BEYOND 4.0

Task 5.6
Working Futures: A Forecasting Exercise

Research results

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Document description

This report contains the results of a forecasting exercise. Two main scenarios are developed for the future: the starting scenario is "nothing changes", and the second scenario is "a high-road future of work". The first scenario contains the predictions and policy recommendations as developed by Frey & Osborne (2017). The second scenario builds on the results of the research of BEYOND 4.0 and highlights a transformation path to deliver inclusive results for the EU. The results have been obtained by presenting results to external experts and letting them evaluate using the Best-Worst Method and DEMATEL. The final results have also been discussed during two separate workshops.

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Abbreviations

AHP = Analytical Hierarchical Process

ANP = Analytic Network Process

BWM = Best-Worst Method

DEMATEL = Decision Making Trial and Evaluation Laboratory

EU = European Union

Eurostat = statistical office of the European Union

F&O = Frey & Osborne

MCDM = Multi-Criteria Decision Making

OECD = Organisation for Economic Co-operation and Development

OSH = Occupational Safety and Health

UBI = Universal Basic Income

WP = Work Package

Summary

The starting point of this study is that economic growth in our European societies is too low, not inclusive and insufficiently green. Behind this stagnating growth lies an economic model that does not provide recommendations and tools to improve the situation. An in depth-examination has been conducted to understand the extent to which predictive methods such as Frey and Osborne (2017) and the task-oriented approaches, based on this economic model, are able to formulate an alternative path for the economy. The conclusion is that these approaches remain within the confines of the dominant economic model and deliver limited recommendations to tackle the current economic problems. To force a breakthrough in this current thinking, an alternative scenario for the future of work is needed. The BEYOND 4.0 study provides building blocks for this alternative scenario, defined as the high-road future of work.

The research has looked at the core results of the BEYOND 4.0 project to identify the drivers of the high-road future of work. These core results have been used in an expert evaluation in two workshops. Twenty-one experts have identified which of the core research results take precedence in factors needed for change. Eventually, eleven sub-challenges in three main challenges have been derived from research that need to be evaluated for delivering this high-road future of work. These challenges have been prioritised and mapped using a combined decision-making approach based on Best-Worst Method (BWM) and Decision Making Trial and Evaluation Laboratory (DEMATEL) techniques. BWM is used to prioritise the challenges, while DEMATEL is used to find the causal interactive relations between and among the high-road future of work challenges.

The results clarify a roadmap for policymakers and stakeholders. The organisational-related challenges are prioritised, followed by institutional-related challenges. Technological-related challenges are rated as least preferred. Investment in technology will be needed in the future but require changes in the organisational and institutional context to deliver more inclusive growth. The organisational and institutional-related challenges are clustered as the 'cause' group, while the technological challenges are clustered as the 'effect' group in the DEMATEL. The causal analysis indicates that policymakers and stakeholders should focus on the 'cause' group challenges as these affect the challenges of the 'effect' group. The priority order and the causal relations for each sub-challenge have been examined, providing further insight into the priorities for those involved in implementing the high-road future of work.

This study focuses on developing one scenario as an alternative to the dominant economic model. Other scenarios could be possible, but the high-road future of work scenario is built on a set of research results analysing the main issues with the current economy. Other alternative scenarios seem less viable. Reshaping current-day capitalism requires a stepwise approach, as suggested in this study. The lesson of the current study is that the starting point of any substantial changes needs to start with redefining the organisational practices in the industry. In this way, the results align with the European initiative to promote Industry 5.0 as an alternative sociotechnical imaginary.

1. Introduction

1.1. The objective of task 5.6

The objective of this task is to make multiple sketches of the future of work as basis for policy decision making. Based on data from previous analyses (WP3, 4 ,5, 8, 9), we make predictions for different future time intervals (3, 10 years, longer). The estimates show future relationships between occupations from case studies among leading companies in various subsectors (WP8). For various analysis levels (nations, EU) we examine what changes would be needed to achieve the new relationship between occupations. Such an analysis highlights measures for policymakers to change the estimated trend and derive (social) costs necessary to achieve that future. The results are underpinned by experts and stakeholder knowledge in two workshops to help estimate the models. This expert knowledge is needed to fix the model parameters in different scenarios. Experts are provided with the results from all tasks as input.

This report starts with an overview of several previous investigations (Dhondt et al., 2021b, 2023) and underpins the eventually selected approach. Finally, we use specific Multi-Criteria Decision-making Methods (MCDM) to formulate the guidance that experts give us on the future of work. A combination of Best-Worst Methods (BWM) and Decision Making Trial and Evaluation Laboratory (DEMATEL) was used (Si et al., 2018).

1.2. Defining the task

Forecasting the future of work has become an important task for researchers. The underlying hope is to identify major risks (or positive avenues) for stakeholder groups and develop effective policy to mitigate those risks. The discussion in recent years is that the latest Artificial Intelligence (AI) and robot technology will increase productivity dramatically. Technology is argued to lead to mass-unemployment, which requires drastic changes in labour market and organisational policies (Brynjolfsson & McAfee, 2015). Future forecasting related those this argument has focused on the number of unemployed and the gravity of the future of work. The future of work is usually portrayed as the future of occupations. This involves extrapolations in various forms. The most well-known extrapolation is of Frey & Osborne (2017). The future of each occupation can be sketched using computerisation probabilities. Rising productivity caused by automation would lead to growing differences in the size of occupations and changes in wages and employment (Bessen et al., 2019).

The future of work is outlined as changes in the structure of occupations (e.g. polarisation). Frey & Osborne (2017), and with them, many other specialists (see, e.g. Nedelkoska and Quintini, 2018; Heald, Smith and Fouarge, 2019) fear new divisions in the workforce between high, middle and lower-educated people. Within organisations, the distance in opportunities and future visions between management and the shopfloor has greatly increased over the years (Autor et al., 2020; Fossen & Sorgner, 2022a). Not only does the latest technology lead to differences between jobs within an organisation, but technology can also create labour enhancement with improved labour market outcomes for workers (Fossen & Sorgner, 2022a). At least, new technology provides the opportunity to do so in those organisations where workers can have a say about technologies (Acemoglu & Restrepo, 2019; Belloc et al., 2020).

In reality, the predictions made over the past decade have not proven right. Frey & 0sborne' s (2017) forecast increasingly diverges from what labour markets in the developed world show in practice. The current economic context for this forecasting is continuous low productivity (Moss et al., 2020). The impacts of this situation are visible in, for example, lower wage growth, too little innovation, too high mental workload, and the growing inequality between work situations at a global scale. To understand these outcomes, it is necessary to take a different approach from that of calculating only the probabilities of computerisation for occupations. Autor, Mindell & Reynolds (2020) do a fair amount of work to estimate the impacts of labour enhancement. However, Autor (2015) admits that it is not easy to use it to predict the future of work using such an approach. After 2000, productivity levels only have cooled down. Where in the past, there have been several waves of productivity increases (19th century; see Perez & Murray Leach, 2021), with the 1990-2000 period being the last significant increase in productivity, the decline in productivity growth forces us to look beyond the capabilities of the latest technologies (Haskel & Westlake, 2018).

Assessing the ramifications of this debate, the basic problem remains that even the power of Industrie 4.0[1] technology seems unable to solve the problem of low productivity (Genz, 2022). As Moss et al. (2020) point out, this debate on the future of work should be brought back to a discussion about what conditions should be regulated to increase productivity. They admit that this is complicated since the number of explanations for the productivity decline is overdetermined (p.8). There are too many explanations. The researchers temper the expectation that one explanation can be found to help solve the problem of too-low productivity growth. This also indicates that formulating a forecast about occupations and employment should not be the main endeavour at the moment. The scientific field also seems increasingly aware of this. It is striking that a journal, such as *Technological forecasting and Social Change*, has no publications on the future of work in the year 2022. Further analysis of the causes of the productivity growth problem does not seem to give us insights to improve the future of work. Rather, it seems important to examine what levers exist in the set of organisational and institutional factors that play a role to yield more productivity.

The research in this subtask of BEYOND 4.0 will not yield precise estimates at the occupational level or in types of work in the future. **Rather, it will look at those drivers in a forecasting exercise and consider: what if we do nothing? What if we do something? And what should be done?** The BEYOND 4.0 project provides us with insights into 'what if nothing changes', but also into those factors that may lead to positive change. This task of BEYOND 4.0 summarises the research results on the drivers and breaks of positive change provided in the different work packages of BEYOND 4.0 and discuss those factors with experts and stakeholders. What is needed to leap to the desired future? This analysis also reveals the risk of remaining in the current productivity slowdown.

An argument for taking this step is also in line with the historical research in the BEYOND 4.0 project (Perez & Murray Leach, 2021). We know that we may be on the eve of a new productivity surge, but we need to formulate plans for that surge to happen in an inclusive way. Such a roadmap is then included in this study. So, the study developed a nothing-changes-scenario and compared that to a scenario in which we are willing to take the necessary steps for inclusive growth. Those steps lie more at the organisational level than just in the influx of new technology. Companies have sufficient

[1] We choose to use the German Industrie 4.0, as this concept was launched by German industry (Warhurst et al., 2020).

technology available but rarely achieve the potential of this technology (Belloc et al., 2020; Dhondt & Dessers, 2022; Dixit et al., 2022; Greenan et al., 2002; Greenan & Napolitano, 2021). It comes down to bridging the distance between 'no change' and the 'desired change'. This bridging was done in discussions with experts and stakeholders. The question presented was what takes precedence in factors needed for change. The potential factors that may influence this change were provided from the BEYOND 4.0 research (WP4, 5, 6, 8, 9). With the answer to that question, we were also able to look at what this means for employment and types of occupations. Experts were asked to contribute their thoughts here.

1.3. From forecast to scenarios

With this agenda, the focus is not first on forecasts based on task composition as suggested by a multitude of research (see Figure 1). The future of work is more related to those factors that help generate higher productivity growth. The objective is not just any productivity growth, but a healthy one, both inclusive and sustainable. The BEYOND 4.0 project identified its main components as follows: learning organisation; increased labour market and social participation, managing technology that favour work enrichment, high quality of work; activating work environments, and supporting social security. In the next sections, we bring those elements together.

For the BEYOND 4.0 project, it is about identifying what is needed to shape a positive future. From the predictions of Frey & Osborne (and others), the picture emerges of major (negative) challenges in the future to which policymakers need to respond. Over the past decade, policymakers have braced for mass unemployment, discussions on universal basic income, prepare for reshoring of work, and/or coupled to strategies to encourage companies to adopt of Industrie 4.0 technology. The latter paradoxical strategy was connected to the idea that this technology would help Europe reconquer markets and employment opportunities. This approach has not prepared policymakers for the current situation of growing employment rates, falling real wages, rising inequality and a further decline in productivity growth. Meanwhile, skyrocketing inflation has only exacerbated this situation. Companies only see their profits growing and the price of labour is declining ever more sharply. A different approach is needed when the objective is to develop healthy productivity growth. In the European context, this has been flagged as Industry 5.0 (Breque et al., 2021). The question is what solutions we can put forward to drive this productivity growth. The key to this lies in the components that have an impact on inclusive and sustainable economic growth.

To derive lessons from the BEYOND 4.0 results, in 2022, we have organised targeted discussions with experts and stakeholders. Those discussions were aimed at prioritising an action repertoire needed to make the leap to that inclusive future.

Once these results were known, we focussed back on the forecasts in occupations and situations. The scenarios under discussion generated forecasts 'if nothing changes' and 'if all effort is directed to the new future'. This new future is labelled as the 'high road future of work'. The comparison of the two future forecasts indicates what policymakers should take into account in their policies. Such an outcome is a different one from what came out of the pessimistic picture of Frey & Osborne (2017) and Brynjolfsson & MacAfee (2015). Policymakers have more to gain from developing a positive perspective than preventing disasters from occurring.

1.4. Structure of the study

First, a brief overview is given into forecasting research in recent years (section 2). These forecasts are largely based on the calculation of computerisation probabilities. Various possibilities have been explored to improve this Frey & Osborne approach (2017). The core idea is that skills determine the future of professions.

Dhondt et al. (2021a) showed that the interpretation of skills depends on how organisations function. Greenan and Napolitano (2021) stress that supporting innovative work environments rests on the fine tuning of a fragile equilibrium that secures and enabling use of digital technologies and new management tools. Acemoglu's views on 'so-so' technology (Acemoglu & Restrepo, 2019) and Belloc's views on participation (Belloc et al., 2020) help to support this interpretation. In particular, the BEYOND 4.0 research (WP4, WP5, WP8, WP9) focuses on the drivers of an alternative future of work. The third section of this report fits the pieces together (learning organisation, skills transfer, reorganising capital: institutional changes). These analyses help to identify the driving forces for an alternative future of work and let our experts and stakeholders look at which factors matter most. To do so, a multi-criteria decision making methodology (section 4) is used to prioritise, weigh and formulate an alternative future scenario of work, called the high-road future of work.

The final section (5) then shows the research implications, given the lessons of BEYOND 4.0.

2. The limits of the computerisation probabilities for the future of work

2.1. The prediction of Frey & Osborne and the current dominant economic model

The core idea of Frey & Osborne (2017) is that the newest technology (AI and robots) substitutes work. To understand and estimate which jobs will disappear, they suggest to look at the skills composition of jobs and tasks. If these jobs and tasks consist of too much routine physical and routine mental tasks, these jobs will be substituted by technology. The methodology implies that it is not really necessary to look at technology itself and how it works out in workplaces. Assessing skill compositions is sufficient to understand which jobs will survive.

Frey & Osborne envisioned an economic scenario in which productivity of companies was going to skyrocket. Computer technologies would make large numbers of occupations redundant. The technological shock would be such that existing labour market institutions would be unable to manage the surplus of unemployed. A better perspective would be to teach the unemployed to cope with a life without work (see also Brynjolfsson & McAfee, 2015). A universal basic income would then come in handy. The school system and companies should do everything possible so that employment would be upskilled to what companies would need. Above all, companies should be self-managing their investments. Self-management of risks and opportunities should guarantee a growing economy.

2.2. Does making Frey & Osborne's methodology more sophisticated help?

Frey and Osborne calculated a high percentage of jobs that would disappear. The job destruction rate did not materialise in the years after publication. The initial reaction to this discrepancy was that estimating future changes in the labour market, based on occupations, would not yield reliable estimations. The methodology needed improvement and the path chosen was a task based approach to the future of work (Arntz et al., 2016; Nedelkoska & Quintini, 2018). The task-based method is becoming even more popular in the research field, as demonstrated by Figure 1.

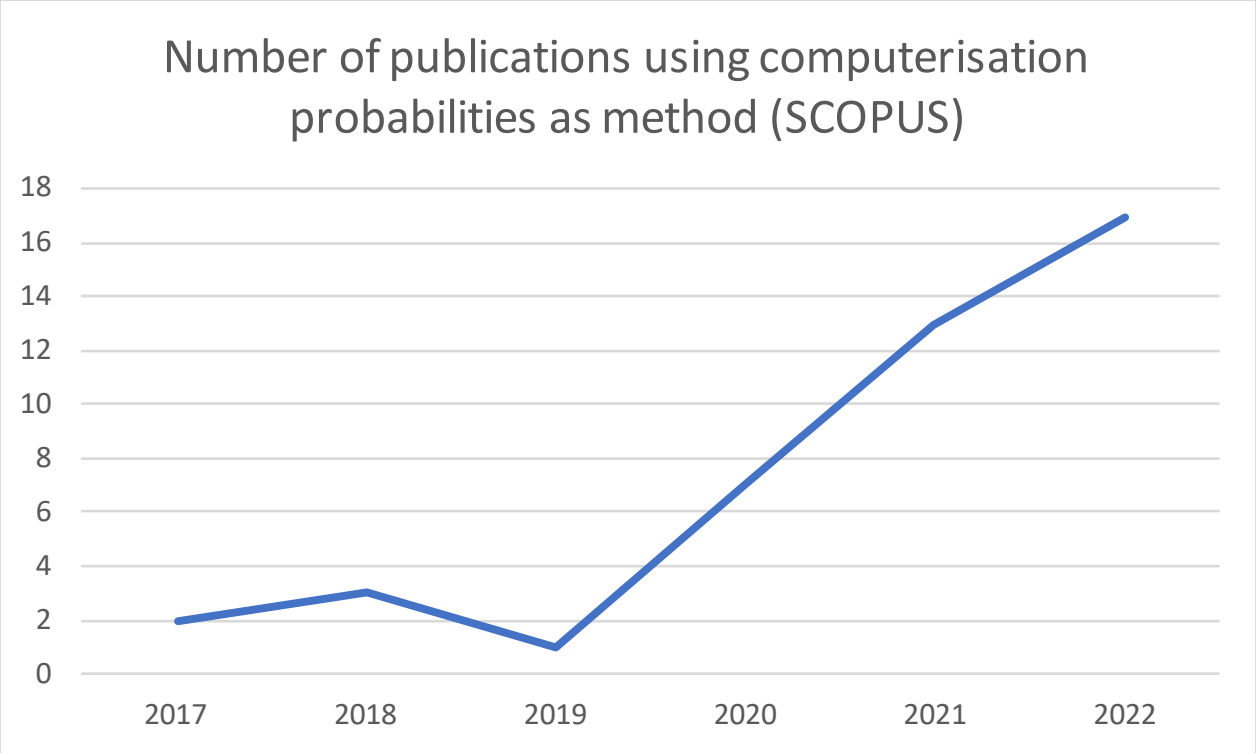

Figure 1. Number of publications citing the task-based approach to computerisation probabilities

The task-based approach changes the perspective from occupations to shifts in tasks. A great number of studies has been conducted to estimate how the future labour market will look alike (Arntz et al., 2017; Heald et al., 2019; Nedelkoska & Quintini, 2018). The SCOPUS search provides a list of more than 43 studies using this task-based approach (for example: Damian et al., 2017; Fossen & Sorgner, 2022b; Haiss et al., 2021; Illéssy et al., 2021; le Roux, 2018; Lima et al., 2021; see list of DOI in Annexe 3).

Several authors suggested that the task-based approach needed sophistication. Kim, Kim & Li (2017) suggested to use Markov chains to improve predictions. The main idea was that Markov chains allowed predictions without too much preliminary understanding of existing contexts (Kim et al., 2017). Jaimovich et al. (2021) suggested more Machine Learning methods[2] to get better predictions

[2] https://www.brookings.edu/research/a-tale-of-two-workers-the-macroeconomics-of-automation/?utm_campaign=Economic%20Studies&utm_source=hs_email&utm_medium=email&utm_content=81897025

of the future. Machine Learning would allow learning from data collected on skills and professions. Frey & Osborne (2017) had already used machine learning for their estimations. One expectation was that a more sophisticated Frey & Osborne methodology adds value to the forecasts of the future of work.

All these improvements remained faithful to the future forecast and policy recommendations made by Frey & Osborne. However, there was more attention to differences in effects for labour market groups with different views on whether there would now be polarisation of labour market opportunities, or whether especially low-skilled people would have to pay the price of progress. Policy would then require different measures.

2.3. The limits of the Frey & Osborne methodology

The first estimations made by Frey and Osborne were made in 2013. Since that date, none of their main expectations have been confirmed by actual developments in labour markets. The same applies for the estimations made by the task-based approach. The current (EU and US) economies did not develop themselves in the way the task-based methodologies expected.

Over the past years, the Frey & Osborne-methodology (and succeeding improvements) has been subjected to an in-depth analysis and critique (Handel, 2022b; Pfeiffer, 2018). The core question is to what degrees current skills composition can predict what will happen to a profession. Several work surveys and skill approaches were compared to predict engineering bottlenecks in professions (Dhondt et al., 2023). Next to Frey & Osborne, there exist other forecasting approaches building on other views on skills. Comparing these different approaches showed that the skills approach suggested by Pfeiffer & Suphan (2015) would yield better predictability of the future of jobs than the methodology of Frey & Osborne. Still, for the Flemish situation, the overall degree of predictive validity remained low (Dhondt et al., 2023). This result was confirmed in an analysis of Handel (2022a) for the US labour market. Dhondt et al. (2021a) observed in Dutch data that the so-called 'soft skills' (creative, social, communication skills) are not for ever fixed in jobs. Depending on the type of organisation one was working in, you can be assigned to use these skills in your work situation. If an organisation changed into a more tayloristic model, then these skills would not be required from employed. Analysing skills surveys would yield more information about the type of labour division used by organisations, rather than that this information would be helpful to estimate what would change in jobs. The study pointed out the importance to monitor the shifts in the use of organisational models. Fernández-Macías & Bisello (2022) move in this direction by proposing a taxonomy of tasks with a distinction between the content of work (physical, intellectual, social tasks) and the methods and tools of work, the former pointing to choices in work organisation and the latter to technology uses. In estimating the future of work, it seems not useful to focus mainly on refining the Frey & Osborne approach with higher quality of the technical instruments (forecasting, Markov chains, machine learning).

However, Frey (2019) doubled down on his predictions. He foresees that automation probabilities help explain high unemployment in regions and the rise of populist movements. Such a reaction may deter businesses from future investments in new technologies.

Again, these latter observations have little solid ground in reality. Populism is not only related to unemployed, but to more profound factors such as how ruling elites have dealt with the population

(Berman, 2021). Various data have been brought together on the actual development of labour markets and what this means for the dominant business model that is visible.

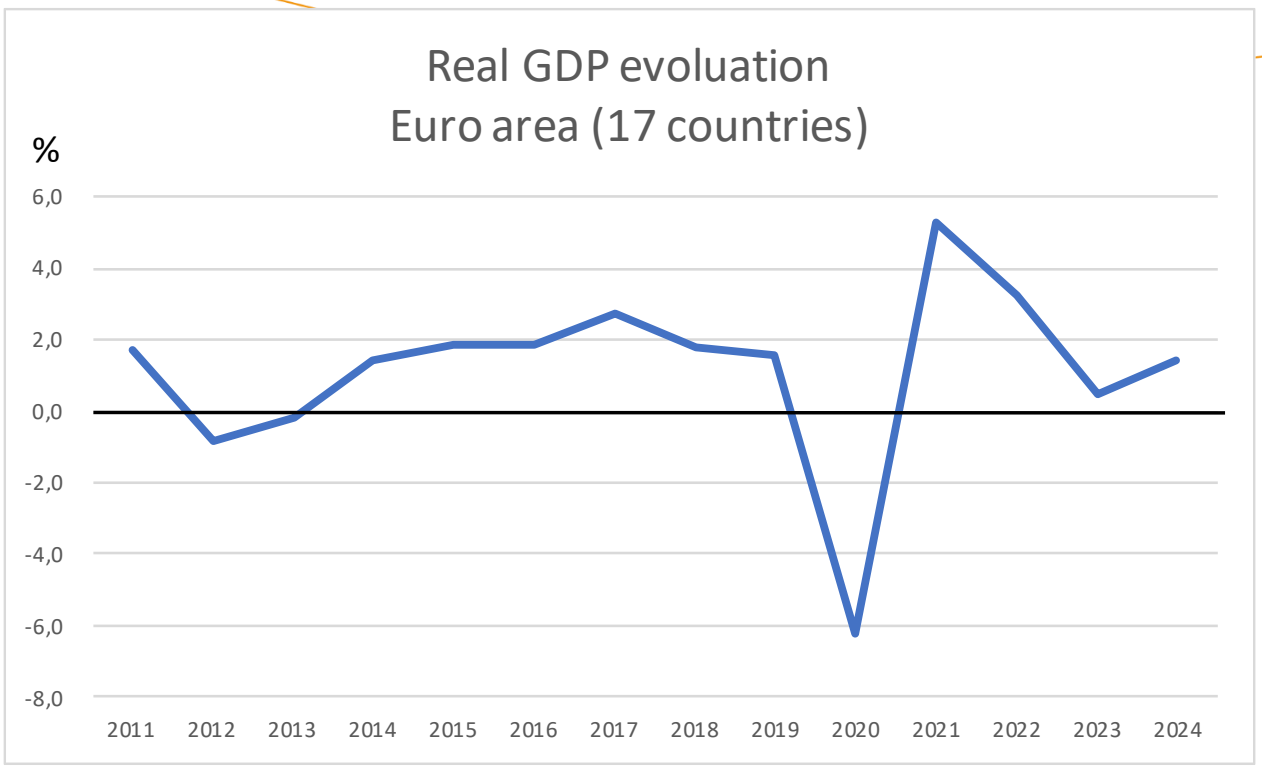

Figure 2. Development and forecast of real GDP in the Euro Area from 2011 until 2024 (source: OECD Economic Outlook No 112 – November 2022 (https://stats.oecd.org/Index.aspx?QueryId=51657#))

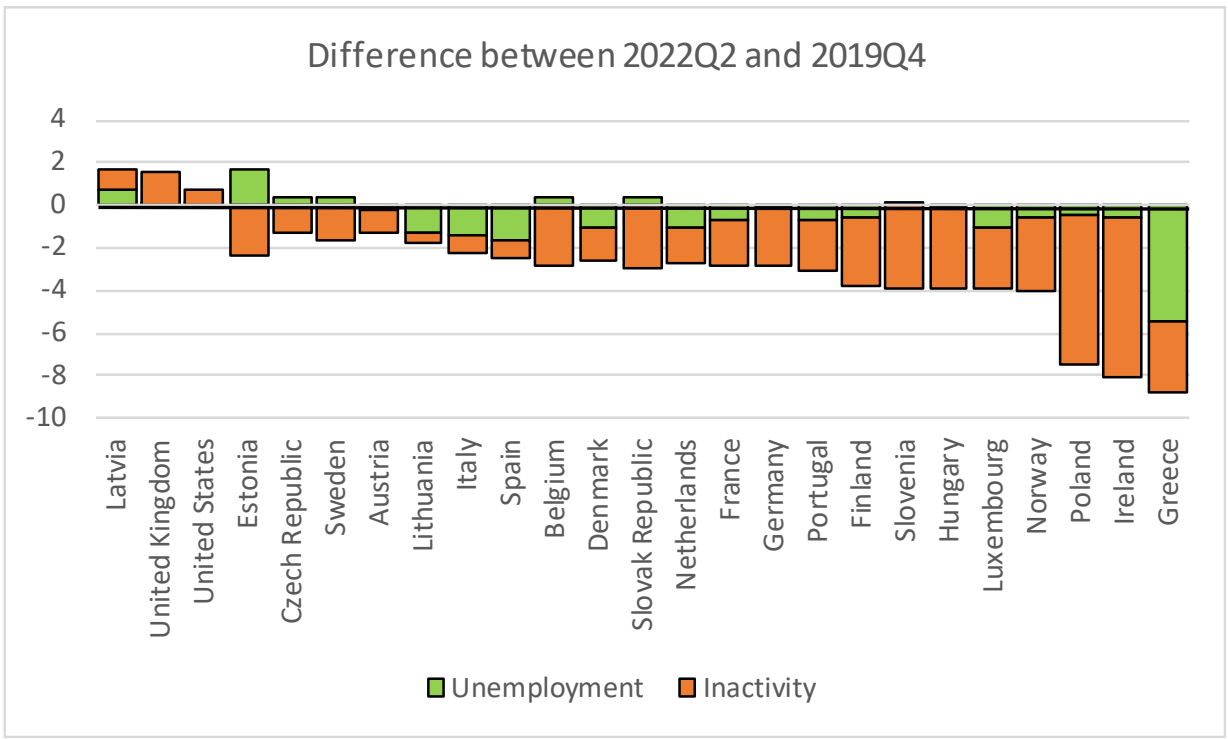

Figure 3. Development of unemployment and inactivity rates in selected OECD economies between 2019Q4 and 2022Q2 (adapted from: OECD, 2022b)

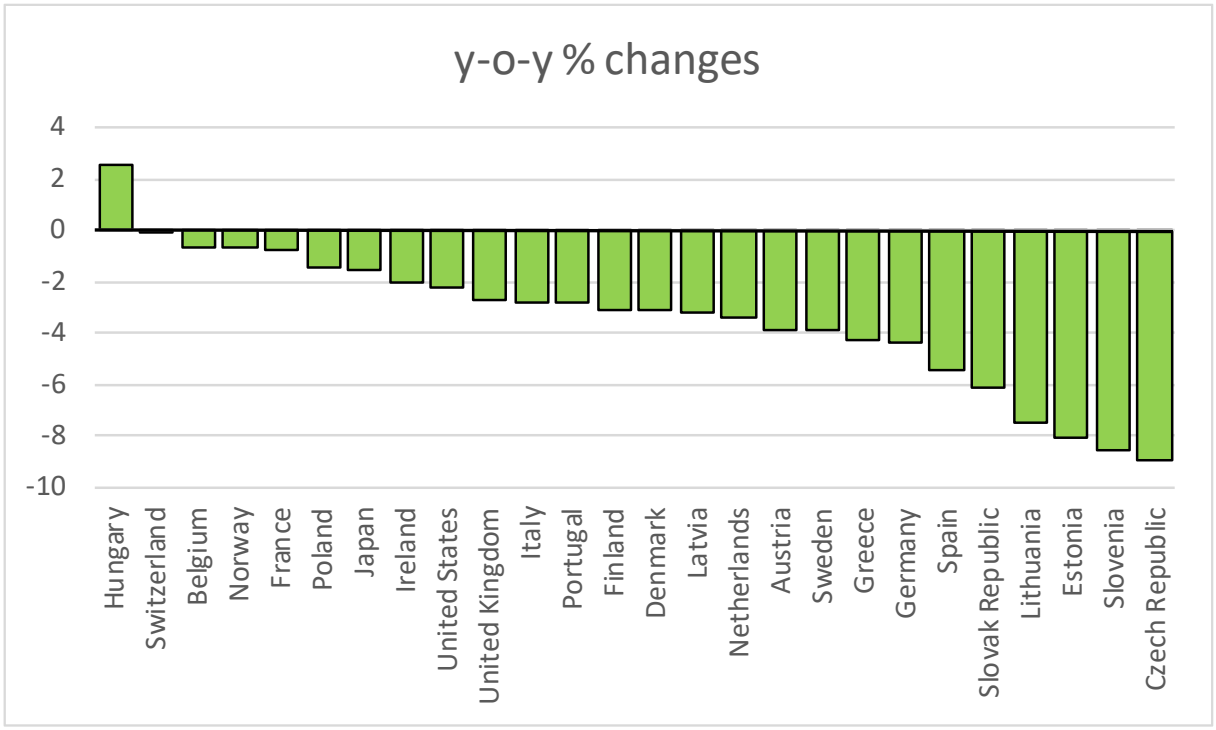

Figure 4. Development of real wages in selected OECD economies in 2022Q3 (adapted from: OECD, 2022a) (Note: Compensation per employee deflated using the personal consumption expenditures deflator)

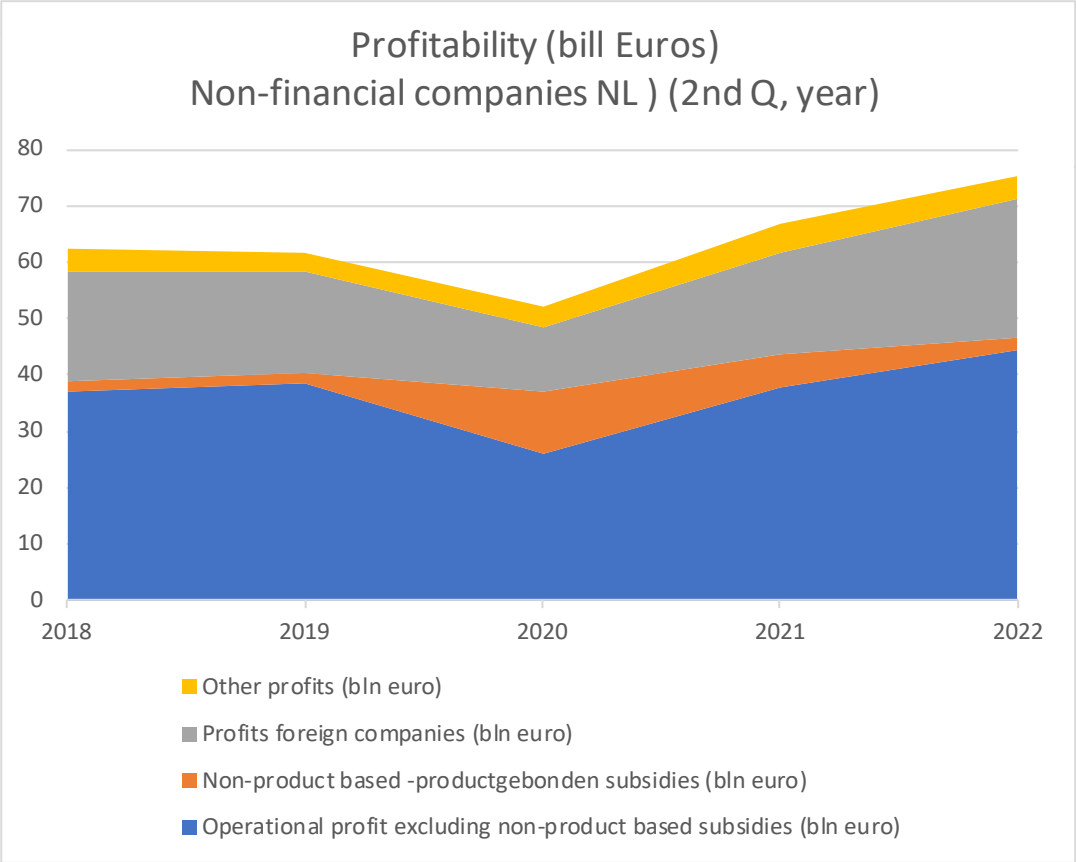

Figure 5. Profitability rate of non-financial companies in the Netherlands between 2018 and 2022 (second quarter) (source: Dutch Statistics, download 22-12-2022)

Figure 2 shows that economic growth in the Eurozone has recovered after the corona period, but no greater growth can be expected for the first few years to come. What is most striking for recent years is the rampant growth in employment. Figure 3 shows how participation rates have risen sharply and unemployment rates continue to decline. Frey & Osborne (2017), as well as Brynjolfsson & MacAfee (2015), saw in the falling prices of technology a reason why companies would invest more in the new technology. However, it is precisely the falling price of labour that causes companies to invest more in labour rather than technology. And paradoxically, companies see profitability rising (Figure 4) precisely as a result of falling real wages (Figure 5 as an example for the Netherlands). For six countries from the BEYOND 4.0 survey (data are too incomplete for Bulgaria to include), the development of profitability, investment and labour share has been calculated. Figure 6 shows this development from 1995, with 2013 as the reference point (index = 100).

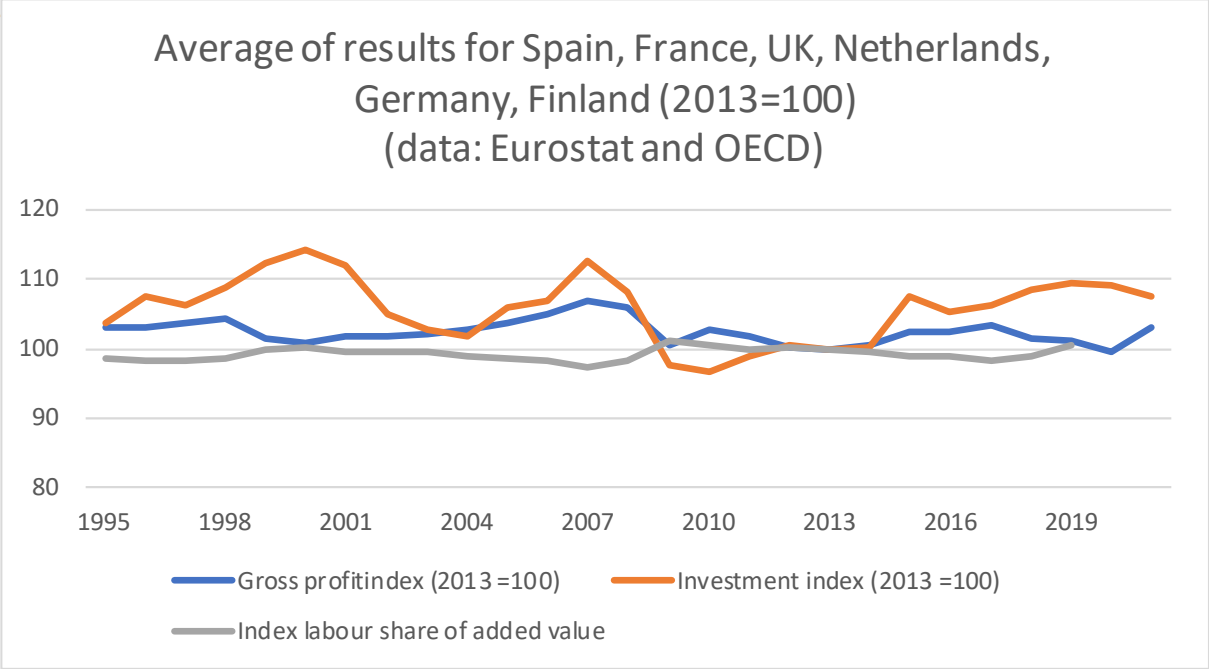

Figure 6. Development of the average for six countries for gross profit index, investment index and index of labour shares of value added in the period 1995-2021 (sources: Eurostat & OECD[3])

The profitability of (non-financial) companies has continued to develop positively since 2013, despite the impact of corona on their operation. In contrast, the labour share has deteriorated (ILO/OECD, 2015). Investment by firms appears to have remained on track during this period, but at a lower rate than in the pre-2013 period. Statements of Frey & Osborne and task-based specialists need to be adjusted. Further commitment to Universal Basic Income (UBI), self-regulation and development of generic skills are probably not the key to achieve a more productive future. Other factors, such as what is implemented as policy within organisations, may be a more important explanation of what will occur in the labour market.

Frey (2019) himself points out that the rise in productivity in the 1990s was generated by complementarities between computer technology with organisational changes (p. 238). He points out that this complementarity between technology and organisation drove productivity gains in the past. Indeed, Corrado and Hulten (2010) have demonstrated that a major shift in the composition of investments and capital formation towards intangibles had occurred between 1948 and 2000 and they argue that it is of critical importance for understanding economic growth. Using European macro-level data, Corrado et al. (2017) provide empirical evidence of productive complementarities between ICT use and the intangible capital resulting from investments in R&D, design, brand, firm-specific training, and organisational change. They indicate what current and future conditions for improving this complementarity are needed. These complementarities rely on the ability to orchestrate a complex set of assets and combine them into new products and services that respond

[3] ESTAT (24/12/2022) Key indicators - annual data [NASA_10_KI__custom_4308777] (Gross profit share of non-financial corporations); Key indicators - annual data [NASA_10_KI__custom_4308804] (Gross investment rate of non-financial corporations); OECD, STAN Structural Indicators (iSTAN) 2022: LVBA: Labour share of value added (26/12/2022 from OECD.Stat).

to the challenges of inclusive and sustainable growth. As Pistor (2019) argues, over the past decades, there was a clear redirection in company policies towards measures to protect capital rather than use technologies and organisational practices to increase and share wealth. If this situation remains unchanged, we need to understand what needs to change for companies to improve organisational practices that promote healthy productivity growth and how best to proceed to move in this direction.

3. The high-road future of work scenario

3.1. The need to change company practices

Frey & Osborne (2017) and the task-based approach point out that digital technology is mainly focused on the substitution of labour by technology. However, Autor et al. (2020) find that currently digital technology is rather labour-augmenting. According to him, alternative futures of work should be possible, or even necessary. A future in which low economic growth remains coupled to high labour market participation rates, declining real wages and high corporate profits is increasingly unacceptable to the working population. The rise of the Trump presidency and Brexit are examples of how working people are turning against the imaginary of the economic elite (Frey, 2019, p. 213). The current economic model needs to change. Pistor (2019) has already pointed out how the current capitalist system gives firms many opportunities to permanently appropriate productivity gains. It takes more than manoeuvring at the margins. The question then becomes which scenario is real where firms invest more in technology while allowing salaries to rise. For now, there is no incentive to do so. Piketty (2014) looks for the solution in changing taxes on wealth. An alternative is to explore whether a high-road future of work (Osterman, 2018) is possible. An increasing number of authors and actors in the literature, as well as in policy itself, point to this.

The issue with the future of work is not so much what the future of work should be. The literature (Bodrožić & Adler, 2018; Pianta & Reljic, 2022; Rodrik & Sabel, 2019), the policy approach (e.g. Industry 5.0 as a goal; Breque et al., 2021), but also the scientific results of the BEYOND 4.0 project, sketch a possible future that is more productive and enriching for our societies. The claim is that we should wish ourselves a high-road future of work. The issue is, therefore, rather, how to get there? What actions matter? Which action weighs most heavily? And is it possible to define a roadmap that should be followed to get to that desired future? A network of experts is engaged to determine the weighting of actions and outline a roadmap. This roadmap is then presented to stakeholders. They could indicate how realistic this roadmap is and what is needed to have it implemented. First, however, more explanation is needed for this high-road future of work. The context for this discussion is the dominant economic model.

The dominant (current) economic model can be outlined as follows. The economy is dominated by large extracting companies that are able through financialisation strategies to control the appropriation of revenues from production. These companies tend to earn more from exploiting low labour costs, rather than invest in high tech strategies. Digital technology is mainly deployed to achieve exploitation rather than exploration and hence companies are less focused on real disruption through offering products and services that are new to the market than on the optimising production processes along the value chain through process and marketing innovations. This

strategy allows them to benefit from globalisation while securing their market share and reducing the uncertainties associated with the global operating scale. Within companies, the pressure is on employees to secure their employability and right-skilling (Schlogl et al., 2021). On the labour market, social security focuses mainly on activation of the workforce regulating conditionality of subsidies. Self-development initiatives are sanctioned or restricted. This impact of this dominant economic model is currently visible in our economies: e.g., low wages, many marginal businesses, little product innovation, labour flexibility, and lagging growth in labour productivity. If nothing is done, then this current model will remain dominant in the future (Moss et al., 2020). It is important to see the company model and practices that drive this dominant economic model. Any improvement of productivity growth will need to start with changes in how companies operate. This situation is maintained by how policymakers approach the topic. On the one hand, policymakers want high skill, high wage jobs, high productivity, high innovation forms and inclusive labour markets and better uses of scarce environmental resources. On the other hand, they allow firms to do the opposite. There is therefore a gap between policy rhetoric and policy implementation.

A desired, alternative economic model can be outlined as a model that strikes the right balance in a number of trade-offs: between new opportunities/change and established practice/continuity; between exploration/innovation and exploitation/standardisation; between flexibility/agility and productivity improvements/cost reductions; between creativity and control. This implies building the framework conditions for making employees as well as individuals involved in the business ecosystem willing to share their good ideas and participate into innovations. In an EU labour market characterised by the growing educational level, the feminisation and the aging of the workforce, the quality of work and employment relationships as well as the quality of contractual relationships within business ecosystems are crucial. Enhancing the learning capacity of organisations and networks in business ecosystems is a key goal to move onto the high-road. The learning capacity of the organisation relates to the skills, management tools and organisational practices concerned with the improvement of individual and organisational learning. It facilitates the creation, acquisition, transfer, integration of knowledge, to distribute it among its members and business partners. It implies the recognition of increased job demands associated with innovation and change at least in the short run, transparency about the consequences of choices as well as the pursuit of fairness and justice (Greenan & Napolitano, 2021). Results from WP5 (Beyond 4.0 D5.1) show that investment into the learning capacity of the organisation is a win-win strategy leading to more innovativeness and a high-road of improved socio-economic outcomes. Further, investments in digital technologies may lead to a high or a low road depending on the learning capacity of the organisation and its innovation strategy. A high learning capacity associated with product and service innovation and, to a lesser extent organisational innovation favours the high-road when low learning capacity, marketing innovation and, to a lesser extent process innovation leads to the low road. Hence technology uses need to be oriented towards combination of innovation that entail new product and services rather than focus on process and marketing innovation only. More participation should be allowed in technology and organisational decisions to secure progress towards increased job quality and better mastered OSH and work-life balance issues (Greenan et al., 2023). Any collaboration with external parties should also focus on controlling unwanted externalities (Ryan-Collins et al., 2022). This desired economic model leads to more value creation at the corporate level and an improvement in the quality of work and life at the individual level (Bodrožić & Adler, 2018; Pianta & Reljic, 2022; Rodrik & Sabel, 2019; Warhurst et al., 2020; Warhurst

& Knox, 2022). The results of the BEYOND 4.0 research show that while the high-road is already visible in companies, it is not the dominant economic model.

3.2. Understanding what is needed for this high-road future of work

The BEYOND 4.0 research has looked at how the digital transformation, at different institutional levels, impacts work. From this research, specific interesting results have become clear that shed light on new ways companies can use digital technologies in more innovative ways and become more inclusive. Put together, these elements can compose a high-road future of work. The core elements of such a high-road are less consumption of resources, increased participation in trade-offs around work-life balance, more resilient behaviour of persons on the labour market, use of higher skill requirements, more job control, less risky work settings and innovative organisational practices.

An internal project team discussion has provided an overview of the main elements that are needed for this high-road future of work. Table 1 outlines the linkages identified by the BEYOND 4.0 research for a high-road future of work. The BEYOND 4.0 studies show that this high-road is currently not at all the dominant strategy in companies, and that we also see a reduction in investment in this perspective. What we need to learn from this long list of issues, is which weight should be given to different aspects of the high-road and how to prioritise in the actions. We define these aspects as 'implementation challenges' (see Alimohammadlou & Sharifian, 2022). We will explain further how such weights can be obtained. The prioritisation will allow to develop a roadmap, and with this a time-perspective (3-10-longer years) for implementation of the scenario. The table distinguishes factors at the institutional, organisational and technological level.

Table 1. Overview of implementation challenges for a High-Road Future of work as derived from our research

Implementation challenges	Explanation	Beyond 4.0 research results	Supporting literature
Institutional level			
- Activating social security system	Social support that enables transitions jobs and mobility between jobs, including new jobs.	WP6, 9	(Focacci et al., 2022)
- Introduction of job quality guarantee	Institutional support for job quality, as done in the Pillar of Social Rights, is a necessary requirement for positive change	WP2	(Focacci et al., 2022)
- Stimulating participation in social valued activities	Social support rules that activate unemployed to participate in socially valued activities create societal support for participation income	WP9	(Hiilamo, 2022)
- Stimulating training of the unemployed		WP9	(Focacci et al., 2022)
- Taxation of wealth, rather than income	Lower taxation of income changes reinforces employment	WP7	(Piketty, 2014)

Implementation challenges	Explanation	Beyond 4.0 research results	Supporting literature
- Counteracting digital rentiership	Digital rentiership channels profits away from employed and from taxation systems and should therefore be avoided	WP7	(Ryan-Collins et al., 2022)
- Stimulating social dialogue	Social partnership is the main way to solve company level and society level social issues.	WP9	(Belloc et al., 2021)
Organisational level			
- Learning capacity	Learning capacity consists of organisational measures to improve individual and collective learning at work. It is focused on the preservation of the cognitive dimension of work, training opportunities, worker autonomy in cognitive tasks, stimulation of intrinsic motivation, autonomous teamwork practices, provision of direct help and support, supportive supervisory style, and direct worker participation.	WP5, D5.1 parts A & D	(Greenan, Napolitano, & El-hamma, 2022; Greenan & Lorenz, 2010)
- Stimulating product & services innovation	Innovation in companies focused on delivering new products and services favours better socio-economic outcomes	WP5, D5.1 parts A & D	(Pianta & Reljic, 2022)
- Not stimulating marketing innovation only	When it is not associated with product and services innovation, marketing innovation deteriorates socioeconomic outcomes	WP5, D5.1 parts A & D	
- Strengthening long-term employment relationships	Long-term contracts make employees invest more in their working environments		(Pianta & Reljic, 2022)
- Increasing wages	Higher wages lead to improvement in job quality and more innovation		(Pianta & Reljic, 2022)
- Strengthen ecosystem behaviour (to counter negative externalities)	Ecosystem concertation helps to counter parasitic ecosystem behaviour and other negative externalities (also: digital localism, Bodrozic & Adler, 2022)	WP4	(Jacobides et al., 2018; Lundvall, 2022; Stam, 2015)
- Strengthen training investments	On the job and informal training generate contextual and workplace related skills that contribute to the learning capacity of the organisation. Higher skills and better job quality are supportive to product and services innovation.	WP5, D5.1 parts A & B & D	(Erhel & Guergoat-Larivière, 2016; Muñoz-de-Bustillo et al., 2017)
- Strengthen deep investment in management competencies to deal	Managers need to encourage employee participation in the change/innovation process through enabling practices. This includes being	WP5, D5.1 parts A & B & D	(Brommeyer et al., 2023)

Implementation challenges	Explanation	Beyond 4.0 research results	Supporting literature
with technology and employability	transparent about the consequences of choices, recognising increased job demands and seeking equity and fairness. These management competencies stimulate product and services and/or organisational innovations		
- Strengthen deep investment in technical competency of employees	More technological competence is a necessity to improve any product and organisational innovation	WP5, D5.1, part B	(Malik et al., 2022)
- Strengthen participation in technology and organisational decisions	Co-decision making in technology and organisational decisions helps to secure progress towards increased job quality and better mastered OSH and work-life balance issues	WP5, D5.1, parts A & C & D WP8	(Acemoglu & Restrepo, 2019; Bailey, 2022; Belloc et al., 2020; Greenan & Napolitano, 2021)
- Increase flow-through opportunities for the low-skilled	Low-skilled employees that have better opportunity to move to better jobs, will invest more in skill development	WP9, WP6	(Appelbaum et al., 2003; Gautie & Schmitt, 2010)
Technology level			
- Stimulate digital technology leading to product innovation	Digital technologies that are used to support product innovation foster more favourable employee outcomes	WP5, D5.1, parts A & D WP8	(Bodrožić & Adler, 2022)
- Counteract uses of technology that lead to the platformisation of work (digital Taylorism)	In platformised work, digital surveillance reinforces the lack of time and procedural autonomy. These organisational strategies based on digital technologies challenge the capacity to generate and share new knowledge	WP5, D5.1, part E	(Bailey, 2022; Litwin et al., 2022)
Countering the uses of technology to optimise processes along the value chain	By focusing on cost reductions, the optimisation of processes tears apart the fabric of collective tacit knowledge among experienced employees both within and across interdependent firms, challenging the capacity to generate and share new knowledge.	WP5, D5.1, part A & D	(Litwin et al., 2022)

These key challenges can be summarised as follows:

- Institutional challenges: these challenges refer to the reform of the current social security systems. The core ideas are to keep focusing on an activating social security system, but to move away from sanctions and other types of incentives. Participation income is developed to support those not willing or able to participate in the labour market, but do want to focus

on important socially valued activities. Taxation needs to have a broader base, reducing the possibilities to evade taxing or making taxation of wealth and labour more comparable in impact. A main driving force for all changes should be in more social dialogue in the employment relationship.

- Organisational challenges: the core idea is that organisations are focused on developing their learning capacity. This can be achieved by ensuring that all employees have the opportunity to develop their skills in the context of work and by creating the framework conditions for people involved in production and the business ecosystem to be willing to share their good ideas and participate in innovations. Higher wages support this strategy. A separate organisational challenge is to ensure that the organisation is focused on innovative products and services. We found that product and service innovations are different from innovations aimed at streamlining processes along the value chain from supply to market. Innovation strategies based solely on process and/or marketing innovation are likely to be exploitative rather than exploratory and, by focusing primarily on cost reduction, may lead to a deterioration in socio-economic outcomes. Collaboration with external stakeholders should be supported, as in other domains such as entrepreneurial ecosystems as they favour the virtuous circle of innovation and socioeconomic outcomes (Focacci & Kirov, 2021; Stam & Spigel, 2017). Not only the technological skills of the employees need to be improved, but also the leadership skills that promote supportive and cooperative change management styles. Employees should also be able to co-decide in decision making about technology and organisation.
- Technological challenges: these challenges are formulated as measures to further support product and service innovation in companies, or to reduce the focus on technological uses that only lead to greater efficiency. The uses of technology that supports the platformisation of work and the optimisation of processes along the value chain are the main examples of digital strategies that are directed only at exploitation and cost reduction rather than building new businesses or product offerings.

The survey results of WP5 provide a view of what a possible future of work could be. The data also show that this future is not at all obvious. On the contrary, an element such as learning capacity seems to be even more compromised and thus out of sight (Greenan, Napolitano, & El-hamma, 2022). If we really want a change, we will have to start working in a targeted way on the various measures. This will require an elaborated roadmap for the selected elements.

3.3. Using MCDM to decide on the future path. Expert judgment through BWM and DEMATEL

These challenges for the high-road future of work, as identified in Table 1, have been put forward to organisational and labour market specialists to assess the importance of the results. Due to various constraints, such as limited time and limited availability of resources to achieve this high-road future of work, policymakers and other stakeholders cannot focus their attention on all implementation challenges. To tackle this difficulty, an interrelationship hierarchy is created to determine which critical challenges should be prioritised. Further, if decision-makers focus on these

critical challenges, it would create a ripple effect, enhancing the intended effect of more inclusive economic growth (Kannan et al., 2022).

Experts are presented with different institutional, organisational and technological challenges that the research team has investigated. These experts needed to solve the question of how they rank the challenges in importance and which relations they see between them. Table 1 has been reduced in complexity into Table 2. These core items have been presented to experts for evaluation.

Table 2. Description of challenges to the high-road future of work: reduced overview

A1. Institutional level challenges	
A4. Stimulating participation in socially valued activities	Social support rules that activate the unemployed to participate in socially valued activities create societal support for participation income.
A5. Stimulating training of the unemployed, investing in developing basic digital skills.	Most unemployed require more support for their basic digital skills.
A6. Stimulating social dialogue and collaboration between societal stakeholders	Social partnership is the main way to solve company-level and society-level issues.
A7. Supporting product innovation-driven business models rather than process- or marketing-driven business models	Innovation in companies focused on delivering new products. Marketing innovation does not create new products but rather more efficiency. Our economies require new products and ideas, not so much more efficiency.
A2. Organisational level challenges	
A8. Improving the learning capacity of an organisation	Learning capacity consists of organisational measures to improve learning at work. It focuses on preserving the cognitive dimension of work, training opportunities, worker autonomy in cognitive tasks, stimulation of intrinsic motivation, autonomous teamwork practices, provision of direct help and support, supportive supervisory style, and direct worker participation.
A9. Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability	Higher skills and better job quality are supportive of product innovation. More technical competence is necessary to improve any product and/or organisational innovation.
A10. Strengthen deep investment in management competencies to deal with technology and employability	Better management competencies are necessary to improve any product and/or organisational innovation.
A11. Strengthen participation in technology	Co-decision-making on technology at the company and societal level helps to make better technology choices.
A3. Technology level challenges	
A12. Stimulate digital technology leading to product innovation	Digital technologies that are used to support product innovation create more learning in organisations.
A13. Counteract platformisation technology (digital Taylorism)	Platformisation technologies lead to digital Taylorism and should be counteracted as a strategy.
A14. Countering supply chain optimisation technology	Supply chain management technologies only lead to more efficiency, not to product innovation.

The challenges in Table 2 are subsequently analysed using a combined BWM and DEMATEL to allow processing of experts' feedback. Such evaluation of a set of criteria at the same time falls under the heading of Multi-Criteria Decision Making (MCDM) models. Over the past decades, a broad set of MCDM models have been introduced. Such models have helped decision-makers and experts to calculate the values of criteria and alternatives based on their preferences. Other methods for determining criterion weights are analytic hierarchical process (AHP) or analytic network process (ANP). AHP assumes that there is a strict hierarchy among criteria between actions. ANP understands that there is a connection between actions, but that this connection can be non-linear. "*ANP is a mathematical tool that can methodically identify and order all kinds of dependency networks of criteria. It is essentially an extension of the AHP based on the concept of the Markov chain. It has a non-linear dynamic structure and is a powerful method that overcomes the problem of interdependence and response between criteria and alternatives in the real world. It has been successfully applied to many decision-making issues under realistic conditions.*" (Liu et al., 2020). ANP requires other methods to be followed to still bring in causality. "*However, there are three shortcomings to the original ANP analysis: its structure is based on assumptions, it requires time-consuming pairwise comparisons, and it is difficult to obtain coherent results when the number of criteria is large*." (Liu et al., 2020). BWM is also an ANP-method, but rather than asking for causal connection, it ranks the criteria in terms of best and worst. The original ANP pairwise comparisons are replaced by BWM to obtain more consistent results with fewer comparisons. BWM, originally proposed by Rezaei (2015), has been successfully applied in many fields. Not only can BWM be used to derive the weights of the criteria, but it also can be combined with other MCDM methods. BWM is used in this study in conjunction with DEMATEL. DEMATEL is designed to transform cause-and-effect relationships between elements in a complex system into a structural model.

BWM is a vector-based method that requires fewer comparisons than matrix-based methods like AHP. BWM uses only integers while making mathematical calculations and help in deriving weights independently and can also be combined with other MCDM methods. The BWM determines the preference of the best criteria over the others while showing the preference of all criteria over the worst one by a number falling between 1 and 9. This simple procedure is precise because it does not conduct secondary comparisons (Guo & Zhao, 2017). BWM has less Minimum Violation, which is a measure to check the ordinal consistency of the MCDM (Multi-Criteria Decision Making) methods by penalising order reversals and violations. The method is widely used to analyse different decision making problems on supply chain management and sustainability (Rezaei, 2015), project management and supplier selection (Jeng and Huang, 2015) and, recently, the evaluation of Industry 4.0 approaches (Alimohammadlou & Sharifian, 2022; Eldrandaly et al., 2022).

The Geneva Research Centre of the Battelle Memorial first proposed the DEMATEL technique at the beginning of the 1970s. DEMATEL visualises complex, causal relationships through matrices and charts. DEMATEL's advantage over AHP is that it helps to uncover the interdependencies among the variables by knowing the strength of relations and classifying them into cause and effect groups (López & Ishizaka, 2019). As a mode of structural modelling, the technique is particularly effective in analysing causal relationships between the components of a system, and it can confirm interdependencies among the factors to reflect the relative relationships they have. DEMATEL, then, is used to investigate and solve complex and interconnected problems. The technique not only converts mutual relationships into cause–effect groups through matrices, but also it

schematically depicts the relationships between the vital elements in a complex system (Si et al., 2018). As with BWM, there are several derivatives such as fuzzy DEMATEL (Si et al., 2018).

The research undertaken in this report aims to capture what is needed to make the change to a high-road future of work happen. The combined BWM-DEMATEL approach offers a scientific means to prioritise and rank the challenges to achieve the high-road to the future of work and establish the causal relations among and between the challenges by classifying the challenges into cause and effect groups. The reasoning to use these methods is that identifying the alternative economic model is mainly an expert exercise, and importance of each of the challenges can be identified by scientists with expert knowledge. In discussion with these experts, we look at what is needed first as an action to get the change done and then how the actions are interrelated. Two workshops have been conducted to allow for this discussion. The outcome is a roadmap of actions.

4. The results of a BWM-DEMATEL expert evaluation

4.1. Proposed method

4.1.1. BWM

The method is deducted from the six-step procedure proposed by Rezaei (2015). We refer to the BWM-publications listed in the reference list for the mathematical presentation and underpinning of the method:

- Step 1: Identify a set of n challenges to the high-road future of work initiatives from the BEYOND 4.0 final results (see Table 2).
- Step 2: Experts identify the best (e.g. most important and most desirable) and worst (e.g. less important and less desirable) challenges.
- Step 3: After selecting the best and worst challenges, the preference of the best challenge to the other challenges is determined using a number between 1 and 9.
- Step 4: Next, the experts determine the preference of all high-road challenges over the worst challenge using a number between 1 and 9. Both steps help assess the vectors best-to-others and others-to-worst.
- Step 5: Calculate the optimal weights of the high-road challenges in such a way that the maximum absolute differences are minimised. A solution is found using linear programming. Software is provided by Rezaei (2015) for this purpose (https://bestworstmethod.com/software/).
- Step 6: The last step is to check the consistency level of the comparisons. A value closer to 0 indicates higher consistency. If the assessment is not sufficiently consistent, the evaluators are asked to review their assessment.

The method also allows combining weight factors (see example: Kannan et al., 2022). To determine the relative importance of all the barriers, 'local weights' of main implementation challenges and

sub-category challenges can be calculated using BWM. The global weights of each sub-category challenges are calculated as product of weight of main category challenge and corresponding local weights. The sub-category challenge with the maximum 'global weight' was ranked '1' in the relative importance list, challenge with the second maximum value in the 'global weight' was ranked '2' and so forth. These challenges were ranked with the descending value of the global weights until all these challenge obtained some rank.

4.1.2. DEMATEL

The five-step procedure of the DEMATEL method (Mangla et al., 2021) is as follows:

- Step 1: The challenges to the high-road future of work are identified from the research results in Table 2.
- Step 2: The direct-relation matrix is computed. Each expert is requested to estimate the strength of relations between any two high-road challenges using a scale with values 0, 1, 2, 3 and 4 in a matrix, where '0' corresponds to "No Influence", '1' corresponds to "Low Influence", '2' corresponds to "Moderate Influence", '3' corresponds to "High Influence" and '4' corresponds to "Very High Influence", which describes the influence of one challenge on the others.
- Step 3: The normalised direct-relation matrix is determined. The average matrix is transformed into a normalised direct relation matrix by dividing each cell with the highest average row sum score.
- Step 4: The normalised direct-relation matrix is converted into a total relation matrix.
- Step 5: A threshold value for the digraph is determined. Normally, the average of scores in the total relation matrix is used as threshold, but other values can be used, if needed.

The results can be presented in the form of digraphs, showing the relationships between the challenges. In the digraphs, the horizontal axis depicts the importance of each challenge, whereas the vertical axis divides the challenges into cause–effect groups. Causal diagrams visualize the complex causal relationships in a structural model, providing valuable insight into the problem under investigation (Alimohammadlou & Sharifian, 2022).

4.2. Data collection

For the purpose of data collection, a total of thirty international experts was identified. Eventually, 21 of them completed the expert evaluation. Among them, eight are university professors in organisational and labour market research. The rest work for an university of think tank. All of them have seven or more years of experience in teaching, research, policy advice and consultancy on the topics of the BEYOND 4.0 research. All these experts are capable to take decisions in their relevant field. As explained, we provided feedback on consistency of responses. In two workshops, a part of the experts provided feedback on the actual outcomes of the two analyses.

4.3. Results

4.3.1. Most desirable and least desirable challenges

The BWM analysis prioritises the main high-road future of work challenges and sub challenges. After selecting the eleven most suitable challenges under the three categories of the challenges (hereinafter referred to as the main challenges), experts were asked to select the most desirable and least desirable challenges. Based on their feedback, organisational challenges represent the most important (best) challenge while technology related challenges represent as the least desirable (worst) challenge respectively. Next to this, experts were asked for their preference on best to other and other to worst challenges. Table 3 to Table 6 show the general distribution of preferences and dislikes among the experts.

Table 3. Best and worst challenges A1-2-3 over other challenges (count of preferred or least preferred challenge among experts)

	A1. Institutional	A2. Organisational	A3. Technological
Best to others: preferred	6	14	0
Others to the worst: least preferred	7	0	13

Table 4. Best and worst challenges A4-5-6-7 over other challenges (count of preferred or least preferred challenge among experts)

	A4 Stimulating participation in socially valued activities	A5 Training and development of digital skills	A6 Stimulating social dialogue and collaboration between societal stakeholders	A7 Supporting product innovation-driven business models
Best to others: preferred	0	7	11	2
Others to the worst: least preferred	10	2	2	6

Table 5. Best and worst challenges A8-9-10-11 over other challenges (count of preferred or least preferred challenge among experts)

	A8 Improving the learning capacity	A9 Investment in the technical competency of employees	A10 Investment in management competencies to deal with technology and employability	A11 Strengthen participation in technology
Best to others: preferred	11	5	4	0
Others to the worst: least preferred	2	3	7	8

Table 6. Best and worst challenges A12-13-14 over other challenges (count of preferred or least preferred challenge among experts)

	A12 Stimulate digital technology leading to product innovation	A13 Counteract platformisation technology	A14 Countering supply chain optimisation technology
Best to others: preferred	10	8	2
Others to the worst: least preferred	4	4	12

After identifying all pair-wise comparisons, the optimal weights and optimal value for main and sub challenges were computed using linear programming. After solving this problem, the value of optimal weights for the main challenge and each sub challenge were obtained in Table 7. Table 7Table 7. Averaged and aggregated weights of main and sub-category challenges for all experts

Challenge	Weight	Consis-tency (ξ^L)		Local weights local challenges	Consis-tency (ξ^L)	Global weight	Rank
A1. Institutional	0,29	0,08	A4. Participation in social valued activities by unemployed	0,13	0,31	0,0409	10
			A5. Stimulating training of the unemployed, investing in developing basic digital skills	0,28		0,069	7
			A6. Stimulating social dialogue and collaboration between societal stakeholders	0,37		0,109	4
			A7. Supporting product innovation driven business models, rather than process or marketing driven business models	0,22		0,0664	9
A2. Organisational	0,53		A8. Improving learning capacity of organisation	0,36	0,4	0,190	1
			A9. Strengthen training investments and focus on deep investment in technical competency of employees to deal with technology and employability	0,24		0,131	2
			A10. Strengthen participation in technology decisions	0,23		0,115	3
			A11. Strengthen deep investments in management competencies to deal with technology and employability	0,17		0,096	5
A3. Techno-logical	0,18		A12. Stimulate digital technology leading to product innovation (see explanation in introduction to survey)	0,39	0,12	0,0656	8
			A13. Counteract platformisation technology (digital Taylorism)	0,38		0,076	6
			A14. Countering supply chain optimisation technology	0,23		0,0405	11

The different challenges show high consistency, reflecting reliable results. The organisational challenges rank the highest global weights. Consequently, the ranking of the challenges is organisational > institutional > technological.

4.3.2. Causal relations using DEMATEL

After determining the most important and less important challenges to the high-road future of work, the most suitable challenges were analysed to identify their causal relationships. Based on the DEMATEL method, the experts were asked to frame the direct relation matrix using a pre-defined scale with values 0, 1, 2, 3 and 4. In annexe 1, the average direct relation matrices for all the comparisons are included.

Figure 7 to Figure 10 show the digraphs for the four comparisons[4]. The threshold values were computed by considering the average of all the elements in the total relation matrices. The digraphs divides the main challenges into 'cause' and 'effect' groups.

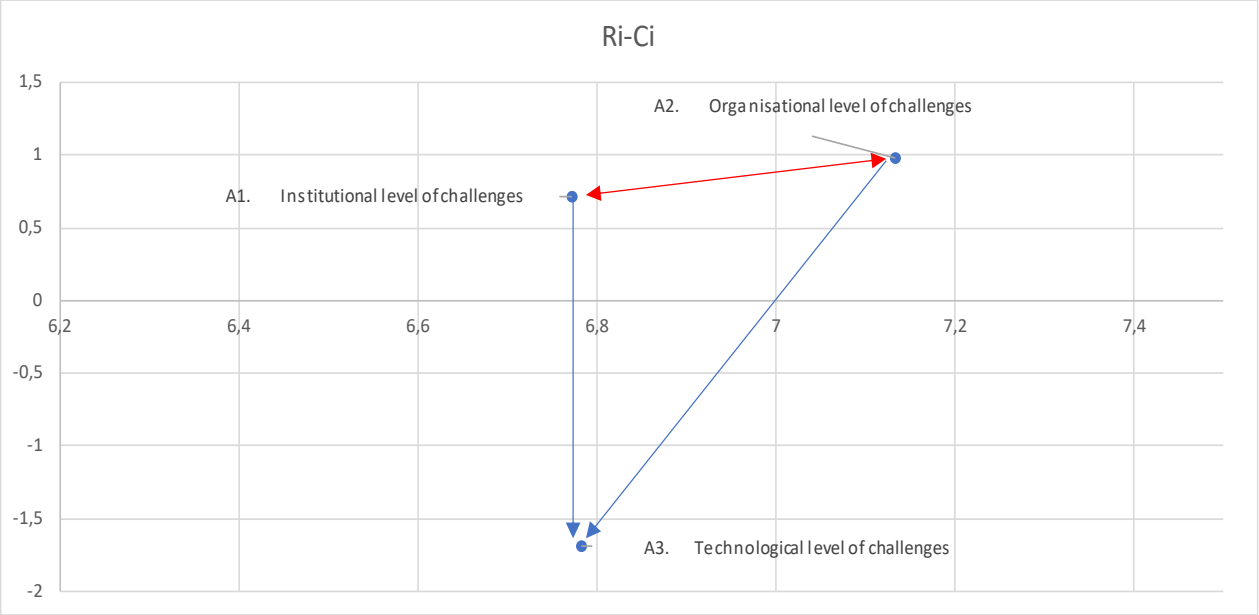

Figure 7. The influential relationship network among the main challenges A1, A2 and A3

Figure 7 shows that the organisational and institutional challenges, critically affect the technological challenges for the high-road future of work. The organisational and institutional challenges belong to the 'cause' group, while the technological challenge comes under the 'effect' group. The 'cause' group challenges need higher managerial attention in improving the high-road future of work initiatives success rate. A focus on the 'cause' group challenges will automatically improve the technological challenges.

[4] Blue lines in the figure indicate that there is directionality in the causality. The red lines show that challenges influence each other.

Table 8. Total relation and direct-indirect influence matrix of main challenges to high-road of future of work

	A1	A2	A3	Ri	Ci	Ri+Ci	Ri-Ci	Identify
A1. Institutional level of challenges	0,74	1,05	1,43	3,22	2,47	5,69	0,75	Cause
A2. Organisational level of challenges	1,10	0,82	1,57	3,48	2,51	6,00	0,97	Cause
A3. Technological level of challenges	0,63	0,65	0,67	1,96	3,67	5,63	-1,72	Effect
Threshold value =			0,96					

The organisational challenge has the highest value of 0.97 (Ri – Ci), which implies that these challenges have very high impact on the high-road of the future of work but receives comparatively less influence in return due to its relatively low (Ri + Ci) score (equal to 5.99). However, institutional challenges are at a similar level with (Ri-Ci)-value at 0.74 and (Ri+Ci) at 5.68. Figure 7 also shows that both challenges influence each other, implying that choices made at both levels are connected. Policymakers should work on both challenges at the same time.

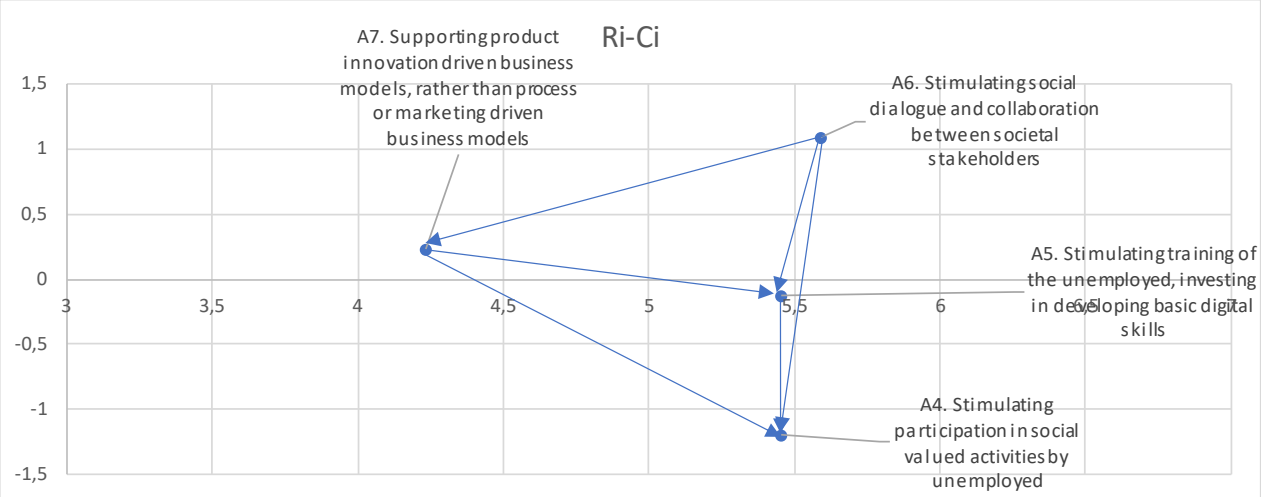

Figure 8. The influential relationship network among the institutional challenges A4, A5, A6 and A7

Figure 8 shows the relationships between the separate institutional challenges. Stimulating social and stakeholder dialogue (A6) and supporting product innovation (A7) critically affect the stimulating the training of unemployed (A5) and the participation of unemployed in socially valued activities (A4). A6 and A7 belong to the 'cause' group, while the other two challenges (A4, A5) come under the 'effect' group. The 'cause' group challenges need higher managerial attention in improving the high-road future of work initiatives success rate. A focus on the 'cause' group challenges will automatically improve the support to the unemployed in different forms.

Table 9. Total relation and direct-indirect influence matrix of institutional challenges to high-road of future of work

	A4	A5	A6	A7	Ri	Ci	Ri+Ci	Ri-Ci	Identify
A4. Stimulating participation in social valued activities by unemployed	0,54	0,63	0,53	0,43	2,13	3,33	5,45	-1,20	Effect
A5. Stimulating training of the unemployed, investing in developing basic digital skills	0,94	0,55	0,63	0,54	2,66	2,79	5,45	-0,13	Effect
A6. Stimulating social dialogue and collaboration between societal stakeholders	1,12	0,96	0,56	0,70	3,34	2,25	5,59	1,09	Cause
A7. Supporting product innovation driven business models, rather than process or marketing driven business models	0,73	0,65	0,52	0,33	2,23	2,00	4,23	0,24	Cause
Threshold value =				0,65					

Stimulating social dialogue and collaboration between societal stakeholders has the highest value of 1.09 (Ri – Ci), which implies that this challenge have very high impact on the high-road of the future of work but receives comparatively less influence in return due to its relatively low (Ri + Ci) score (equal to 5.59). Supporting product innovation is also a causing criterion, but not at the same level with (Ri-Ci)-value at 0.24 and (Ri+Ci) at 4.23.

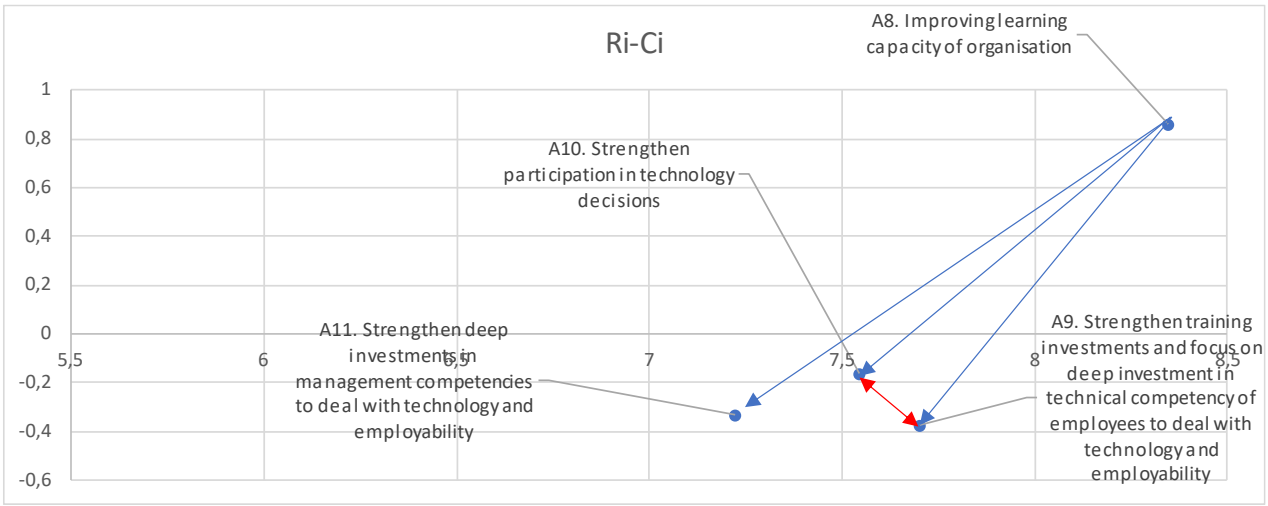

Figure 9. The influential relationship network among the organisational challenges A8, A9, A10 and A11

Figure 9 shows the relationships between the separate organisational challenges. Improving the learning capacity of organisations (A8) is the main driver for all organisational challenges. All three other challenges are in the 'effect' group. The 'cause' group challenge has the strongest impact in improving the high-road future of work initiatives success rate.

Table 10. Total relation and direct-indirect influence matrix of organisational challenges to high-road of future of work

	A8	A9	A10	A11	Ri	Ci	Ri+Ci	Ri-Ci	Identify
A8. Improving learning capacity of organisation	0,94	1,27	1,21	1,18	4,61	3,74	8,35	0,86	Cause
A9. Strengthen training investments and focus on deep investment in technical competency of employees to deal with technology and employability	0,95	0,80	0,97	0,94	3,66	4,04	7,70	-0,37	Effect
A10. Strengthen participation in technology decisions	0,95	1,02	0,77	0,95	3,69	3,85	7,55	-0,16	Effect
A11. Strengthen deep investments in management competencies to deal with technology and employability	0,90	0,94	0,90	0,71	3,45	3,78	7,23	-0,33	Effect
Threshold value =				0,96					

Improving learning capacity of the organisation has the highest value of 0.86 (Ri – Ci), which implies that this challenge have very high impact on the high-road of the future of work but receives comparatively less influence in return due to its relatively low (Ri + Ci) score (equal to 8.35). The other three challenges are mainly effects and influenced by A8.

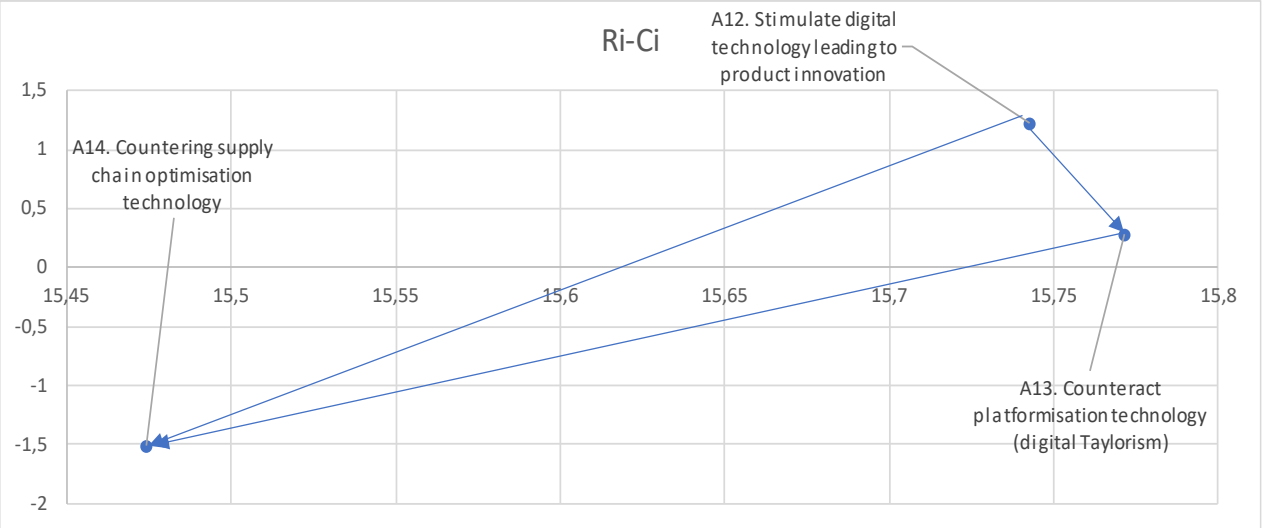

Figure 10. The influential relationship network among the technological challenges A12, A13 and A14

Figure 10 shows the relationships between the separate technological challenges. Stimulating digital technology leading to product innovation (A12) and counteracting platformisation technologies (A13) critically affect the countering of supply chain optimisation technology (A14). A12 and A14 belong to the 'cause' group, while the other challenge (A14) comes under the 'effect' group.

Table 11. Total relation and direct-indirect influence matrix of technological challenges to high-road of future of work

	A12	A13	A14	Ri	Ci	Ri+Ci	Ri-Ci	Identify
A12. Stimulate digital technology leading to product innovation	2,42	2,90	3,17	8,48	7,26	15,74	1,22	Cause
A13. Counteract platformisation technology (digital Taylorism)	2,59	2,44	3,00	8,03	7,74	15,77	0,29	Cause
A14. Countering supply chain optimisation technology	2,25	2,41	2,33	6,98	8,49	15,47	-1,51	Effect
Threshold value =			2,61					

Stimulating digital technology leading to product innovation the highest value of 1.22 (Ri – Ci), which implies that this challenge has very high impact on the high-road of the future of work but receives comparatively less influence in return due to its relatively low (Ri + Ci) score (equal to 15.74). Counteracting platformisation also works as a causing factor (0. 29; 15.77).

4.4. Workshop results

Seven experts and ten stakeholders (trade unions, ministries, innovation centres, employers' associations) participated in the two workshops that were organised following the BWM and DEMATEL expert analysis. An additional eleven experts sent written comments to the feedback that was provided to them. The participants to the workshops were asked to identify the benefits and the risks of the roadmap to the high-road future of work. They could also react to the methodology itself, add topics and discuss elements other elements. Their reactions can be categorized under seven headings. Table 12 provides a summary into the main reactions (for full results: Dhondt & Oeij, 2022).

Table 12. Overview of main reactions to research results after the two workshops

Heading	Main explanations
Benefits	An intentional positive goal makes it easier to collaborate.
Difficult methodology	Hard to choose the challenges; hard to be consistent. Methodology pushes in a certain direction.
Terminological confusion	Institutional challenges: could be broader Product/process innovation: it seems that process innovation can also drive productivity in a positive way Platform technologies: does this cover sufficiently the topic?
Evaluation	Are all factors listed? Do listed challenges cover the full topics?
Added topics	Worker-ownership: should this not be a topic? Augmenting technology; OSH; redundancy in competencies; fairer wages Educational system
Decision maker	Who is the decision maker? At what level: EU, national, company

Heading	Main explanations
Research input	Can you explain more about the results that have been used?

The survey itself provided an explanation of the main concepts. Table 1 provides a fuller overview of more concepts and elements that could be added to future research. Some of the topics will be taken up in the discussion of the results.

5. Discussion and conclusion

5.1. Research implications

The results of the BWM and DEMATEL analyses shows that the experts establish a hierarchy and network relationship between the different challenges. Figure 11 summarises the results as a roadmap for policymaking. The thickness of the font indicates which factors should take precedence over other factors. The arrows show what challenges are interrelated.

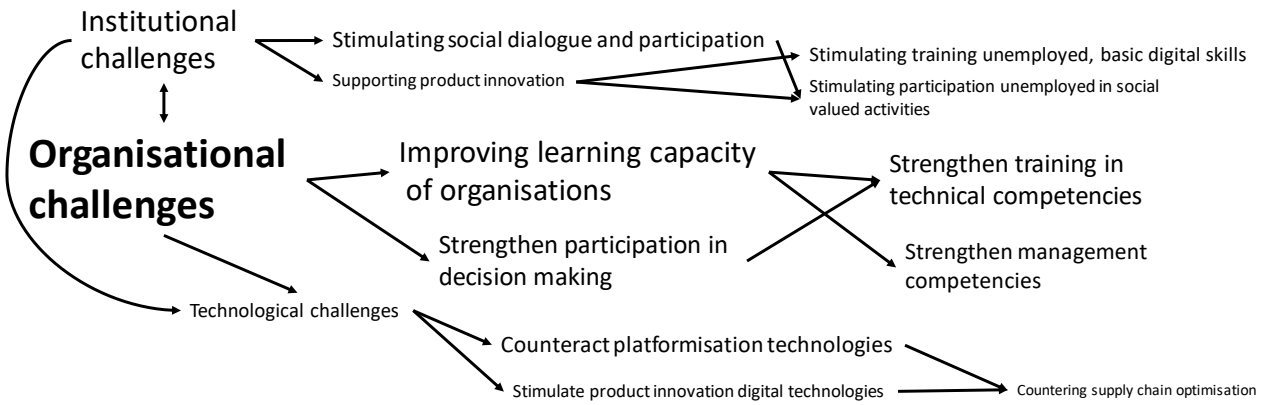

Figure 11. Summary of the relationships and weights of all the challenges to achieve a high-road future of work

This overview can also be read as a time perspective how the various actions should be carried out. The organisational challenges should be tackled at the outset, but in conjunction with the institutional challenges. The central focus should be on improving the learning capacity of the organisations. It seems appropriate that participation in decision-making on technology and a strengthening of social and societal dialogue should be reinforced at the same time. Derived from this, technical competences of workers should be improved. These actions will have to be worked out in a short term horizon (three years). The actions aimed at strengthening management competences to deal with technology, but also the action to counter the impact of platformisation technologies will have to be realised in a second phase. This seems to require a time horizon of up to 10 years. All other actions can be taken up at the start, but their impact should not be

overestimated. Only in time, when the central challenges of the roadmap become more established, can the other challenges contribute to the impact.

The exact scale of the measures on productivity growth and inclusive growth has not been established in this project. However, with the focus on these challenges, these (productivity) impacts are expected to reach higher levels than they show today.

The proposed changes do change the nature of current capitalism. In fact, current capitalism has largely drifted away from a model in which capital takes risks to bring about innovation and growth. The financialisation strategies that companies have developed in recent decades (Pistor, 2019) aim to 'derisk' capital owners' investments to a large extent (Mazzucato, 2021). The proposals elaborated in the high-road future of work roadmap are aimed at restoring a better foundation to the process of creative destruction (Schumpeter). Companies that see their 'capital' primarily as an investment asset, and are less committed to risk-free financing for their shareholders, need more commitment from their workforce and better use of their technology.

5.2. Limitations and future research directions

While this research has provided numerous contributions, there are a few limitations as well.

First, the collection of challenges is derived from the separate research results in BEYOND 4.0. The research channelled the input for tables 1 and 2. The design of the research has been comprehensive, but has also been limited by available data in the European statistical system and by the fact that it does not support the linkage between data from employer and employee level surveys. More in-depths and recent analyses are currently not possible (Greenan, Napolitano, & Hamon-Cholet, 2022). Even so, the direction of the research is very much directed at the core issues with what needs to change in current company practices (Moss et al., 2020; Pistor, 2019).

Second, this study considers inputs from 21 experts; even if this is a substantial number of experts for this kind of research, these experts' opinions may be subjective and could vary among different sets of decision-making body. Care has been taken to engage specialists from all over the world, to avoid a too European-centrist view on affairs.

Participants in the workshops pointed out that the definitions were not always clear and that additional dimensions could be added to the discussion. While these comments are understandable, the discussion needed to be limited to what BEYOND 4.0 produced as results. This includes the fact that, due to important data limitations (source), specific analyses needed to be conducted. Despite these limitations, these various analyses provide insights into drivers of a desired future.

A final limitation pointed out by our participants is whether the results are not an artefact of the chosen methodology. BWM forces experts to be consistent with themselves. In practice, this turns out to be less easy than initially thought. Nevertheless, the BWM and DEMATEL are separate methods and their results converged in outcome. This strengthens the reliability of the separate results.

5.3. Conclusion

The starting point of the study is that economic growth in our European societies is too low and insufficiently inclusive. Behind this stagnating growth lies an economic model that does not provide recommendations to improve the situation. An in depth-examination has been conducted to understand the extent to which predictive methods such as Frey and Osborne and the task-oriented approaches are able to formulate an alternative path for the economy. The conclusion is that they remain with the confines of the dominant economic model, and they do not deliver recommendations to reform the current problems. To force a breakthrough in the current thinking, an alternative scenario for the future of work is needed. The BEYOND 4.0 study provides building blocks for this alternative scenario, defined as the high-road future of work.

In this study, three main challenges and eleven sub-challenges have been derived from research that need to be solved for delivering this alternative scenario. These challenges have been prioritised and evaluated using a combined decision-making approach based on BWM and DEMATEL techniques. BWM is used to prioritise challenges while DEMATEL is used to find the causal interactive relations between and among the high-road future of work challenges.

The results clarify a roadmap for policymakers and stakeholders. The organisational related challenges are ranked first, followed by institutional related challenges. Technological related challenges are rated as least preferred. Investment in technology will be needed, but require changes in the organisational and the institutional context. The organisational and institutional related challenges are clustered as the 'cause' group, while the technological challenges are clustered as the 'effect' group in the DEMATEL. The causal analysis indicates that policymakers and stakeholders should focus on the 'cause' group challenges as these affect the challenges of the 'effect' group. The priority order and the causal relations for each of the sub-challenges have been examined providing further insight into the priorities for those involved in implementing the high-road future of work.

This study focuses on developing one scenario as alternative for the dominant model. Other scenarios could be possible, but the high-road future of work scenario is built on a set of research results analysing the main issues with the current economy. Other alternative scenarios seem less viable. The participants in the workshops did suggest extra dimensions that could be included in future research. The research results also indicate a time frame for the challenges to show impact. How strong the impact may be on inclusive growth, that could be a part of future expert judgment research (for example, using Structured Expert Judgment (Werner et al., 2017)). The individuals' opinions on the high-road future of work challenges are inherently subjective. However, these opinions at a global scale and feedback in follow-up workshops have proven an extra test on reliability of results. In this way, the results align with the European initiative to promote Industry 5.0 as an alternative sociotechnical imaginary ((Breque et al., 2021; Jasanoff & Kim, 2015).

Pistor (2019) indicates that reshaping current-day capitalism requires an incremental legal approach. Next to such rolling back of the financialisation strategies developed by major companies and capital owners, there is need of a perspective on what can guide creative destruction within the organisational setting. The lesson of the current study is that the starting point of any substantial changes needs to start with redefining the organisational practices.

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Annexe 1: The average direct relation matrices in the DEMATEL

Table 13. Average direct relation matrix challenges A1, A2 and A3 (normalised matrix)

High-Road Future of work	A1	A2	A3
A1. Institutional level of challenges	0,000	0,408	0,469
A2. Organisational level of challenges	0,418	0,000	0,582
A3. Technological level of challenges	0,214	0,235	0,000

Table 14. Average direct relation matrix challenges A4, A5, A6 and A7 (normalised matrix)

HIGH-ROAD	A4	A5	A6	A7
A4. Stimulating participation in social valued activities by unemployed	0,0	1,7	1,6	0,9
A5. Stimulating training of the unemployed, investing in developing basic digital skills	2,8	0,0	1,7	1,3
A6. Stimulating social dialogue and collaboration between societal stakeholders	3,0	2,7	0,0	2,0
A7. Supporting product innovation driven business models, rather than process or marketing driven business models	1,7	1,7	1,3	0,0

Table 15. Average direct relation matrix A8, A9, A10 and A11 (normalised matrix)

HIGH-ROAD	A8	A9	A10	A11
A8. Improving learning capacity of organisation	0,0	3,1	2,9	2,7
A9. Strengthen training investments and focus on deep investment in technical competency of employees to deal with technology and employability	2,3	0,0	2,2	1,9
A10. Strengthen participation in technology decisions	2,2	2,3	0,0	2,1
A11. Strengthen deep investments in management competencies to deal with technology and employability	2,2	1,9	1,8	0,0

Table 16. Average direct relation matrix A12, A13 and A14 (normalised matrix)

HIGH-ROAD	A12	A13	A14
A12. Stimulate digital technology leading to product innovation	0,0	2,3	2,5
A13. Counteract platformisation technology (digital Taylorism)	2,1	0,0	2,3
A14. Countering supply chain optimisation technology	1,7	1,9	0,0

Annexe 2: The BWM and DEMATEL survey

Date: 29-11-2022 (v2)

Survey High-Road Future of Work - Rating the implementation challenges

BACKGROUND SURVEY

The H2020 Beyond4.0 has researched how technological change impacts employment. Our core result is that the impact depends on how work is organised. If we organise work in such a way that employees have more control over their situation, technology is used to the benefit of the employee, the company and society in general. We call this outcome the "high-road future of work". In our economies, we see that the 'high-road' is not the dominant tendency. In our research, we have investigated which challenges need to be solved to achieve this 'high-road'. The 'high-road 'Future of Work scenario would lead to the following positive impacts:

- Less consumption of resources
- Increased participation in trade-offs around work-life balance
- Resilience of the labour market
- Higher skill requirements
- High job control, high job demands (active work)
- Less sedentary work
- Self-managing teams

To achieve this goal, the H2020 Beyond 4.0 research has mapped a set of implementation challenges that need to be tackled. These challenges are also identified by supporting literature. The implementation challenges can be summarised in three major categories and by a more detailed list of sub-dimensions:

- A1. Institutional level of challenges
- A2. Organisational level of challenges
- A3. Technological level of challenges

Below, you can find more explanation of what these challenges mean and of what they are composed of. The questionnaire proposes several sets of questions that allow for an analysis using **Best-Worst Method** and **DEMATEL**. BWM and DEMATEL are methods to allow multi-criteria-decision-making (see source below for an example).

Answers are aggregated at the level of all participating experts. Further disaggregation is not and will not be relevant. No personal details or characteristics, you are experts in this field.

To help you in responding to the questions, I also completed the questionnaire; you can find my answers as examples. We want to insist that the methodology we follow does NOT ask you to create rankings, but direct comparisons.

When answering the questions, look at the white fields!

Results will be shared after completion.

CONCEPTS: MAIN CHALLENGES + SUB-DIMENSIONS

Institutional level challenges	
Stimulating participation in socially valued activities	Social support rules that activate the unemployed to participate in socially valued activities create societal support for participation income.
Stimulating training of the unemployed, investing in developing basic digital skills.	Most unemployed require more support for their basic digital skills.
Stimulating social dialogue and collaboration between societal stakeholders	Social partnership is the main way to solve company-level and society-level issues.
Supporting product innovation-driven business models rather than business models driven ONLY by process or marketing innovation	When not combined with new products and ideas, process innovation and marketing innovation may increase the competitive advantage of firms at a high social cost.
Organisational level challenges	
Improving the learning capacity of an organisation	Learning capacity consists of organisational measures to improve learning at work. It focuses on preserving the cognitive dimension of work, training opportunities, worker autonomy in cognitive tasks, stimulation of intrinsic motivation, autonomous teamwork practices, provision of direct help and support, supportive supervisory style, and direct worker participation.
Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability	Higher skills and better job quality are supportive of product innovation. More technical competence is necessary to stimulate product and/or organisational innovation.
Strengthen deep investment in management competencies to deal with technology and employability	Managers need to learn how to encourage employee participation in the change process through enabling practices. This includes being transparent about the consequences of choices, recognising increased work demands and seeking equity and fairness. These management competencies stimulate product and/or organisational innovation
Strengthen participation in technology	Co-decision-making on technology at the company and societal level helps to make better technology choices.
Technology level challenges	
Stimulate digital technology leading to product innovation	Digital technologies that are used to support product innovation create more learning in organisations.
Counteract uses of technology that lead to the platformisation of work (digital Taylorism)	In platformised work, digital surveillance reinforces the lack of time and procedural autonomy. These organisational strategies based on digital technologies challenge the capacity to generate and share new knowledge.
Countering supply chain optimisation technology	By focussing on cost reduction, the optimisation of processes tears apart the fabric of collective tacit knowledge shared among experienced employees both within and across interdependent firms, challenging the capacity to generate and share new knowledge

Example BWM and DEMATEL analysis: Alimohammadlou, M. (2022). Industry 4.0 implementation challenges in small and medium size enterprises : A hybrid method of interval valued fuzzy BWM and DEMATEL. Research Square, 9. https://doi.org/10.1007/s00500-022-07569-9

THE SURVEY

The High-Road Future of Work scenario would lead to the following impacts:

- Less consumption of resources
- Increased participation in trade-offs around work-life balance
- Resilience of the labour market
- Higher skill requirements
- High job control, high job demands (active work)
- Less sedentary work
- Self-managing teams

We use two different scoring-systems. Both are not rankings!

- The first scoring system indicates the importance of a challenge, and varies between 1 (equal importance) and 9 (extremely more important). Scores 2 to 8 are varying degrees of importance.
- The second scoring system indicates the influence a factor has on 'High-Road Future of Work' in comparison with another factor. Zero means no influence; 1 = limited influence; 2 = reasonable influence; 3 = great influence; 4 = very great influence. A score of 4 means that a factor has 4x more influence to achieve the 'High-Road Future of Work' than the other factor. You are asked to compare pair-wise, not rank.

A. LEVEL OF THE THREE DIMENSIONS

Compare the following three main dimensions for influencing the high-road future of work (see Introduction-TAB for explanation)

Question 1: Which of the following three main dimensions do you find "most important" for achieving a high-road future of work? **(select one)**

- A1. Institutional level of challenges
- A2. Organisational level of challenges
- A3. Technological level of challenges

Indicate your highest preference : ☐

Question 2: Compare "your preference" to the other challenges.

- Use "1" if your preference is **equally** important as the other challenge.
- Use "9" if your preference is **more** important than the other challenge.

The scale varies between 1 and 9. You may vary with 1, 2, 3, 4, 5, 6, 7, 8 and 9: varying degrees of importance.

Your answer:

	A1	A2	A3
Your choice =			

Question 3: Which of the following three main dimensions do you find "**least important**" for achieving a high-road future of work?

- A1. Institutional level of challenges
- A2. Organisational level of challenges
- A3. Technological level of challenges

Indicate your least important preference :

Question 4: As question 2, compare "your preference" to the other challenges on a scale from 1 to 9. Now you score the listed challenge in comparison to your **least preference**. How much more important do you find the listed challenge compared to your least preference?

[THIS IS NOT A RANK-ORDER]

		Your: ?
A1.	Institutional level of challenges	
A2.	Organisational level of challenges	
A3.	Technological level of challenges	

Question 5: For the impacts of the High-Road Future of Work scenario that is proposed, to what degree do the three dimensions contribute? Compare pairwise.

[YOU ARE NOT ASKED TO RANK-ORDER, BUT TO MAKE PAIRWISE COMPARISONS]

Start with comparing A1 to A2, then A1 to A3, etc. Use a scale from 0 to 4 (0=no influence; 1 = limited ; 2 = reasonable ; 3 = great ; 4 = very great influence). The score gives the amount of influence (0x, 1x, ...) you think the dimension has for the 'High-Road Future of Work' compared with the other. I scored A1 as having 3x more influence than A2 for the High-road FoW.

Answer: **Your answer:**

For the three dimensions:	**A1**	**A2**	**A3**
A1. Institutional level of challenges	0		
A2. Organisational level of challenges		0	
A3. Technological level of challenges			0

B. CHALLENGES AT THE INSTITUTIONAL LEVEL

Question 6: Which of the following institutional challenges do you find "most important" for achieving a high-road future of work?

- A4. Stimulating participation in socially valued activities by unemployed
- A5. Stimulating training of the unemployed, investing in developing basic digital skills
- A6. Stimulating social dialogue and collaboration between societal stakeholders
- A7. Supporting product innovation-driven business models rather than process or marketing-driven business models

Indicate your highest preference : ☐

Question 7: Compare "your preference" to the other challenges on a scale of 1 to 9 (see question 2): 1 (= equal importance) and 9 (= extremely more important for the high-road).

[THIS IS NOT A RANK-ORDER]

Your answer:

	A4	**A5**	**A6**	**A7**
Your choice =				

Question 8: Which of the following four institutional implementation challenges do you find "least important" for achieving a high-road future of work?

- A4. Stimulating participation in socially valued activities by unemployed
- A5. Stimulating training of the unemployed, investing in developing basic digital skills
- A6. Stimulating social dialogue and collaboration between societal stakeholders
- A7. Supporting product innovation-driven business models rather than process or marketing-driven business models

Indicate your least important preference :

Question 9: As question 2, compare "your preference" to the other challenges on a scale from 1 to 9. Now you quantify the listed challenge in comparison to your **least preference**. How much more important do you find the listed challenge compared to your least preference?

[THIS IS NOT A RANK-ORDER]

Answer:	**Your:**
	?
A4. Stimulating participation in socially valued activities by unemployed	
A5. Stimulating training of the unemployed, investing in developing basic digital skills	
A6. Stimulating social dialogue and collaboration between societal stakeholders	
A7. Supporting product innovation-driven business models rather than process or marketing-driven business models	

Question 10: For the impacts of the High-Road Future of Work scenario that is proposed, to what degree do the four implementation challenges contribute? (0 to 4)

[YOU ARE NOT ASKED TO RANK-ORDER, BUT TO MAKE ONE-ON-ONE COMPARISONS]

Start with comparing A4 (horizontal) to A5 (vertical). My score is 1: this means that A4 has limited influence on the 'High-Road Future of Work' compared to A5.

Answer: **Your:**

For the four implementation challenges:	A4. Participation	A5. Training	A6. Social dialogue	A7. Business model
A4. Stimulating participation in socially valued activities	0			
A5. Stimulating training of the unemployed, investing in developing basic digital skills		0		
A6. Stimulating social dialogue and collaboration between societal stakeholders			0	
A7. Supporting product innovation-driven business models rather than process or marketing-driven business models				0

C. CHALLENGES AT THE ORGANISATIONAL LEVEL

Question 11: Which of the following organisational challenges do you find "most important" for achieving a high-road future of work?

- A8. Improving learning capacity of an organisation
- A9. Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability
- A10. Strengthen participation in technology decisions
- A11. Strengthen deep investments in management competencies to deal with technology and employability

Indicate your highest preference :

Question 12: Compare "your preference" to the other challenges on a scale 1 to 9 (see question 2): 1 (= equal importance) and 9 (= extremely more important for the high-road).

[THIS IS NOT A RANK-ORDER]

Your answer:

Your preference	A8	A9	A10	A11
Your choice =				

Question 13: Which of the following four organisational implementation challenges do you find "least important" for achieving a high-road future of work?

- A8. Improving learning capacity of an organisation
- A9. Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability
- A10. Strengthen participation in technology decisions
- A11. Strengthen deep investments in management competencies to deal with technology and employability

Indicate your least important preference :

Question 14: As question 2, compare "your preference" to the other challenges on a scale from 1 to 9. Now you quantify the listed challenge in comparison to your **least preference**. How much more important do you find the listed challenge compared to your least preference?

[THIS IS NOT A RANK-ORDER]

Answer:

	Your: ?
A8. Improving learning capacity of an organisation	
A9. Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability	
A10. Strengthen participation in technology decisions	
A11. Strengthen deep investments in management competencies to deal with technology and employability	

Question 15: For the proposed High-Road Future of Work scenario's impacts, to what degree do the four organisational implementation challenges contribute?

[THIS IS NOT A RANK-ORDER]

Start with comparing A8 (horizontal) to A9 (vertical). My score is 4: this means that A8 greatly influences the 'High-Road Future of Work' compared to A9.

Answer: **Your:**

For the four organisational challenges:	A8. learning capacity	A9. training	A10. participation	A11 management
A8. Improving learning capacity of an organisation	0			
A9. Strengthen training investments and focus on deep investment in the technical competency of employees to deal with technology and employability		0		
A10. Strengthen participation in technology decisions			0	
A11. Strengthen deep investments in management competencies to deal with technology and employability				0

D. LEVEL OF TECHNOLOGICAL IMPLEMENTATION CHALLENGES

Compare the following three main dimensions for influencing the high-road future of work.

Question 16: Which of the following technological challenges do you find "most important" for achieving a high-road future of work?

- A12. Stimulate digital technology leading to product innovation *(see explanation in the introduction to survey)*
- A13. Counteract platformisation technology (digital Taylorism)
- A14. Countering supply chain optimisation technology

Indicate your highest preference :

Question 17: Compare "your preference" to the other challenges on scale 1 to 9 (see question 2): 1 (= equal importance) and 9 (= extremely more important for the high-road).

[THIS IS NOT A RANK-ORDER]

Your answer:

Your preference	**A12**	**A13**	**A14**
Your choice =			

Question 18: Which of the following three technological implementation challenges do you find "least important" for achieving a high-road future of work?

- A12.. Stimulate digital technology leading to product innovation
- A13. Counteract platformisation technology (digital Taylorism)
- A14. Countering supply chain optimisation technology

Indicate your least important preference :

Question 19: As question 2, compare "your preference" to the other challenges on a scale from 1 to 9. Now you quantify the listed challenge in comparison to your **least preference**. How much more important do you find the listed challenge compared to your least preference?

[THIS IS NOT A RANK-ORDER]

Answer:

	Your: **?**
A12.. Stimulate digital technology leading to product innovation	
A13. Counteract platformisation technology (digital Taylorism)	
A14. Countering supply chain optimisation technology	

Question 20: For the proposed High-Road Future of Work scenario's impacts, to what degree do the three technology challenges contribute?

[THIS IS NOT A RANK-ORDER]

Start with comparing A12 to A13, then to A14. Use a scale from 0 to 4 (0=no influence; 1 = limited ; 2 = reasonable ; 3 = great ; 4 = very great influence). You can see my score for A12 is 3x more influence in comparison to A13 for the 'High-Road Future of Work' than the other.

Answer: **Your answer:**

For the three challenges:	**A12**	**A13**	**A14**
A12.. Stimulate digital technology leading to product innovation	0		
A13. Counteract platformisation technology (digital Taylorism)		0	
A14. Countering supply chain optimisation technology			0

Question 21: Do you have any comments following this questionnaire? What would you suggest needs to be done to achieve a high-road Future of Work, other than already indicated?

THANK YOU FOR YOUR CONTRIBUTION

Annexe 3: List of publications using computerisation probabilities

Author	Date	DOI
Adamczyk, W.B., Monasterio, L., Fochezatto, A.	2021	10.1016/j.techsoc.2021.101722
Albuquerque, P.H.M., Saavedra, C.A.P.B., de Morais, R.L., Peng, Y.	2019	10.1080/10978526.2019.1633238
Anakpo, G., Kollamparambil, U.	2022	10.1080/0376835X.2021.1978931
Anelli, M., Colantone, I., Stanig, P.	2021	10.1073/pnas.2111611118
Bannò, M., Filippi, E., Trento, S.	2021	10.1425/103268
Cheng, W.-J., Pien, L.-C., Cheng, Y.	2021	10.1002/ajim.23210
Cheng, W.-J., Pien, L.-C., Kubo, T., Cheng, Y.	2020	10.3390/ijerph17155499
Chernenko, I.M., Kelchevskaya, N.R., Pelymskaya, I.S., Vasina, V.N.	2022	10.1007/978-981-16-8829-4_77
Christenko, A.	2022	10.1016/j.techsoc.2022.101976
Crowley, F., Doran, J.	2022	10.1007/s00168-022-01180-4
Dengler, K., Gundert, S.	2021	10.1093/esr/jcaa066
Dengler, K., Matthes, B.	2018	10.1016/j.techfore.2018.09.024
Egana-delSol, P., Bustelo, M., Ripani, L., Soler, N., Viollaz, M.	2022	10.1016/j.techfore.2021.121333
Fossen, F.M., Sorgner, A.	2022	10.1016/j.techfore.2021.121381
Fuei, L.K.	2017	10.1355/ae34-2h
Gardberg, M., Heyman, F., Norbäck, P.-J., Persson, L.	2020	10.1016/j.econlet.2020.109032
Gruetzemacher, R., Paradice, D., Lee, K.B.	2020	10.1016/j.techfore.2020.120323
Haiss, P., Mahlberg, B., Michlits, D.	2021	10.1007/s10663-020-09497-z
Hessel, P., Christiansen, S., Skirbekk, V.	2018	10.1136/oemed-2017-104349
Huang, A.Y., Fisher, T., Ding, H., Guo, Z.	2021	10.1108/IJCHM-01-2021-0073
Illéssy, M., Huszár, Á., Makó, C.	2021	10.3390/soc11030093
Ioshisaqui, A.S., Attux, R., Luna, I.	2022	10.1016/j.bdr.2022.100333
Josten, C., Lordan, G.	2022	10.1371/journal.pone.0266326
Kim, Y.J., Kim, K., Lee, S.	2017	10.1016/j.futures.2017.01.003
le Roux, D.B.	2018	10.1080/20421338.2018.1478482
Lekfuangfu, W.N., Nakavachara, V.	2021	10.1016/j.econmod.2021.105561
Lima, Y., Strauch, J.C.M., Esteves, M.G.P., de Souza, J.M., Chaves, M.B., Gomes, D.T.	2021	10.1108/ER-08-2020-0364
Liu, L.	2022	10.1177/00221856221129639
Mason, P.L.	2022	10.1177/00346446211055203
Miklós, I., Ákos, H.	2022	10.20311/stat2022.2.hu0137
Otoiu, A., Titan, E., Paraschiv, D.M., Dinu, V., Manea, D.I.	2022	10.7441/joc.2022.03.08
Otto, J., Han, C.	2020	10.1504/IJDATS.2020.111479
Ottoni Eloy Vaz, B., E Oliveira, P.R., Estrela Ferreira Fernandes, L.A., Dos Santos, A.T.P., Barreira, T.C.	2022	10.1590/0103-6351/6367
Paolillo, A., Colella, F., Nosengo, N., Schiano, F., Stewart, W., Zambrano, D., Chappuis, I., Lalive, R., Floreano, D.	2022	10.1126/scirobotics.abg5561
Park, H., Lee, K.	2021	10.35611/jkt.2021.25.5.110
Piazolo, D., Dogan, U.C.	2021	10.1108/JPIF-09-2019-0125
Plumwongrot, P., Pholphirul, P.	2022	10.1080/10438599.2022.2051020
Ramos, M.E., Garza-Rodríguez, J., Gibaja-Romero, D.E.	2022	10.1016/j.techsoc.2021.101837

Schmidpeter, B., Winter-Ebmer, R.	2021	10.1016/j.euroecorev.2021.103808
Sowa, S., Smith, J., Manches, A.	2022	10.1007/s10775-022-09573-9
Spencer, D., Slater, G.	2020	10.1093/cjres/rsaa003
Zemtsov, S.	2020	10.1111/rsp3.12286
Zhou, G., Chu, G., Li, L., Meng, L.	2020	10.1080/17538963.2019.1681201