that their paper has been misunderstood and that it definitely does not claim that half of all jobs will be automated in a decade or two (The Economist, 2019b). The more accurate conclusion of Frey and Osborne (2017) is that the least risky jobs of being automated are in occupations that require academic training and occupations such as therapy or social work that require skills such empathy or emotional awareness.

2.2.1 The effects of digitalisation on labour demand

In theory, the effect of new technologies on labour demand is ambiguous: it may reduce the demand for workers in an occupation through substitution, but it may also increase the demand for workers. Focusing on substitution potentials is misleading because this ignores the *complementarities* that increase productivity and the countervailing economic forces that can compensate for the displacement of workers through automation (Autor, 2014; Vivarelli, 2015; Acemoglu & Restropo, 2018; Gregory et al. 2019).

Economic analysis regards the various types of machines and labour as production factors. Two production factors are perfect substitutes if they can be substituted at a constant rate, for example if every two workers can be substituted by one machine. Self-checkout machines in a supermarket and cashier workers are a good example of nearly perfect substitutes (although these machines also shift some of the work to clients). Profit-maximising firms should in theory shift from using labour to using the perfect substitute machinery in a sudden and discontinuous way if the price of capital drops below that of labour as a result of technological progress. Production factors are perfect complements if they must be used in fixed proportions, for example if every truck requires a truck driver. If a new technology lowers the price of trucks, then more trucks are used for transporting goods and the demand for truck drivers increases. In this case where labour complements capital, labour demand increases as a result of technologies that lower the price of capital.

In practice, capital goods are no perfect substitutes or complements for labour, but instead they partly substitute and partly complement certain work tasks. Each pair of capital goods and work tasks is characterised by a cross-elasticity of labour demand, i.e. the percent change in the demand for that work task resulting from a one percent increase in the price of the capital good. The cross-elasticity is negative for complements and positive for substitutes, and the size of the elasticity varies. In the construction industry, an excavator substitutes for manual digging work using a shovel, but it increases the productivity of and the demand for construction workers who can operate an excavator. Even self-checkout machines in supermarkets are no perfect substitute for labour because some customers may not know how to use the machines and some workers may still be required to oversee a number of self-checkout machines to solve problems.

Even if the substitution effect of a new technology dominates so that *the first-order effect* is automation and a replacement of human labour in an occupation, the final demand for labour in that occupation could increase because the overall effect also depends on how the demand for products by consumers responds to falling prices. After all, as productivity increases with technological progress, the cost of production falls and prices are likely to fall (this assumes that product markets are

competitive, which need not be the case). If consumers respond to falling prices by consuming a lot more (elastic demand), then more workers are needed and this increased demand may compensate or even exceed the employment loss that resulted from the first-order substitution effect. Economic theory predicts that labour demand increases as a result of technological progress if product demand is elastic and it falls if the elasticity of product demand is less than 1 (Neisser, 1942; Blien & Sanner, 2014; Bessen, 2018). For example, the demand for basic necessities such as food and housing is relatively inelastic: people do not buy a lot more vegetables as they become cheaper. Because of this, the productivity increase in agriculture over the 20th century and the substitution of farm labour by machinery did not lead to the type of increase in demand for agricultural products that could have off-set the substitution effect. The result was a large decrease in agricultural employment over this period. In contrast, the demand for air travel is relatively price elastic, so that the declining price of airline tickets over the years has led to a surge in consumer demand. As a result, the demand for airline pilots has increased, even though many of their tasks have been automated and productivity in the occupation has increased. In the 19th century, employment in the textile factories did not decline although the automation by steam engines boosted productivity, because consumer demand for clothes was elastic in that period (Bessen, 2015). We refer to the effect of technological change in an industry on labour demand in that industry resulting from changes in prices and the scale of production in that industry, as *the second-order effect* or the scale effect.

Technological change in one occupation or in one market may also affect the demand for other occupations or the demand for products in other markets (Autor & Salomons, 2018; Caselli & Manning, 2019). These indirect effects in the economy as a whole can be referred to as the *third-order effect* of technological change, to distinguish it from the substitution and scale effects in the market where the technological change took place. The main reason why the demand in other sectors may increase, is that technological change lowers product prices so that consumers have more income to spend in other sectors. (1) Labour demand can be affected in industries that are directly related to the new technologies, such as the increased demand for workers in the production of robots. However, the workers displaced by introducing labour-saving technologies can – in theory – never be fully reabsorbed in the production of the labour-saving devices since otherwise the cost of production would not be smaller than before and there would be no economic incentive to adopt the new technology (Neisser, 1942). (2) Labour demand may increase in a technologically advancing industry if it competes with a technologically lagging industry, as in the example of e-commerce where the number of workers delivering parcels and picking orders increases rapidly. Amazon.com, one of the large e-commerce companies, employed over 1 million workers in 2020 – and this number is rising. (3) Labour demand may also increase in industries that are completely unrelated to technological change. As productivity increases, real wages tend to increase – either through increasing wages or falling product prices – and consumers can spend this additional income on goods and services in any sector of the economy depending on their preferences. The way consumers spend their additional income on various products is determined by the income elasticity of the demand for each product. The demand for basic necessities such as food and housing is generally assumed to be income inelastic (as well as price inelastic as was discussed higher). An example of an income elastic product is the demand for personal coaches: employment in this type of "new wealth jobs" has been increasing substantially in recent decades (European Commission, 2019). It is hard to predict how consumers spend additional income, especially because income elasticities appear to change over time. Bessen (2018) shows that the demand for many products, such as clothes and manufacturing products, shows an inverted U pattern over time where demand (and employment) first increases with productivity over many decades, before it starts declining with further productivity growth. The decline of manufacturing during the past decades in Europe and the US is the declining part of the inverted U curve for

manufacturing. Bessen explains this general pattern by arguing that initially, i.e. at a time when product prices are still relatively high, demand is income elastic (so that rising incomes result in increasing employment in this industry) and that demand becomes inelastic as product prices fall (so that further productivity and income gains result in declining employment shares in this industry).

2.2.2 Digitalisation and the changing task composition of occupations

Technology does not just affect the demand for occupations as a whole – it also changes the task composition within occupations (Autor et al. 2003; Autor, 2014; Arntz et al. 2016). Any occupation is essentially a bundle of tasks, where a task is a unit of work activity that produces output such as moving an object, communicating a piece of information or organising the work of others. Occupations are generally composed of a variety of tasks and new technologies usually allow for the automation of only some tasks of an occupation. An example of the changing task content is the occupation of office secretary work, in which the tasks have shifted away from typewriting towards more management related tasks (Khalid et al. 2002).

The literature on the effects of digitalisation usually distinguishes between *routine tasks*, i.e. tasks that follow an exhaustive set of rules and can thus be computerised, and *non-routine tasks*, i.e. tasks that are not sufficiently well understood to be specified in computer code and executed by machines (Autor et al., 2003; Autor, 2014). Routine tasks are important in activities such as bookkeeping, clerical work and repetitive production tasks. Autor et al. (2003) further distinguish between two types of non-routine tasks: *abstract non-routine tasks*, that require problem-solving capabilities, intuition, creativity and persuasion and are characteristic of professional, technical and managerial occupations, and *manual non-routine tasks*, that require situational adaptability, visual and language recognition and in-person interactions and are characteristic of food serving jobs, cleaning work, health work and security work.

The literature that followed Autor et al. (2003) assumes that routine tasks are relatively easy to automate, so that digitalisation leads to a decline in labour demand for routine tasks and to an increased demand for non-routine tasks. This is the *routine-biased technical change hypothesis*. Within occupations, the result is a shift over time from routine tasks towards more non-routine tasks as technological change lowers the price of digital capital. A recent example of changing work tasks in an occupation, is the shift to online teaching in higher education as a result of the Covid-19 crisis. Much of the teaching by university professors can be considered a routine task in the sense that the same lecture is taught every year. Video recordings of these lectures allow for a substantial automation of teaching, which is shifting the task content of university lecturers towards more non-routine tasks, such as responding to individual questions and evaluating students.

The empirical evidence largely confirms the shift over time towards non-routine labour and the increasing skill requirements in occupations. Autor et al. (2003) show that the demand for routine tasks has decreased over the past decades and they present evidence from the US Dictionary of Occupational Titles, which contains qualitative descriptions of occupations, that non-routine tasks have become more important within nominally identical occupations. A seminal study by Spitz-Oener (2006) using German survey data on the tasks done by workers going back to 1979, shows that a large part of the increased skill requirements over the past decades results from the changing tasks within occupations, rather than from changing employment shares between occupations and that the changes in skill requirements have been most pronounced in the rapidly computerising occupations. Research also shows that the task composition within occupations not only varies across time, but also

across jobs at the same moment in time (Autor and Handel, 2013): workers within a similar occupation often carry out very different tasks. Considering that workers adjust to new technologies by altering the tasks they do on the job, strongly nuances the alarming predictions on job loss due to automation. Arntz et al. (2016) show that, if it is assumed that machines displace certain tasks instead of whole occupations, only 9 percent of the US jobs are at risk of automation – not 47 percent as suggested by Frey and Osborne (2017) – because many workers that Frey and Osborne consider to be in the high-risk category also perform tasks that are difficult to automate.

2.2.3 Digitalisation and skills: deskilling, upskilling and job polarisation

Different work tasks require different skills and as technology alters the task content of occupations, skill requirements in occupations and in the economy at large change accordingly. As an example, consider the changing task content of a construction worker when excavators were introduced to automate the digging work that used to be done using a shovel (Autor, 2014). The excavator substitutes the manual work of digging using a shovel and a construction worker who knows how to operate a shovel but not an excavator, will likely lose employment. A construction worker who does have (or learns) the skills to operate an excavator, supplies a task that complements the new technology and that is more valuable in the sense that construction work becomes more productive as the task composition of the average construction worker shifts. But the transition can be hard. Shop workers who lose their jobs as traditional retailing declines, might consider a job in the e-commerce and logistic sectors that are gaining market share. However, most jobs in e-commerce require a university degree, which most workers in conventional retailing do not have (The Economist, 2017).

Theoretically, the effect of technological change on the demand for skills, and higher levels of education, is not straightforward. New technologies could lead to *deskilling*, i.e. the substitution of skilled labour by machines that are operated by unskilled labour (Braverman, 1974; Katz & Margo, 2013; Kunst, 2019). The replacement of artisans by mechanisation and the factory system in the 18th and 19th centuries, and the division of labour into simple steps that could be carried out by unskilled workers using special purpose machines, was regarded as a process of deskilling by the classical economists such as Adam Smith and Karl Marx. The workers who operated the machines were less skilled than the artisans they replaced, in the sense that the artisan could make a product from start to finish whereas the operator only needed to perform a small set of relatively simple tasks. On the other hand, new technologies could lead to *upskilling* if machines substitute unskilled labour and require more skilled labour to operate them (Griliches, 1969; Autor et al., 1998). This latter theory is referred to as the skill-biased technological change hypothesis.

Empirical evidence supports the hypothesis that new technologies complement, rather than substitute, more-skilled workers and that technological progress has raised the demand for educated workers. Educational levels have increased a lot over the past decades and over this period the wages of higher educated workers have not fallen (on the contrary), which implies that the demand for higher educated workers must have increased over time with technological change (Autor et al., 1998). Although upskilling appears to be the main result of technological change, there is evidence of deskilling among some groups of workers (Autor, 2019; Kunst, 2019). Autor (2019) argues that technology has been deskilling for less-skilled workers in the sense that non-college workers today perform less-skilled work than they did five decades ago. Non-college workers used to do a lot of middle-skills jobs, such as production work in manufacturing or white-collar office and administrative

work, but employment in these occupations has declined because of automation which forced these workers into occupations that are less-skilled and pay lower wages.

However, empirical evidence also shows that technological change is routine-biased, rather than skill-biased. The evidence shows a process of *job polarisation* that has occurred in the past decades, i.e. the simultaneous growth of high-education and low-education jobs and the fall in employment in the middle of the skill distribution (Autor et al., 2006; Goos & Manning, 2007; Goos et al., 2014). The routine-biased technological change hypothesis states that the routine tasks that tend to be automated are common in middle-skill occupations, whereas non-routine tasks dominate in both low-skilled jobs (with manual non-routine tasks as in cleaning occupations) and high-skilled jobs (abstract non-routine tasks as in management jobs). The employment growth at the lower end of the skill distribution is almost entirely in service occupations, involving assisting or caring for others, such as food service workers, security guards, gardeners, cleaners, home health aides, childcare workers, personal coaches, hairdressers and beauticians. Autor and Dorn (2013) argue that this growth in service occupations results from growing consumer demand for these services as productivity in other sectors and incomes increase. This has increased the wages in service occupations so that low-skill workers are reallocating their labour supply away from routine tasks and toward these service occupations.

Perhaps more important than the skill level, is the type of skills that workers have. The work of a radiologist may be highly skilled but if it can be automated as AI technology improves, then these skills offer little protection. What matters is the extent to which specific skills complement new technologies. Skills that allow workers to use new technologies or operate new machinery strengthen the labour market position of workers. A related dilemma for policy makers, and students, is whether to invest in general skills, that are useful over a broad range of occupations, or in vocational skills acquired through work-placed learning. Theory and empirical evidence suggest that vocational training may be more effective in the short-run for workers, whereas general training may be more effective in the long-run because specific vocational skills tend to become obsolete as technologies change over time (Hanushek et al., 2017).

2.2.4 Effect heterogeneity: which workers are affected?

The effects of digitalisation on labour market outcomes depend on the characteristics of the workers involved. Skills are probably the most important worker characteristic for determining whether the worker will be competing with or complementing new technologies. But other characteristics matter too, such as gender, race, age and geography (OECD, 2018; Black & Spitz-Oener, 2010). The increase of telework may strengthen the position of women, compared to men, as it allows for a better combination of their careers with the roles they continue to adopt in the family (although it could also slow down or reverse the tendency towards a more gender-balanced division of household work and towards the outsourcing/socialisation of household labour). Men and women also continue to work in very different occupations in most countries, so the challenges posed by technology may differ by gender. Women work more often in occupations that require in-person interactions, such as health workers, that are less likely to be substituted by new technologies. However, Autor and Handel (2013) find that females are substantially more likely than males to do repetitive tasks. The fact that in most countries many more girls than boys currently graduate from university, could strengthen the labour market position of women, but girls participate less in STEM fields, which are more likely to complement new technologies. In any case, the substantial declines of manual routine jobs in

manufacturing (a male dominated occupation) and secretary office jobs (a female dominated occupation) show that no gender is immune for the challenges posed by the process of digitalisation.

Digitalisation poses specific challenges for older workers (e.g. over 50 years old), a group that has increased rapidly in size as the effective retirement age has increased. Older workers invest less in human capital (and organisations invest less in older workers), so they are more likely to lack the skills to adjust to the changing work tasks in their job resulting from the digitalisation process. If older workers are less flexible to adapt to new task requirements in their jobs, then the changing task structure in the economy may be forced upon them through unemployment and transitions to other jobs and occupations – instead of via task change within the job. Evidence shows that companies that fail to innovate, employ more older workers (Aubert et al., 2006). Moreover, older job seekers are less likely to find a job than younger job seekers, which at least to some extent is related to skill obsolescence and adaptability problems (Vansteenkiste et al., 2015). The rise of the gig economy is sometimes seen as a promising way to increase the labour supply of older workers by allowing them to choose more flexibly the working hours and work intensity they need, but it could imply earnings losses for older workers. For example, a study among Uber drivers suggests that earnings decline with age, whereas earnings increase with age for workers in traditional jobs (Cook et al., 2019).

The spatial structure and the way jobs and workers are located geographically also matters. Empirical research shows there is a large geographic variation in the risk of automation. A cross-country comparison in Europe suggests that jobs in Nordic countries are less automatable than jobs in South European countries, which is largely explained by country differences in the occupational mix within sectors and the task mix within occupations (OECD, 2018b). The effects of automation are likely to differ between cities and rural areas as well: evidence for the U.S. shows that job growth is mainly concentrated in cities and their peripheries, whereas rural areas are declining (McKinsey, 2019).

2.3. Social and economic consequences of digitalisation

2.3.1 Income and inequality

The most important consequence of automation and the changing occupational structure is that the associated productivity increase tends to increase incomes and consumer welfare. As occupations shift and economies grow, so does total income. Both economic theory and empirical evidence also demonstrate a strong relation between productivity and the wages earned by workers (Stansbury & Summers, 2017; Caselli & Manning, 2019). In competitive markets, productivity puts downward pressure on product prices, so that real wages and purchasing power increase. Productivity also pushes wages up because the higher benefits from additional hiring causes firms to increase their demand for labour. Digitalisation also leads to entirely new products, such as smartphones and Wikipedia, and more product variation, such as more TV channels and customised products, that have increased welfare in ways that are hard to measure in traditional GDP indicators.

Income inequality, which has risen strongly in rich countries since 1980 (Nolan et al., 2019), is often considered to be another consequence of technological change. Even when average incomes grow, income inequality may widen and the incomes of some occupations or groups – such as low-skilled workers – might fall. Mobility, either geographical or occupational, is crucial for workers to seize opportunities in other jobs. As an extreme example, consider a hypothetical group of workers whose

skills only allow them to do cashier work in a supermarket. As supermarkets introduce self-checkout machines and the demand for cashier workers falls, the wage in this market will inevitably fall as workers compete for the remaining jobs. On the other side of the skills spectrum, the wage of high-skilled workers tends to rise as new machines increase the demand for skilled workers to operate them. This skill-biased technological change is considered to be the main driver of the increase in income inequality in many countries – next to other factors such as declining union power and import competition (Autor et al., 1998). Job polarisation also increases income inequality if it is assumed that the wages of low-skilled jobs do not rise because it is relatively easy to enter these jobs, and that the wages of high-skilled do rise because labour supply responds slowly to the increased demand in these jobs (Autor, 2014). This reasoning illustrates the fact that the impact of automation on the wages of specific occupations is not straightforward, because wages do not just depend on labour demand in the occupation – of which the effects of automation are relatively straightforward – but also on how labour supply responds in this occupation and on the price elasticity in the product market.

Income inequality could also have risen as a result of technological change if capital owners managed to turn the productivity gains into higher profits. In standard economic models competition drives prices down so that profits are competed away, but research shows that the market power of firms and profit rates have substantially increased over the past decades (The Economist, 2016; De Loecker & Eeckhout, 2020). New technologies have also given rise to the "superstar phenomenon", i.e. the fact that in some professions a few persons earn astronomically high salaries because technology allows the very talented to reach very large markets (Rosen, 1981; Krueger, 2019). More and more markets exhibit this type of winner-take-all results, which widens the gap between the earnings of the top and those of the rest.

2.3.2 Job quality and sustainable employment

The quality of a job is not just determined by the wage but by the entire package of job features that includes various dimensions of non-wage attributes (Munoz-Bustillo et al., 2009; Vandenbrande et al., 2012): job content (the intensity of work, task variety, repetitive work, autonomy in how to organise the work, …), working conditions (risk of injuries, hard physical work, …), employment conditions (job security, working times, promotion chances, on-the-job learning, …) and social relationships at work (e.g. participation in decision making).

The process of digitalisation and occupational change pose both opportunities and threats for the quality of jobs (Peña-Casas et al., 2018). Since technology is routine-biased, it is mostly the routine and repetitive jobs that are automated so that job quality in that dimension could be expected to improve. Workers in jobs that face threats from automation feel that the recognition for their work disappears – as has been documented in the case of supermarket cashier workers (Bernard, 2013). New technologies may reduce the risk of injuries on the job and the need for hard physical work, as is clear in the use of industrial robots for welding (joining metals using high heat), the use of robots to assist in lifting heavy objects, the use of sensors by workers to detect gas or the monitoring of traffic control to improve safety in the air and railways. But other types of risks and illnesses may increase. Digitalisation has allowed for a better monitoring of workers by management, which may increase effort levels, the intensity of work and mental stress (Gallie, 2017). As occupations shift towards more tasks as operators of computer capital, more workers are spending more hours behind their laptops, which poses health risks in terms of musculoskeletal disorders (Wahlström, 2005). Telework presents opportunities for more flexible working hours, a better work-life balance and more autonomy for

workers, but it also isolates workers and it blurs the boundaries between work and non-work time which may make it harder for workers to disconnect from work, increases stress and complicates the regulation of working times through collective bargaining (Daniels et al, 2001). Platform work and the gig economy present similar opportunities for more flexible working hours, but the fact that many workers in these jobs are self-employed poses risks for employment protection, such as social insurance and the lack of trade union representation (Drahokoupil & Piasna, 2019).

2.3.3 Unemployment

Although some commentators speculate that automation will result in massive unemployment and "the end of work" (Rifkin, 1995; Ford, 2015), the general view in the economic literature is that technological change does not substantially reduce employment in the economy as a whole (Autor, 2014; Vivarelli, 2015; Caselli & Manning, 2019; European Commission, 2019). Throughout history, new technologies have produced fears about widespread unemployment, most famously in the Luddite movement in the 19th century, yet unemployment has never risen secularly with automation over the past centuries and unemployment today is not substantially higher in technologically more advanced countries than in other countries. The main mechanisms that compensate for the automation of specific job tasks are falling product prices that increase real incomes and the demand in other sectors of the economy, and the fact that automation increases the demand for labour complementing these technologies.

However, there are a number of theoretical reasons why a wave of automation could increase the unemployment rate temporarily – at least for some groups in the labour market. First, structural unemployment may arise from skill mismatch if the workers who lose their jobs in the declining occupations lack the necessary skills to find jobs in rising occupations. Second, if the job losses are concentrated in one region, for example the Rust Belt region in the US where many manufacturing jobs were lost over the past decades, and if the employment growth is concentrated in another region, for example in Silicon Valley, then a type of inter-regional spatial mismatch arises with high unemployment rates in the declining regions that may persist for decades (Moretti, 2012; Amior & Manning, 2018; Theys et al., 2019). Third, frictional unemployment may increase if a wave of automation results in higher levels of job destruction and job creation. More turnover in the labour market implies that more workers are in between jobs at any moment in time (Aghion & Howitt, 1994). Fourth, unemployment may arise if automation results in weak aggregate demand across the economy when the returns from automation flow to profitable firms or high-income earners who save (The Economist, 2017b; European Commission, 2019). The increased labour demand that can compensate for job losses from automation depends on aggregate demand in the economy, so policies that sustain aggregate demand and reduce inequality may support labour demand.

2.4. Conclusion: digitalisation and the Belgian labour market

Only a few fragmentary studies have analysed Belgian data to investigate automation, occupational change and their consequences for labour market outcomes. Research on job polarisation confirms that middle-skill jobs are disappearing in favour of low-skill and high-skill jobs, but the growth of the share of low-skill jobs appears to be more limited in Belgium than in other countries (Goos et al., 2009; De Mulder and Duprez, 2015; Buyst et al., 2018). Goos et al. (2009) report that the share of middle-skill jobs in Belgium has decreased by 9.5 percentage points between 1993 and 2006, but the share of

low-skill jobs has only increased by 1.5 percentage points. However, in the manufacturing industry in Belgium the number of low-skill jobs has declined considerably: in 2000, low-skill jobs accounted for 18 percent of industrial employment, but by 2013 this was only 5 percent (De Mulder & Duprez, 2015). A related study of manufacturing workers who lost their jobs when carmaker Ford closed its plant in Genk in 2014, shows that workers who were doing routine jobs at Ford had much lower re-employment probabilities afterwards, and that workers who did enter a new job now do more non-routine tasks than they did at Ford (Goos et al., 2020). An analysis of data about vacancies and job seekers from the Flemish Public Employment Services VDAB, investigates to what extent the task compositions of different occupations overlap, and finds that job seekers hardly move to occupations where they possess only part of the task competencies (Goos et al., 2019). The study by Arntz et al. (2013) estimates that 7 percent of all Belgian workers are in a job that has a high risk of automation and that these are mostly low-skill and low-income workers. A study about Belgian platform workers investigated the personal characteristics and the motivation of riders at Deliveroo in 2017 (Drahokoupil & Piasna, 2019). The results show that the typical Deliveroo rider is young and looking for flexible time schedules: 85 percent of the riders are students, the mean age is 22 years old, almost 70 percent of the riders live with their parents, only 12 percent are women, they work around 5 hours per week on average, they often work during weekends and evenings (only 4 percent say they never work in the evening), the majority has no other job and is not looking for another or an additional job, and around 70 percent say they ride for Deliveroo because of the flexibility of the time schedule.

More research is required to describe the changing occupational structure of the Belgian labour market, the changing taks composition in Belgium and the effects of digitalisation on individual labour market outcomes. Research is also needed on the role of the organisational level in mediating between technology and sustainable work and on the micro-level of specific occupations in both the traditional sectors of the economy and the emerging sectors of the digital economy. These are the topics of the next parts of this working paper.

3. Unpacking the organisational level

3.1. Introduction

As described in the previous paragraphs, the increasing use of digital information and technologies, or digitalisation, influences our society on multiple levels. In addition to labour market effects, new digital technologies also challenge the current reality of work on the organisational and job level affecting human-technology interaction, requiring new skills and imposing hierarchical changes (Veile et al., 2019). This part of the working paper focuses on the organisational black box related to digitalisation, including organisational models and managerial practices that may promote sustainable employment in a context of technological innovation. This literature review discusses the state of affairs regarding the 'organisational level' as a defining intermediate factor between the implementation of digital technologies and employment sustainability outcomes. The following paragraphs (1) describe the concepts and definitions related to the study of the organisational level and (2) present the results of the literature review.

3.2. The organisational level: concepts and definitions

The literature review that is presented here focuses on the effects of digital technologies on the organisation. It is written from a perspective that highlights the affordances and constraints of technologies, rather than the specific features of the technology. This perspective is called TACT (Technology Affordances and Constraints Theory) and is explained in the next section. The information in the literature review is structured according to our theoretical understanding of organisations. This refers to a section on Work organization and a section on Employment relationship. Both concepts are explained below.

3.2.1 Technology affordances and constraints

The perspective of Technology Affordances and Constraints Theory refers to the potential of interactions between people and technology. The theory's essential premise is that the impact of a digital tool can only be understood when considering the synergy between its specific technicities on the one hand and the organisational adoption and human experience on the other hand. This synergy leads to so-called technological affordances and constraints. **Technology affordances** represent the action potential of new technologies: how meeting a particular goal can be facilitated by the use of technology. For example, the combination of the technological features of a certain digital file-sharing platform and the personal skills of a group of employees using this platform, leads to the technology affordance "information sharing". This is not inherent to the technological tool, nor is it characteristic for the group of individuals using the tool or the organisational context in which the tool is applied. "Information sharing" refers to what potentially can be reached when this platform is used and is thus an affordance resulting from the interaction between humans and the tool. This should, however, be distinguished from what was *actually* afforded by the technology. If, in the given example, employees

use this platform for informal chatting rather than for sharing work-related content, "information sharing" is a technology affordance that is not afforded in reality.

Technology constraints, on the other hand, determine *"ways in which an individual or organisation can be held back from accomplishing a particular goal when using a technology or system"* (Majchrzak & Markus, 2012, p. 1). A technology constraint of the file-sharing platform could for example be "decreasing direct communication" as it limits employee personal conversations regarding file-sharing.

3.2.2 Work organisation & employment relationship

According to Van Hootegem (2000) and Huys et al. (2013), each organisation can be understood as the result of combined organisational choices in the field of its labour division and employment relationship. In this model, organisational choices with regard to labour division include the production organisation (structure of the primary value-adding process), the production technology (machinery and technology to produce outputs), and work organisation (grouping tasks into work packages to design workplaces). The combination of production organisation, production technology and work organisation results in a certain organisational structure, within which specific jobs are defined (Huys et al., 2013; Van Hootegem, 2000). In our conceptual framework, we enlarged and renamed this concept to **work organisation** to reframe the focus on how organisations deal with jobs and roles within an organisational structure. In this literature review, the concept of work organisation thus includes choices regarding the production organisation and technology, as well as the creation of jobs, roles, and an organisational structure. The relation between these elements and technology is described in the following paragraphs.

The **employment relationship** concept refers to aspects relating to the way humans fit into these jobs, discussing allocation, disciplining and industrial relations (Huys et al., 2013; Van Hootegem, 2000). This also relates to the role of leadership, human resource management (HRM) and other managerial practices; elements that are also forming and formed by the organisation's corporate culture. The following paragraphs present a literature review on the relation between digital technologies and the employment relationship.

Evidently, choices concerning the work organisation affect the possibilities regarding employment relationships and vice versa as together these aspects compose the organisation as a living organism. A conceptual framework, however, requires conceptual categories and definitions to allow a fruitful analysis. The forthcoming study will search for the optimal combination of elements in the work organisation and the employment relationship to guarantee employment sustainability in the context of digital technologies.

3.3. Literature review

3.3.1 Work organisation

Organisational structures are often understood in two categories: organic and mechanistic designs. Whereas the first is more flexible and characterised by decentralisation, empowerment, few rules and formalities, horizontal communication and collaborative teamwork, the latter is more rigid and known for stricter vertical and hierarchical regulations (Wilkesmann & Wilkesmann, 2018a). Regarding the fit between digital technologies and organisational structure, Shamim et al. (2016) argue that since the digital transformation creates an unstable environment, the innovation and change management that is required fits best with an organic organisational design. Here, decision-making processes are faster and both managers and employees are able to react more flexible to the changing challenges (Veile et al., 2019). In addition, a complex digital transformation affects all organisational processes and rigid organisational structures are less likely to implement such profound changes (Fettig et al., 2018).

Nevertheless, Wilkesmann & Wilkesmann (2018) describe the different use of new digital technologies in organic and in mechanistic organisation structures. Technologies in mechanistic organisational structures tend to reinforce the reproduction of routines and have employees filling the gaps; whereas in organic structures, technologies mainly contribute to innovations. It is likely that path-dependency following the existing organisational structure steers the selection, implementation and use of new technologies (Lall et al., 2016). Reversely, new technologies necessitate a change in the way work is organised, leading to the emergence of and search for new forms of work and organisation (Van Hootegem, 2016). For example, a technology that allows direct and immediate communication could create the technology affordance of "communicating across hierarchical levels", impacting the traditional organisational hierarchy. Expert interviews with managers in technology-adopting companies stress the importance of simultaneously adapting the organisational structure to the use of digital technologies (Veile et al., 2019). In this regard, Cagliano et al. (2019) showed that enterprises tend to transition from a vertical organisation with a centralised decision making structure to a flat, decentralised organisation, when the technical complexity increases.

Changes in the organisational structure imply changes on the job level, regarding the combination of different tasks as well as the internal functional hierarchy. Veile et al. (2019) recommend that an adaptation should be made in terms of job design to encompass new tasks and responsibilities as a result of working with new technologies. This includes the adjustment of relevant job characteristics to combat new job quality risks. Examples could include changes in compensation following task complexity or flexible working hours, updated training opportunities, efforts to install teamwork and flexible workplaces, attention for social support from colleagues and managers to prevent isolation. Lacking to adapt the job design can increase stress and affect well-being (Kadir & Broberg, 2020).

Naturally, the introduction of new technologies also affects the nature of tasks. Veile et al. (2019) observed that with an increased automation, machines undertook routine tasks and left employees with more intellectual demands such as decision making. Moreover, Cagliano et al. (2019) explain that workers' tasks differ with the level of technological complexity that is introduced. When organisations install isolated applications related to automation of limited technological complexity, the remaining tasks are characterised by specialised manual activities. When organisations fully implement and integrate a large set of technologies, tasks shift to multitasking activities mainly related to the production, reparation or control of the concerning technology, with a higher proportion of cognitive

tasks (Cagliano et al., 2019). A technology that replaces manual activities could for example lead to the technological constraint "diminishing low-educated work".

These changes fuel the discussion on and prediction of job losses. Certain job or task characteristics, however, seem to shield jobs and tasks from being replaced or profoundly changed by digital technology. For now, the disruptive impact of digital technologies is limited in jobs that demand complex and flexible decision-making or require a personal relation, such as personal care or assistance (Brolis et al., 2018). Nevertheless, changes in task composition undeniably have direct and significant effects on skills requirements and the quality of job characteristics, in turn influencing employment sustainability (see infra).

3.3.2 Employment relationship

Similar to the previous paragraphs, technology affordances and constraints are expected to affect how employment relationships are formed, and vice versa. Literature on this topic is limited and mainly focuses on the managerial preconditions for introducing new technologies, rather than on how employment relationships change as a result.

When implementing new digital technologies, companies step out of their comfort zone. Together with changing the general architecture of an organisation's structure, Veile et al. (2019) emphasise the need for a systematic cultural change addressing the new organisational reality. This cultural change should be initiated by the management (top-down approach) and conducted incrementally. The culture that enterprises should aim for is described in terms of willingness to learn, openness to new things, and the promotion of creativity, idea generation and an entrepreneurial mindset (El Sawy et al., 2016). Kiel et al. (2017, p. 16) mention an "*adaptable corporate culture convinced of the need to pursue the novel industrial paradigm*". This corporate culture is reflected in the disciplining and leadership style of managers, the HRM-practices with regard to allocation and training and the context of employee involvement and industrial relations.

Considering leadership style, the most commonly discussed type of leadership in the context of digitalisation is the transformational leadership style (Shamim et al., 2016). Even though transformational leadership is mainly considered relevant during specific changes, in practice it might become a vested way of coordination because of continuous change processes that confront organisations (Schoemaker et al., 2018; Imran et al., 2020). In the specific context of the 4th Industrial Revolution, also knowledge-oriented leadership is put forward. This new construct focuses on the development, conservation and sharing of knowledge in the company by combining the ad-hoc flexibility of transformational leadership with the more stable fundaments of transactional leadership (Shamim et al., 2016).

Disciplining in the context of a digital transformation should tolerate mistakes and focus on creativity to rapidly learn from failures (Veile et al., 2019). According to the Self-Determination Theory (SDT) (Rigby & Ryan, 2018; Van den Broeck et al., 2016) in particular an 'autonomy-supportive context' will promote the autonomous motivation of employees and make jobs more resourceful, allow workers to have more control and learn them to apply new skills; crucial elements to successfully implement a digital transformation (Tuckey, Bakker, & Dollard, 2012; van de Voorde et al., 2016). Research shows clear relations between an autonomy-supportive context and employee engagement and well-being, with employment relations to guarantee crucial preconditions (Gagné & Bhave, 2010). Various new technological applications have a strong potential to create this 'autonomy-supportive context', while

some digital tools challenge traditional autonomy-supportive HR- and leadership-practices (Hertel, Stone, Johnson, & Passmore, 2017). For example, an application to change work schedules anytime and anywhere, allows the technology affordance "flexible scheduling". Whether this affordance leads to better or worse outcomes for the employees (e.g. regarding work-life balance), depends on how the organisation approaches this technology. The organisational context thus serves as a moderator in the relation between technology affordance or constraint and employment sustainability.

Looking at allocation, leading members of the firms interrogated by Horváth and Szabó (2019) stated that the absence of a leader with appropriate skills and experience to pilot Industry 4.0 projects was mainly an issue in smaller businesses. This is in line with studies on HRM in small and medium enterprises showing that these businesses traditionally operate more in a flexible and informal manner, where both managers and employees are less likely to receive formal training and companies encounter difficulty attracting and retaining highly competent employees (Singh & Vohra, 2005). Appropriate digital skills to understand, handle and coordinate the new technologies, however, are stated to be a necessary precondition for a digital transformation which can be met through training and education or through attracting specialised employees (Brolis et al., 2018; Veile et al., 2019).

From the employee-side, employee involvement is frequently underlined as a precondition for a successful implementation of new technologies for several reasons. Employees are the ones who will apply and operate the new technology (Veile et al., 2019), and since they are familiar with the current work processes and interactions, their involvement logically can help to improve them (Kadir & Broberg, 2020). Involvement of the employees also affects perceived well-being and operational performance (Kadir & Broberg, 2020; Tortorella & Fettermann, 2018).

On a macro-level, employee involvement is studied in the context of industrial relations and social dialogue. Recently, also trade unions' attention for the topic is sharpened. Eurofound (2016) affirms the key role of social partners in achieving win-win strategies for dealing with organisational change. In 2018, Voss and Riede (2018) stated that 65% of questioned trade union representatives and company level workers mentioned that digitalisation has risen as a topic of information and consultation. Recently, the European cross-sectoral social partners published a framework agreement to optimise the benefits and deal with the challenges of digitalisation in the world of work (Business Europe et al., 2020). In Belgium, digitalisation was also one of the topics of the 2017-2018 InterProfessional Agreement and was identified as an important societal challenge.

3.3.3 Effects on employment sustainability

With regard to the effect of digital technologies on employment sustainability, an ambivalence is found between the enhancement due to the decline in physical tasks and an upgrade of work in terms of intellectual tasks (Eurofound, 2019) and the scenarios of increased polarisation leading to worse work and employment conditions or unemployment among the low-skilled workforce (Ghobakhloo, 2020). Empirical analyses show how the use of specific technologies affects subelements of the broad concept of employment sustainability both positively and negatively. With regard to job quality, for example, increased physical health risks include visual fatigue caused by augmented screen time and more musculoskeletal problems due to sedentary tasks (EU-OSHA, 2017; Tran & Sokas, 2017). On the other hand, robots that are used for alleviating the lifting of heavy weights lead to fewer injuries (Brolis et al., 2018). In addition, the technology affordance of 'working anytime anywhere' allows flexibility, impacting both job quality and the quality of work, as this could lead to better or worse work-life balance. Moreover, whether the outcome is sustainable also depends on how organisations, managers

and employees approach this. The same holds for scheduling tools that optimise the allocation and timing of tasks, as they lead to more efficiency but may also diminish rest moments and thus increase work load (Brolis et al., 2018). A direct communication tool can increase the level of autonomy but also the level of control, depending on its application. As regards up-to-date skills, Brolis et al. (2018) stipulate that even though some technologies do not seem complex (e.g. asking cleaners to use a smartphone for work schedules), all workers should receive training to acquire the necessary numerical or computer skills. Lastly, various research highlights how the use of technologies, especially in the platform economy, can lead to the isolation of workers (EU-OSHA, 2017).

The separate effects on subelements of employment sustainability are expected to be amplified because different types of tasks tend to systematically bundle together (Fernández-Macías et al., 2016). Intellectual and social tasks are often combined, while physical demands co-occur with routine tasks and the use of machines. This implies that certain jobs and sectors currently deal with an enormous impact of the increased use of technologies, whereas other are rather untouched. The fact that the impact of new technologies is unequal over jobs and sectors, leads to an increased difference in job quality and job polarisation may be at hand (Peña-Cases et al., 2018).

More importantly, the large majority of research concludes that the impact of digital technologies on job quality depends on the context in which these innovations are applied and how they are used. The role of managers and HRM practises is thus crucial. For (middle) managers, the most prominent questions in the context of digitalisation relate to employee autonomy, control mechanisms and standardisation of processes (Cagliano et al., 2019). This refers to the difficulty to install an autonomy-supportive context to increase employee engagement and well-being. For this context, elements of work organisation as well as employment relation are crucial.

Cagliano et al. (2019) observed a strict prescription of work procedures and limited autonomy in so-called “process-automated factories”, i.e. organisations with a low number of digital technologies that are integrated mainly at production phases level. In “Smart Factories”, on the other hand, a high number of digital technologies are fully integrated in the operation processes and workers experience autonomy in work procedures in terms of control, problem solving and working methods. Cirillo et al. (2019) found that the introduction of Industry 4.0 artefacts cause diverse effects on employees’ autonomy levels. Some practices increase employee discretion, while other facilitate strict managerial control mechanisms. An example of the latter is the use of software to check if employees perform their tasks in a designated amount of time (Kadir & Broberg, 2020) or task allocation by a digital system of which operations workers have to perform, when and in what order (Wilkesmann & Wilkesmann, 2018b). In personal care, for example, technology allows to optimise employees’ work schedule. On the one hand, this allows them to better arrange their working hours, while on the other hand it might lead to more time pressure (Brolis et al., 2018).

The type and use of digital technologies, as well as the organisational structure in which they are installed, thus determines certain job characteristics and overall job quality. Butollo et al. (2019) declare that, currently, implemented projects tend to increase standardisation and work control. This might be explained by the observation that the desire for control has been highlighted as a significant driving force for people in a leadership position (Horváth and Szabó, 2019). Research shows that rather than the technology itself, different forms of organisational design impact the result and workers’ perceptions of working with digital technologies (Wilkesmann & Wilkesmann, 2018b). Nevertheless, literature on this topic is limited.

3.4. Conclusion

This literature review shows the overwhelming impact of digital technology on all aspects of the organisation. In the work organisation as well as in the employment relationship, the recurrent advice is to align strategy, technology and organisation to create optimal outcomes, both financial and with regard to well-being. Nevertheless, the vast majority of research on digital technologies consists of theoretical papers, outweighing by far the empirical research in organisational contexts (Cagliano et al., 2019; Frank et al., 2019; Kadir & Broberg, 2020). Future research should therefore focus on data collection in order to specify the precise requirements for shaping different elements in the work organisation and the employment relationship and how to align these.

In addition, especially the digitalisation of the manufacturing sector is mostly studied from a technical point of view. Implications of technological innovations in terms of labour and employment relations is still a relatively young field (Habraken & Bondarouk, 2017; Vacek, 2016). It would be beneficial for future research to include other sectors and to open this perspective from a sole focus on technical features to the potential interaction between technology and people in the context of an organisation (as described in the TACT).

4. Changing tasks and occupations in established industries

4.1. Introduction

A vast amount of literature dealing with the effects of technological changes on occupations has already been produced over the years. Within this literature, a consensus emerged on the fact that digitalisation tends, among other effects, to automate certain tasks rather than whole occupations, so that the job content of occupations changes (Acemoglu & Restrepo, 2019; Autor, 2015). Over time, several different models investigating the changing content of jobs have been constructed (Valenduc & Vendramin, 2019).

However, in-depth qualitative case-studies of technology-related change in specific occupations are still rare. As a matter of fact, empirical literature about the effects of digitalisation on occupations only amount to a small part of the literature. A vast part of the literature tends to rely on secondary sources or experimental tests (e.g. Nawaz & Gomes, 2019); or consists of conceptual (e.g. Strohmeier, 2020) or prospective papers (e.g. Black & van Esch, 2020). Therefore, the objective of this induction paper is to synthetise the already empirically documented effects of digitalisation on five transversal occupations, at the micro-level. It focuses on the perspective of workers and on day-to-day work practices.

This paper is organised as follows: firstly, we will expose through a methodological section how we have proceeded to select the occupations. Secondly, we will present the results of the investigations on the changing occupations on several aspects (technologies used as well as changes on work, employment and social relations of workers). We will present, in a third step, some contextual elements related to these changes. This will help us to discuss, in a fourth section, how sustainability is addressed through the investigated papers. Finally, we will conclude by identifying some literature gaps to be filled by further empirical work.

4.2. Methodology

In order to identify the five occupations, we proceeded in three phases.

Firstly, a broad exploration of the literature regarding digitalisation and changing occupations has been carried out, resulting in the identification of thirteen occupations that could constitute interesting cases for the rest of the study (i.e. bookkeeping, accounting and auditing clerks; car assemblers; cashiers, counter and rental clerks; customer advisors; legal aids/paralegals; middle-managers, R&D managers; recruiters; salespersons; secretaries, office clerks and administrative assistants; senior executives and management consulting occupations; supply chain managers; truck drivers).

Secondly, we selected five out of the thirteen occupations for which we deepened the literature review. Different selection criteria guided our choice of these occupations: the transversality of the occupations (not related to a specific sector or enterprise), the diversity regarding the notion of core or support type of work; the diversity regarding the level of the occupation (managing or operational);

the diversity in whether or not occupations involve direct contact with clients and other users and the diversity in the skill level of occupations. Those occupations are:

- **Assembly line workers**: workstations wherein a product is assembled progressively by different workers or machines, each of them executing a subset of the needed assembly operation (Moreira et al., 2015). We extended the occupation of car assemblers to the larger category of assembly line workers to increase transversality and anchor one of the occupations studied in a blue-collar, industrial context.
- **Customer advisors**: workers who interact with customers after the purchase of goods/services. Their main aim is usually to provide service and support to clients in order to increase customers' satisfaction (Jasmand, Blazevic, & De Ruyter, 2012). One aim of the study of customers advisors is to scrutinise the usual claim of redeployment towards higher added-value tasks with digitalisation, in a service context.
- **Middle managers:** managers who typically head a function, team or office and supervise day-to-day operations (Chen, Berman, & Wang, 2017). The middle manager acts as an important link between senior management and its organisational core. Examining the middle managers occupation can help to highlight the differences and similarities of the changes undergone in numerous organisational contexts.
- **Recruiters**: workers in charge of recruitment (the act of building a pool of potential candidates for a vacancy) and selection (assessing the capabilities and fitting of those candidates for the said vacancy) (Stone et al., 2015). Studying recruiters will bring significant insights in a field most exclusively centred on the experiences of the recruits.
- **R&D managers:** managers responsible for the research, planning and implementation of new programs and protocols. They also supervise the development of new products from the initial planning phase to implementation or production (Study, 2020). The industrial context and the field of management of expertise with digitalisation will be approached through this latest occupation.

Thirdly, these five occupations were each subjected to a literature review **focusing mostly on empirical papers**. Table 2 provides an overview of the mobilised papers. Findings were organised around (1) the type of technologies used, (2) the changes undergone regarding digitalisation on the dimensions of job quality, (3) the contextual factors surrounding the implementation and the effects of technologies and (4) what it means in terms of sustainability of work. The conceptual framework used within the second point is derived from the 'four A dimensions' of job quality. The A's refer to the Dutch A-words '*arbeidsinhoud*' (job content), '*arbeidsomstandigheden'* (working conditions), '*arbeidsvoorwaarden*' (employment conditions), '*arbeidsverhoudingen*' (employment relations or social relations at work) (Vandenbrande et al., 2012). Following the work done by Lamberts et al. (2016), we synthetised those in three dimensions that are work (regrouping job content, working conditions), employment (corresponding to employment conditions) and social relations (corresponding to employment relations).

Table 2. Overview of the selected papers for the literature review

Occupation	N° of papers analysed	Paper type						
		Empirical paper				Non-empirical paper		
		Quantitative methods	Qualitative methods	Mixed methods	**Subtot.**	Lit. review	Other	Subtot.
Assembly line workers	32 (100%)	3 (9,5%)	10 (31,5%)	7 (22%)	**20 (63%)**	4 (12%)	8 (25%)	12 (37%)
Customer advisors	20 (100%)	5 (25%)	5 (25%)	7 (35%)	**17 (85%)**	2 (10%)	1 (5%)	3 (15%)
Middle managers	18 (100%)	3 (17%)	8 (44%)	2 (11%)	**13 (72%)**	4 (22%)	1 (6%)	5 (28%)
Recruiters	35 (100%)	12 (34%)	10 (29%)	5 (14%)	**27 (77%)**	4 (11,5%)	4 (11,5%)	8 (23%)
R&D managers	33 (100%)	9 (27,5%)	9 (27,5%)	7 (21%)	**25 (76%)**	2 (6%)	6 (18%)	8 (24%)
All occupations	138 (100%)	32 (23%)	42 (31%)	28 (20%)	**102 (74%)**	16 (12%)	20 (14%)	36 (26%)

4.3. Results

4.3.1 Types of technologies

According to the empirical papers analysed, the five selected occupations have mainly been using the following types of technologies over the last years.

Information and communication technologies (ICT) (*i.e.* internet, laptop, chat systems, mobile phone and applications, e-mail, social networks, etc.) are to be mentioned for every occupation. They facilitate the sharing of ideas and discussion with anyone, anytime and anywhere. They can play a role in managing geographically dispersed teams for R&D managers (Mazzuchelli et al., 2019); as well as for customer advisors, to expand customer service beyond the lines of local services and to reach any customer who has access to the internet (Bitner, Zeithaml, & Gremler, 2010).

The **Internet of things (IoT)** can be defined as *"a set of physical and virtual objects which are connected together via a network for communication and sensing or interaction with internal and external environment*" (Abdel-Basset, Manogaran & Mohamed, 2018, p. 615). The IoT allows for the real-time connectivity and interconnection needed by middle managers for quick decision-making and coordination (Sommarberg, Gustafsson, Cheung & Aalto, 2018). Assembly line workers also use **smart data technologies** providing real-time information on the entire supply chain and **smart logistics** such as sensors that can contribute to better plan maintenance or reducing inventories (Rosini, 2018). In R&D management, such technologies are increasingly used for virtual experimentation and simulation.

Artificial intelligence (AI) also seems to be rather transversally mobilised. It can help middle managers to collect information in order to make decisions, as AI tools can map-out data and identify patterns of behaviour from this data (Canals, 2020). In recruitment, AI is introduced notably through the use of screening software such as automated skills systems (Hoang et al., 2018), AI-analysis of video interviews and the use of chatbots. In the assembly line systems, the augmented-reality techniques through optical control systems and interactive/adaptative interaction mechanisms can guide and assist the workers in real-time during the manual assembly processes (Pilati et al., 2020).

Robotic desktop automation (RDA) and Robotic process automation (RPA) are transversal automation technologies used by customer advisors (e.g. e-mail analysers and virtual assistants) and by recruiters (e.g. automated sorting of CVs (Levy, 2018) and automated hiring systems). Those technologies can help in automating low added value and time-consuming tasks (as handling customer requests, for example). RDA refers to virtual assistants responding to actions triggered by employees and performing certain tasks to simplify a workflow. They are often associated with front office work. Workers' intervention in RPA is minimal and often limited to exception handling, while the technology executes the workflow, most of the time in back office work (IEEE, 2017).

Regarding **business analytics,** customer service workers increasingly work with cloud services and big data in terms of managing and sharing files (Jantti & Hyvarinen, 2018). The implementation of algorithms and the use of big data techniques in R&D is one other growing field of technology development, with the goal of improving tasks of strategic planning processes (Bauer & Schimpf, 2018). It is also said to facilitate middle managers' decision making or to help managing data from call centres and servers. HR analytics is also being increasingly pushed as a 'must-have' capability.

Two types of technologies related to the work of assembly line workers are left to be cited. The first is **automation, industrial robots and collaborative robots.** This type of technology can carry out non-ergonomic or physically demanding tasks in place of the workers, even if still rarely being used in current series production according to Fletcher et al. (2020). Semi-autonomous systems, robots or technologies traditionally only occurred on the shop floor, programmed to execute physical actions. Through the combination of bigger computing power and available data, such technologies are now increasingly able to take up many office functions and services (Canals, 2020). The second type of technology is the **automated guided vehicles (AGV),** whose applications are to be found in all industrial branches, as the handling of material flows in industrial environments is one of the most important aspects of logistic systems (Schulze, Behling & Burhs, 2008).

4.3.2 The evolution of the occupations related to digitalisation

Most of the aforesaid types of technologies are usually presented as helping the workers to be more productive in their tasks, with the goal of enhancing their efficiency and their well-being. In order to document these assertions, we have investigated concretely how those types of technologies are changing the following aspects of job quality: work, employment and social relations at work.

Changes in the work dimension

Skills and competences needed with technological tools are described for the five considered occupations. Some of those skills and competences, such as data literacy, seem transversally required. For the assembly-line workers, Salento (2018) stipulates that job specialisation will become less important than multi-purpose skills and capacity for adaptation within the assembly systems. Workers face greater demands in terms of managing complexity, problem solving and abstraction (Kaasinen et al., 2013). Middle-managers are required to further develop their analytical and communication skills to complement what the ICT-tools can achieve (Lavtar, 2013). New forms of knowledge can also be required such as the acquisition of a new, common lexicon for better understanding of the new technological tools and their associated work practices (Palazzesi, Frigerio, & Rajola, 2014). Customer advisors can develop abilities such as the presentation of visual and informative content on various technological devices (Jantti & Hyvarinen, 2018; Perez & Martín, 2018). Eckhardt et al. (2014) noted, for recruiters, an evolution in terms of digital skills from standard IT skills (such as word processing or e-mails) to more elaborated IT capabilities (such as searching pool databases or using Google Analytics). Recruiters also have to possess more and more business skills such as online marketing skills (Eckhardt et al., 2014). Finally, Fareri et al (2020) found out that mastering an increasing number of technologies is expected from the R&D managers.

In the five analysed occupations, the process of digitalisation generates **more complex tasks to be** handled by workers while 'simple tasks' or 'physical' ones seem to be increasingly assigned to technological tools. The intellectual tasks of the assembly line workers become increasingly important (Eurofound, 2017; Scholten, 2017; Rosini, 2018). By freeing up workers' time to carry out more complex tasks, the virtual assistant of the customer advisors was found to alleviate their workload and help them in improving their services (Warhurst & Hunt, 2019b). Planning workflows therefore became easier (Jantti & Hyvarinen, 2018). The implementation of new technologies is transforming the job scope and job description of mid-level managers and supervisors (Chang & Bright, 2012). Job scopes are no longer oriented on routine-decision-making but tend much more towards the development of new and innovative processes (Demirel & Türetken, 2020). Lavtar (2013) agrees in his literature review by stating that "*middle managers have switched from executive positions to strategic decision planners and information and knowledge sharing facilitators inside an organisation"* (p.881). Digitalisation also leads to the **diversification** of tasks to be handled by workers. For example, in the recruitment field, the range goes from the interpretation of indicators, the determination and justification of recruiting budgets, new marketing tasks (Eckhardt et al., 2014) to combining different interview approaches in order to increase the validity of the process (Miles & Sadler-Smith, 2014).

In some cases, this complexity and increasing number of tasks to be handled can lead **to a new task division between workers**. Companies can promote a division of the recruitment process between specialists working together rather than have the recruitment be handled by one person from one end to another (Eckhardt et al., 2014). In R&D teams, the *'technological gatekeeper'* (i.e. the member of an R&D team responsible for acquiring, translating and disseminating external information throughout

the R&D unit) assignments are redistributed between different members due to the amount and diversity of information now available with digitalisation (Whelan et al., 2010 & 2013). The complex job tasks that are usually carried out by higher qualified middle managers have been "fine-sliced" into smaller and often simpler work tasks leading to a deskilling of these professions (Dörrenbächer, Geppert, Pastuh & Tomenendal, 2018). Perez & Martín (2018) also observed that customer service workers often experience feelings of down-skilling due to technology-use at work. **Coordination mechanisms** can also be modified through technology. Regarding performance evaluation, algorithms developed can automatically analyse a series of indicators that are then used as supports for the evaluation interview led by R&D managers. Standardisation of processes therefore becomes increasingly important (Loyarte-López et al., 2020). **Decision support system** tools help to reduce uncertainties, complexities and bias while generating profit, according to Wei et al. (2016). However, algorithms themselves can be flawed. In one much publicised example, Amazon had to scrap the development of an AI recruiting tool that showed bias against women. Because the training dataset was mostly composed of male CVs, the AI assumed that being a man was an asset in being recruited and systematically decreased women's CV value (Dastin, 2018).

In some cases, technological tools have nevertheless increased **workers' workload** and **work pace.** Considering customer advisors, the efficient handling of 'simple tasks' with technological tools has caused the average number of clients per worker to increase along with the associated workload (Abdullateef et al., 2014; Perez & Martín, 2018). In addition, many customer advisors are required to have "*multi-channel capabilities*" (e.g. phone, mail and social network support) (Jantti & Hyvarinen, 2019), which can generate feelings of exhaustion (Bordi, Okkonen, Mäkiniemi, & Heikkilä-Tammi, 2018). New technologies have also increased the speed of information delivery, leading thus to a higher work pace for middle-managers (Chang & Bright, 2012). In the recruitment sphere, McColl and Michelotti (2019) found that audio and video disruption influenced digitised interview pace and flow (through the limitation of posing specific questions and the necessity to repeat/rephrase the questions). Eckhardt et al. (2014) stipulate that by using the same database for all system-based tasks of the process, the latter was more streamlined, tasks were handled faster, and the length of the recruitment process was shortened. The work pace of R&D managers is impacted too, by the shortening of product development and the quicker availabity of prototypes due to the more frequent recourse to outside prototype developers with faster prototyping capabilities (Marion & Friar, 2012). Within complex assembly systems, when tasks demands are becoming more complex (i.e. highly variating), mental workload is said to increase (Bläsing et al., 2020). Recent studies are starting to assert the need to integrate such cognitive workload into the design of the automated manufacturing workplaces (D'Addona et al., 2018).

The co-occurrence of the tasks could induce workers' exhaustion, especially when combined with an **increased control by management**. Close monitoring of work performance using technology generally provoked feelings of distrust and loss of control among the workers (Perez & Martín, 2018). Technological workplace surveillance increased formal control and thereby reduced the employees' feelings of autonomy (Abdullateef et al., 2014).

Regarding **material and physical conditions** of work, some technologies can help to reduce risky tasks and/or physically demanding ones and thus improve ergonomics at the workplace. For example, sensors are available in day-to-day technologies. Smartphones, smartwatches and activity trackers give the workers direct feedback (whether visual or by gesture control) on the way they are handling tasks (Kaczmarek *et al.,* 2015; Faccio *et al.,* 2019; Römer & Bruder, 2015; Vernim & Reinhart, 2016). It seems that if the operators remain necessary for industrial production, their task profile will change:

"*The operator is no longer important because of his muscular strength, but rather because of his abilities, experience and senses*" (Rauch et al, 2020, p. 13).

Changes in the employment dimension

The influence of technologies on **training opportunities and policies** has been investigated in few cases. Oestreich et al (2019) found out that, in the assembly process, the support of the learning process of workers through self-learning digital assistance systems leads to similar performance curves (compared with the 'classical' learning process through personal explanation).

When considering **working time arrangements,** the boundaries between professional and private life become more and more blurred, in both ways. The constant connectivity that comes along with ICT tools enables flexibility in choosing working hours. At the same time, it enables working during times of non-paid work time, regardless of location and working hours, which ultimately leads to work intensification and work-life imbalances observed for middle managers (Farrell & Morris, 2013; McWhite Seymour, 2016). Similarly, the broadening responsibilities imposed on customer service workers, as well as requirements to keep up with technologies, often make them work not only during work times, but also in their free time (Jantti & Hyvarinen, 2018). Dragano and Lunau (2020) refer to '*techno-overload'*, as the fact that work with digital technologies becomes demanding due to high pace, multitasking and expectations with regard to response times. The use of new robotic systems also lead the assembly line workers to experience changes in their working routines (related to their individual rhythm, speed and working steps) (Weiss & Huber, 2016).

The increased use of **temporary workforce** is aimed at enhancing the company's ability to answer quickly to fluctuations in markets demands, such as the introduction of digitalisation and more flexible assembly processes (Rosini, 2018). The use of temporary workers can contribute to enhance the employment stability for the core workers, that is the permanently employed ones. The latter can also be involved in teaching, mentoring and coaching junior and temporary workers (Rosini, 2018). As far as the **outsourcing** issue is concerned, there is a growing use of contractors or independent professionals in managerial positions (instead of employing middle managers) (McKeown, 2015). Outsourcing the entire R&D department has turned into a growing field of interest in the R&D literature (e. g. Giacomarra et al., 2019; Marion & Friar, 2012; Schimpf, 2016; Teirlinck & Spithoven, 2013) but has yet to be explored for the specific case of R&D managers. It seems that this outsourcing decision does not depend entirely on the digitalisation process, the latter acting as a 'facilitator' of the outsourcing decision directly dependent on considerations linked, for example, to human capital, availability of skills and firm size (Giacomarra et al., 2019; Teirlinck & Spithoven, 2013).

Within companies, certainties from before, such as job security, a safe career path and seniority-based pay erode and opportunities for job development are endangered (Farrell & Morris, 2013). This feeling of **job insecurity** can be nourished by the introduction of cloud-based talent management software that causes middle-managers to be more exposed to company-wide labour markets and fierce competitions of posts and jobs within the company itself (Dörrenbächer et al., 2018). A similar comment applies to customer advisors, for whom digitalisation leads to feelings of **uncertainty** and **worries** about job stability, even if some findings indicate that they are still far from being completely replaced by technology (Jantti & Hyvarinen, 2018).

Changes in the social relations dimension

Regarding the automotive sector, teamwork is strengthened due to new line work organisation with fewer workstations (Rosini, 2018). This organisation proved more flexible and efficient in dealing with complex assembly processes than automating assembly technologies (Pardi, 2019). Information technologies can help meeting the challenge of management and coordination of geographically dispersed teams, especially in terms of trusted communication flows. Mazzuchelli et al. (2019) highlighted the critical role of structural social capital and IT support in enhancing knowledge sharing and innovation by overcoming communication barriers, creating social ties and transforming data into knowledge. However, the management of geographically dispersed teams colludes with the distribution of R&D across actors through the availability of the web-enabled freelance economy (as mentioned in the "employment" section), with platforms such as Upwork.

4.4. Contextual factors

Technology implementation is mediated by – but also inseparable from – organisational structures and dynamics. Alongside the potential of technologies in itself, organisational forces are a strong determinant of the implementation of technologies and of their resulting effects, a concept referred to as "bounded automation" by Fleming (2019).

The **organisational structure and strategies** are considered for the five occupations, since they are seen as crucial points in fostering integration as well as promoting and supporting knowledge sharing between different R&D teams (Teirlinck, 2017). The degree to which organisational structure can support the use of the technology has an influence on the use of social media in recruitment (El Ouirdi et al., 2016). Some organisational strategies (e.g. delayering and flattening organisational hierarchies) are said to potentially lead to the disappearance of the middle-management occupation (Chen et al., 2017). As far as the customer advisors are concerned, a 'polarising' organisational strategy (i.e. hire different workers who are exclusively responsible for online standard customer requests, apart from workers who are responsible for face-to-face customers service) will have largely different digitalisation-related consequences compared to an organisational strategy that chooses to train and educate existing customer service workers (Perez & Martín, 2018). Considering the assembly line workers, *new forms of organisations* (i.e. organisational structure, decentralisation and flexibility of work practices) and "*collaborative climate*" are "*said to facilitate product-process technology integration, thus allow for accurate and timely dissemination of information among functional departments*" (Gillani *et al.,* 2020, p.3). Conversely, as noted earlier, technological implementation can contribute to the reshaping of organisational structures.

For both the recruiters and the R&D managers, the **sector and size of the enterprise** seem to play a role in investing resources in digital tools (Blackburn et al., 2017). **Technological problems** are also to be considered, as the workload and work content depend strongly on the functioning of the technological tools, according to Vuori et al. (2019).

Empirical investigations focussing on customers advisors and assembly line workers have shown that the **active participation of employees** in implementing technological infrastructure has positive consequences for business performance as well as for the employees themselves (e.g. reducing workload, role ambiguity and enhancing organisational learning) (Garrido-Moreno, Lockett, & García-Morales, 2014 ; Kaasinen et al. 2020). The importance of investments in **training related to the implemented digital technologies** has also been considered. Employees can feel that they are not

given the adequate resources and necessary time to learn about the new, often complex technologies (Jantti and Hyvarinen, 2018; Vuori, Helander & Okkonen, 2019). The lack of training is mentioned by interviewees as a factor affecting the recruitment outcome in the case of digitised interviews (McColl & Michelotti, 2019). Considering the middle-managers, receiving training about the technologies and making their processes transparent enhances interaction with the technologies and provides opportunities for them to further develop analytical skills (Jarrahi, 2018). The availability of tools on which customer advisors can rely to improve their skills (e.g. training activities, work organisation and management style) is crucial in determining the outcome of feeling well-equipped to face the changing work environment and its required skill levels (Jantti & Hyvarinen, 2018; Perez & Martín, 2018). These two sets of actions (i.e. promotion of an active participation and training) can thus be considered as capacitation tools for actors.

4.5. Digitalisation and employment sustainability of the five occupations

Findings from this literature review indicate, first, that the concept of sustainable employment is scarcely investigated in relation to the five selected occupations. Second, when studied, the notion of sustainability often comes after other considerations such as economics or efficiency-related ones. These can either emerge as the prominent ones during fieldwork or can be embedded in the authors' theoretical foundations. We found evidence of the importance of economics for **assembly line workers**, for which Brozzi et al. (2020) highlighted that the "*consideration of economic opportunities prevails over environmental and social ones*" (p.2). The improved working environment for workers has been rated overall "*of secondary importance*" (p. 12). Similarly, McColl and Michelotti (2019) stated that **recruiters** perceived the implementation of digitised interviews as supported by economic efficiency rather than recruitment effectiveness. The notion of sustainability in **customer advisors**' related papers is often secondary to larger objectives about the effectiveness of digital implementation, such as how customer service workers' attitudes and motivation towards technological innovations permits good implementation of technological tools (Garrido-Moreno et al., 2014). The same can be said about studies focusing on middle managers' role in implementing technological change within companies (Paavola, Hallikainen, & Elbanna, 2017). For **R&D managers**, preoccupations about sustainability often relate to the organisational structure surrounding the R&D team in a broader way. Loyarte-López et al. (2020) also briefly state that the rating system they developed enhances the employability of R&D workers. Besides the fact that employability is only a subdimension of sustainable work, we express serious doubts regarding the neutrality of that assertion, underpinned by control and standardisation objectives.

Therefore, this literature review shows that relatively few studies approach the topic of employment sustainability in the way it was defined by Eurofound (2015) and will be studied in this project. Some of its critical elements (especially regarding skills, work-life balance or autonomy) are approached, but studying the employment sustainability in itself is rarely mentioned as an objective in the explored literature. This calls for comprehensive empirical studies regarding the impact of digital technologies on the work experiences and the sustainability of work of the five occupations.

4.6. Conclusion

This part of the working paper has highlighted the results of the literature review related to empirical studies of technology-related change in five specific occupations. Different **types of technologies** have been investigated and gathered into categories (ICT, IoT, AI, RDA/RPA, business analytics, AGV and cobots). The upcoming empirical work will help us determine whether or not this categorisation might be considered as exhaustive. The potential of these technologies often relates more to the improvement of productivity and efficiency rather than their contribution to job quality or employment sustainability. The changes brought by these technologies were described. In terms of **work**, the topic of skill requirements is a very well investigated issue. It seems that workers must handle more diverse and complex tasks due to digitalisation. This increased complexity sometimes leads to new task divisions and coordination mechanisms, while the surveillance allowed by technological tools also seems to reduce the employees' feelings of autonomy and trust. In some cases, technological tools have proved to increase the workers' workload and work pace, even if others can help them to avoid risky tasks and/or physically demanding ones, thus improving ergonomics at the workplace. In terms of **employment**, it seems that self-learning digital assistant systems achieve similar performances as those obtained through 'classical' learning processes. In addition, the expected constant connectivity of the workers can lead to a blurring of the boundaries (and thus a potential imbalance) between their professional and private life. Furthermore, the very necessity for certain companies to quickly answer to fluctuations in markets demands by increasing the external flexibility, as well as the broadening of the company-wide labour market (through cloud-based talent management software), can nurture workers' worries and feeling of insecurity. The aspect of **social relations at work** seems not yet very well investigated and mainly relates to the improvement of teamwork and coordination of geographically distant teams.

Organisational structures and strategies are well depicted as influencing contextual factors, and so are the workers' intervention and the importance of their training. The question of sustainable work is scarcely investigated and seems only considered through the prism of economy or efficiency. Several gaps exist in the literature that need to be filled by further empirical work, for example the role of trade unions, questions of total workforce management (i.e. a model of management that includes not only permanent workers but also contigent workers) and the impact of digitalisation on renumeration.

5. Work and employment conditions in the platform economy

5.1. Introduction

Beyond transforming work and employment in existing industries, digitalisation has also contributed to the emergence of several types of new business models that cut transaction costs by installing digital intermediaries between clients, producers, service providers, etc., a phenomenon which has notably been described as the **platform economy**. Platform-mediated work is « *[…] increasing and is now the main source of income for as many as 2% of adults across 14 EU member states […]* » (European Commission, 2019). While definitions of the platform economy greatly diverge, the platform economy may be broadly defined as organisational configurations that extend through *ecosystems* of multiple subcontracting relationships and (inter)dependences "*where labour becomes organised and mediated through internet-based platforms*" (Ellmer et al., 2019).

The following part of this working paper presents the results of an extensive review of both empirical and theoretic social science literature on the platform economy and is structured following the key themes that emerge from the literature with regards to work and employment conditions. Given its complexities and ambiguities, **mapping the boundaries, characteristics and categories of the platform economy** is a crucial first step to understanding its impact on labour markets, work relations and employment conditions. Having established the historic and societal context of the platform economy, as well as its defining criteria and internal differentiation, we provide insights from the literature on **workers' demographic profiles** and then discuss specific **work and employment conditions in the platform economy**. Based on the latter, we raise relevant questions regarding **perspectives for collective action**.

5.2. Mapping the platform economy: boundaries, characteristics and categories

5.2.1 The platform in the economy

The thesis that human labour in general will eventually be substituted by automation, algorithmic matching, artificial intelligence etc. (Brynjolfsson & McAfee, 2014; Institute of Labor Economics et al., 2019) has to be put into perspective with more nuanced observations. Fleming (2019) advances the concept of "bounded automation" to describe how effects of digitalisation are dependent on organisational forces rather than being determined by technology alone. While some authors refer to a polarisation of employment due to digitalisation, characterised by a decrease in intermediate level jobs (Albessart et al., 2017) and expansions of employment at the extremes of the skill spectrum (Autor et al., 2003; Berger & Frey, 2016), other theories predict a convergence towards a *hyper-industrialised* society characterised by a globalised division of labour and a geographic polarisation of (digital, connected) activity (Veltz, 2017). Mobilising large volumes of partly low-skilled, often fragmented, precarious and repetitive human labour (Casilli, 2019) indeed allows work to be

distributed across a globally dispersed labour market and humans to be replaced by other, less favourably positioned, humans (Ellmer et al., 2019; Vallas & Schor, 2020). Overall, rather than a reduction in human labour, several authors point to the large volumes of paid or unpaid tasks behind ostensibly automated processes, that generate value in the context of digital labour (Casilli, 2019). Human labour thus appears to be shifted, rather than replaced, by digitalisation.

Furthermore, while the platform economy is frequently presented as being radically disruptive in terms of work organisation and the labour market, this *radically disruptive* nature also needs to be put into question (Méda, 2019; Valenduc & Vendramin, 2016). Indeed, the transformations underway in the context of the platform economy are part of continuing trends that predate digitalised platforms and affect the economy in a broader sense. They merge several pre-existing trends in terms of work organisation (Huws, 2017), some of which are the historical tendencies towards externalisation (Stanworth & Stanworth, 1995; Weil, 2014) and fragmentation of work and employment (Casilli, 2019).

The platform economy as a whole is likely to leave a durable imprint on society (Piret, 2019). They contribute to the institutionalisation of more precarious/fragmented forms of employment and the accumulation of data, setting new challenges for social security and generating new modalities or opportunities of work. An in-depth analysis of the platform economy should therefore provide insights into the transformations taking place in the wider working worlds, exemplifying what is sometimes described as "uberisation", an economic model characterised prominently, but not exclusively, by digital intermediation (Abdelnour, 2017, p. 154).

In fact, the functioning of the platform economy is highly (inter)dependent on the institutionalisation of its employment principles by public policies (Abdelnour, 2014; Baumann et al., 2016). In France, on-demand services like Uber and Deliveroo have been massively supported by the auto-entrepreneur status, originated in the 2008 law on “modernisation of the economy” (Abdelnour, 2017, p. 187), despite the *contentieux* confronting UberPop (Nasom-Tissandier & Sweeney, 2019). In Belgium, the De Croo law has been a key factor (Vandaele, 2017; Willems, 2019), as well as the role of the part-time self-employment regime. The importance of the “student-work” status and the legislation concerning false self-employment also need to be taken into account in this context. Further focus needs to be placed on the tension between introducing a new specific employment status, and applying existing legislation to accommodate online platform work (the latter being favoured by the Belgian High Council for Employment) (Garben, 2017).

5.2.2 Characterising the platform economy: what sets it apart?

While it is generally recognised that investigation into the phenomenon is necessary (Vallas & Schor, 2020), defining the platform economy remains difficult (Kenney & Zysman, 2019). This is notably related to the variety of terminology associated with platform work ("digital labour", "collaborative economy", "Sharing Economy" or "collaborative consumption" (Barnes & Mattsson, 2016; Binninger et al., 2015) on the one hand, and the wide variety of platform types, platform workers and platform work on the other hand (Kenney & Zysman, 2019; Sutherland & Jarrahi, 2018).

The terminology related to the platform economy is not only diverse and ambiguous, but also tends to be of a normative nature (Forde et al., 2017; Gerwe & Silva, 2017; Stuart et al., 2017; Warhurst & Hunt, 2019a). The definition of processes and structures such as “peer-to-peer” is highly controversial in itself, and classifying platform-based corporations under the “sharing economy” has been largely contested in different parts of the literature (Brühn & Götz, 2014; Oskam & Boswijk, 2016; Schwalbe,

2014). Among other things, this may lead to confusion between collaborative initiatives aimed at mutualising resources on the one hand and commercial enterprises that centralise trade, rentals or on-demand services on the other hand. While platforms share certain characteristics with collaborative or solidarity focused economic activities – offering different forms of employment to people looking for professional alternatives etc. – the approximation of the two is highly problematic. Key differences are, for example, in the externalisation of assets, the types of social relations and the intrinsic meanings attributed to the work by workers (Rodet, 2019). It is therefore crucial to identify platforms by a series of characteristics that set the platform economy apart.

Overall, a few key characteristics of platforms emerge from the varying definitions in the literature:

- Platforms rely on **digital infrastructures** that allow two or more groups to interact (Srnicek, 2017) and to a large extent, but not exclusively, use "digital means of production" (Kovaleinen et al., 2019).
- Platforms make use of **algorithmic matching** to coordinate economic transactions (Casilli, 2019).
- Platforms act as **intermediaries** between heterogenous actors. Platform firms tend to define themselves as intermediaries rather than employers (Casilli, 2019; Kovaleinen et al., 2019), thus moving away from the traditional employment relationship (Srnicek 2017).
- Platforms **extract value** from these transactions (Casilli, 2019). This distinguishes platform firms from not-for-profit initiatives, cooperatives, collaborative and sharing projects.
- The organisation of labour via platforms is involved in larger trends of the **externalisation** of labour and means of production (Casilli, 2019). Extending the just-in-time inventory system to the provision of labour service, platforms individualise the workforce they use or employ (Kovaleinen et al., 2019), specifically with regard to employment relations. In 'lean platforms' (Srnicek, 2017), based on the externalisation of labour and assets, capital investment is decentralised towards platform users (Szoc, 2015).
- Platforms exercise some level of **control** over the organisation and execution of the productive process. The rules governing the development of products and services as well as market mechanisms are [most commonly] determined by the owners of the platforms (Srnicek, 2017). Sutherland and Jahari (2018) point to examples of platforms with 'decentralised' forms of control. The dimension of *ownership* of the platforms and its intervention in transactions, matching and pricing need to be taken into consideration in order to account for existing power structures.

These elements form a series of diverse **organisational configurations** that extend through *ecosystems* of multiple subcontracting relationships and (inter)dependences. In creating market-like conditions for value circulation and transactions (Casilli, 2019, p. 64), they challenge the distinction between markets and corporations. They also blur the line between workers and consumers, due to the amount of free/unpaid work (Simonet, 2018) and their positioning as "neutral" intermediaries. This in turn challenges existing structures of worker representation and collective bargaining.

5.2.3 Divisions, categories and stratifications within the platform economy

The reach of the platform economy is not strictly limited to digital activities, nor is it confined to novel occupations or places of intermediation. Given the diversity of types of platform activities and the fact that work and employment conditions vary vastly across different platforms, one of the objectives of the 4th work package of the SEAD project is to establish a typology distinguishing different categories of platforms.

In sum, previous categorisations of the platform economy refer mostly to characteristics that pertain to the type of **activity**, market segment or portion of the economy, to the **profiles** of the actors involved or to the **organisational, economic model** of the platform itself.

Type of activity

A distinction can be made according to traded products, either ***goods, assets* or *services*** (Warhurst & Hunt, 2019b) that may be more or less capital or labour intensive (Stuart et al., 2017). In reality, goods, assets and service are very often combined/undistinguishable.

Platform activities can be locally bound or geographically dispersed. While several authors distinguish between online and offline work (Ellmer et al., 2019; Forde et al., 2017; Vallas & Schor, 2020), others differentiate **Web-based** versus **location-based** (digital) labour (Schmidt, 2017) or "online" and "on-location" work (Kilhoffer et al., 2020). This is closely related to whether work is **person-bound** (as with freelancers in an open marketplace who obtain responsibility for a job they are specifically qualified for from start to finish) or **bound to an undefined group of people** (as with contest-based crowd work where workers may be numerous and interchangeable for a single task) (Schmidt, 2017)**.** Casilli (2019) distinguishes **visible** and **invisible** activities, with the former being most visible through their inscription into physical space. Public response and awareness towards platform work may be conditioned by its visbility, with especially (lower-skilled) on-location platforms receiving more attention due to their presence in public space (Kilhoffer et al., 2020). It is understood in this distinction that many platforms require a combination of either aspect in order to function.

Activities vary according to the **skill level** required for the execution of the task, i.e. low- and medium-skilled services (e.g. babysitting, cleaning, delivery…), and highly skilled services (e.g. web design, photography…) (Forde et al., 2017; Kilhoffer et al., 2020)**.** This may include (formal) professional qualifications as well as the required specialisation on the specific platform tools. Warhurst and Hunt (2019b) differentiate **routine or non-routine work**.

Regarding the nature of the activity itself, Casilli (2019, p. 164) identifies three distinct categories of *digital labour* 1) **On-demand services** (such as Uber, Deliveroo), 2) **Microtasking** ("crowdwork" such as Amazon Mechanical Turk) and 3) '**Networked Labour'**, as performed by 'produsers' (users contributing to the production of networked content often without compensation). The latter is pre-eminently associated with unpaid labour, (Dujarier, 2014, 2016; Menger, 2017), while the former two are assimilated with atypical employment and micro-work respectively. Moving forward, we will be referring primarily to the former two.

Profiles of the actors involved

In the literature, distinctions are made between platforms that directly target **consumers** and those focussed on **business-clients** hiring contract labour from around the world (as in the case of Upwork) (Kuhn & Maleki, 2017). Distinctions between client to client and business to client (Täuscher & Laudien, 2018), for example, do not always hold up in practice**.** While many authors distinguish between platform workers (on demand, freelance or crowdwork/microtask) and produsers (Casilli, 2019) or prosumption[2] (Beer & Burrows, 2013; Lupton, 2014), and volunteers/activists, the latter two may be regarded as less relevant with regard to questions of sustainable employment. The predominant employment status and relationship to the platform that distinguish platform workers will be discussed in paragraph 4.2.

Organisation and economic model

Platforms have varying decision authority and level of control over work organisation, content, user interaction and transaction. Sutherland and Jarrahi (2018) compare centralised vs. decentralised platforms, according to levels of regulation or flexibility, level of automation in matchmaking, scale, management of transactions and interpersonal trust. Platforms vary with regard to the level of platform intervention in the underlying contract of the interaction (Forde et al., 2017), modalities of pricing (Forde et al., 2017), such as surge pricing vs. static pricing (Lin & Zhou, 2019), marketplace-like structures and downward bidding (Gerber & Krzywdzinski, 2019; Kovaleinen et al., 2019). They also employ different modes of value extraction: subscription-based marketplaces vs commission on transactions made on the platform.

In order to separate the platform economy from collaborative, cooperative and sharing practices, we also consider the criteria of profit (and monetisation (Brolis et al., 2018)) as a primary or as a secondary objective for 1) the platforms and 2) the users/workers. Nanteuil-Miribel & Zune (2016) distinguish **on-demand production** aimed at bringing together providers and consumers of services, where offers are exchanged in response to standardised demands and **collaborative consumption**, where platforms are intermediaries for access to goods or assets, in the form of barter, sharing, rental or utilisation, from **cooperative production** (following the example of the open source, oriented towards the production of commons). In the context of the overall SEAD project, it is also necessary to set apart platform digitalisation within the **traditional economy** (new ways of internal organisation or outside subcontracting) and autonomous platform firms outside of the traditional economy, where digitally borne companies usurp existing markets or create entirely new ones (Vallas & Schor, 2020).

The aforementioned criteria are neither exhaustive nor do all of them apply to all platforms simultaneously, but crossing them will allow us to establish a case typology and determine a final selection of relevant cases. Depending on these characteristics, platform companies imply a different socio-demographic profile of workers (2) and varying working and employment conditions (3).

[2] A contraction between *production* and *consumption,* most often expressing the 'dual nature of interaction with digital technologies' (Lupton 2015), where users are actively encourages to contribute and share content in the form of blog posts, tweets, status updates, likes, etc..

5.3. Platform workers' socio-demographic profile

The empirical evidence with regard to the socio-demographic profile of platform workers is still scarce (Piasna & Drahokoupil, 2019). Furthermore, most estimations refer to case studies (Huws et al., 2016) of specific platforms, such as Amazon Mechanical Turk (Huff & Tingley, 2015), Deliveroo or Upwork (Popiel, 2017). Overall, platform workers are often described in these studies as being young, male and highly educated (De Groen et al., 2018), but looking further into detail offers a more nuanced picture.

While men are generally found to be more likely to conduct platform work, general statistics often conceal variations regarding the type of platform work conducted by men and women (Huws et al., 2016; Piasna & Drahokoupil, 2019). Some studies find no **gender differences** in participation in platform work (Huws et al., 2016). Women are less likely to perform creative tasks, microtasks (Berg, Rani, et al., 2018), transportation work or software development on platforms (Huws et al., 2019), but are more likely to engage in translation work (Urzì Brancati et al., 2019).

The COLLEEM-survey points to a negative correlation between **age** and the probability of being a platform worker (Urzì Brancati et al., 2019). Huws et al. (2016) find that older age groups are also actively participating, albeit only recently, which encourages investigation into the possibility of a U-shaped age curve. While some authors find that a high level of **education** is positively correlated to most types of tasks on platforms (Hoang et al., 2020), micro-tasking, transportation and on-location work is generally not as highly educated (Urzì Brancati et al., 2019). Moreover, a large part of the population that is engaged in platform work is still in education (Piasna & Drahokoupil, 2019).

Studies argue that platform labour relies heavily on **migrant** labour (Tassinari & Maccarrone, 2020; van Doorn et al., 2020). In the case of on-location platform work, this is explained by the lack of entry barriers (de Groen et al., 2018). For online platform work, workers who might face discrimination in the traditional labour market may be 'protected' on platforms due to more anonymity and less potential for discrimination and harassment (De Stefano, 2016). The latter has been contradicted by observations of structural inequality and discrimination on platforms (see 4.2.).

Geographical profile is very much dependent on whether the work itself is location-bound or can be conducted entirely online. Discussions are related to the idea of remote and globally dispersed labour (Kuhn & Maleki, 2017), with a variety of consequences with regard to workers' bargaining power, legal status, and the regulations that apply to their situation as well as workers' feelings of isolation and "placelessness" (Ellmer et al., 2019; Johnston, 2020; Vallas & Schor, 2020). Furthermore, the global division of labour and competition is also related to wage asymmetries (Popiel, 2017). The geographical profile also gives indications as to the capacity of platform work as a factor of labour market integration: online platform work may allow workers to gain access to the labour market whereas otherwise it would be difficult (de Groen et al., 2018). Location-based platform work, however, is often tied to urban areas (Maginn et al., 2018).

5.4. Work and employment conditions

Regarding work and employment conditions, the literature has highlighted questions such as workloads, atypical working hours, (constraint) flexibility, precariousness, work intensification and subjective insecurity (Barraud de Lagarie & Sigalo Santos, 2019; Méda, 2019).

While previous studies highlight the liberating potential of digital work (cf. Berg, Furrer, et al., 2018), the aspiration to autonomy promoted by platform corporations is often contrasted by the

heteronomous character of the flexibility imposed by platforms (Casilli, 2019). As one key dimension, **autonomy** can apply to work status, work content and working conditions can be highly ambivalent, especially for some categories of self-employed workers (Florin & Pichault, 2020). Distinctions must be made between autonomy within (stable) employment and independent employment statuses. Depending on the type of control workers have, working conditions are expected to vary (Howcroft & Bergvall-Kåreborn, 2019; Warhurst & Hunt, 2019b). Although flexibility (i.e. in choosing working hours) may be a motivation to choose for platform work (Ellmer et al., 2019; Schor et al., 2020), the digital tool appears as a control mechanism (*dispositif de contrôle*) occupying a management function (Brugière, 2019), while the triangular relationships in crowdworking combine platform surveillance with evaluation by clients (Pichault & McKeown, 2019). The (partial) automation of prescription moreover contributes to a remoteness from hierarchy and an invisibility of subordination (Lemozy, 2019).

Legal discussions regarding their employment status are often based on the amount of control workers have over their work assignments and compensation, as well as on the amount of control platforms have over client interactions and working conditions (Forde et al., 2017). Workers may either actively search among advertised projects and submit a bid with their own price-setting, choose from piece-rate jobs posted by clients or be assigned to jobs via an algorithm with payment determined by the platform (Kuhn & Maleki, 2017).

Working times may vary with type of platform activity. Whereas Piasna et Drahokoupil (2019) find that the working hours of location-based platform workers are also unsocial and irregular, their working hours are often described as short, contrary to the long hours that are described as characteristic of online platform work. Platform work often implies unpaid 'unproductive time' spent waiting for job-allocation (De Stefano, 2016), or actively searching for jobs that often fail to materialise (Howcroft et al., 2019). Berg (2016) for example, has found that workers on Amazon Mechanical Turk and Crowdflower spend almost 20 minutes doing unpaid work or waiting for work, for every hour that they are in fact working and being paid. Other studies state that food-delivery platform workers have waiting times from a just few minutes to maximum 20 minutes between tasks (de Groen et al., 2018).

The time spent looking for work is also related to the efforts and strain associated with carrying out work, or '**work intensity'** (de Groen et al., 2018). According to de Groen et al. (2018), for food-delivery platform workers, the pace of work varies and becomes stressful reaching the 2.2-2.8 food deliveries per hour that the platforms often expect, especially in case of complications. For workers who engage in on-location, worker-initiated work, it turns out that work intensity is bearable, seeing as they choose themselves how many tasks they want to perform. However, Wood et al. (2018) find that online platform work can be highly intense. For instance, online platform workers who tend to complete small, fragmented tasks find that they have to work at high speed and to tight deadlines. Whereas challenges related to the physical environment have been stated to be particularly problematic in the case of (low-skilled) on-location platform work, social relations have been identified as a key issue in online work (Kilhoffer et al., 2020, p. 91).

Moreover, a great deal of emphasis is put on work **fragmentation and standardisation** with regard to platform work (Bellini & Lucciarini, 2019). Studies argue that the work activities many platform workers complete are increasingly precarious, fragmented and alienating. The existence of online platforms has led to an extreme form of subdivision of tasks in the case of micro-labour (Howcroft et al., 2019). At Amazon Mechanical Turk, tasks are so fragmented that workers rarely understand what relation these small tasks have to the final commodity to which it contributes (Huws, 2014). The breaking down of jobs into small tasks can, according to Bogliacino et.al. (2020), induce processes of deskilling (and

skill mismatch (Berg, Rani, et al., 2018)) and have negative consequences for individual and aggregate productivity. Even with less fragmented tasks the heteronomous organisation of work by the platform may imply forms of (self-) automation of digital workers (Plant, 1997, 1998), as well as split attention and consciousness which represent significant risks in the work environment (Woodcock & Waters, 2017).

Employment status tends to vary among platforms and workers, according to platform types and depending on the time allocated to platform activity (De Groen et al., 2018). However, certain trends can be identified. Taking into account that platform work can be both a main profession as well as an additional activity, Urzì Brancati et al. (2019) define five possible employment statuses in platform work e.g. self-employed; employee; employee and self-employed in a secondary platform activity; "unemployed" (e.g. unemployed, student, homeworker); unemployed and self-employed in a secondary platform activity. While many platforms qualify platform workers as independent contractors – a sub-category of self-employment – regardless of the level of control exercised on the worker by the platform (Urzì Brancati, Pesole, & Fernández-Macías, 2019), many accounts refer to the ambiguity of the employment status for the workers involved (Kenney & Zysman, 2019; Warhurst & Hunt, 2019b).

However, detailed information on their employment status is important in that it can provide or limit access to protection systems and social security options (e.g. overtime pay, social security contributions, health insurance, unemployment benefits) (Ellmer et al., 2019). It is therefore also one of the most important challenges considering platform work from a policy perspective (Urzì Brancati et al., 2019). While many workers are aware of the tax-related technicalities of their employment status, they are less aware of the employment or **social protection** arrangements related to their employment statuses, much of which is explained by platform work being a secondary source of work (de Groen et al., 2018).

In order to fully understand the impact of the platform economy on employment, more research is necessary into identifying the role platform work plays in workers' overall **activity and income** and in their **careers/life courses**. The high occurrence of platform work as an activity next to other activities and as a small supplement to their main income (Huws et al., 2016), also puts findings in perspective with regard to the income levels of platform workers. While the **income levels** of platform workers are generally highly variable (Popiel, 2017), low income levels are frequent (Ellmer et al., 2019). In terms of work frequency, their work is often scarce, or seasonal (Popiel, 2017). This has to be seen in relation to the level of **dependence** on the platform (Kuhn & Maleki, 2017; Schor et al., 2020). On the one hand, platform work can provide an additional income source next to other, more stable employment (Ellmer et al., 2019); but on the other hand, workers can be entirely dependent on platform income, e.g. for lack of (perceived) alternatives (Ellmer et al., 2019; Kuhn & Maleki, 2017).

Low entry barriers and space-time flexibility in platform work indeed offer income and **access** to workers who would otherwise be excluded from the labour market (De Groen et al., 2018; De Stefano, 2016). However, access and outcomes may be unequally distributed and dependent in part on a vertical hierarchy among platforms (Schor et al., 2020). Phenomena of polarisation have been observed as a key characteristic of platforms like Airbnb (Decroly et al., 2019) and Etsy (Jourdain & Naulin, 2019), with a small number of users concentrating the overwhelming majority of revenue generated through the respective platforms. Platform employment may merely reflect and accentuate existing fractures and inequalities within the overall labour market and its margins (Abdelnour, 2017, pp. 171, 257). There are multiple observations of structural **inequality and discrimination** (on factors of race, gender and age) (Cheng & Foley, 2018; Kakar et al., 2018) in the platform economy. Casilli

(2019, p. 105) claims that these discriminations are not simply a reproduction of discrimination practices in the overall labour market, or mere by-products of the interactions on the platform, but rather inherently inscribed into their core business of data generation and surveillance not only regarding products and services but also regarding the users themselves (Degryse, 2016).

More attention needs to be paid to worker **trajectories** into and out of platform employment and to the way this type of work fits into their broader career perspectives. The example of the self-employed workforce (Abdelnour, 2017) highlights the heterogeneity of situations that might occur in the platform economy, ranging from complementing existing (insufficient) income, labour market integration, escaping non-employment, to escaping salaried employment. Worldwide, motivations for crowdwork have been cited as insufficient pay from primary/alternative employment or the need to work from home due to family or health constraints (Berg, Rani, et al., 2018). We will evaluate to what extent platform work is related to a disengagement from salaried employment (Abdelnour, 2017, p. 309) or a more or less abstract adherence to a "dominant ideology" or "new spirit of capitalism" of activity, flexibility and autonomy (Abdelnour, 2017, p. 298). Qualitative research is necessary to evaluate to what extent platform work is perceived as a stepping stone into (other forms of) employment or, inversely, converted into more consolidated career paths (cfr. Idowu & Elbanna, 2020).

5.5. Employment relations and perspectives for collective action

The platform economy poses several challenges for collective action and questions existing structures of industrial relations. We outline frictions and obstacles to collective bargaining and then go on to highlight new opportunities for solidarity and modes of collective action in the platform economy.

5.5.1 Frictions and obstacles to collective action

Fragmentation of work and employment

On a collective level, the fragmentation of work that characterises platform work hampers attempts at collective action and can affect workers' bargaining power (Bellini & Lucciarini, 2019; Bogliacino et al., 2019). The atomisation of workers, high turnover and concurrent short employment times, the inter-individual competition instigated by the platform structure, independent employment status and « total work engagement » are structural factors of platform work that make collective action more difficult and sometimes less likely (Abdelnour & Bernard, 2019). The segmentation of attachment to jobs (Broughton et al., 2018) creates a division in interests and positions within the given workforce. The real-time surveillance, mechanisms of control and sanctions orchestrated by more centralised platform applications limit drivers' margins of action and subversion (Brugière, 2019; Tassinari & Maccarrone, 2020) and encourage docility towards organisational constraints (Lemozy, 2019). The (spatial) dispersal of workers also reduces chances to build working collectives, to "forge a sense of shared identity" (Tassinari & Maccarrone, 2020) and maintain trust (Salehi et al., 2015).

At an individual level, the fragmentation of employment and the institutionalisation of income stacking make salary demands both less compelling and more difficult to achieve (Abdelnour, 2017, p. 310). Whether the platform activity in question is the primary source of income for any given worker is indeed identified as a key factor for participation in movements and mobilisation is more likely when

income is (existentially) threatened (Abdelnour & Bernard, 2018, 2019). The fact that this type of employment is often perceived as being temporary in essence further discourages durable engagement (Jan, 2018). The level of dependence on compliance with the platforms can also make resistance more risky for workers (Brugière, 2019). While anti-union socialisation is put forward as a factor discouraging collective action in service-on-demand platforms (Abdelnour & Bernard, 2019), certain studies suggest that platform workers do not have significantly different attitudes to trade unions from their peers, but that, rather, there has been a lack of proactive union outreach towards delivery riders, for example (Vandaele et al., 2019).

Eroding institutions of labour and worker representation

Moreover, the organisational configurations of the platform economy also undermine the established frameworks for collective bargaining and solidarity (Vandaele, 2017; Willems, 2019). As the boundaries between the company and the market become blurred (Casilli 2019), digital platforms contribute to the decline of the corporation as an alternative to pure market logics (Coase, 1987; Winter & Williamson, 1991). In this respect, digital platforms supersede networked organisations, which tend to become widespread, described as hybrid solutions between "hierarchy" and "market" (Thorelli, 1986), as hierarchical relationships are being replaced by seemingly neutral algorithmic matching (Casilli 2019, 75). Even more so than in the case of temporary work, subcontracting or franchising, where the employer is diluted between de jure hierarchical power and de facto economic power (Béroud & Bouffartigue, 2009; Thébaud-Mony, 2001), in the case of platform capitalism, the democratic deficit results from the dissimulation of power relations and the dismantling of the employer's role as an institutional interlocutor within companies that are reduced to their intermediation function. The apparent “dematerialisation” of management is a core challenge to organised resistance (Brugière, 2019).

Qualifying platform work is in itself a central challenge for collective mobilisation, due to 1) the volume of unpaid work (Krinsky & Simonet, 2012), 2) invisible work in ostensibly automated systems ("AI washing") (Casilli, 2019, p. 12), 3) employment stacking and 4) the positioning of platforms as “neutral” intermediaries (Abdelnour & Méda, 2019; Casilli, 2019) where “*the underlying power relations between capital and labor become obscured »* (Gerber & Krzywdzinski, 2019). Questioning this “neutrality” is central to analysing professional relations and to enforcing labour rights in labour conflicts (Barraud de Lagarie & Sigalo Santos, 2019; Nasom-Tissandier & Sweeney, 2019). Moreover, “*debates on the regulation of platform work are mainly concerned with the issue of worker (mis)classification* [as self-employed]” (Ellmer et al., 2019). For on-demand services, workers’ demands almost systematically aim to reduce the gap that separates them from traditional employment regimes equivalent to their position (Casilli, 2019, p. 102).

Moreover, platform work requires new frameworks for regulation and bargaining through its partially deterritorialised and transnational character. While Europeanisation of collective action and bargaining has been a subject for other sectors (Bevort & Jobert, 2011; Hilal, 2007; Wagner, 2007); the transnational dimensions of platform work and digital labour require more in-depth study.

5.5.2 Vectors and spaces of collective action

At the same time, work and employment conditions in the platform economy offer a unique opportunity to look further into the conditions for so called « unlikely mobilisations » (Collovald & Mathieu, 2009). As one important factor, mobilisation is closely associated with specific spaces. Despite work arrangements being made online, the attachment of location-based work to actual urban areas and physical spaces (*free spaces* (Tassinari & Maccarrone, 2020)) allow for initiatives of social action. Virtual spaces and "digital communities" (Vandaele, 2020) developed in parallel to contribute to building a sense of a common condition, as well as strategies of resistance and subversion (Salehi et al., 2015; Tassinari & Maccarrone, 2020). Due to the decentralised nature of the work itself, these spaces, and the importance of bottlenecks in the production flow require close attention (Alimahomed-Wilson & Ness, 2018; Courty, 1994). More generally, regrouping otherwise dispersed workers in larger platforms may contribute to realising a common condition and to create professional socialisation.

A common observation is that of a hybrid situation (Abdelnour & Bernard, 2018; Leterme et al., 2018), featuring the co-existence, complementarity and alliance of traditional mainstream trade unions, « union-like organisations defending platform workers' needs and interests » (Vandaele, 2018), or free, network based activist groups (Vandaele, 2020). Strategic intermediaries between traditional unionism and platform movements play a significant role in this. As is the case in network unionism (a way to account for multiple outsourcing in dispersed network-firm models), individual activists may carry significant responsibility in organising and consolidating movements (Lafuente Hernández et al., 2015). In the case of delivery workers, bottom up unionism is developed by the most active minority of professional drivers (Brugière, 2019). In cases where conventional trade unions are deemed "unpractical", alternative forms of organisation may emerge (Salehi et al., 2015) and be more suited (Ellmer et al., 2019).

Platform workers integrate new forms of worker's organisations (e.g. Smart (Drahokoupil & Piasna, 2019)or FairCrowdWork) as well as existing employee's organisations (Kilhoffer et al., 2017). In Belgium in 2016, a couriers collective was founded on social networks, and in 2017-2018 mobilisations took place following the bankruptcy of the platform Take Eat Easy and the deterioration of working conditions and layoffs of Deliveroo's couriers (Leterme et al., 2018). In 2018 the « Transnational Federation of Couriers » was born, and initiatives like « United Freelancers » took place at the national union level, encouraging the affiliation of platform workers. However, we still lack a legal framework equivalent to the established standards of social dialogue (Kilhoffer et al., 2017). Forms of resistance include strategies of subversion within work itself (such as non-conformity to standards of service, bypassing platform intermediation in client interaction, etc.), as well as both traditional and innovative repertoires of collective action (Brugière, 2019).

5.6. Conclusion

While recent years have seen a multiplication of both scientific publications and institutional reports on the platform economy, the available empirical data remains scarce and information on Belgian workers is extremely limited. More research is therefore needed on its specific dynamics and effects in Belgium, especially since it has been established that the platform economy must be understood in interaction with local labour markets, legislation and regulation systems.

Faced with an extremely complex, heterogenous and rapidly evolving phenomenon, consistent definitions of the platform economy, its outlines, boundaries and sub-categories, have yet to emerge. This literature review develops a number of common characteristics and criteria of differentiation within the platform economy. However, a more operational and stable definition and typology need to be consolidated through original empirical data that considers recent developments and local specificities. Moreover, although we have found that the platform economy is generally different from collaborative, cooperative and sharing practices, the overlaps and differentiations will require further attention.

The platform economy covers a wide range of organisational configurations that stretch across complex networks of actors and vary according to the *type of activity*, the *types of actors* involved and the *organisational and economic model*. This heterogeneity can account for a great diversity of situations with regard to work and employment conditions, health and well-being, as well as representation and regulation, which are also impacted by internal stratifications and inequalities as well as hierarchies among platforms. Quantitative data on workers' profiles and work and employment conditions is therefore necessary. Moreover, there is a gap in the literature concerning worker trajectories in and out of platform work in relation with motivation and overall careers and income.

6. The four SEAD work packages

This working paper provided a state-of-the-art of the literature considering the four main topics addressed in the SEAD project. Within the project, each of these topics is the central study objective of a separate work package. Here, we will briefly describe the topic and the specific objectives of each work package.

WP1. Macro-economic effects of digitalisation on labour markets

The main aim of the first work package of this project is to study how digitalisation is affecting the occupational structure of the Belgian economy, as well as worker outcomes. Using both descriptive and econometric statistical methods, a comprehensive macro-analysis will be presented of how new technologies are shaping labour market and employment sustainability outcomes. The conclusions of this first work package will inform the three other work packages of the SEAD project.

The specific objectives are the following:

1) To describe the change in the sectoral and occupational composition of the Belgian labour market over the past decades and to compare this evolution to the one witnessed in neighbouring countries.
2) To describe the changing task composition of occupations in Belgium over the past decades and how this relates to workers' characteristics.
3) To investigate which are the declining and growing occupations in Belgium and what this implies for skills and competence requirements.
4) To investigate the effects of digitalisation on individual labour market outcomes of workers.

WP2. Organisations as a moderator between technology and work experiences

The second work package of the SEAD project will highlight the role managers and organisations play in shaping the effects of technology on job quality and day-to-day work experiences. To this end, an exploratory qualitative research methodology will be applied, containing an in-depth case study of 25 organisations. In these organisations, interviews and focus groups will be organised with people in different functions (including managerial and executing functions). This analysis will target organisations who make extensive use of digital technologies in various sectors in Belgium, including the service sector, the manufacturing sector and the platform economy. The case studies will focus on the organisational level specifically, thus addressing the current gap in the literature.

WP3. Digitalisation and changing occupations

The objective of work package 3 is to provide in-depth insights on how digitalisation has affected the five selected occupations (assembly line workers, customer advisors, middle managers, recruiters and R&D managers) in Belgium, using semi-structured interviews with workers. For the interviews, an appropriate recruitment and fieldwork strategy will be designed. Then, a topic list – common across all five occupations – will be created, containing items on types of technologies, contextual factors, changes in job quality and employment sustainability. Another option that will be explored is content analysis of job classifications, because a comparison of past job classifications could help document the evolution of the selected occupations and the possible link with digitalisation.

WP4. Digital platform work as an emerging employment phenomenon

The fourth and final SEAD work package focuses on the platform economy. In this work package, multiple methods will be combined to gain insight into this emerging employment phenomenon in Belgium. Given the recent and highly dynamic character of the platform economy in Belgium, mapping out the existing and relevant platforms requires exploratory fieldwork and thus is an objective in itself for this work package. Platform data (obtained by means of agreements with platform owners or through the use of web scraping techniques) will be used to create socio-demographic, professional and economic profiles of the workers engaging in platform work. Furthermore, an online survey will be conducted to gather information about the work and employment conditions and health and well-being situation of the workers involved. Finally, in-depth interviews with platform workers and representatives will produce information on how they experience their work and will shed light on the trajectories into and out of platform work, as well as perspectives for collective action in platform environments.

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