social sciences

Tracked for Impact Factor

CITESCORE 3.4

Review

Aside from Deterministic Prophecies, What Is Missing in the Contemporary Debate on Automation and the Future of Work? The Case of Automated Vehicles

Daniel Silva and Liliana Cunha

MDPI

https://doi.org/10.3390/socsci11120566

social sciences

MDPI

Review

Aside from Deterministic Prophecies, What Is Missing in the Contemporary Debate on Automation and the Future of Work? The Case of Automated Vehicles

Daniel Silva * and **Liliana Cunha**

Center for Psychology, Faculty of Psychology and Education Sciences, University of Porto, Rua Alfredo Allen, 4200-135 Porto, Portugal
* Correspondence: danielsilva@fpce.up.pt

Abstract: Debates around the future of work have (re-)emerged strongly as concerns about a new era of workplace automation grow from a plethora of narratives estimating the potential of machine substitution. This research aims to analyse how these perspectives dictate current discussions based on taken-for-granted assumptions about work. The analysis takes the lens of work psychology and delves into the case of automated vehicles (AVs), an oft-debated form of automation by its implications for the transport workforce. We explore how the debate is subdued to a deterministic "metrological universe", overloading the present epoch with certainty about imaginaries of "driverless futures". However, when we move our attention beyond the quantitative speculation of future employment and connect automation with the concrete socio-professional realities of transport workers, such imaginaries are deconstructed while key issues regarding the quality of work with AVs emerge. By arguing that such issues remain "forgotten" in dominant technological discussions, bipartite and tripartite actions towards decent work are gathered, considering the institutional constellation in road transport. As future research, we propose to challenge those governance models predicated on the language of AV acceptance, which ultimately places the responsibility of managing the uncertainties that AVs hold on the shoulders of transport workers.

Keywords: automation; work activity; division of labour; automated vehicles; transport workforce; technological change; future of work; decent work

Citation: Silva, Daniel, and Liliana Cunha. 2022. Aside from Deterministic Prophecies, What Is Missing in the Contemporary Debate on Automation and the Future of Work? The Case of Automated Vehicles. *Social Sciences* 11: 566. https://doi.org/10.3390/socsci11120566

Academic Editor: Nigel Parton

Received: 8 July 2022
Accepted: 27 November 2022
Published: 1 December 2022

1. Introduction

The rise of increasingly capable machines powered by automation technology is at the heart of the present debate on the future of work. Automation, the use of artificial intelligence, and the heralded "revolution of automated vehicles" have fuelled many uncertainties about what future work might look like (Autor et al. 2022; COE 2017; WEF 2020). Current discussions revolve around multiple announcements of paradigmatic changes ("Second machine age"; "Industry of the future"; "Work 4.0"), vigorously imbued with arguments about an inescapable and unquestionable technological momentum. From this view, there seems to be a prevailing agreement that work and employment relations are "on the brink of a technologically driven seismic shift" (Howcroft and Taylor 2022, p. 2), a transformation across the board often phrased in terms of "rupture", "disruption", or "irreversible change". Gaudart (2021) notes that, as part of a discourse about the future, such qualifiers aim at capturing the very idea that, apparently, "what we will do tomorrow will have nothing to do with what we do today, and even less to do with what we did yesterday" (p. 9, free translation). In the past, Zuboff (1988) traced how visions of automated futures—premised on an aura of progress—resulted in images of a future work that rendered its present actors obsolete. The future would come at the price of a necessary "cut" (a "discontinuity") with the past so one could take advantage of all the promises around automation.

Santana and Cobo (2020) illustrate how the debate on automation, technological change and the future of work has intensified since 2015 onwards, with the job's probability of automation and its associated implications for employment structures, skills, and inequality taking a front seat in research strands. Despite the intensity of the debate, the term "future of work" does not assume a demarcated meaning in the literature (Balliester and Elsheikhi 2018; Santana and Cobo 2020; Schlogl et al. 2021). Between policy and labour economics research, the term "adopts various, sometimes even contradictory, meanings and can serve a range of normative commitments without losing acceptance" (Schlogl et al. 2021, p. 309). In tune with Bergman and Karlsson's (2011) cogent remarks on the problematic nature of predictions when approaching the future of work, to some extent most publications tend not to offer a vision of the future in the strict sense, instead, they invoke it as something in which to reflect their beliefs and assumptions.

As machines become able to do tasks that until now only humans could perform, the Future of Work Debate (hereafter "FOWD") takes place under the mixture of two uplifting features. First, according to the last report on the future of jobs from the World Economic Forum (WEF 2020), the pace of automation adoption is expected to remain unabated and may accelerate. Second, the debate has covered many sectors of the economy (COE 2017; Eurofound 2018; OECD 2018; WEF 2020) and not only manufacturing assembly sectors where the implementation of automation has a long history. Mobility and road transport is one of the sectors where more pressing questions have been raised, considering the possible implications for transport workers resulting from the introduction of automated vehicles (AVs). As Autor et al. (2022) maintain, in the FOWD few sectors better illustrate the vivid promises and fears of automation than AVs. Indeed, automated driving is an emerging technology which augurs to alter the division of labour between humans and machines at unheard levels. Scholars (e.g., Ford 2015; Frey and Osborne 2017), intergovernmental organisations (e.g., OECD 2018), and consulting firms (e.g., MGI 2017; PwC 2018) estimate that professional drivers are exposed to a high risk of substitutability by machines. To determine this "automatability risk", their work is taken as involving many automatable tasks given the proportion of physical and "routine" manual work it entails (PwC 2018).

How will transport workers be impacted by the automation of driving? How do the technological and social promises related to AVs and the future of work provide answers to the problems that professional drivers currently face? What should decisions on automation consider for the quality of work of professional drivers? These questions, at the heart of our research, acquire renewed importance given the need to bring into focus issues concerning the present and future of decent work, as inscribed in the agenda of the International Labour Organization (ILO 2019, 2020).

At present, some prospective studies that elaborate quantitative modelling of employment from sectoral-level data are highly diffused (e.g., Frey and Osborne 2017). While focusing exclusively on tasks that can be theoretically automated, these analyses are backed by influential technocentric and futuristic presages that picture automation as a route to the "decline" of human work as we know it (Brynjolfsson and McAfee 2014; Ford 2015; Susskind 2020). Despite their small number, Meda (2019) and Frey (2021) argue, such publications have been cited extensively, saturating the academic and media spaces with their normative assumptions and deterministic stories of full automation, making a potentially "workless" (or "driverless") future a focal point for many concerns about the "age of automation" we are in (Autor et al. 2022; Dellot and Wallace-Stephens 2017). The risk, however, is that such analyses end up overlooking important implications of automation for work, like working and employment conditions and industrial relations (Eurofound 2018). So it is not only employment as such, but also the quality of work, and particularly, how automation can support in pursuit of the goals of safe, healthy and sustainable working conditions.

This article intervenes and challenges these trends in the FOWD from the work psychology point of view. Taking the case of AVs, we aim at identifying which issues have been given priority when addressing the future of work in road transport and the issues that tend to remain in the background (as "secondary issues"). Our research turns from speculative narratives on automation effects and techno-futuristic frameworks to visions and discussions regarding human labour in the workplace forged through increasing levels of vehicle automation. By affirming that integrating automation into vehicles is only half the way to implementing AVs, we seek to provide an impetus towards working conditions and safe work, which goals are not dependent on automation *simpliciter*. Rather, they require organisational, institutional, and policy interventions related to automation, which we bring together here intending to contribute to the design of work situations with AVs and reorient the debate on the future of work in road transport.

To reach this, our research is informed by the "activity approach", which has been resolutely developed in the epistemological universe of the French-speaking school of ergonomics and work psychology (Béguin and Clot 2004; Daniellou 2005; De Keyser 1991; Leplat 2004). Work activity is here understood from a psychological lens (Yvon and Clot 2001), that is, as a product of a coupling between the tasks assigned (which provide external determinants) and the worker (who provides internal determinants) (Leplat 2004). Examples of external determinants are task goals, requirements and conditions, for example, in terms of technical and organisational constraints; whereas examples of internal determinants are the worker's health state, skills, regulations, reasoning, meanings and values. Therefore, from a psychological point of view, there is an essential distinction between the prescribed dimension of work (tasks) and the actual work (work as it is actually done). Some prominent analyses fuelling the FOWD adopt the prescribed dimension of work (representative tasks codified in job descriptions) as the main unit to determine what could be "standardisable" and thus automatable. While these normative models of work reduce the activity to a mere hermitic and mechanical execution of tasks, neglecting all social, organisational and collective issues (Yvon and Clot 2001), they tell us very little about the content of work, how it is done, or the debates of values related to work performance (Schwartz 1997). Conversely, the reality of work always exceeds the perimeter of any normative model and accounts for the constraints, possibilities of development, consequences on health and the quality of production and safety.

With the FOWD in mind, this review is structured as follows. We first look at the two main analytical camps that have shaped this debate (the "substitutive view" and the "complementarity view") to distil a few critical insights about their assumptions on work. Additionally, while the engendered perspectives are pessimistic or optimistic in tone, we discuss how they seem to be heavily architected by a new relapse into technological determinism. We then combine this literature with road transport-oriented publications to gain insight into how the FOWD has been held in this sector. In lieu of the predicted "driverless futures", we bring together a set of perspectives hinting that work in road transport becomes increasingly mediated by automated systems, which will continue to require human labour. We extend the discussion beyond job quantities and concentrate on human labour-related factors that intervene in the dynamics of AV implementation, resulting in opportunities that can be leveraged through higher levels of vehicle automation or, on the other hand, in challenges affecting safe and efficient interactions between humans and automation. Despite besetting by a strong determinism in the way technology is thought of—as if automation were the "silver bullet" to remedy all road mobility problems—we reflect upon what future work with AVs we would like to create, calling up for the role of policymakers and social partners. In terms of future research, we challenge the dominant "AV acceptance" framework and critically discuss how this tends to abstain the involvement of transport workers (relegated to the status of passive "users") from AV design projects and public debate, favouring the politics and rhetoric of individual adaptation. Eventually, the article concludes with a glimpse of the possible implications of automation for political action.

2. Materials and Methods

The article is based on the literature review of the main visions permeating the FOWD, with particular emphasis on the case of AVs. The core method of the article is a non-systematic review in that it is not the result of a specific literature search. The study employs an integrative approach (Cronin and George 2020; Snyder 2019) by reviewing primary and secondary sources. According to Snyder (2019), adopting an integrative method to review the literature could be particularly useful when (i) addressing emerging topics (which is the case of AVs) to assess, critique and synthesise the literature; and (ii) the purpose of the review is not to cover the full body of work on a topic but rather to combine perspectives and insights from different fields and/or research traditions. Such a type of knowledge-synthesis vehicle is consistent with our goal of developing a narrative analysis of a large corpus of data with the aim of generating a comprehensive view of different, often disconnected, perspectives.

In line with Cronin and George's (2020) stages for synthesising research, our methodology followed three main steps. In step 1, we explored the type of documents available on the topic under analysis to decide our corpus's structure. Given the intensity of the debate (see Santana and Cobo 2020) and the proliferation of views, we decided to follow a broad approach based on the strategy of documentary review of articles, book chapters, working papers, institutional reports, and private practice reports.

Step 2 was devoted to the literature search. At this stage, the process was broken down into two subphases: firstly, we collated a corpus of documents regarding the analysis of the expected implications of automation for the future of work; subsequently, the second round of literature search collated a subset of data dealing specifically with automated driving and its impacts on the driving workforce. As for the literature search, we identified it via keyword and relevant terms searches, our prior knowledge of the literature, and hand-searching on the references. In the case of database searching, two bibliographic databases were preferably used (Scopus; and DOAJ—Directory of Open Access Journals), along with the use of Google Scholar and Google web search tools to identify non-academic publications. Keywords and relevant searched phrases were defined by combining the terminology that is used when addressing this topic (explored in step 1) with our prior knowledge. Then, we selected a compilation of the search words in the titles, abstracts and keywords of the publications: (i) "future of work", "automation", and "division of labour" are examples of the words and strings that were searched non-systematically in the initial stage of the search; and (ii) "automated vehicles", "transport/driving workforce", "AV job implications", and "working conditions" are examples used in the second stage. Documents which did not place a relevant emphasis on social issues related to automation/technological change were excluded. As referred to, the search was augmented by further methods, such as snowballing, hand-searching and contributions that stem from our knowledge in the fields of work psychology and activity ergonomics.

Finally, step 3 concerned the thematic synthesis aimed to provide an integration of the themes (or categories) emerging from the literature. According to Cronin and George (2020), this process is about seeking out and synthesising patterns amongst publications, rather than delving into each finding. To this end, we followed a bottom-up (interpretative and inductive) strategy to create initial codes that later were merged into themes using NVivo 12 software. The descriptive themes are developed in Sections 3–6. To go beyond the content of the selected publications, we followed a narrative approach.

3. The (Re-)Emergence of the Debate on Automation and the Future of Work

3.1. Two Analytical Streams Premised on Measures of "Routine" Work?

The FOWD and the underlying concerns on workplace automation are nothing new (Autor 2015; Bouquin 2020; Carrère-Gée 2017; Cherry 2020; Howcroft and Rubery 2021; du Tertre and Santilli 1992; Valenduc and Vendramin 2016, 2019; Zuboff 1988); rather, there is a substantial precedent. Automation discussions have cyclically resurfaced as successive technological waves have been deployed in the workplace, particularly after the surge of technical innovations linked to the automation of industrial production in the 1960s and 1970s (Bassett and Roberts 2019; Cherry 2020; du Tertre and Santilli 1992). At that time, authors in the field of sociology and psychology turned their attention to the impacts of automated machines on the content and organisation of work and labour skills[1]. Particularly, (Naville [1963] 2016) defined automation as "a stage of the general principle of automatism", whose main strategy aims at "having equipment and machines performing operations that previously required the direct or indirect intervention of workers, or operations that workers were not able to do" (p. 128, free translation).

The FOWD continued in the following decades as waves of technical innovations expanded the spectrum of tasks that could be automated. Thus, instead of the idea of an unprecedented revolution that is strongly linked to today's wave of automation, Bouquin (2020) argues that taking the current FOWD as "unrivalled" leads us to "historical myopia" (p. 29). Cherry (2020), in looking at historical materials, examines the debate on automation and the future of work that took place in the 1960s and sets comparisons with today's conversations. Despite similarities between the deliberations on automation in the two epochs, today there is a tendency to frame the phenomenon as a novel debate, since when writing about the future of work, Cherry (2020) continues, "there are reasons for starting afresh, especially because each type of technology presents challenges and questions that appear *sui generis* to the scholars studying it" (p. 13).

Yet, if we are not facing a "new" issue, as technology has long been altering the division of labour between workers and machines, what determines that this debate reaches our times with a renewed impetus and an ever-growing relevance? Three interlinked fronts of change might help to explain the topical status of the FWOD and why it is reignited and intensified in the space of public discourse. First, the combination of multiple new technologies and their rapid expansion into the world of work have been leading to unprecedented levels of interaction between workers and machines. For example, in taking note of the analysis provided by the Eurofound (2018), in today's digital age, automation may be distinguished by the use of a panoply of new technical innovations—with artificial intelligence and the algorithmic control of machinery at their heart. Second, unlike past uses of automation which were centred on physical and repetitive tasks, machines become able to perform tasks not previously amenable to automation and those only humans could do. For instance, apart from the material world, machines are now able to take over tasks requiring the cognitive sphere and affective aspects. This constitutes the main argument of some analysts to posit the emergence of a "second machine age" (Brynjolfsson and McAfee 2014)[2]. Thirdly and finally, in contrast with the past, this wave of automation and its exponentially paced application in production processes promises to expand potentially into most, if not all, sectors of activity. This time around, Bassett and Roberts (2019) add, such an extension of automation's reach has led to prophecies about an "unparalleled" shift in the division of labour between workers and machines, in which employment for many workers will be significantly "eroded": "every industry in existence is likely to become less labour-intensive" (Ford 2015, p. 14).

Bearing this in mind, the perspectives driving the present debate on automation and work can be placed in a "pessimism−optimism continuum", ranging between two extreme camps according to the anticipated impacts on labour markets (Balliester and Elsheikhi 2018; COE 2017; Frey 2021; Gamkrelidze et al. 2021; Spencer 2018; Valenduc and Vendramin 2016, 2019). The analyses are catalogued as "pessimistic" (referring to machine-human substitution) or "optimistic" (related to machine-human complementarities). The first camp gathers perspectives focusing on the "substituting force" of automation (Frey and Osborne 2017; Ford 2015); whereas the second one deals with the "complementing force" (Arntz et al. 2016; Autor 2015; Autor et al. 2022).

As a matter of fact, Frey and Osborne's (2017) study is considered one of the leading studies of the current FOWD, achieving prominence and attracting a great deal of media attention. It has been labelled as the most pessimistic view on the future of human work by predicting that 47% of total employment in the USA will be eradicated through automation. For this estimate, the authors develop a classification of professions according to the probability of human work to machine replacement. The high-risk category refers to jobs that "could be automated relatively soon, perhaps over the next decade or two" (Frey and

Osborne 2017, p. 268). According to this projection, most of the transport workforce is likely to be substituted by technological capabilities.

Criticisms have been consistently made of Frey and Osborne's (2017) research, both in terms of its epistemic assumptions and methodological options. Valenduc and Vendramin (2019) stress the fact that the study was based on a very limited understanding of work, taking professions as a set of tasks common to all individual jobs, and whose automation potential depends on the technologies. Frey (2021) points towards the level of "epistemic opacity" behind it, signalling a particular shortcoming in its methodology. Concretely, to classify professions as being either automatable or not, Frey and Osborne's model rests on a previous classification carried out by a group of technical experts. Frey (2021) precisely draws attention to the fact that these self-assessments could reflect a typical *"deformation profissionelle"* of experts in technology, which could lead to conclude that any task labelled as "routine" work might be automatable[3]. Autor (2015) and Pfeiffer (2018) also contest this kind of conclusion, alluding to the fact that technical experts' assessments (quite often involved in the promotion of technical breakthroughs) run the risk of hyperbolising the potential of technology. Principally, Pfeiffer (2018) points out the limits of assessments of technological change based on what is considered "routine" manual work, adding, "(. . .) what experience-based knowledge actually is—and in what sense it becomes important on a daily basis for different tasks—cannot be derived solely from the perspective of technical experts and their ideas about the tasks" (p. 211).

At this point, Feldman and Pentland's (2003) conceptualisation of routine practices in organisations is particularly significant for this debate. The authors provide a useful ontology that helps to see what routine work consists of as a duality of two related dimensions: structure and agency. While the structure represents the abstract idea of a "routine", the agency is the actual performance of this routine by a specific person, in a given context (Feldman and Pentland 2003). Although each dimension is necessary to describe what is involved in routine work, in fact, not infrequently what is seen as "routine" is assessed only by its structure part. We could say that this structure encodes the static, fixed and unchanging properties of work, representing its prescribed dimension, as noted in our introductory section. Problematically, technical assessments of work—by reviving the traditional view that reduces manual work to repetitive and automatic gestures and, therefore, *ipso facto* "replaceable"—tend to underestimate the other dimension: how workers really perform them.

On this and to strengthen our interpretation and reflection, we also build upon the contributions of the ergological approach[4] (Schwartz 1997). In the eyes of this perspective, Schwartz and Durrive (2003) classify studies that rely exclusively on canvassing the opinion of technical experts on work changes as resulting from "hypothetical-deductive approaches", reflecting attempts to anticipate and standardise professional activities and all the variability they face in real work environments. Such "deductive thinking" tends to distract from the human work experience, considering the debates of norms and values in which all work activities are immersed. Thus, without entering the workplace to discover workers' perspectives, how they manage such debates, and what lies behind what is apparently "routine" work, one might assume that there are more situations susceptible to automation than there actually are. Under these circumstances, we are on fertile ground for prophetic rhetoric, as we will discuss ahead.

Besides Frey and Osborne's (2017) estimate, other forecasts for the impacts of automation reveal different figures. The McKinsey Global Institute (MGI 2017) infers that, across 46 countries (accounting for 80% of the world's workforce), less than 5% of professions consist of "routine activities" fully automatable by 2030. However, 62% of professions have at least 30% of routine work that can technically be automated by adapting currently demonstrated technologies. The transport sector has one of the highest technical "potentials for automation", according to the study.

One of the projections which found a much less pronounced potential for automation was conducted on behalf of the Organisation for Economic Co-operation and Development

(OECD) (Arntz et al. 2016). Contrary to other prognoses which have caused extreme apprehension by their pessimistic scenarios, Arntz et al. (2016) conclude that across 21 OECD countries only 9% of professions are potentially automatable. According to the authors, the reason for this substantial difference is that workers perform a significant share of "non-routine interactive tasks", which are less prone to automation.

3.2. Some Perils in "Quantifying" the Future of Work

Regardless of the general tone of pessimism or optimism of the predictions mentioned above, there are a few notable features that unite them in the FOWD. First of all, they tend to reflect today's technological capabilities based on hypothetical projections and assessments, rather than the actual application of new automation technologies in the workplace (Arntz et al. 2016; Frey 2021; Gamkrelidze et al. 2021; Valenduc and Vendramin 2019). On the other hand, even though the figures put forward vary widely, these estimates convey the message that technology serves somewhat to curtail the volume of employment (Spencer 2018) and, consequently, with the potential to make human work redundant/obsolete in the future. In line with what Carrère-Gée (2017) expresses, this way ends up restricting perspectives on job creation. Put another way, automation technology is narrowly viewed as anathema to human work.

Central to this discussion is also what several critics have reiterated regarding the nature of research on the topic, where most studies use aggregated data. Indeed, quantitative approaches pervade the discussions, aiming at predicting and measuring the future of work solely in terms of labour market transformations based on statistical and macroeconomic models, deductive logic, or experts' assessments (Howcroft and Rubery 2021; Howcroft and Taylor 2022; Pfeiffer 2018; Valenduc and Vendramin 2016). Significantly, the future of work is thus quantified, in which narratives of worker displacement produce conditional measures (Morgan 2019). Indeed, predicting quantities for work has become an influential source of authority, like "an empirics of what will happen" (Morgan 2019, p. 12). Such predictions may be placed in what Vatin (2009) calls the "metrological universe", a pool of operations, instruments and mechanisms that create measures, classifications, ratios, or quantified descriptions through which work activities are subjected only to the market measurement. For example, and by taking note of Vatin's (2009) reflection, the current classifications of professions according to their probability of automation ultimately lead to certain professions being valued over others on the mercantile scene. Thereby, professions involving the so-called "non-routine", or unmeasurable, work take a higher significance for the future since they would be less susceptible to be "programmable", in comparison to professions involving "routine" manual work and, therefore, at "higher risk" of automatability. Pfeiffer (2018) provides scrutiny of this distinction (a "non-trivial" one, in the author's words) behind many quantitative labour market analyses and shows that what is labelled as "routine" and "repetitive" work involves experience in dealing with complexity, unpredictability and imponderability of work situations. In the tradition of work psychology studies, Béguin and Clot (2004) claim that even the most repetitive gesture of a worker is not an event with no history of a given professional activity; rather, seen from a psychological angle, work activity is always unique at every occurrence.

Undoubtedly, the emphasis on predicting quantitative effects is questionable because of the oversimplifications they induce. Of relevance here is what Howcroft and Taylor (2022) point out regarding the belief that technology possesses an intrinsic momentum, which presupposes the absence of alternatives by portraying a single and inevitable direction for future work. Through this deterministic lens, technology is seen as a panacea for economic, competitiveness, safety and production problems, like "remedies", with a lack of systematic analysis of these problems (Barcellini 2022). Additionally, commentators like Dellot and Wallace-Stephens (2017) recognise that this logic can in fact result in a significant omission in recent studies on automation and work. When the attention is fixated on estimating the number of jobs that could be displaced, we are distracted from the ways automation transforms other aspects of the worker landscape, such as the division of labour, the quality of working conditions, productivity demands, risk factors (and related occupational health policies), or workers' organisation and bargaining power (e.g., weakening workers' bargaining positions; Balliester and Elsheikhi 2018). For example, Rabardel (1995) and, more recently, Gaudart (2021) and Barcellini (2022) call attention to the reductions that arise whenever work is exclusively thought of for its "techno-centred properties". Concrete, "[the worker], his/her actual activity, and the ecosystem in which he/she evolves are rarely considered in guiding the development and diffusion of technological systems: technology is not a solution, but it is the solution (. . .). This is the techno-centred approach, which is a dominant approach to some extent" (Gaudart 2021, p. 25, free translation). In endowing the analyses with the causality of technological determinism, many studies engage in projective speculation, in what Howcroft and Rubery (2021) term "futurology" exercises. The main reason for the intensification of this speculative and prophetic nature is the fact that analysts put a heavy emphasis on the technical innovations side while failing to consider the work activities side required to operate the new automated work systems. Schwartz and Durrive (2003) address this tendency to speculate about the future of work "at the expenses of work activity, giving rise to a standoff, as a *tabula rasa*. (. . .) It is a way of vanishing the work activity and its essential characteristics" (p. 34, free translation). Cherry (2020) also refers to this *tabula rasa* effect that seems to prevail when addressing the effects of each technological wave on work, contributing to a somewhat "ahistorical approach, where issues related to changing workplace are viewed in a vacuum" (p. 13).

Lastly, the forecasts reviewed also have in common the premise that automation solutions are technologically feasible and instantly available to firms, which will adopt and "accept" them. In such circumstances, where technology is treated as the "Alpha and Omega of organisational efficiency" (Bobillier Chaumon 2021a, p. 29), it is neglected the fact that technological change is governed and constrained by complex processes linked to socioeconomic, organisational, and workplace-related issues.

While much of the current writing is centred on technology per se, loosely reducing activities to a dichotomy of "routine" vs. "non-routine" work, the need to adopt a "more down-to-earth perspective" on concrete work situations (Barcellini 2022; COE 2017; Valenduc and Vendramin 2019) has been brought into the debate. The challenge on the table is to investigate actual and immediate reconfigurations of the content and methods of work, rather than speculating on their changes in futuristic frameworks and believing that everything regarding work is (pre)determined by technology. In light of this backdrop, the following sections take the case of AVs for analysis to look at what lies beyond what is markedly suggested by some quantitative analyses on automation effects. What forms of division of labour between humans and machines emerge by getting automation into vehicles? Is the transport workforce really destined to be made redundant?

4. The FOWD in Road Transport: AV-Related Repercussions for Transport Workers

Automated vehicles have been in the limelight in public debate, garnering widespread research interest and challenging regulatory frameworks. In the European context, the centrality of AVs for the future of road transport was attested in 2018 when the European Commission adopted the 3rd Mobility Package, including legislative and policy initiatives, among which the strategy towards automated mobility, also known as the "mobility of the future" (European Commission 2018). This interest has reached new levels as the promises of AVs grow. In their analysis, Wynsberghe and Pereira (2022) refer to these promises as falling into two major categories: technological promises, concerning the expected performance of AV technologies; and social promises, that is, the perceived social benefits as the outcome of the uptake of AVs. Safer and more efficient transport operations have topped the list of technological promises, which will expectedly contribute to reducing congestion, energy consumption, and accident rate and severity (e.g., Brown et al. 2019; WEF 2021). Other social benefits are often invoked, such as more sustainable and accessible transport systems, with the potential to reinforce social inclusion through new and growing mobility solutions (ERTRAC 2019). Thus, the "technological qualities" of AVs set high expectations, relying on the assumption that automation will be able to reverse the negative representations of current vehicles (Kaufmann et al. 2019).

Notwithstanding the indisputable value of these anticipated outcomes[5], the fact is that they are rooted in a substituting view: "the foundational rationale of AVs promoters is that of substituting (in most cases, full substitution) human-controlled vehicles by automated vehicles" (Orfeuil and Leriche 2019, p. 98, free translation). According to the imagined "driverless paradigm", the human driver is no longer the epicentre of driving but is replaced by powerful automation technologies. The picture is thus that human drivers, being linked to the negative externalities of current road transport modes, need to be "sidelined" for AV technologies to enter the scene and make their promises possible. In this context, the resulting concentration on the technology reproduces "a crude form of technological determinism" (Bissell et al. 2020, p. 116), leading the discussions around AV futures being object-centred and overwhelming focused on time-to-market performance measures (Mladenović 2019). This way, other dimensions related to the complete implementation context of AVs appear to be sparsely considered, particularly its social implications related to changes in the responsibilities and role of drivers (how automation changes the ways drivers work), the consequences that stem from new human–machine interactions (HMI), or the quality of work with AVs. These issues remain outside the silo of enthusiasm around the technological expectation of "no hands" needed to control AVs.

To start with, despite all the merits of automation and the aspirations for "driverless vehicles", experts indicate that, in the foreseeable future, the control of driving tasks will be distributed between the human and the automated system. This reality can best be understood through the harmonised classification system for automated driving levels provided by the Society of Automotive Engineers (SAE). Standing out as the most widely accepted and adopted, this classification specifies six linear levels in which human actions are theoretically "replaceable", from no automation (manual driving—level 0) to full automation (fully automated vehicles—level 5). The differences between these degrees of automation can help us discuss the potential workforce impacts[6]. Notwithstanding, as Leonard et al. (2020) recall, these Levels of Automation (hereafter "LoA") are relatively agnostic to the domains and environments where AVs can operate, which poses difficulties in anticipating the full range of implications for workers.

Current discussions on the future of work with AVs espouse a vast uncertainty about when AVs will arrive, their scales and contexts of adoption (Alonso Raposo et al. 2018; Brown et al. 2019; Leonard et al. 2020; Nikitas et al. 2021; U.S. DOT 2021), or even the time and further development needed for AV technologies to reach sufficient maturity (Shladover 2022). Yet, this does not preclude reflection from the experience and perspectives existing in the literature. When it comes to debating the future of road transport, a major concern is employment. The abovementioned predictions across sectors of the economy (Frey and Osborne 2017; MGI 2017; PwC 2018) placed transport workers at high risk of automatability, giving rise to a "steering wheel-free future" imaginary, which is none other than a future that is presented as inescapable. However, when employing a closer inspection by digging behind these grand projections, there are reasons to doubt such scenarios. Table 1 presents the synthesis of the perspectives reviewed, revealing that the labour impacts of AVs could be very different when some details are factored in: the time and pace at which automation occurs (Alonso Raposo et al. 2018; Leonard et al. 2020; Smit et al. 2020); and the work of drivers that is beyond what is apparently "routine" and "predictable".

Table 1. Summary of the perspectives on potential AV-related impacts on the transport workforce.

Authors	Context (and Focus)	Perspective
Alonso Raposo et al. (2018)	EU-28 (Freight and passenger transport)	From the present state of the art, AVs are not able to perform all the tasks required in most driving-related jobs. Professional drivers perform complementary and hardly automated tasks that limit pure labour substitution. A partial task substitution is likely to occur, as is the case of truck platooning, leading to a decrease in the demand for truck drivers. However, these employment effects should be counterbalanced by a slow AVs rollout with retraining programmes to prepare workers on time and mitigate the transition costs.
Brown et al. (2019)	US (Personal mobility and freight)	The automation of driving will displace a certain number of professional drivers. Yet, it will also expand demand for some existing jobs (e.g., drivers, management of routes, logistics, or monitor performance) and create new jobs (e.g., supervisors of automated fleets; designers and mechanics of AVs components). In the case of freight, driving is only one part of the work and the demand for workers to load, unload and stock goods (less easily automated tasks) could increase in the future.
Leonard et al. (2020)	US (Trucks and light-duty vehicles)	The transition to AVs will not be jobless. New employment opportunities are expected such as in the management of vehicles (e.g., safety drivers or remote management roles). New customer services, field support technician, and maintenance roles are also likely to appear. The quality of these new jobs is uncertain and will depend on policy choices. AVs' advancement rate will be slower than many have predicted, which will provide time to prepare the transport workforce. For example, new training needs about the automated system features will arise. Removing workers from the vehicle (level 5) is no more than an aspiration for now.
Smit et al. (2020)	EU-27 (Personal mobility, buses, and trucks)	Significant restructuring of jobs and skill requirements are estimated. New jobs will be created, as is the case of stewards/supervisors employed to facilitate automated passenger transport services. In the case of freight transport, workers will be required to supervise automated trucks and light-duty vehicles, either in vehicles or remotely (in control centres). This will have an impact in terms of skill requirements since the supervision and interaction with AVs will demand different skills from traditional driving (e.g., supervision and selective intervention skills).
U.S. DOT (2021)	US (Long-haul trucking and transit buses)	LoA 1–4 are unlike to bring about job displacement because the human driver is still required. Yet, changes in the nature of the driving position are expected, as well as associated training needs. The adoption of the highest LoA is highly uncertain but might reduce the need for drivers and lead to periods of transitional unemployment. It is crucial to look at the real work activity of professional drivers, especially long-haul drivers, insofar as they are responsible for many non-driving tasks (cargo security, paperwork, operating non-truck equipment) in diverse environments. These tasks need to be considered by transport firms when seeking to operate higher LoA.

These perspectives converge in considering that the future of AVs will not be without human work. The transition to jobs with AVs represents potential pathways for employment, as long as new "(re)training" and "reskilling" opportunities and resources are offered to drivers. For example, it is expected to see increasing numbers of automated shuttles/buses in cities, which will positively affect employment (see Table 1; Smit et al. 2020). However, training to work with these vehicles will be crucial, as Ioppolo et al. (2019) and Leonard et al. (2020) highlight. Autor et al. (2022) also allude to these new employment pathways. Firstly, new roles are expected to be assigned to drivers, such as automation supervision or safety driver roles (at levels 2–4), which will be critical for the safe, efficient and appropriate operation of AVs. Additionally, remote management or dispatcher are roles that could emerge and bring professional drivers into control rooms (Autor et al. 2022; Smit et al. 2020). Still, in both cases, these changes in the responsibilities and role of the driver are likely to require different skill sets and additional, or different, training to interact with automation (Zmud and Reed 2018). Other roles and specialities will be brought in with the introduction of AVs and their incremental advancement towards wide-scale use, such as jobs devoted to ensuring the maintenance, safety and reliability of AVs and components, as well as infrastructures (Brown et al. 2019; Pettigrew et al. 2018; Smit et al. 2020). In their qualitative study with key players in the development of AVs (governments, unions, AVs manufacturers, technology firms, insurers, and academics), Pettigrew et al. (2018) suggest that these new positions will require skills that are not common in the current workplace.

5. More Than Just "Job Quantities": Reorienting the Debate on Working with AVs

Building upon the perspectives analysed above, we observe that the anticipated labour impacts of AVs depend on the LoA considered and that some of which will presumably only be realised at the highest level. Until that is possible, important challenges remain up for debate, operating as "inhibiting forces" that could slow down the pace of AV deployment more than expected if they are not sufficiently addressed at this point. Going forward, we have sketched a comprehensive model meant to picture some of the main drivers of AV implementation and, on the other hand, the main "barriers" that challenge those forces pushing towards the "desirability" of AVs[7] (see Figure 1).

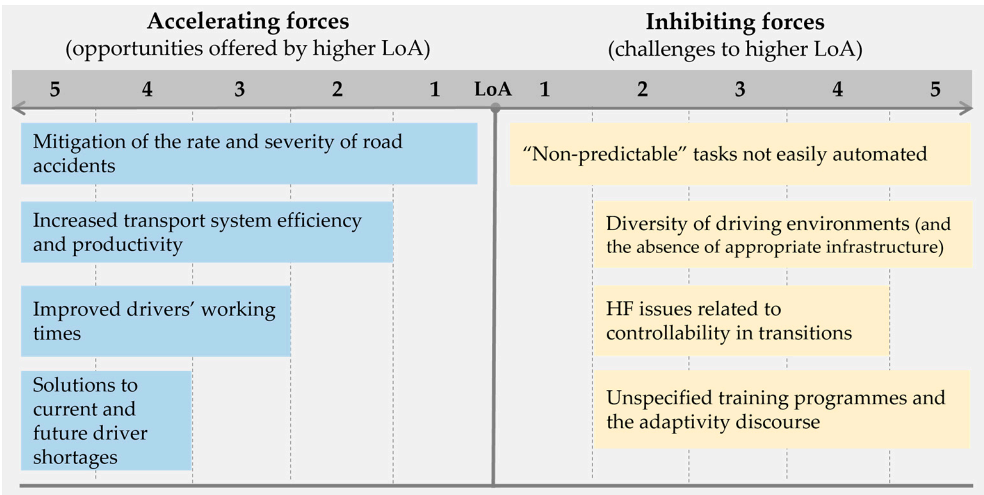

Figure 1. Key "drivers" and "challenges" linked to the implementation of AVs.

5.1. Forces Driving the Adoption of Higher LoA

Besides the expectations in terms of improved road safety across all modes of road transport (private vehicles, public passenger transport, freight transport), there are a few specific anticipated outcomes that drive the implementation of higher LoA for the case of driving professionals (see Figure 1). To begin with, the prospects point out that automated driving at higher LoA (from level 2 onwards) is expected to increase the number of mobility services and intensify total transport activity, enhancing productivity (Brown et al. 2019; Paddeu et al. 2019; Nikitas et al. 2021; WEF 2021), especially in the case of freight transport through solutions of truck platooning, for example. However, a similar expectation is also present in the case of automated services for public passenger transport (Smit et al. 2020; see Table 1).

The increased productivity prospect is partially grounded on arguments anticipating that automation could support more efficient use of professional drivers' working hours, either in the case of intermediate LoA requiring a worker on board (levels 3 and 4) or in cases of workers operating vehicles remotely (level 5) (Paddeu et al. 2019; Smit et al. 2020; WEF 2021). Specifically, when operating vehicles at levels 3 and 4, workers may be able to do non-driving tasks when the automated mode is activated, such as processing documentation, assisting customers, or resting (Paddeu et al. 2019). What is more, driving in automated mode could help drivers log more consecutive hours (e.g., enabling them to extend the consecutive driving time of 4.5 h allowed by the European driving time directive), a time during which the driver will expectedly "experience less cognitive load" (WEF 2021, p. 22). Put simply, and in line with Paddeu et al.'s (2019) view, up from level 3, automation allows for driver rest and productivity to occur simultaneously. Such an outcome is very debatable, mainly at LoA whose efficient operation relies on the human ability to recover from abnormalities, a point we return to later (in Section 5.2). In turn, Smit et al. (2020) anticipate that the possibility of remotely operating vehicles (level 5) could raise opportunities for making working hours more flexible (e.g., long and irregular working hours are often invoked as one of the main barriers to the "attractiveness" of working in the sector).

Relatedly, another factor driving the adoption of automation is the opportunity to reduce the physical and psychological demandingness that transport workers are subject to. Particularly, truck and bus drivers reveal their job as highly demanding in terms of work pace, fatigue, concentration, repetitive movements, irregular work schedules (e.g., overtime; long time away from home), and situations of tension in the relationship with the public (Cunha et al. 2021; Rydstedt et al. 1998; Sousa and Ramos 2018). According to the European Transport Workers' Federation (ETF 2021), allied to this highly demanding work environment is the fact that the road transport sector is characterised by low salaries, which often opens the door for pay incentives for drivers to "skip" breaks or work longer hours, regardless of the fatigue they feel. In this context, driving automation is seen as a possible solution to raise the attractiveness of the road transport sector by making the work environment less stressful and tiring (Brown et al. 2019; WEF 2021), reducing the physical demands and pace of the work, as well as "broadening" the required skills to perform it (Nikitas et al. 2021; Smit et al. 2020). On the topic of skills, according to Leonard et al. (2020), "drivers will need to acquire and apply new skills of working with and monitoring the automation. Opportunities for upskilling and reskilling, therefore, will coexist (. . .)" (p. 17). Smit et al. (2020) consider that AVs could provide the opportunity "to raise skill levels", involving more "technical" ("IT-related") and "customer-related" skills, since the operations in AVs will expectedly involve a shift from manoeuvring to supervising. In the same vein, Ioppolo et al. (2019) suggest that AVs require more "technical" and "creative" skills that will be needed in "tasks that are not fully predefined" (p. 31). Overall, in comparison to manual driving, AVs are seen as favouring "more advanced" (Ioppolo et al. 2019) and "higher qualifications" which might result in making driving work "more attractive" (Smit et al. 2020).

Taken together, these forces towards higher LoA could support the sector to face growing labour shortages, a problem which cannot be disconnected from the lack of decent working and employment conditions that push workers out of the profession, as signalled by the Ioppolo et al. (2019) and expressed by the ETF in the 2022 health and safety magazine from the European Trade Union Institute (ETUI)[8]. This Achilles heel of road transport is doubly challenging across Europe (ETF 2017; Ioppolo et al. 2019) and in the US (Brown et al. 2019; Gittleman and Monaco 2020; OECD/ITF 2017): on the one hand, the sector has long struggled with attracting new workers, who see the work at the wheel as unappealing and potentially unhealthy (Brown et al. 2019; Pettigrew et al. 2018); and, on the other hand, the current workforce no longer wants to perform the job under hard working conditions, leading the drivers to desire to retire before the statutory retirement age (Sousa and Ramos 2018). That said, high turnover rates, difficulties in retaining drivers, and lower average retirement age are problems that could affect all modes of transport if the working reality of the sector remains unchanged. Against this background, AV technologies and related technological change are believed to be key for taking action towards improving working conditions, supporting the definition of jobs where the transport workforce may remain safe, healthy, integrated, and efficient throughout their careers. This is especially important given the context of the ageing workforce (21% of European transport workers are over 55 years old; IRU 2022), a trend that will be more pronounced in the future as projections suggest that the overall population will live longer[9]. Vehicle automation could thus support drivers to remain on the job longer by (i) addressing the difficult working conditions that contribute to their health decline; (ii) assisting older workers in facing challenges involved in decision-making processes due to their declines in perceptual abilities, slower motor responses and deterioration of visual acuity associated with the natural process of ageing (Sousa and Ramos 2018).

As well as having the potential to help retain drivers for longer, automated driving systems can also positively influence the overall attractiveness of the road transport sector to new and younger workers (Smit et al. 2020). Take the example of the trucking industry. It may be easier to recruit and retain truck drivers in general if a long portion of the route could be performed using automated modes (e.g., at level 4 of vehicle automation), thus reducing the physical toll of driving (Gittleman and Monaco 2020; Paddeu et al. 2019; U.S. DOT 2021). All in all, by improving working conditions through the integration of automation in the workplace, the expectation is that this could favour the employability of drivers of different ages.

5.2. Forces Challenging the Adoption of Higher LoA

The driving forces, in different forms of "plausibility" and "desirability" of AVs (Wynsberghe and Pereira 2022), do not guarantee per se satisfactory outcomes. As noted, the exact outcomes of automation are not yet clear (European Commission 2021) and, consequently, the quality of future work with AVs remains uncertain (Ioppolo et al. 2019; Leonard et al. 2020). Indeed, the integration and operation of automated driving systems are not "plug-and-play" processes, and important challenges and complexities are raised for drivers while interacting with automation. Figure 1 lists some of these oft-overlooked social-related challenges that might lead automation to progress more slowly than expected if appropriate measures are not in place. Thus far, the European Commission (2021) stresses, the focus of measures is often on addressing the technical aspects of automation and less on the social dimension. Three particular challenges merit reference: (i) the nature of drivers' work; (ii) HMI issues, especially at LoA requiring control transitions between drivers and automation; and (iii) the relative lack of definition on training and new skills required for safe and efficient interactions with automation.

The overarching goal of AV technologies is to automate the work at the wheel. However, besides all the non-driving tasks that are not explicit or codifiable to be automated (e.g., loading/unloading; customer service; Gittleman and Monaco 2020; U.S. DOT 2021), there are regulations and arbitrations that drivers undertake while driving and that are out of the reach of automation. With specific reference to bus drivers, previous research shows how these workers arbitrate values towards the optimisation of the mobility public service, considering passengers' needs in different ways. Epting (2021) systematises a set of care-based tasks performed by bus drivers towards the passengers' well-being and safety, particularly vulnerable people who require care (e.g., visually impaired persons, or elderly passengers). Similarly, in rural contexts markedly more dependent on transport than urban areas, Cunha and Lacomblez's (2010) study reveals the ways bus drivers often make detours to the defined route plans to ensure that the bus routes are closer to some passengers. This way, bus drivers provide some passengers with more than just mobility, as they contribute to a sense of inclusion (Epting 2021) and citizenship by managing values that are associated with common welfare (Cunha and Lacomblez 2010). Considering the highly supportive actions that bus drivers ensure, Epting (2021) reflects on the goal of fully automating all buses in all instances—in light of a "driverless" model of mobility—and how this could disregard the passengers who benefit from the care and bolster of drivers. Moreover, automation could also constrain drivers' control over the work by limiting their margin to conciliate distinct, and often conflicting, values, for example, profitability goals for the services provided (e.g., meeting the timetables set for the routes; time for docking at bus stops) and goals oriented towards the passengers' needs. If such arbitrations are left out of the decisions on how to design and integrate automation in the workplace, the risk is drivers feel that they are losing control over their activity since they could be deprived of the ability to undertake some supportive actions when the automated modes are activated. Here, Monéger et al.'s (2018) research dedicated to the analysis of the drivers' work activity in an automated bus prototype (at level 4) is particularly relevant. The authors reveal how these workers were unintentionally placed in critical situations while automation was controlling the driving. On the one side, the workers needed to comply with the procedures defined for the reliability of the service; and, on the other side, they had to manage the impossibility to respond to passengers' requests to stop at places other than the "official" bus stops. Therefore, with the automated mode activated, the workers felt limited to do the work activity as in the past, when it was oriented towards some values that were close to the passengers' needs.

A second key factor challenging the adoption of higher LoA relates to what has been coined as "human factor (HF) challenges", principally at those LoA requiring transitions of control between drivers and automation (levels 2–4). Issues linked to human disengagement from the driving loop (being "out-of-the-loop") and "inaccurate" mental models of vehicle operation have long been addressed in the Human Factors/Ergonomics community[10]. At stake is the nature and quality of HMIs, especially due to the changing nature of the driver's role towards an increasingly passive monitoring position. Previous HF research reveals a set of concerns related to human performance in automated systems, mainly when drivers are solicited to take over manual control (Endsley 2017; Kyriakidis et al. 2019; Noy et al. 2018), such as reduced situation awareness, cognitive overload (which somehow contradicts one of the most publicised AV promises), and displacement of the human body and its know-how (a process known as "deskilling"; e.g., deterioration of manoeuvring skills). Higher LoA (4 and 5) might not necessarily exempt these issues because, on the one hand, automation failures remain an inevitable threat and, on the other hand, "mode errors" could occur when humans are exposed to prolonged periods of high automation (Banks et al. 2019). For example, a mode error is illustrated by Lee (2020) in noting that "safety drivers" (at levels 3 and 4) and "remote operators" (at level 5) are expected to intervene when automation encounters difficulties. The danger, though, is relying on the automated system to perform safety-critical functions in uncertain and rare situations (for which the drivers do not yet have a complete mental model/representation of automation behaviour) when the system is not capable of doing so.

Having identified such safety concerns related to HMI, possible design solutions have been debated at this early maturity stage of AVs, most of them under the guise that the human role remains key in the driving system. Recognising the significance of the problem of human disengagement (the more the driver is out of the loop, the worse), "design philosophies" have been systematised from the knowledge and experience in aviation (see Banks et al. 2019; Simões et al. 2020), a sector that has led the adoption of automation. Banks et al. (2019) illustrate how the two main design approaches applied to aviation—"hard automation" (the system can override the control inputs from the driver, an approach followed by Airbus) vs. "soft automation" (the driver can override automated functions, a scheme followed by Boeing)—continue to reveal out-of-loop problems, such as increased cognitive workload and reduced situation awareness. As well as that, Frison et al. (2020) point out that driving automation implies different preconditions which make the situation more complex (e.g., driving environments are highly time-critical, requiring interventions in seconds; and contrary to aviation automation, there will be great variability in terms of training, driving and technological experience amongst drivers). Thereby, Banks et al. (2019) argue that driving automation has followed a different approach towards "shared control", a concept aiming at combining the driver's and machine's controls to reach safe work (Hoc et al. 2009). The argument for the shared control approach (also referred to as human-automation "cooperation", "collaboration", or "teaming"; Hoc et al. 2009; Norman 2015) is that automation should support drivers rather than replace them. This cooperative relationship implies the development and maintenance of a "common frame of reference" (Hoc et al. 2009) between the two agents (operator and machine), i.e., a mutual understanding of the contexts concerned: the automated system must be able to identify relevant characteristics of the situation and understand human goals and actions; whereas the human may need to understand how automation works and its possible behaviours. Nonetheless, as Gamkrelidze et al. (2021) note, without this common reference, we are not in the presence of real cooperation, but of unidirectional interactions (e.g., when the automated system takes a manoeuvre without providing humans with explanation and without taking their goals into account). In the context of driving simulation, Guo et al. (2019) explore some possibilities to overcome this long-lasting challenge of the shared control approaches: automation communicates its intended manoeuvre and possible alternatives to the driver, who can select an alternative if he/she does not agree with the intention of the automated system.

Despite the interest and research efforts towards design approaches inspired by the principles of shared control and cooperative activity, Kyriakidis et al. (2019) and Merriman et al. (2021) note that the AV design remains non-standardised, and these vehicles might enter the market, even in their initial limited application (at lower LoA), before an agreement is made between manufacturers[11]. At the time of writing, a simple example of this lack of design unification can be observed in the way vehicle manufacturers are free to choose means/signals to inform drivers about the need to intervene when automation exceeds its capabilities (visual/auditory messages are usually used). The European Road Transport Research Advisory Council (ERTRAC 2019) brings into the debate the need to tackle what part of HMI design for AVs should be standardised and what needs to be left open for novel solutions, without inducing negative consequences for drivers.

Another factor challenging the implementation of AVs concerns the lack of specification on driver training programmes. Arguments abound on the crucial role of training to prepare the transport workforce to interact with AVs (see Table 1). At a time when vehicle manufacturers can assume different design specificities, training is thus envisaged as a solution to attain the benefits that AVs promise and prevent the safety issues related to their implementation. Despite this, the nature and content of this training seem to be vague, running the risk of staying merely at the level of intentions. In its report, the ERTRAC (2019) states that the public debate needs concrete answers about driver training. How will the training address the differences between automation functionalities with which vehicles are equipped? What skills will be needed to perform the supervision of AVs and manually intervene when needed? If manual driving training disappears over time with increased LoA, how can deskilling be prevented? In their research, Merriman et al. (2021) present the goals and respective contents that driver training programmes should seek to address (e.g., content to help drivers to develop mental models about their role while operating an AV and system's capabilities and limitations). Still, how this training will be developed, for how long, and what methods will be put in place according to drivers' needs, remain relatively unspecified issues.

As reinforced in Silva and Cunha's (2022) qualitative study with AV designers, learning how to use an AV (i.e., the appropriation of the technical artefact) "does not happen overnight" (p. 596). For instance, Rabardel (1995) shows how the development of representations for action (mental models) goes beyond the constitution of representations in themselves. The construction of representations concerns the elaboration of "operational invariants", that is, stable and pertinent features for the activity. However, the implementation of representations implies considering these specific characteristics for the action situation, which often involves the reorganisation of initial representations. This move from a functioning representation to a utilisation representation is not spontaneous learning; it is rather a complex process that requires time and situations of use (e.g., Haué et al. 2020) and involves considering progressively less and less the external properties of the machine and more and more mentally represented technical functions (Rabardel 1995).

Finally, training is suggested as the "solution" to prepare workers not only for the transformation of their work at the wheel but also for new roles and positions that are likely to emerge with the AV (e.g., remote management roles; AV maintenance roles; see Table 1). The widely invoked recommendations create significant pressure for reskilling/retraining (with its variations of "upskilling" the transport workforce) as the way forward for workers to develop skills other than the "manual" ones often associated with driving and which are seen as susceptible to automation. However, the dominance of this "training narrative" may be threefold problematic. First, apart from revealing a sweeping lack of knowledge about the nature of work in reducing the professional activity to a set of normative tasks (Yvon and Clot 2001), this narrative discredits the past work experience of workers (Gaudart 2021), as if their skills were no longer valid. Zuboff (1988) showed how, as the past wave of factory automation intensified, the pressure on workers to trade their "embodied" know-how (key in their experience of competence) for more "intellective/creative" skills led to feelings of loss of competence and control, weakening the sense of professional identity. On this point, Bobillier Chaumon (2021a) emphasises how such factors could affect workers' well-being and health. Second, by engaging in the training narrative, the responsibility is put on the shoulders of workers, who need to embrace novel technologies and acquire new skill sets to be able to project the future of their professional paths within a "new" road transport sector with AVs. Therefore, the downside of skill-centred recommendations is that they covertly set the stage for conversations around the "adaptivity" and "flexibility" of workers to face the velocity of change. Schlogl et al. (2021) neatly argue that this focus on new skill sets in the FOWD, as a central part of the adaptation discourse, is a complement to deterministic thinking: "adapt to rigid technological imperatives or face redundancy" (p. 322). Consequently, only workers are called upon to overcome the challenges of future work, whereas policymakers are required to "help workers build skills needed in an automated world" (Brown et al. 2019, p. 4), and companies are exempted from this equation (Schlogl et al. 2021). Third, and related, by suggesting that reskilling/upskilling assumes the status of a *laissez-passer* to the future, the danger, as Meda (2019) puts it, is to assume that all that is possible will necessarily come to pass and that workers need to adapt to it. In a vein with determinism, such perspectives are passive in terms of labour policies and organisational strategies (Parker and Grote 2022; Schlogl et al. 2021), conferring to technology a privileged role able to shape the future independently and virtuously. In doing so, discussions abstain from a careful look at the problems workers currently face.

In the section that follows, we argue against these passive "wait-and-see" positions which, relying on technological determinism, place the spotlight only on individual-level action (i.e., workers need to mute their past work experience so as to remain employed).

6. Managing the Mobility of the Future: What Future with AVs We Would Like to Create?

6.1. Questioning the Future of Work from Another Angle

As we have addressed in Section 3, in the FOWD literature, dominant labour market prophecies have resuscitated the fear of technological unemployment from the primacy of "technological absolutism", in which automation is thought of as an independent system/force. However, visions of technology as following its own "inner logic" have been criticised for many reasons. We allude to two of them by their consequences on the themes that are privileged in discussions about the future of work. First, technologically deterministic thinking leads us to suppose that automation peremptorily influences the social organisation, driving its direction by itself, even if, as Valenduc (2005) maintains, this thinking is today presumed to be politically incorrect. Second, backed by assumptions of pregiven effects, quantitative narratives on automation implications (like empiricism of the future) unproblematically accumulate credence through their contingent "metrologisations" of the world of work. While producing a clear dividing line between the market and the spaces of work—giving rise to an inescapable disconnection from concrete socio-professional realities – they ground prescriptions for change (Howcroft and Taylor 2022). It moreover provides a picture in the present time that everything regarding the future has already been decided in a non-negotiable manner and, as such, workers are left to adapt.

That said, to reverse this tendency in the FOWD, it is necessary to change the angle of questions when addressing the future of work, as we are reminded by Schlogl et al. (2021). Instead of speculating on what automation will bring to work in road transport or what work will look like, the alternative is to question what future with AVs we would like to create. Additionally, this view fundamentally implies that passive and techno-centric views are abandoned and broader approaches to work design come into play. In this vein, according to Barcellini (2022), the design of work is viewed as a "transition process" which involves a set of projects—political, social, organisational, and technical—that will together shape a "future work". The management of this transition, Barcellini (2022) adds, has more to do with future work situations (e.g., how tasks can be shared between humans and machines and in what working conditions, and the consequences that can be generated for workers) than the characteristics of technologies themselves.

6.2. Possible Roads Ahead: Initiatives and Design Choices for Decent Work

The automation of driving could offer opportunities to forge a path towards better work in road transport. As discussed above (see Section 5.1), these opportunities are linked to changing working conditions as automation can take over some physically demanding tasks, improve working hours, and increase safety levels. However, such deliberations are framed in futuristic terms (only possible at some point in the future when AV technologies are sufficiently mature), overlooking the potentialities of the analysis of current work activity and its working conditions to inform the design of AVs. Focusing only on the future, as Braun and Randell (2020) adduce, is to engage our gaze entirely on the terrain of the "proponents/prophets of AVs" (who are usually actors from technological and automotive companies involved in the design and promotion of AV technologies; Orfeuil and Leriche 2019). Key here is that when attention is concentrated on what will be new in an AV future (e.g., the technological apparatus), the significance of the present working realities (where these AV technologies will be integrated) is neglected.

Against this background, Cunha et al. (2021) analysed the working conditions in road transport with the advent of AVs, seeking to shed light on some factors intrinsically related to the work and its conditions that should be considered when designing work scenarios with AVs. With a sample of 336 Portuguese professional drivers, the authors reveal how his activity is deeply plagued by a high work pace, very strict deadlines, and long working hours. Of concern is the association that the authors reveal between such conditions and the work intensification felt by transport workers, particularly translated into the feeling of "being exploited at work" (Cunha et al. 2021). As early as 2022, also the ETUI issued a special report called "Workers on the route", addressing the many challenges that transport workers face, particularly, their detrimental conditions (see Note 8). The feeling of exploitation is also raised in this report, especially in the case of truck drivers. Despite this, these workers signal that, in many respects, trucks are not just giant *metal boxes* that people see on the streets. By spending most of their time in the vehicle, trucks become drivers' home, a place to which they get attached to, and, like our own home, it is filled with their energy, hopes and sorrows. This reality is likely to be related to what recent research finds about truck drivers' reluctance about introducing automation into their work environment. Particularly, transport workers express their concerns about possible reduced autonomy/freedom and lower quality of work (Bhoopalam et al. 2021; Castritius et al. 2020), limited possibilities to perform driving tasks they find pleasant (Cunha et al. 2022), and increased feelings of continuous monitoring and disciplining (European Commission 2021). These factors remind us that thinking about the future of work in road transport and how automation could support better work implies going beyond the dominant concerns on the technical feasibility and implementation of AVs and coming to grips with the full range of implications related to human labour.

In a nutshell, getting automation into vehicles is only a part of the path towards better work in road transport. As Parker and Grote (2022) indicate, contrary to overly passive perspectives focused on how workers need to adapt to technology, at stake are choices regarding work design, particularly how technology could be designed and adapted to suit work and better meet workers' skills, experience, needs, and values. In the case of driving automation, Zmud and Reed (2018) argue that automation should go hand-in-hand with the interest of doing the job safely and in fair working conditions. The authors take the example of freight transport. The operating window for truck operations might be lengthened if automation can be proven to manage long periods of highway driving safely and efficiently (e.g., leading to increased delivery efficiency and productivity). Yet, the authors observe, this will only come to fruition if the workplace environment and the shared control of driving are made acceptable for the driver, for example, with the provision of managed and practised procedures to resume controls when needed, situationally adaptative handover protocols (OECD/ITF 2018), appropriate failsafe systems (Kyriakidis et al. 2019; Zmud and Reed 2018) for situations when the driver fails to respond to take-over requests for any reason, possibilities to rest, and even the access to toilet facilities.

Nonetheless, these proactive efforts to shape work design need to be attached to higher-level policies and actors. Therefore, measures at policy and organisational levels will determine how the transition to AVs will be managed. The efforts should segue into harnessing the potential of technology and related productivity growth to achieve decent work, involving new possibilities for workers' participation and support through technological transitions they face throughout their working lives (ILO 2019). Specifically, the ILO's (2020) guidelines on the promotion of decent work in transport claim, depending on the level of automation, "effective social dialogue and updating competencies and training policies can help to effectively manage the transition" (p. 10). In this context, the institutions and key actors in the transport sector (decision-makers, employers' organisations and trade unions) matter in defining the possible *roads ahead* to decent work as vehicles become increasingly automated. Table 2 lists the main inter-institutional initiatives aimed to set transition pathways to AVs which do not adversely affect the working lives of workers.

The perusal of these recommendations allows us to see that a fair transition for the labour force requires, first and foremost, collective action and dialogue, industrial relations, and collective representation in designing the future of work with AVs. The continued engagement of governments, employers and trade unions is crucial to ensure that "any productivity gains from autonomous transport devices do not occur at a heavy cost to workers" (Ioppolo et al. 2019, p. 39). For the trucking industry case, for example, the OECD/ITF (2017) recommends the creation of a "temporary transition advisory board" made up of representatives from unions, companies, vehicle manufacturers and governments, with the mission of advising policymakers on work issues related to AVs.

Table 2. Initiatives and actions that can be used to prepare and manage the mobility of the future.

Description	Governments (Policymaking)	Employers	Trade Unions
• Policy portfolios should be implemented from the initial stages of the transition to AVs, alongside investments in public transit and infrastructures that may aid the safe and efficient operation of AVs (Leonard et al. 2020). • New legislation will be required for mandatory periodic training associated with the transformation of work and new skills requirements related to automation (European Commission 2021). • Transitional assistance schemes should be planned, requiring the provision of funds to support a fair transition for workers that could be displaced (European Commission 2021; OECD/ITF 2017).	x		
• Policymakers could engage transport firms in policy dialogue, providing relevant information related to linking AVs and the changes in work and skills requirements to improve working conditions (European Commission 2021; Smit et al. 2020). • Employers' organisations should then channel knowledge to individual companies so that they remain up to date on developments within the sector (European Commission 2021).	x	x	
• Research and efforts must be directed at specifying adapted training programmes to support workers in performing the job both on board, in shared driving with automated systems, and remotely (e.g., supporting a working knowledge of when and how to use automation and an understanding of its capabilities and limits). • The active involvement of social partners in training design is crucial, for example, to provide input in the form of workers' needs and skills (Ioppolo et al. 2019). • Employers should incorporate these training contents, providing possibilities, resources, and time for learning.	x	x	x
• Dedicated provisions could be set in collective labour agreements regarding the consequences of automation to guarantee that working conditions are safeguarded and improved (European Commission 2021). For example, when automation leverages productivity, a budget can be made available at company level for training and health promotion.		x	x
• Trade unions need to be actively engaged in dialogue with workers to allow them to prepare for their future careers. Actions like providing information, training, and facilitating the active dialogue between workers and employers may be followed, to guarantee the protection of workers' rights and interests, setting agreements (e.g., at workplace level), and thus asserting decent work (ETF 2017; ITF 2019; IndustriALL 2022).			x

6.3. Pathways for Future Research: Challenging the Dominant Framing of "AV Acceptance" and Engaging with Transport Workers' Views

Preparing and managing the mobility of the future is a joint endeavour in which the research community is also called to play an important part. Particularly in the field of work psychology, researchers are challenged to analyse the real work activity of transport workers (e.g., in order to inform design solutions that can be consistent with the reality of work), as well as take up the role of "mediators" in the dialogue between all parties, opening up possibilities to effectively inscribe the work activity in road transport into design decisions. This challenge is even more relevant given that the involvement of professional drivers has been insufficient when it comes to thinking about the possible future scenarios of automated mobility. Johansson et al. (2022), focusing on the case of bus drivers, and Castritius et al. (2020), looking at the case of truck drivers, suggest that research has been devoted to explaining professional drivers' acceptance of AVs while missing the influence of work context and organisation. In fact, the framing of "AV acceptance" has been intensively investigated in driving automation research, exploring drivers' perceptions (the perceived ease of use and perceived usefulness) and when, how, and why drivers are inclined to make use of AVs, principally for private uses. The methodologies adopted to evaluate these perceptions are quantitative and normative measures based on standardised questionnaires and scales of acceptance, as Frison et al. (2020) show in their review.

It is worth reflecting upon some consequences for research that derive from this highly diffused paradigm of social acceptance of AVs. Bobillier Chaumon (2021b), exploring the epistemological and theoretical fields of social acceptance, refers to how this paradigm concentrates the attention on subjective representations of technology by its "potential users". Therefore, it does deal with a "prognosis of the use", like an anticipated (a priori) evaluation, without any contact with the technology at issue. The point here is that in trying to predict future "user behaviour" (e.g., the rejection or adoption of AVs), the potential "user" is demanded to apply "probabilistic reasoning on the future by evaluating the systemic benefits and risks of the use of the device, without any confrontation with the reality of the [work] activity" (Bobillier Chaumon 2021b, p. 240). The adoption of technology is, therefore, framed as a "computational process", where positive perceptions would lead to a favourable adoption and negative perceptions would ground the rejection of technology. The main pitfall of this prism, however, relates to the origin of any action/intervention. Focusing exclusively on "users' perceptions"—which can be measured, modelled, and controlled via quantitative measures –, in the case of rejection of a given technology, possible actions are directed towards the individual variable through behavioural incentives or corrections (Bobillier Chaumon 2021b). Generally speaking, what is at issue is how to change individual perceptions rather than how to design and adapt technology to the professional activities concerned. Thus, the ways technology is integrated into professional activities, the general conditions where the activity is performed, and how workers appropriate technology while performing their activity are examples of situated issues that are missing in prospective studies of AV acceptance.

On the contrary, the "situated acceptance" paradigm brings to the fore the reality of work activity, the worker's lived experience in interacting with technology and the meaning and values attached to it in concrete work situations. This perspective inscribes the study of the frameworks of the use of technology and how they evolve as work experience is developed (Rabardel 1995), rather than studying technology per se, in anticipated and decontextualised manners. In terms of methodological options, this approach extends its methodological range beyond questionnaires, and gives priority to the analysis of previous work activity (before the integration of the technology) and then to the analysis of the actual uses of technology in real situations and their effects on the ways of working, which in fact determine the situated acceptance.

Studies undertaking experiments with AV prototypes (enabling drivers to have direct contact with more realistic AV representations) are mostly set up in simulation environments. These studies have focused on the HMIs at level 3 of vehicle automation, namely the measurement of the "take-over request performance" of drivers, in situations where automation exceeds its operational design domains or when faced with an emergency (Frison et al. 2020). In turn, studies analysing the situated acceptance of AVs in actual contexts of work and from the workers' experience are scarce—to the best of our knowledge, the exceptions are Monéger et al.'s (2018) and Johansson et al.'s (2022) studies devoted to the situated acceptance of AV technologies by bus drivers. There are other studies carried out in settings close to reality, but often quite remote from real situations (Lemonnier et al. 2020). For example, in the case of automated buses, most of them are placed and piloted at technically feasible locations (e.g., closed circuits/areas), operating at very low speeds and short distances. In addition, the assessments have generally short durations, with single sessions of interaction with the AV prototype, providing data regarding the first use of AV technologies, rather than on the development of a working experience with technology (e.g., considering long-lasting effects of AV technologies; Frison et al. 2020). Hence, all contextual information about work environments where professional drivers work is not considered.

In this context, Lemonnier et al. (2020) advocate, the predominance of research designs premised on the social acceptance of AVs might be explained by the current foundational development stage of AVs (although some automated functions are available on the market, AVs are not yet manufactured), as well as the relative absence of policy and legal trajectories for their operation in the public space. Nevertheless, these "acceptance-related studies" (relying on the massive use of questionnaires to evaluate the perceived usefulness of AVs) might have some downsides. First, AVs have no precise contours for respondents, requiring "a lot of imaginative power" to envision what an AV might look like (Frison et al. 2020), which is aggravated by a multitude of variations of the term "automated vehicle" (e.g., "autonomous vehicle"; "self-driving vehicle"; "driverless vehicle", conveying the idea that the vehicle will be independent of human action). Precisely, Payre et al. (2021) flag this lack of clarity and how this reality could increase expectations of current technology, which could result in a backlash of "rejection" as these expectations cannot be technologically met. Second, in light of a techno-centric view presenting AVs as an "unarguable solution" for most road transport problems, any problem related to the implementation and adoption becomes one of public acceptance. Stilgoe and Cohen (2021) claim that, in these terms, the behaviour of the public is seen as a limiting factor, which must be solved to achieve optimal acceptance. It, therefore, reifies a "problem", which is located outside technology and its limitations and uncertainties, but in the perceptions and behaviours of the public (Stilgoe and Cohen 2021). Third, and relatedly, in placing the problem on the side of the public, it is broadly argued that the biggest barrier to the adoption of AVs is human/psychological, and not technical in nature. As Shladover (2022) notes, the terrain of AV proponents gives a distorted view that the technology is ready for widespread adoption, with only drivers' acceptance and reglementary issues remaining to be solved. We can find this tendency in the literature with the language of "human factor aspects" in automated driving (e.g., Nastjuk et al. 2020; Sciaccaluga and Delponte 2020). The idea is that humans can have many "resistances" (or "reservations") about automated driving (e.g., resistance due to "internal factors", such as gender, age, and motivational patterns; or resistance related to the technological features, such as the interface and design of the system; Sciaccaluga and Delponte 2020). Such "human factor-related resistances" thus would limit AV adoption on a large scale, and understanding and intervening in them would have the potential to inherently advance this technology's success (Nastjuk et al. 2020). This view thickens the arguments that the "human factor" should be "improved on", or "transformed", in order to deal with what the machine makes possible.

Allied with the language of user acceptance which reduces humans to the passive component of the technical system, the fact that research attention has been more directed towards AVs for private use also epitomises the lack of voices from professional drivers in the design and implementation of AVs. However, as we have stressed here, the regular activity of driving is far from being subjected to the same constraints as professional driving. Our recent experience in a multidisciplinary project aimed at studying future scenarios of driver-automation interaction in critical situations (e.g., facing unexpected events on the road) in a driving simulator—"Autodriving project" (e.g., Cunha et al. 2022; Simões et al. 2020)—corroborates this poor integration of transport workers and their concrete driving activities in the design stage. The professional driving activity tends to be framed in abstract ways, i.e., without a specific status in the design and testing stages.

The focus is almost exclusively oriented towards behaviours (taken as individual choices that can be disconnected from the social and organisational contexts that determine human actions) and related adaptations/corrections necessary to improve the "take-over request performance" in a view of facilitating the envisioned operation of AVs. We concur with Stilgoe and Cohen's (2021) observations when the authors state that, in this way, we are indirectly asking drivers to "bring stability to the many uncertainties faced by technology's developers" (p. 853). In doing so, the future of work with AVs is only approached through prescribed procedures and adaptations, taking for granted that the work of these professionals will merely involve the execution of such procedures.

In terms of future research, these challenges require designers and researchers to reshape their focus, particularly when at issue is AVs for professional contexts. We advocate the need to come to grips with the role of transport workers' needs, experience, and values for the situated acceptance of AVs. Following the course of this article, we intend to proceed with our research in this way by exploring research questions such as:

- In real work situations, how these AV technologies could be integrated into professional driving activities? Which new possibilities do they provide for the activity and which new constraints do they impose on the (individual and collective) activity of work (e.g., narrowing operational leeway; impeding workers to maintain professional regulations that are consistent with their criteria for a job well done)? Additionally, what are the possible consequences on the status of driving professions?
- While automation seems to constrain workers' bodies with immobility (soliciting less and less the workers' bodies in favour of an increasingly "intellectual presence" required in automation supervision), at the same time, there is a requirement for the human body to be in action (e.g., to regain the manual control of the vehicle). This is a paradox of automation that Moricot (2020) observes in aeronautics and might assume new contours in the case of driving automation. What are the consequences that can be generated for drivers when placed in these specific situations in that they must mobilise their bodies to compensate for the limits of automated modes?
- Relatedly, in terms of skills, what transformations occur in manual driving skills (e.g., which cognitive schemes related to conventional driving should be inhibited, and which new schemes should be developed)? What are the possibilities to retain some manual driving skills that will be required at the intermediate LoA?

On the one hand, these questions point out the important role of situated acceptance, an acceptance that exceeds purely individual factors and connects with organisational, relational (e.g., referring to the collective work activity), professional and identity dimensions (e.g., the extent to which workers have their know-how recognised in working within automated systems) (Bobillier Chaumon 2021b). On the other hand, these questions also stress the important role of work activity analysis to design human-automation systems for professional contexts of driving. Contrary to the residual position that is conferred to the worker and his/her actual work, we will seek to engage transport workers through a participative and collaborative approach grounded in the association of the analysis of the work activity with the simulation of future activity. This position is inscribed in the tradition of activity-oriented perspectives to ergonomics and work psychology (Barcellini 2022; Béguin 2007; Daniellou 2005; De Keyser 1991), which tries to correct a persistent asymmetry during the design of future work. In Béguin's (2007) words, this asymmetry refers to "a disparity in the proportional attention given on the one hand to the specification of machines and on the other hand to those who, through their activity, ensure the function" (p. 115). For example, work activity analysis could contribute to the identification of reference situations that could be then mobilised in simulation contexts with a view of exploring the potential transformations of the work activity (Gamkrelidze et al. 2021). This constructive approach (bringing together AV experts, designers, researchers, and transport workers) has the potential to inscribe workers as "co-designers" of future work situations (Silva and Cunha 2022), permitting opposition to a tendency in the development of AVs, which Norman (2015) alludes to, that sees humans as "second-class citizens" (p. 76) compared to the machine (the "first-class citizen"). Workers might not know the technology at stake, but they are the real experts in their work and, as such, can help design not only technological solutions adapted to their trades but also pathways for integrating these technologies into their activities.

7. Concluding Remarks: Automation and Implications for Political Action

The propensity to offer deterministic worldviews that narratives of "driverless futures" suggest would lead us to firmly narrow the horizon of the future. In this review, we have compiled data that help to dismantle these perspectives which are predicated on abstract conceptions of work. Our analysis contributes to broadening the focus beyond technology and rehabilitating for the FOWD a praxis regarding human labour and decent work. We have called into the debate the crucial role that collective action and dialogue have in preparing and safeguarding the driving workforce in relation to AVs.

The implications of automation are not predetermined and unquestionable, but rather pulsate multiple forms of what is possible. In this regard, a final thought is necessary on the implications of automation for political action. Whether automation is integrated into professional activities properly, it could be a source of prosperity in the long term. However, active policy intervention and regulation are needed in governing automation and its consequences (De Stefano 2019). An example of the need for regulation relates to working hours with AVs, since there is a risk of working hours being spread out over a 24 h period due to increased flexibility (European Commission 2021).

Up to now, as Schlogl et al. (2021) touch on, in policy literature, a discourse around workers' adaptivity seems to prevail. In the case of the transport workforce, we have stressed this pattern, with the prescription of "retraining/upskilling" measures for workers to favour their "employability" with the introduction of AVs. The ubiquitous framing of social acceptance of AVs condenses a prominent ramification of this adaptation discourse: the idea that "users" reject a new technology based on inappropriate representations about it (and its actual capabilities) which need to be "corrected". To this end, often training and "skill dissemination" measures are suggested as necessary for "users" to accept AV technologies and then cope with all the uncertainties they hold—particularly discernible at intermediate levels of vehicle automation in which the crux responsibility for managing and overcoming the technological limitations lies with drivers. Taken together, these aspects favour the political status quo, insofar as the political actors/legislators are only called upon to create policies and strategies for retraining/reskilling that can support workers in this process of "adaptation". This unveils the way the framing of policy absorbs an automation discourse according to "market conforming logics" that allows governments to limit their responsibility for shaping the future of work (Morgan 2019). Passively, policy responses remain tied to manifestos for retraining programmes aimed at developing new skill sets (in the case of transport workers, referred to as more "creative" and "intellective" skills, or simply "non-routine"). Besides being centred on individual adaptation to technological change, this public policy strategy misses how these skills will be needed in new jobs or existing jobs but reconfigured by automation, and the future quality of work in these jobs. In their research, Gallego and Kurer (2022) illustrate how the debate on more fundamental and structural policy responses to automation-induced labour transformations is still in its infancy. In the case of road transport, perhaps all the uncertainty surrounding AVs might even be preventing this debate from taking its first steps. However, postponing this reflection within the contemporary FOWD only leads to pushing the problem forward. At a time when automation poses many doubts on how work and employment will be impacted, what will be the terms of quality of work in automated environments, and if these future jobs will secure adequate standards of living (De Stefano 2019), the danger is that a tide of political disillusionment (e.g., manifested in the turn to protest voting) could grow as the political silence lingers on. This possible "revolt" against the political establishment (political discord) is a cause for concern for policymaking, which requires another policy typology for the Welfare State able to keep up with the magnitude of automation-enabled changes (Gallego and Kurer 2022). Some of the possible alternatives to the current standard responses that remain passively oriented towards individual adaptability are: a redistributive policy agenda, including the provision of funds to assist transport workers during technological transitions—as the European Commission (2021) recommends (see Table 2)—and/or un(der)employed workers, preventing the emergence of new social divides (Valenduc and Vendramin 2016) since it is likely that certain workers will find themselves on the fringes of the "automation age"; new forms of taxation over the gains of automation (and thus support their distribution and combat emerging forms of inequality within the working population); or concrete education reforms to implement lifelong learning (Gallego and Kurer 2022). True, the paths that will be opened from the introduction of AVs are still unclear but leaving this transition to be (un)governed by global market forces, as Mladenović (2019) emphasises, will not result, and may have detrimental consequences on the whole society.

Author Contributions: Conceptualisation, D.S. and L.C.; methodology, D.S. and L.C.; investigation, D.S.; writing—original draft preparation, D.S.; writing—review and editing, D.S. and L.C.; supervision, L.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the FCT–Portuguese Foundation for Science and Technology, grant number SFRH/BD/139135/2018 and by national funds through the FCT–Portuguese Foundation for Science and Technology, under the project UIDB/00050/2020.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Project PTDC/ECI-TRA/28526/2017 - POCI-01-0145-FEDER-028526—funded by FEDER funds through COMPETE2020—Programa Operacional Competitividade e Internacionalização (POCI) and by national funds (PIDDAC) through FCT/MCTES.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Notes

1 (Naville [1963] 2016) shed light on a phenomenon of "distancing" between workers and their object of work, principally with respect to the working time organisation. Tellingly, he said, "(. . .) there is no longer any parallelism between the time of human operations and the time of machines. The pace, speed, or quantities can be very different between human and machine" (p. 240, free translation).

2 Brynjolfsson and McAfee (2014) advocate that today's automation wave is very different due to the increasing power of technology to absorb not only manual work but also cognitive and "non-routine" work. By echoing the maxim that "this time it is different", the authors argue that we have reached an inflexion point (a "second machine age") in which technological advances allow us to blow past previous limitations and take us into "new territory": "machines have escaped their narrow confines and started to demonstrate broad abilities in pattern recognition, complex communication, and other domains that used to be exclusively human" (Brynjolfsson and McAfee 2014, p. 82).

3 In Frey and Osborne's (2017) predictive model, "routine" work is "mainly consisting of tasks following well-defined procedures that can easily be performed by sophisticated algorithms" (p. 255). In a similar vein, Ford (2015) employed the term "predictable" work to refer to "the jobs most likely to be threatened by technology" (p. 13).

4 This approach has been under construction since the 1980s in the French context, bringing together different disciplines (work psychology; activity-centred ergonomics; sociology; occupational health; linguistics) to understand the complexity of work. Through the lens of Ergology, work activity is not a mere application of norms and procedures; rather, managing the distance between the prescribed dimension of work and the real conditions of work is what makes it possible to understand the activity as a permanent debate of norms: a debate of "antecedent norms" (that codifies and precedes work activity) and the real work. In this sense, through the management of such debates, work activity expresses the individuality, values, and unique history (both individual and collective) of those who perform it (Schwartz 1997; Schwartz and Durrive 2003).

5 As growing expectations continue to accumulate on AVs (seen as "promising" technologies), some authors reiterate the need to critically examine these promises principally those related to improved road safety by assuming that, once the human driver is replaced, the incidence of road accidents will massively decrease (Braun and Randell 2020; Noy et al. 2018; OECD/ITF 2018).

Although such deductions have been widely accepted as "a received fact" (Braun and Randell 2020), they warrant scrutiny. First, the AV language tends to emphasise that humans are error-prone and, in turn, technology is an error-free solution with unlimited operational design domains (Silva and Cunha 2022). Second, AV promises of safety are still unproven due to the lack of real data (U.S. DOT 2021).

6 According to the SAE terminology, levels 1–3 of vehicle automation continue to assume the presence of a human driver as the fallback (or the "system backup"). Automated driving at levels 4 and 5 does not require the human driver for fallback performance, as long as the vehicle remains in its defined use cases. Only at the highest LoA (level 5) the automated system is capable of performing all driving tasks under all conditions, requiring no human involvement. The latest version of the SAE classification is dated 2021 and can be found at: https://www.sae.org/standards/content/j3016_202104/ (accessed on 2 May 2022).

7 It is important to note that this model has not considered the purely technological-related aspects and their levels of maturity and readiness that could speed up, or slow down, this process. Our focus is the nuance of discussions regarding human labour.

8 The ETUI's magazine (HesaMag) dedicated to transport workers is available online: https://www.etui.org/sites/default/files/2022-05/HesaMag_25_Workers%20on%20the%20route_1.pdf (accessed on 22 June 2022).

9 According to the International Road Transport Union (IRU 2022), Europe has the highest share of professional drivers over 55 years: 32% of bus/coach drivers and 34% of truck drivers are above 55 years old. This reality is partially explained by the general ageing of the European population and by difficulties in attracting new entrants to the driver profession.

10 The concept of "mental model" is close to "operative image" or "representations for action", concepts used mainly in the field of activity ergonomics and work psychology (see Rabardel 1995).

11 To mitigate this, in September 2022 the "Human Factors in International Regulations for Automated Driving Systems" group, operating under the aegis of the International Ergonomics Association (IEA) and dedicated to supporting the United Nations Economic Commission for Europe (UNECE), elaborated on an informal framework consisting of 11 key design principles for AVs. The framework is available online: https://unece.org/sites/default/files/2022-08/ECE-TRANS-WP1-Informal%202022-3e.pdf (accessed on 31 October 2022).

References

Alonso Raposo, Maria, Monica Grosso, Jacques Després, Enrique Macias, Maria Galasi, Alois Krasenbrink, Jette Krause, Lorenzo Maria Levati, Andromachi Mourtzouchou, Bert Saveyn, and et al. 2018. *An Analysis of Possible Socio-Economic Effects of a Cooperative, Connected and Automated Mobility (CCAM) in Europe—Effects of Automated Driving on the Economy, Employment and Skills*. Luxembourg: Publications Office of the European Union.

Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. *The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis*. OECD Social, Employment and Migration Working Papers, No. 189. Paris: OECD.

Autor, David. 2015. Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives* 29: 3–30. [CrossRef]

Autor, David, David Mindell, and Elisabeth Reynolds. 2022. *The Work of the Future: Building Better Jobs in an Age of Intelligent Machines*. Cambridge: MIT Press.

Balliester, Thereza, and Adam Elsheikhi. 2018. *The Future of Work: A Literature Review*. Working Paper No. 29. Geneva: International Labour Office.

Banks, Victoria, Katherine Plant, and Neville Stanton. 2019. Driving aviation forward; contrasting driving automation and aviation automation. *Theoretical Issues in Ergonomics Science* 20: 250–64. [CrossRef]

Barcellini, Flore. 2022. The design of "future work" in industrial contexts. In *Managing Future Challenges for Safety: Demographic Change, Digitalisation and Complexity in the 2030s*. Edited by Hervé Laroche, Corinne Bieder and Jesús Villena-López. Berlin/Heidelberg: Springer, pp. 75–83.

Bassett, Caroline, and Ben Roberts. 2019. Automation now and then: Automation fevers, anxieties and utopias. *New Formations* 98: 9–28. [CrossRef]

Béguin, Pascal. 2007. Taking activity into account during the design process. *Activités* 4: 115–21. [CrossRef]

Béguin, Pascal, and Yves Clot. 2004. Situated action in the development of activity. *Activités* 1: 1–17. [CrossRef]

Bergman, Ann, and Jan Karlsson. 2011. Three observations on work in the future. *Work, Employment and Society* 25: 561–68. [CrossRef]

Bhoopalam, Anirudh, Roy van den Berg, Niels Agatz, and Caspar Chorus. 2021. The Long Road to Automated Trucking: Insights from Driver Focus Groups. Available online: https://ssrn.com/abstract=3779469 (accessed on 25 October 2022).

Bissell, David, Thomas Birtchnell, Anthony Elliott, and Eric Hsu. 2020. Autonomous automobilities: The social impacts of driverless vehicles. *Current Sociology* 68: 116–34. [CrossRef]

Bobillier Chaumon, Marc-Éric. 2021a. Technologies émergentes et transformations digitales de l'activité: Enjeux pour l'activité et la santé au travail. *Psychologie du Travail et des Organisations* 27: 17–32. [CrossRef]

Bobillier Chaumon, Marc-Éric. 2021b. Exploring the situated acceptance of emerging technologies in and concerning activity: Approaches and processes. In *Digital Transformations in the Challenge of Activity and Work: Understanding and Supporting Technological Changes*. Edited by Marc-Éric Bobillier Chaumon. London: ISTE Ltd., pp. 237–52.

Bouquin, Stephen. 2020. L'automatisation, entre promesses non tenues et réalités contrastées. *Les Mondes du Travail* 24/25: 23–37.

Braun, Robert, and Richard Randell. 2020. Futuramas of the present: The "driver problem" in the autonomous vehicle sociotechnical imaginary. *Humanities and Social Sciences Communications* 7: 1–10. [CrossRef]

Brown, Austin, Hannah Safford, and Daniel Sperling. 2019. Historical perspectives on managing automation and other disruptions in transportation. In *Empowering the New Mobility Workforce. Educating, Training, and Inspiring Future Transportation Professionals*. Edited by Tyler Reeb. Amsterdam: Elsevier, pp. 3–30.

Brynjolfsson, Erik, and Andrew McAfee. 2014. *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies*. New York: W.W. Norton & Company.

Carrère-Gée, Marie-Claire. 2017. Nouvelle vague technologique et emploi. *Futuribles* 421: 5–18. [CrossRef]

Castritius, Sarah-Maria, Heiko Hecht, Johanna Moller, Christoph Dietz, Patric Schubert, Christoph Bernhard, Simone Morviliu, Christian Haas, and Sabine Hammer. 2020. Acceptance of truck platooning by professional drivers on German highways. A mixed methods approach. *Applied Ergonomics* 85: 1–10. [CrossRef] [PubMed]

Cherry, Miriam. 2020. Back to the future: A continuity of dialogue on work and technology at the ILO. *International Labour Review* 159: 1–23. [CrossRef]

COE—Conseil d'orientation pour l'emploi. 2017. *Automatisation, numérisation et emploi: Les impacts sur le volume, la structure et la localisation de l'emploi*; Paris: Conseil d'orientation pour l'emploi.

Cronin, Matthew, and Elizabeth George. 2020. The why and how of the integrative review. *Organizational Research Methods*, 1–25. [CrossRef]

Cunha, Liliana, and Marianne Lacomblez. 2010. Work and values debate in times of change: The paradoxes related to public service notion. Paper presented at the 12th Biennial Conference of the International Society for the Study of Work and Organizational Values (ISSWOV), Lisbon, Portugal, June 27–30; Lisbon: ISSWOV, pp. 171–76.

Cunha, Liliana, Carla Barros, Pilar Baylina, and Daniel Silva. 2021. Work intensification in the road transport industry: An approach to new working scenarios with automated vehicles. *Work: A Journal of Prevention, Assessment & Rehabilitation* 69: 847–57.

Cunha, Liliana, Daniel Silva, Daniela Monteiro, Sara Ferreira, António Lobo, António Couto, Anabela Simões, and Catarina Neto. 2022. Who really wants automated vehicles? Determinant factors of acceptability profiles in Portugal. In *Intelligent Human Systems Integration (IHSI 2022): Integrating People and Intelligent Systems*. Edited by Tareq Ahram, Waldemar Karwowski, Pepetto Di Bucchianico, Redha Taiar, Luca Casarotto and Pietro Costa. New York: AHFE International, vol. 22.

Daniellou, François. 2005. The French-speaking ergonomists' approach to work activity: Cross-influences of field intervention and conceptual models. *Theoretical Issues in Ergonomics Science* 6: 409–27. [CrossRef]

De Keyser, Veronique. 1991. Work analysis in French language ergonomics: Origins and current research trends. *Ergonomics* 34: 653–69. [CrossRef]

De Stefano, Valerio. 2019. Introduction: Automation, artificial intelligence and labour protection. *Comparative Labor Law & Policy Journal* 41: 1–12.

Dellot, Benedict, and Fabian Wallace-Stephens. 2017. *The Age of Automation: Artificial Intelligence, Robotics and the Future of Low-Skilled Work*. London: Royal Society for the Encouragement of Arts, Manufacturers and Commerce (RSA) Future Work Centre.

du Tertre, Christian, and Giancarlo Santilli. 1992. *Automatisation et travail. Utopies, réalités, débats*. Paris: PUF.

Endsley, Mica. 2017. From here to autonomy: Lessons learned from human-automation research. *Human Factors* 59: 5–27. [CrossRef]

Epting, Shane. 2021. Ethical requirements for transport systems with automated buses. *Technology in Society* 64: 101506. [CrossRef]

ERTRAC. 2019. *Connected Automated Driving Roadmap*. Brussels: European Road Transport Research Advisory Council.

ETF—European Transport Workers' Federation. 2017. *TRENDS—Anticipating the Impact of Changes in Transport on Employment, Working Conditions, Professions and Skills*. Brussels: ETF.

ETF—European Transport Workers' Federation. 2021. *Driver Fatigue in European Road Transport*. Brussels: ETF.

Eurofound. 2018. *Automation, Digitalisation and Platforms: Implications for Work and Employment*. Luxembourg: Publications Office of the European Union.

European Commission. 2018. *On the Road to Automated Mobility: An EU Strategy for Mobility of the Future*. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0283&from=PT (accessed on 6 April 2021).

European Commission (Directorate-General for Mobility and Transport). 2021. *Study on the Social Dimension of the Transition to Automation and Digitalisation in Transport, Focusing on the Labour Force: Final Report*. Luxembourg: Publications Office of the European Union.

Feldman, Martha, and Brian Pentland. 2003. Rconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly* 48: 94–118. [CrossRef]

Ford, Martin. 2015. *The Rise of the Robots: Technology and the Threat of Mass Unemployment*. London: Oneworld.

Frey, Philipp. 2021. Visions of automation: A comparative discussion of two approaches. *Societies* 11: 63. [CrossRef]

Frey, Carl, and Michael Osborne. 2017. The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change* 114: 254–80. [CrossRef]

Frison, Anna-Katharina, Yannick Forster, Philipp Wintersberger, Viktoria Geisel, and Andreas Riener. 2020. Where we come from and where we are going: A systematic review of human factors research in driving automation. *Applied Sciences* 10: 8914. [CrossRef]

Gallego, Aina, and Thomas Kurer. 2022. Automation, digitalization, and artificial intelligence in the workplace: Implications for political behavior. *Annual Review of Political Science* 25: 463–84. [CrossRef]

Gamkrelidze, Tamari, Moustafa Zouinar, and Flore Barcellini. 2021. The 'old' issues of the 'new' artificial intelligence systems in professional activities. In *Digital Transformations in the Challenge of Activity and Work: Understanding and Supporting Technological Changes*. Edited by Marc-Éric Bobillier Chaumon. London: ISTE Ltd., pp. 71–86.

Gaudart, Corinne. 2021. Le travail du futur, l'activité, les temporalités. In *Travail de demain, expérience d'aujourd'hui*. Edited by Camille Bachellerie, Catherine Delgoulet, Serge Volkoff and Valérie Zara-Meylan. Paris: Ceet—Centre d'études de l'emploi et du travail, vol. 109, pp. 9–27.

Gittleman, Maury, and Kristen Monaco. 2020. Truck-driving jobs: Are they headed for rapid elimination? *ILR Review* 73: 3–24. [CrossRef]

Guo, Chunshi, Chouki Sentouh, Jean-Christophe Popieul, Jean-Baptiste Haué, Sabine Langlois, Jean-Jacques Loeillet, Boussaad Soualmi, and Thomas That. 2019. Cooperation between driver and automated driving system: Implementation and evaluation. *Transportation Research Part F: Traffic Psychology and Behaviour* 61: 314–25. [CrossRef]

Haué, Jean-Baptiste, Sophie Le Bellu, and Cécile Barbier. 2020. Le véhicule autonome: Se désengager et se réengager dans la conduite. *Activités* 17: 1–25. [CrossRef]

Hoc, Jean-Michel, Mark Young, and Jean-Marc Blosseville. 2009. Cooperation between drivers and automation: Implications for safety. *Theoretical Issues in Ergonomics Science* 10: 135–60. [CrossRef]

Howcroft, Debra, and Jill Rubery. 2021. Labour and technology: Reflecting on a century of debate in the International Labour Review. *International Labour Review* 2: 1–11. [CrossRef]

Howcroft, Debra, and Phil Taylor. 2022. Automation and the future of work: A social shaping of technology approach. *New Technology, Work and Employment*, 1–20. [CrossRef]

ILO—International Labour Organization. 2019. *ILO Centenary Declaration for the Future of Work*. Available online: https://www.ilo.org/global/about-the-ilo/mission-and-objectives/centenary-declaration/lang--en/index.htm (accessed on 7 September 2022).

ILO—International Labour Organization. 2020. *Guidelines on the Promotion of Decent Work and Road Safety in the Transport Sector*. Geneva: Publications of the International Labour Office.

IndustriALL. 2022. From manufacturing to mobility—Unions prepare for the mobility sector of the future. In *Global Worker—The Biannual Magazine of IndustriALL*. Geneva: IndustriALL Global Union. Available online: https://www.industriall-union.org/report-from-manufacturing-to-mobility-unions-prepare-for-the-mobility-sector-of-the-future (accessed on 12 October 2022).

Ioppolo, Rebecca, Advait Deshpande, Stijn Hoorens, and Salil Gunashekar. 2019. *Autonomous Transport Devices: Implications of Game-changing Technologies in the Services Sector in Europe*. Dublin: European Foundation for the Improvement of Living and Working Conditions (Eurofound).

IRU—International Road Transport Union. 2022. *Driver Shortage Global Report 2022: Understanding the Impact of Driver Shortages in the Industry*. Geneva: IRU.

ITF—International Transport Workers' Federation. 2019. *Transport 2040: Automation, Technology, Employment—The Future of Work*. London: WMU/ITF.

Johansson, Mikael, Fredrick Ekman, MariAnne Karlsson, Helena Stromberg, and Joakin Jonsson. 2022. ADAS at work: Assessing professional bus drivers' experience and acceptance of a narrow navigation system. *Cognition, Technology & Work* 24: 625–39.

Kaufmann, Vincent, Guillaume Drevon, Elodie Dupuit, and Emmanuel Ravalet. 2019. *Quelles mobilités demain avec la voiture autonome?* Lausanne: École Polytechnique Fédérale de Lausanne.

Kyriakidis, Miltos, Joost de Winter, Neville Stanton, Thierry Bellet, Bart van Arem, Karel Brookhuis, and Riender Happee. 2019. A human factors perspective on automated driving. *Theoretical Issues in Ergonomics Science* 20: 223–49. [CrossRef]

Lee, John. 2020. Driver trust in automated, connected, and intelligent vehicles. In *Handbook of Human Factors for Automated, Connected, and Intelligent Vehicles*. Edited by Donald Fisher, William Horrey, John Lee and Michael Regan. Boca Raton: CRC Press Taylor & Francis Group, pp. 67–94.

Lemonnier, Aurore, Sonia Adelé, and Corinne Dionisio. 2020. The determinants of acceptability and behavioural intention of automated vehicles—A review. *Le Travail Humain* 83: 297–342. [CrossRef]

Leonard, John, David Mindell, and Erik Stayton. 2020. *Autonomous Vehicles, Mobility, and Employment Policy: The Roads Ahead*. Cambridge: MIT Work of the Future.

Leplat, Jacques. 2004. L'analyse psychologique du travail. *European Review of Applied Psychology* 54: 101–8. [CrossRef]

Meda, Dominique. 2019. Three scenarios for the future of work. *International Labour Review* 158: 627–52. [CrossRef]

Merriman, Siobhan, Katherine Plant, Kirsten Revell, and Neville Stanton. 2021. Challenges for automated vehicle driver training: A thematic analysis from manual and automated driving. *Transportation Research Part F: Traffic Psychology and Behaviour* 76: 238–68. [CrossRef]

MGI—McKinsey Global Institute. 2017. *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*. Chicago: McKinsey & Company. Available online: https://www.mckinsey.com/~{}/media/BAB489A30B724BECB5DEDC41E9BB9FAC.ashx (accessed on 27 January 2022).

Mladenović, Milos. 2019. How should we drive self-driving vehicles? Anticipation and collective imagination in planning mobility futures. In *The Governance of Smart Transportation Systems*. Edited by Matthias Finger and Maxime Audouin. Berlin/Heidelberg: Springer International Publishing, pp. 103–22.

Monéger, Ferdinand, Fabien Coutarel, Ladislav Moták, Patrick Chambres, Marie Izaute, and Michel Dhome. 2018. L'expérience vécue et les valeurs en acte des accompagnants pour la conception d'un service de transport par navettes destinées à être autonome. *Activités* 15: 1–34. [CrossRef]

Morgan, Jamie. 2019. Will we work in twenty-first century capitalism? A critique of the fourth industrial revolution literature. *Economy and Society* 48: 1–28. [CrossRef]

Moricot, Caroline. 2020. *Agir à distance: Enquête sur la délocalisation du geste technique*. Paris: Classiques Garnier.

Nastjuk, Ilja, Bernd Herrenkind, Mauricio Marrone, Alfred Benedikt Brendel, and Lutz Kolbe. 2020. What drives the acceptance of autonomous driving? An investigation of acceptance factors from an end-user's perspective. *Technological Forecasting & Social Change* 161: 120319.

Naville, Pierre. 2016. *Vers l'automatisme Social?* Paris: Éditions Syllepse. First published 1963.

Nikitas, Alexandros, Alexandra-Elena Vitel, and Corneliu Cotet. 2021. Autonomous vehicles and employment: An urban futures revolution or catastrophe? *Cities* 114: 1–14. [CrossRef]

Norman, Donald. 2015. The human side of automation. In *Road Vehicle Automation 2*. Lecture Notes in Mobility. Edited by Gereon Meyer and Sven Beiker. Berlin and Heidelberg: Springer, pp. 73–79.

Noy, Ian, David Shinar, and William Horrey. 2018. Automated driving: Safety blind spots. *Safety Science* 102: 68–78. [CrossRef]

OECD. 2018. *Job Creation and Local Economic Development 2018: Preparing for the Future of Work*. Paris: OECD Publishing.

OECD/ITF—International Transport Forum. 2017. *Managing the Transition to Driverless Road Freight Transport*. Paris: ITF.

OECD/ITF—International Transport Forum. 2018. *Safer Roads with Automated Vehicles?* Paris: ITF.

Orfeuil, Jean-Pierre, and Yann Leriche. 2019. *Piloter le véhicule autonome au service de la ville*. Paris: Descartes & Cie.

Paddeu, Daniela, Thomas Calvert, Ben Clark, and Graham Parkhurst. 2019. *New Technology and Automation in Freight Transport and Handling Systems. Future of Mobility: Evidence Review*; London: Government Office for Science.

Parker, Sharon, and Gudela Grote. 2022. Automation, algorithms, and beyond: Why work design matters more than ever in a digital world. *Applied Psychology* 71: 1171–204. [CrossRef]

Payre, William, Stewart Birrell, and Andrew Parkes. 2021. Although autonomous cars are not yet manufactured, their acceptance already is. *Theoretical Issues in Ergonomics Science* 22: 567–80. [CrossRef]

Pettigrew, Simone, Lin Fritschi, and Richard Norman. 2018. The potential implications of autonomous vehicles in and around the workplace. *International Journal of Environmental Research and Public Health* 15: 1876. [CrossRef]

Pfeiffer, Sabine. 2018. The 'future of employment' on the shop floor: Why production jobs are less susceptible to computerization than assumed. *International Journal for Research in Vocational Education and Training* 5: 208–25. [CrossRef]

PwC—PricewaterhouseCoopers. 2018. Will Robots Really Steal Our Jobs? An international Analysis of the Potential Long-Term Impact of Automation. Available online: https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf (accessed on 15 February 2022).

Rabardel, Pierre. 1995. *Les Hommes et les Technologies: Approche Cognitive des Instruments Contemporains*. Paris: Armand Colin.

Rydstedt, Leif, Gunn Johansson, and Gary Evans. 1998. The human side of the road: Improving the working conditions of urban bus drivers. *Journal of Occupational Health Psychology* 3: 161–71. [CrossRef]

Santana, Monica, and Manuel Cobo. 2020. What is the future of work? A science mapping analysis. *European Management Journal* 38: 846–62. [CrossRef]

Schlogl, Lukas, Elias Weiss, and Barbara Prainsack. 2021. Constructing the 'Future of Work': An analysis of the policy discourse. *New Technology, Work and Employment* 36: 307–26. [CrossRef]

Schwartz, Yves. 1997. *Reconnaissances du Travail: Pour une Approche Ergologique*. Paris: PUF.

Schwartz, Yves, and Louis Durrive. 2003. *Travail et Ergologie: Entretiens sur l'activité Humaine*. Toulouse: Octares.

Sciaccaluga, Martina, and Ilaria Delponte. 2020. Investigation on human factors and key aspects involved in autonomous vehicles—AVs—Acceptance: New instruments and perspectives. *Transportation Research Procedia* 45: 708–15. [CrossRef]

Shladover, Steven. 2022. Opportunities, challenges, and uncertainties in urban road transport automation. *Sustainability* 14: 1853. [CrossRef]

Silva, Daniel, and Liliana Cunha. 2022. The challenges of automated driving: Contributions towards a human-automation research agenda from the lens of the activity. In *Occupational and Environmental Safety and Health III*. Edited by Pedro Arezes, João Santos Baptista, Paula Carneiro, Jacqueline Castelo Branco, Nélson Costa, Joana Duarte, Joana Guedes, Rui Melo A. Sérgio Miguel and Gonçalo Perestelo. Cham: Springer, vol. 406, pp. 591–602.

Simões, Anabela, Liliana Cunha, Sara Ferreira, José Carvalhais, José Tavares, António Lobo, António Couto, and Daniel Silva. 2020. The user and the automated driving: A state-of-the-art. In *Advances in Human Factors of Transportation. AHFE 2019*. Edited by Neville Stanton. Cham: Springer, vol. 964, pp. 190–201.

Smit, Geert, Michael Flickenschild, Nils Verkennis, Angelo Martino, Claudia De Stasio, Davide Fiorello, Wolfgang Schade, Christian Scherf, Daniel Berthold, Meike Stich, and et al. 2020. *Study on Exploring the Possible Employment Implications of Connected and Automated Driving—Final Report*. Rotterdam: ECORYS.

Snyder, Hannah. 2019. Literature review as a research methodology: An overview and guidelines. *Journal of Business Research* 104: 333–39. [CrossRef]

Sousa, Inês, and Sara Ramos. 2018. Working conditions, health and retirement intentions: A case study of truck drivers. *International Journal of Workplace Health Management* 11: 114–29. [CrossRef]

Spencer, David. 2018. Fear and hope in an age of mass automation: Debating the future of work. *New Technology, Work and Employment* 33: 1–12. [CrossRef]

Stilgoe, Jack, and Tom Cohen. 2021. Rejecting acceptance: Learning from public dialogue on self-driving vehicles. *Science and Public Policy* 48: 849–59. [CrossRef]

Susskind, Daniel. 2020. *A World without Work: Technology, Automation and How We Should Respond*. London: Allen Lane.

U.S. DOT—United States Department of Transportation. 2021. *Driving Automation Systems in Long-Haul Trucking and Bus Transit. Preliminary Analysis of Potential Workforce Impacts*; Washington: Department of Transportation.

Valenduc, Gérard. 2005. *La technologie, un jeu de société: Au-delà du déterminisme technologique et du constructivisme social*. Louvaine-la-Neuve: Academia Bruylant.

Valenduc, Gérard, and Patricia Vendramin. 2016. *Work in the Digital Economy: Sorting the Old from the New*. Brussels: ETUI.

Valenduc, Gérard, and Patricia Vendramin. 2019. The mirage of the end of work. *Foresight Brief* 6: 1–16.

Vatin, François. 2009. *Évaluer et valoriser: Une sociologie économique de la mesure*. Toulouse: Presses universitaires du Mirail.

WEF—World Economic Forum. 2020. *The Future of Jobs Report 2020*. Geneva: WEF.

WEF—World Economic Forum. 2021. *Autonomous Trucks: An Opportunity to Make Road freight Safer, Cleaner and More Efficient*. Geneva: WEF.

Wynsberghe, Axelle, and Ângela Pereira. 2022. The politics and imaginary of 'autonomous vehicles': A participatory journey. *Humanities & Social Sciences Communications* 9: 1–10.

Yvon, Frédéric, and Yves Clot. 2001. Le travail en moins: Une approche psychologique de l'activité. *Cités* 4: 63–73. [CrossRef]

Zmud, Johanna, and Nick Reed. 2018. Synthesis of the socioeconomic impacts of connected and automated vehicles and shared mobility. In *Summary of the Sixth EU-U.S. Transportation Research Symposium*. Washington: The National Academies Press, pp. 25–61.

Zuboff, Shoshana. 1988. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books, Inc.