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Digital Transformation: A Threat to Meaningful Work?

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Abstract

The latest industrial revolution, Industry 4.0, is characterised by digital transformation and like all previous industrial revolutions significantly impacting the content of jobs and the conditions under which they are performed. Some tasks have been fully automated, new ones have emerged and technological developments now allow for digital workplace surveillance and supervision, taking over tasks previously performed by managers. These changes in work are not neutral; they are likely to affect how useful workers perceive their jobs. Like during previous industrial revolutions, the impact can moreover be expected to vary between workers with low, intermediate and high educational levels. This study empirically explores these effects across European countries making use of the European Working Conditions Telephone Survey of 2021. The results of the hierarchical regression models show that although the overall impact on employees' sense of having useful work may be positive, it is negative for highly educated workers. The centrality of computer work has a positive effect on the perception of having useful work for those with a low level of education and a negative effect for those with a high level of education. Moreover, experiencing extensive managerial authority of a digital system has a negative effect on the perception of doing useful work for workers across educational levels, but the negative effect is less pronounced for workers with a low level of education. This indicates that the digital transitions taking place in European workplaces are not neutral in terms of employees' perceptions of their jobs. The overall effect can potentially be positive if employees are granted sufficient levels of autonomy in their jobs.

Keywords: Useful work; Meaningful work; Digital transformation; Workplace; Digitalisation.

1. Introduction.

Since the invention of the steam engine and the ensuing First Industrial Revolution (Industry 1.0), a series of major technological transformations have reshaped societies. The

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latest revolution, Industry 4.0, is characterised by digital transformation.[1] Developments are progressing rapidly, as evidenced by the swift advancements in Generative Artificial Intelligence (GenAI). Industry 5.0 and 6.0 are already within reach.[2] As with all previous industrial revolutions, digital transformation is significantly impacting human labour.[3] During the technological transformations throughout history, employees have feared being replaced by machines, leading to the extinction of certain professions or, worse, large-scale unemployment.[4] This is no different today. Yet, insofar history has shown that where certain professions indeed disappeared due to technological transformations (e.g. typesetters and video store clerks), new professions have emerged in the slipstream.[5] Consequently, technological transformations so far have not resulted in large-scale unemployment.

Even though the digital transformation is not causing large scale unemployment, it is changing the nature and content of jobs as well as the conditions under which they are performed.[6] These changes in work are not neutral; they are likely to affect the people who do the work and how they perceive their jobs.[7] Central in this debate is the notion of meaningful work, which is "the perception that one's work has worth, significance, or a higher purpose".[8] In other words, the sense that your work is useful. The consequences of the digital transformation for workers' sense of doing useful work can be both positive and negative and depend on the choices made by employers. Smids and colleagues argue that the presence of robots on the shop floor may make work more meaningful for employees if boring and repetitive tasks are automated, allowing more time to be spent on interesting tasks.[9] However, depending on how robots are utilised, their presence may also render work meaningless if employers make choices that worsen the nature of work. Others have argued that similar processes apply to the adoption of GenAI in the workplace.[10]

The changes in work due to digital transformation might vary across the labour market and have a different impact on various groups of employees. This could be especially true

[1] Heiner L. *et al.*, *Industry 4.0*, in *Business & information systems engineering*, 6, 2014, 239–242.
[2] Skobelev P.O., Yu Borovik S., *On the way from Industry 4.0 to Industry 5.0: From digital manufacturing to digital society*, in *Industry 4.0,* 2, 6, 2017, 307–311.
[3] Gradillas M., Thomas L.D.W., *Distinguishing digitization and digitalization: A systematic review and conceptual framework*, in *Journal of Product Innovation Management*, 2023.
[4] Frey C.B., Osborne M.A., *The future of employment: How susceptible are jobs to computerization?*, in *Technological forecasting and social change*, 114, 2017, 154–280. *See* also Ford M., *Rise of the robots: technology and the threat of a jobless future*, Basic Books, New York, 2015.
[5] Kogan L. and others, *Technological Innovation, Resource Allocation, and Growth*, in *The Quarterly Journal of Economics*, 132, 2, 2017, 665–712.
[6]Autor D.H., *Why are there still so many jobs? The history and future of workplace automation,* in *Journal of economic perspectives*, 29, 3, 2015, 3–30. *See* also Balsmeier B., Woerter M., *Is this time different? How digitalization influences job creation and destruction*, in *Research policy*, 48, 8, 2019.
[7] Bankins S., Formosa P., *The ethical implications of artificial intelligence (AI) for meaningful work*, in *Journal of Business Ethics*, 185, 4, 2023, 725-740. *See* also: Holt M., Lang B., Sutton S.G., *Potential Employees' Ethical Perceptions of Active Monitoring: The Dark Side of Data Analytics*, in *Journal of Information Systems*, 31, 2, 2017, 107–124; Karayaman S., *The Alienating Effect of Technology: Does Technological Innovation Cause Work Alienation*, in *Journal of Management and Economic Studies*, 6, 2, 2024.
[8] Bankins S., Formosa P., *ibidem*, 725. *See* also Michaelson C. *et al.*, *Meaningful Work: Connecting Business Ethics and Organization Studies*, in *Journal of Business Ethics*, 121, 1, 2014, 77–90.
[9] Smids J., Nyholm S., Berkers H., *Robots in the workplace: a threat to or opportunity for meaningful work?*, in *Philosophy & Technology*, 33, 3, 2020, 503–522.
[10] Bankins S., Formosa P., nt. (7).

for low-educated and high-educated workers.[11] After all, employers might make distinct choices regarding the use of technology at various levels within the organisational work process affecting lower and higher educated workers differently. This study aims to *empirically explore the effect of digital transformation on employees' perceptions of doing useful work across groups with varying educational levels*.

This study adds to the literature in the following way. Since most studies towards the effects of digital transformation on meaningful work have been theoretical in nature,[12] this article adds to this debate by being amongst the first to empirically test with large-scale data the relations between digital transformation and workers perceptions of their jobs. To this end, the European Working Conditions Telephone Survey (2021) is used, containing workers from 36 different countries. This large-scale data moreover allows disentangling the effect of working with digital means (content) from the influence of being managed by a digital system rather than a human manager (authority), providing some rough insight in the mechanism driving the relation between digital transformation and the feeling of doing useful work. Finally, by looking at how the processes work out differently for workers with a low, intermediate and high educational level, we can gain insight in the extent to which digital transformation processes have differential effects.

2. Meaningful work and the potential effect of the digital transformation.

Meaningful work is an old concept and is closely related to the sense of doing useful work. The broader discussion on meaningful work can be traced back to Seeman's[13] and Blauner's[14] adaptations of Marx's concept of alienation to individuals' perceptions of their jobs. According to them, a sense of meaninglessness is one of the characteristics of alienated workers and entails not seeing the purpose of their labour, in other words they render their work as useless. The concept of useless work gained widespread attention with David Graeber's essay "On the Phenomenon of Bullshit Jobs".[15] Graeber defines bullshit jobs as those made up of tasks that people "secretly believe do not really need to be performed". Individuals in bullshit jobs thus often feel their work is useless because they do not perceive its purpose. Conversely, useful work can be characterised by a sense of purpose, where people feel that their efforts contribute to something valuable. Perceiving one's work as such today has become one of the central values that people attach to work and has become just as important as it earning them a living.[16]

[11]Kirchner S., Meyer S.-C., Tisch A., *"Digital Taylorism" for some, "digital self-determination" for others? Inequality in job autonomy across different task domains*, in *Zeitschrift für Sozialreform*, 69, 1, 2023, 57–84.
[12] Bankins S., Formosa P., nt. (7); Smids J., Nyholm S., Berkers H., nt. (9).
[13] Seeman M., *On The Meaning of Alienation*, in *American Sociological Review*, 24, 6, 1959, 783-791.
[14] Blauner R., *Alienation and freedom: The factory worker and his industry*, in *The Sociological Quarterly*, 6, 1, 1965.
[15] Graeber D., *On the Phenomenon of Bullshit Jobs: A Work Rant*, in *Strike!* Maganize, 2023, available at: https://strikemag.org/bullshit-jobs/ (last accessed on 19 November 2024).
[16] Inglehart R., *Modernization and postmodernization: cultural, economic, and political change in 43 societies*, Princeton University Press, Princeton, 1997.

The digital transformation in the workplace alters the content of jobs available.[17] Tasks previously performed by employees are now fully automated, freeing up time for other activities and boosting productivity, while new tasks have emerged as a result of technological advancements.[18] Many of these new tasks involve digital technology. Today, many workers use digital tools daily for work purposes, with computer-based tasks comprising a major part of their workday. These changes are ongoing and have been accelerated by the Covid-19 crisis.[19]

The digital transformation is altering job content and is likely to work out different for various groups of employees. For workers with low levels of education, digital transformation often results in more simplistic tasks.[20] The *new jobs* created as a result of digital transformation for low-educated workers may be of a very different nature than the new jobs created for high-educated workers. One example of a new type of job for low-skilled workers that has emerged as a result of digital transformation is click work, which is used to train algorithms.[21] Workers engaged in such work often do not know the end product of their contributions, which may reduce their sense of doing useful work.[22] Furthermore, how the digital transformation has altered the tasks within *existing jobs* may also vary significantly. Low-skilled work that existed before and has been increasingly digitalised often has become more simplistic. For example, forklift operators in warehouses might previously have decided where to place pallets of goods themselves are now instructed by an app where to place each pallet.[23] In contrast, workers with high levels of education who are affected by digital transformation of work are more likely to lead the development of digital products, such as ICT professionals.[24] For them, algorithms may take over the more simplistic routine programming tasks, freeing up time for innovative and complicated coding. A centrality of digital work is not likely to reduce their view on the purpose of their labour and their sense of doing useful work. Therefore, it can be hypothesised that: *the centrality of digital work will overall lead to a low sense of doing useful work for employees with a low level of education (hypothesis 1), whereas it will lead to a high sense of doing useful work for employees with high levels of education (hypothesis 2).*

Digital transformation processes not only potentially change the content of work but also affect employee management. The developments enable digital workplace surveillance, supervision and task allocation, taking over tasks previously performed by managers and thus

[17] Karayaman S., nt. (7).
[18] Autor D.H., nt. (6). *See* also Balsmeier B., Woerter M., nt. (6).
[19] Almeida F., Duarte Santos J., Augusto Monteiro J., *The challenges and opportunities in the digitalization of companies in a post-COVID-19 World*, in *IEEE Engineering Management Review*, 48, 3, 2020, 97–103; Amankwah-Amoah J. *et al.*, *COVID-19 and digitalization: The great acceleration*, in *Journal of business research*, 136, 2021, 602–611.
[20] Kirchner S., Meyer S.-C., Tisch A., nt. (11).
[21] Casilli A.A., *Waiting for robots: the ever-elusive myth of automation and the global exploitation of digital labor*, in *Sociologias*, 23, 57, 2021, 112–133.
[22] Wong S.I., Fieseler C., Kost D., *Digital labourers' proactivity and the venture for meaningful work: Fruitful or fruitless?*, in *Journal of Occupational and Organizational Psychology*, 93, 4, 2020, 887–911.
[23] Jaehrling K., *et al.*, *The digitisation of warehousing work. Innovations, employment and job quality in French, German and Dutch retail logistics companies,* in Jaehrling K. (*ed.*), *Virtuous circles between innovations, job quality and employment in Europe? Case study evidence from the manufacturing sector, private and public service sector*, QuInnE, 2018.
[24] Casilli A.A, nt. (21).

changing the conditions under which work occurs.[25] Digital technologies, for example, make it possible to monitor employees continuously, even outside the immediate oversight of their supervisors. Moreover, the use of appraisal systems through which customers can evaluate worker performance has increased significantly due to technological innovations.[26] However, digital transformations potentially impact not only the managerial task of monitoring employee performance but also the task of setting work goals. Nowadays, digital systems may determine what needs to be done, where, and when.

As with the impact on the content of jobs, the impact of digital management might be more severe for lower educated workers. In the example of warehouse order pickers, they are increasingly receiving on-the-spot instructions from software systems, for example through data goggles, rather than receiving instructions beforehand from their manager. This leaves the individual workers with less autonomy and decision-making power about how to perform the work.[27] This might in turn detach them from the purpose of their work as there is less need (as the software has already made the decisions the worker used to make) and opportunity (as it is harder to gain insight into the algorithms making the decisions) to think through the whole work process, leading to a reduced sense of doing useful work. In high-skilled jobs, digital systems may also dictate task allocation. For instance, in an ICT company, a computerised system might assign tasks, but employees are likely still responsible for how to complete them leaving them more autonomy than lower educated workers, resulting in the negative impact of being managed by a digital system being potentially less severe. Thus, the impact on workers with low levels of education may be more negative compared to highly educated workers.[28] This leads to the expectations that: *a higher influence of digital systems' control over employees' work leads to a decreased sense of having useful work (hypothesis 3) and this negative effect is stronger for workers with low educational levels than for workers with high educational levels (hypothesis 4).*

It might be argued that the influence of a digital system on what workers do is no different from the authority traditionally exercised by managers or the needs and demands of clients and customers. These authorities can also take away the autonomy workers perceive in their work.[29] However, what distinguishes the influence of a computerised system from that of traditional actors is the level of detail with which workers can be managed and controlled. After all, every move and action can be monitored. Moreover, the lack of a human face and voice removes the possibility of negotiation. This absence might therefore further diminish their sense of control and thus their sense of doing useful work. It can thus be hypothesised: *the negative influence of digital systems' control over employees' work on their perception of doing useful work is larger than the same level of influence of managers or customers on the sense of doing useful work (hypothesis 5).*

[25] Ball K., *Surveillance in the workplace: Past, present, and future*, in *Surveillance and Society*, 20, 4, 2022.; Holt M., Lang B., Sutton S.G., nt. (7); Manokha I., *New Means of Workplace Surveillance*, in *Monthly Review*, 70, 9, 2019, 25–39.
[26] Ball K., *ibidem;* Manokha I., *ibidem.*
[27] Jaehrling K., *et al.*, nt. (23).
[28] Kirchner S., Meyer S.-C., Tisch A., nt. (11).
[29] Wu D., Lin H., *Job autonomy, harmonious passion, and work engagement: The moderating role of observational monitoring*, in *Social Behavior and Personality: an international journal*, 52, 1, 2024, 1–10.

3. Data and methodology.

3.1. Data.

The European Working Conditions Telephone Survey (EWCTS), conducted by Eurofound, is used to test the hypotheses. This survey was carried out by telephone in 2021 during the COVID-19 crisis across 36 European countries, including the EU Member States, the United Kingdom, Norway, Switzerland, Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia. In most countries, respondents were randomly selected through calls to cell phone numbers generated by a computer. In Sweden, respondents were randomly chosen from an official residents' register. Participants were eligible if they were 16 years or older, were residents of the country being studied, and had worked for pay or profit for at least one hour in the previous week.

Interviews were conducted in respondents' native languages and lasted an average of 22 minutes. The questionnaire was available in 54 languages. Sample sizes varied between countries due to budget constraints and differences in workforce size, ranging from 1,000 to 4,200 respondents per country. The total number of respondents was 71,758. However, not all questions were asked to all the respondents. To address interview fatigue, the length of the interviews was reduced by employing a modular structure. Therefore, the answers in some modules are only asked to half of the respondents, reducing the sample size. Moreover, sometimes respondents refused to answer some questions or responded with "don't know" or "does not apply", further reducing the sample size used for the analyses.

The response rate for the EWCTS was only 5 percent. This relatively low percentage can likely be attributed to the special circumstances of the COVID-19 crisis. The extent to which this has resulted in a skewed sample will be discussed in the descriptive statistics section of the results.

3.2. Operationalisation.

In this section it is described how the central concepts in the hypotheses (sense of doing useful work; digital work; control of digital systems; manager and customer over employees; work; educational level) are measured using questions from the survey data. Also, the measurement of the control variables included in the analyses is described.

Sense of doing useful work (dependent variable). The extent to which people have the feeling that their work is useful is measured using the question "[…] thinking about your main job, please tell me how often the following applies to your work situation: you have the feeling of doing useful work". Respondents could answer on a scale with the categories "never", "rarely", "sometimes", "often" and "always". The variable is used as continuous variable in the analyses.

Digital work (explanatory variable). The extent to which the content of the work is digital is measured using the question: "How often does your main paid job involve: Working with computer, laptop, tablet, smartphone?". Answer categories were: "never", "rarely",

"sometimes", "often" and "always". This variable is also treated as a continuous variable in the analyses.

Control of digital systems, manager and customer over employees' work (explanatory variables). The extent to which a digital system/manager/customer has managerial authority over what people do in their work is measured using the questions: to what extent does a computerised system influence what you do in your work? The same question was asked for managers and customers/suppliers. The questions could be answered using the categories: "To a large extent", "to some extent", "not much", "not at all" and "does not apply". The order of the answer categories was mirrored, so a higher number reflects more influence. The answer category "does not apply" was merged with the answer category "not at all", since for example the absence of a manager (e.g. for self-employed workers) means that there is no influence at all. The variables were added to the models as continuous variables.

Educational level (explanatory variable). The educational level of the respondents was measured using the ISCED score. The original variable in the EWCTS contains nine levels. These were recoded into low educational level (ISCED categories 0- 2), intermediate educational level (ISCED 3 and 4) and high educational level (ISCED 5-8), following the definition of the International Labour Organisation (ILO). The levels were added to the analyses as dummy variables with low educational level as the reference category.

Age, sex, sector, labour market position and centrality of digital work in a country (control variables). Age is measured as an absolute number (years) and added to the models as a continuous variable. Sex was measured in three categories: male, female and other. Since not many respondents replied "other", this could not be included as a separate category. The respondents of this category were randomly assigned to either male or female (procedure carried out by Eurofound before publication of the dataset). Male and female were recoded into dummy variables and male served as the reference category in the models. Sector is included in the analysis as a distinction between private sector and all other sectors (e.g. public sector, non-profit sector), since work in public and not for profit sectors might more easily be perceived as useful due to their societal goals. The variable is recoded into a dummy variable with the private sector serving as the reference category in the models. The labour market position indicates whether somebody holds a tenured position or has a flexible contract (e.g. temporary contract or temporary agency work; a tenured position serves as the reference category). After all, workers with tenure often have more responsibility and opportunities in their work, which might result in them perceiving their work as more useful. The level of digitisation in a country is measured as the aggregate (mean) in the country the respondent belongs to of the answers to the question "How often does your main paid job involve: working with computer, laptop, tablet, smartphone?". This variable was added to the models on the second (country) level to control for the extent to which people live in a digitised society and work in a digitised labour market.

3.3. Method.

To test the hypotheses, models were estimated that take into account the multilevel structure of the data, where the respondents (level 1) are grouped within countries (level 2). These multilevel models allow for the proper inclusion of both the respondent-level variables (e.g., *useful work*) and the country-level variable *level of digitisation in a country* (average of *digital work* within countries). Moreover, the models correctly handle the interrelatedness of observations (which would otherwise violate the assumption of independent observations), as respondents within the same country might be more similar with respect to work in a digitised labour market than respondents in different countries. For this purpose, models that take into account the (small) variation in the *useful work* variable between countries, were estimated, starting with a model with only control variables. Explanatory variables and interactions were added (in blocks) to address the hypotheses (*see* Table 2 for the order of adding the variables). The multilevel models were estimated using the R software (package lme4, using restricted maximum likelihood).[30]

The three *managerial authority* variables (digital systems, manager and customer), as well as the continuous exploratory variable *digital work*, were centred (mean value subtracted from the variable scores) to reduce the strong associations (known as multicollinearity) these variables have with the interactions terms in which they are included. Reducing multicollinearity in this way leads to better estimates of standard errors and testing of the significance of parameters.

Due to the modular structure of the questionnaire, the variable *useful work* and the three *managerial authority* variables have a large number of missing values (resp. 33% and on average 50%). Moreover, by including all four variables in the analysis, the number of respondents answering all four questions together even dropped further, giving a sample size of 20932. Because these missing data were created by design, it is expected that they will not bias the results of the analyses. On top of this, all variables (except *sex*) have a small amount of "ordinary" missing data (item nonresponse, e.g., refusals, don't know, omitted questions), with missing data percentages ranging from 0.1% to 1.2%. Removing all respondents with missing data on any variable in the analyses resulted in a sample size of 20019 completely observed respondents. All analyses were conducted over these completely observed cases.

To assess the possibility of bias due to all missing data (by design and item nonresponse), descriptive statistics of all variables were calculated in two ways: 1) using all available data for each variable separately, and 2) using the data of the 20019 respondents with data on all variables in the analyses. Table 1 contains the descriptive statistics for both procedures, showing only small differences, which shows that complete-case analysis will not lead to biased results. The assumptions of the multilevel models were checked using the full models on both sample sizes. This showed that the normality assumption was violated, due to the categorical and skewed nature of the dependent variable *useful work*. Although the large sample size and the robust estimation procedure (restricted maximum likelihood) give some

[30] *See* for example: Bates D. and others, *Fitting Linear Mixed-Effects Models Using lme4*, in *Journal of Statistical Software*, 67, 1, 2015, 1-48.

protection against violation of assumptions, the non-normality may result in biased estimates of standard errors. Therefore, so-called Sandwich estimators were used to provide better estimates of the standard errors in case of non-normality.[31] Hypotheses tests and confidence intervals based on these standard errors give the same results as the ordinary multilevel analyses, and therefore the standard results are presented. For each model, R^2 values, indicating proportion of explained variation, are calculated for both levels of analyses (respondent and country). Model fit is examined by calculating the Akaike Information Criterion (AIC), which is used to compare the models.

4. Results.

4.1. Descriptive statistics.

Table 1 shows the descriptive statistics of the variables included in the models, for both the sample with complete cases (for the variables in the analyses) and the sample with all observed cases for each variable (as discussed in the previous section). Differences between the two sets are small, and lead to the same general description of the data. The descriptive results of the smaller analysis-sample are discussed.

The employees in the data range in age from 16 years old to 84. This means that the dataset includes some employees that have reached the pension age but have continued working nevertheless. The average age is almost 42 years old. Most respondents have a high educational level (57.9%), followed by intermediate (35.8%) and a low level of education (6.8%). This means that in this dataset, those with a high level of education are overrepresented and descriptive statistics (e.g. average sense of doing useful work) might be skewed towards this group. The overrepresentation of the higher educated is unlikely to have consequences for the relations between the variables that are studied in the next phase: still sufficient lower educated employees participated to compare the effects for the groups with different levels of education. The division between men (50.4%) and women (49.6%) is almost fifty/fifty. Just over 60 percent of the workers belongs to the private sector and almost 40 percent to other sectors (e.g. public sector or an NGO), as is generally the situation in most economies. Finally, 82.2% of the respondents holds a tenured position and 17.8% has a flexible contract.

On average, respondents feel their work is almost always useful (mean = 4.42, SD = 0.82). Moreover, most employees often use computers or other digital devices during their work, (mean = 4.10, SD = 1.39) although the variation in answers to this variable is higher than for the question about useful. Note that the data was collected during the COVID-19 crisis, meaning that the frequent use of computers and other digital devices might be higher as a result. On average, managers, customers and digital systems to some extent influence what employees do in their working day. The difference in influence by the three types of actors

[31] Snijders T.A.B., Bosker R.J., *Multilevel analysis: an introduction to basic and advanced multilevel modeling (2nd ed.)*, SAGE Publications, Thousand Oaks, 2012.

is not that large, with the largest influence experienced by digital systems (mean = 2.97, SD = 1.17), followed by managers (mean = 2.82, SD = 0.95) and customers (mean = 2.66, SD = 1.16).

Table 1: Descriptive statistics

		Complete cases (N = 20019)		**All available data**		
Variable	**Categories**	**Mean/ percentage**	**SD**	**Mean/ percentage**	**SD**	**N**
Age		41.63	12.02	41.96	12.31	71625
Educational level	*Low*	6.3%	-	7.5%		71393
	Intermediate	35.7%	-	36.0%		
	High	58.0%	-	56.5%		
Gender	*Male*	50.3%	-	52.3%		71758
	Female	49.7%	-	47.7%		
Sector	*Private*	60.3%	-	64.6%		70859
	Other	39.7%	-	35.4%		
Labour market position	*Tenure*	82.1%		81.6%		61986
	Flexible	17.9%		18.4%		
Useful work		4.42	0.82	4.42	0.83	48147
Digital work		4.10	1.39	4.04	1.42	71731
Control manager		2.82	0.95	2.80	0.96	31079
Control customer		2.66	1.16	2.72	1.16	35628
Control digital		2.97	1.17	2.92	1.18	35673

4.2. Hypotheses testing.

Table 2 shows the estimated parameters of the multilevel random intercept models developed to test the hypotheses. Based on an empty model (a model without predictors; not shown), the intraclass correlation coefficient was calculated (ICC= 0.017), which showed that only 1.7 percent of the total variance is located at the national level and 98.3 percent at the level of the individual respondents. We nevertheless opted for a multilevel model since one of the control variables, centrality of digital work in a country, is located at the national level, causing multilevel analysis to be the preferable method of analysis. The table shows that at the level of the individual, the variables included in the models explain only a small percentage of the variance observed in the variable "useful work": the control variables explain 2 percent and the addition of the variables on digital work and level of education explain another 0.5 percent at best (R^2-level 1 of model 3 = 0.025). However, at the national level the models are explaining more than 20 percent of the variance (R^2-level 2 of model 2 = 0.212). Nevertheless, we need to keep in mind that the percentage of the variance located at the national level was very small to begin with. Finally, the AIC fit measure shows that adding the variables of interest in model 2 means a significant improvement of the model compared to model 1 (decrease in AIC). Models 3 and 4 are both compared with model 2: adding the interaction terms in both instances improves the model.

Model 1 is the model containing all the control variables. Overall, women have a larger sense of doing useful work then men ($b = 0.036$, $p < 0.01$). Moreover, this sense seems to be growing when people get older ($b = 0.008$, $p < 0.01$). As expected, employees in sectors other

than the private sector, such as the public sector and NGO's, tend to have a larger sense of doing useful work than those in the private sector ($b = 0.115$, $p < 0.01$). Contrary to what was expected, employees with flexible contracts have a somewhat larger sense of doing useful work than workers with tenure ($b = 0.041$, $p < 0.01$). Finally, when more digital work is taking place in a country, the sense of employees that their work is useful tends to be smaller. This is apart from whether they themselves do work with a large digital component.

Model 2 includes the direct effects of the variables included in the hypotheses and *Model 3 and Model 4* add the interaction-effects. As one can see in model 2, there is a small and non-significant positive relation between doing computer work and employees' sense of doing useful work ($b = 0.008$, $p > 0.05$). Moreover, employees with an intermediate level of education have a greater sense of having useful work than workers with a low level of education, whereas for employees with a high level of education this is smaller, however, both differences are small and not significant. If we look at model 3, it can be observed that the relation of digital work and having a sense of doing useful work is *positive* for employees with a low educational level (the direct-effect of computer work: $b = 0.051$, $p < 0.01$). The relationship is nevertheless small (almost zero, 0.051 – 0.041, due to the interaction) for those with an intermediate educational level, and even *negative* for those with a high educational level (0.051 – 0.064; both interaction effects are significant). This means that both hypothesis 1 and hypothesis 2 are discarded: we find the opposite from what was expected.

Model 2 also shows that the more influential a digital system is on what employees do in their work (managerial authority of a digital system), the lower their sense of doing useful work ($b = –0.019$, $p < 0.01$). This is in line with hypothesis 3. *Model 4*, however, shows a non-significant positive effect of managerial authority of a digital system for employees with a low educational level ($b = 0.035$, $p > 0.05$), whereas the interaction effects show stronger negative effects for intermediate and high educational levels (resp., $b = –0.054$ and $b = –0.062$, with $p < 0.01$). This is in contrast with the expectations as formulated in hypothesis 4.

Model 2 lastly shows that also a larger influence from one's (human) manager on what one does in their work has a negative impact on the sense of doing useful work ($b = –0.035$, $p < 0.01$). The influence of customers has only a very small and non-significant negative effect. Overall, the impact of having a human manager that has a decisive influence on what you do in your work is more negative for employees' sense of doing useful work than a digital system or customer having the same influence. This contradicts the expectation as formulated in hypothesis 5 that stated that we could expect the negative influence of digital systems to be largest.

Table 2: Multilevel random intercept models explaining the sense of useful work (N level 1 = 20019, level 2 = 36)

		Model1		**Model2**		**Model 3**		**Model 4**	
		b (*SE*)		*b* (*SE*)		*b* (*SE*)		*b* (*SE*)	
Intercept		4.875 (0.212)	**	5.020 (0.211)	**	4.910 (0.216)	**	4.910 (0.216)	**
Gender	*Male*	ref		ref		ref		ref	
	Female	0.036 (0.012)	**	0.046 (0.012)	**	0.047 (0.012)	**	0.047 (0.012)	**
Age		0.008 (0.000)	**	0.007 (0.000)	**	0.007 (0.000)	**	0.007 (0.000)	**
Sector	*Private*	ref		ref		ref		ref	
	Other	0.115 (0.012)	**	0.125 (0.012)	**	0.123 (0.012)	**	0.124 (0.012)	**
Labour market position	*Tenure*	ref		ref		ref		ref	
	Flexible	0.041 (0.016)	**	0.034 (0.016)	**	0.033 (0.016)	**	0.033 (0.016)	**
Digital work	*Country*	–0.208 (0.052)	**	–0.203 (0.051)	**	–0.204 (0.052)	**	–0.205 (0.052)	**
Digital work	*Individual*			0.008 (0.005)		0.051 (0.013)	**	0.006 (0.005)	
Control digital system				–0.019 (0.006)	**	–0.020 (0.006)	**	0.035 (0.019)	
Control manager				–0.035 (0.006)	**	–0.035 (0.006)	**	–0.035 (0.006)	**
Control customer				–0.000 (0.005)		–0.001 (0.005)		–0.001 (0.005)	
Educational level	*Low*	ref		ref		ref		ref	
	Intermediate			0.049 (0.025)		–0.013 (0.032)		0.006 (0.029)	
	High			–0.033 (0.026)		–0.086 (0.031)	**	–0.072 (0.029)	**
Digital work *	*Low*	ref		ref		ref		ref	
educational level	*Intermediate*					–0.041 (0.014)	**		
	High					–0.064 (0.016)	**		
Control digital system*	*Low*	ref		ref		ref		ref	
Educational level	*Intermediate*							–0.054 (0.020)	**
	High							–0.062 (0.020)	**
Model	Var.INT	0.009		0.008		0.009		0.009	
evaluation	Var.RES	0.642		0.640		0.639		0.642	
	R^2 level 1	0.020		0.024		0.025		0.025	
	R^2 level 2	0.222		0.240		0.221		0.224	
	AIC	48039		47959		47946		47953	

** p<0.01

5. Discussion of the results.

This study suggests that the digital transformation taking place in workplaces is not neutral in terms of employees' perceptions of their jobs. However, the consequences are both positive and negative. First, employees for whom digital tools such as smartphones and computers are central to their daily work are found to perceive their jobs as more useful. However, this positive effect is not universal. Contrary to the expectations formulated in section 2, the centrality of digital work has a positive effect on the perception of having a useful job for those with a low level of education and a negative effect for those with a high level of education. One possible explanation is that the underlying dynamics described in the literature – work becomes simpler for less educated workers as a result of digital transformation, while digital work becomes more creative for more educated workers – do

not apply, at least not to the European context. Alternatively, it could be that the described effects of digital transformation on work content are based on very specific examples, such as micro-work feeding algorithms, warehouse work and software developers. These examples of the digital transformation of work may not be representative of the labour market as a whole. More research is needed on the impact of digital transformation on the content of work, and how this is perceived by employees, to gain a better understanding of why the impact is positive for lower educated and negative for higher educated workers.

The results moreover show that when a digital system controls your work, in other words becomes your manager, workers perceive their work as less useful. However, this study also shows that it is not necessarily just the fact that it is a digital system that affects the sense of doing useful work, a greater influence of a human manager on what people do in their work has an even stronger negative effect. This suggests that, in general, people who perceive less third-party influence on their work, and therefore more autonomy, have a greater perception of doing useful work. This is consistent with the literature on employee satisfaction.[32]

Nevertheless, the results show that the negative consequences of experiencing extensive managerial control of a digital system on the perception of doing useful work are largest for workers with a high level of education. The negative effect is less pronounced for workers with a low level of education. One possible explanation is that highly educated workers are used to and value a greater degree of autonomy in their work, which is taken away by being micromanaged by digital systems. Thus, unlike previous industrial revolutions, this time it is not mainly workers with low levels of education who are vulnerable to the negative effects of the changes taking place, but negative effects are now being perceived across the workforce, and particularly among those with higher levels of education. This means that across the labour market, attention should be paid to when and how digital transformation is implemented in the workplace to retain meaningful work for the human workforce.[33]

This study shows that it is not only the digital transformation taking place in the context of workers' own jobs that matters for their sense of doing useful work, but also the extent to which work is becoming digital in the society around them. If many workers in a society are doing digital work, workers in that society tend to perceive their work as less useful. More research is needed to find out what is causing the negative impact on people's perceptions of doing useful work. Possible explanations that might be worthwhile to explore are, first, that in countries where companies and organisations are highly digital, work becomes less tangible. Second, it could be that in countries where there is a lot of digital work, the administrative workload increases, adding to the workload in a way that people tend to perceive as less meaningful.

The data used for this study were collected at the height of the COVID-19 crisis, when many people were working from home. Since digitalisation of work took off during this period and has continued since, this data provides a good opportunity to study its effects which have continued after the crisis. However, the fact that the data are situated in the

[32] Lysova E.I., *et al.*, *Fostering meaningful work in organizations: A multi-level review and integration*, in *Journal of Vocational Behavior*, 110, 2019, 374–389; Martela F., *et al.*, *What makes work meaningful? Longitudinal evidence for the importance of autonomy and beneficence for meaningful work*, in *Journal of Vocational Behavior*, 131, 103631, 2021.
[33] Smids J., Nyholm S., Berkers H., nt. (9).

COVID-19 crisis may also have some limiting effects on the ability to generalise the results. For example, it may have led to higher estimates of how much digital work employees do and how much digital management is taking place. In addition, people may have perceived their work as less meaningful during this period, when many had less contact with colleagues. This may have been particularly true for those working digitally from home causing an overestimation of the impact of digital transformation on workers' perceptions of meaningful work. More research is needed to determine the impact on labour markets in the aftermath of the COVID-19 crisis. We therefore recommend that questions on digital transformation in general, and on the digital transformation of work and the workplace, be retained and added to large-scale international surveys on working conditions.

The EWCTS 2021 dataset has some shortcomings that could be improved in future surveys to allow for studying the effects of the digital transformation in work and workers. First, it is characterised by an over-representation of those with higher education. The descriptive statistics may therefore be biased towards these groups. However, the relationships between the variables examined in the models are unlikely to be affected, as all levels of education were sufficiently represented in the data. Second, the operationalisation of the concepts of "digital work" and "authority from digital systems" are not ideal for capturing digital transformation of work. The question measuring "digital work" focuses on laptops, smartphones, computers and tablets, leaving out digital work with other means. Third, the extent to which digital systems exercise authority over what employees do in their work was measured with only one question on the extent to which a computerised system influences what employees do in their work. A wider range of questions could be included in future questionnaires to get a better idea of how computerised systems manage employees, for example distinguishing between goal setting, task performance and task evaluation.

6. Conclusion.

This study was one of the first to empirically test, on a large scale, the impact of digital workplace transformation on how we perceive our jobs. It has shown that, contrary to some of the gloomy messages about the impact of digital workplace transformation on human work expressed in theoretical articles, the overall impact could be positive. However, the study also shows that there are some risk factors. The first risk factor is that even if the overall impact is positive, this is not the case for more highly educated workers. Employers should be aware of the need to give their employees sufficient autonomy when reorganising their companies. As workers are also negatively affected by a higher level of digital work in the society around them, it would also be advisable for governments to get involved in shaping the digital transformation of workplaces.

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