LUDOVIKA
UNIVERSITY PRESS

PRO PUBLICO BONO
PUBLIC ADMINISTRATION

Volume 12. (2024)
No. 1.

ISSN 2063-9058 (print)
ISSN 2786-0760 (online)

PRO PUBLICO BONO – Public Administration

Special Issue: RESPONSIBLE ARTIFICIAL INTELLIGENCE AND PLATFORM LABOUR

TABLE OF CONTENTS – 2024/1

2024

PRO PUBLICO BONO – Public Administration, 2024/1, 3–8. • DOI: 10.32575/ppb.2024.1.1

EDITORS' NOTE: INTRODUCTION TO THE THEMATIC ISSUE ON RESPONSIBLE ARTIFICIAL INTELLIGENCE AND PLATFORM LABOUR

Hojjat Adeli, The Ohio State University, Columbus, Ohio, USA

Csaba Makó, Institute of the Information Society, Ludovika University of Public Service, Budapest, Hungary

Norbert Kis, Institute for Environmental Sustainability, Ludovika University of Public Service, Hungary

Bernát Török, Institute of the Information Society, Ludovika University of Public Service, Budapest, Hungary

By increasing the number of social and industrial applications of big data, Artificial Intelligence (AI), Machine Learning (ML) and Algorithmic Management (AM) technologies have become increasingly important for Digital Transformation. AI and ML have become an integral part of our life, the cognitive work system and its broader social or organisational context. Multi-disciplinary research into AI and ML, along with convincing empirical evidence, is essential for it to be understandable, useable, and useful. The scope of explainable AI (XAI) is very broad, encompassing diverse technical methods, theories of explainability and understanding, philosophical perspectives, ethical considerations, legal issues, human-centred evaluations, and applications. These involve many different fields, including but not limited to computer science and informatics, legal studies, cognitive science/psychology, sociology and political sciences. This special issue aims to provide a common forum to bring these different perspectives together for the benefit of the international research community.

The essays in this special issue deal with an extremely rapidly growing field of studies, highlighting the contributions of AI, ML and AM technologies to both social and energy sciences, as well as providing legal perspectives on AI regulation and especially on the variety of labour platforms.[1]

[1] The number of online web-based (e.g. Upwork, Topcoder) and location-based (e.g. Uber, Foodora) platforms rose from 142 to over 777 in 2020. ILO (2021): The Role of Digital Labour Platforms in Transforming the World of Work, 19, see: https://www.ilo.org/publications/flagship-reports/role-digital-labour-platforms-transforming-world-work

The essays in the Special Issue explore novel concepts and practices in the following fields: deep learning in the social sciences, AI and ML in smart grids, theoretical perspectives on the legal regulation of AI, the legal and social regulation of various types of labour platforms and the inclusiveness of digitalisation.

The essays are organised in two sections.

1. Applications of AI and ML: Selected examples in social science and energy sciences, with a special focus on regulation issues
2. Legal regulation, digital usage groups and a variety of empirical experiences of platform labour as it relates to work practices

1: Application of AI and ML: Selected examples in social and energy sciences, with a special focus on regulation issues

The leading essay by Sina Ardabili, Amir Mosavi, Csaba Makó and Péter Sasvári, *A Comprehensive Review and Evaluation of Deep Learning Methods in Social Sciences* analyses the emergence of Deep Learning (DL) as a novel data-driven methodology. The paper aims to systematically review and assess the performance of DL methods in the field of social sciences. Publications were sourced from Scopus and Web of Science (WoS). Applications in social sciences were categorised into twelve domains: social information, social network analysis, social development, social movements, social inequalities, social cooperation, social conflicts, social technology, social health, social risks, the social environment, and social media. The findings suggest that evaluation criteria play a crucial role in determining the effectiveness of DL models.

Rituraj Rituraj, David T. Varkonyi, Amir Mosavi, József Pap, Annamária R. Várkonyi-Kóczy and Csaba Makó's article, *Machine Learning in Smart Grids: A Systematic Review, Novel Taxonomy, and Comparative Performance Evaluation* presents a state-of-the-art review of machine learning (ML) methods and applications used in smart grids to predict and optimise energy management. The article proposes a new taxonomy for categorising ML models and evaluates their performance based on accuracy, interpretability, and computational efficiency. Finally, the article discusses some of the limitations, challenges and future trends of using ML in smart grid applications. The value-added contribution of the article is that it highlights how ML can enable the creation of efficient and reliable smart grid systems.

In his article, *Upside Down: Liability, Risk Allocation and Artificial Intelligence,* Tamás Fézer challenges the currently dominant concepts of liability in relation to the rapid growth of AI and ML. This paper examines some of the most affected fields of tortious liability, and analyses whether the existing legal standards in civil liability can still be used, or whether a brand-new approach needs to be adopted and therefore, novel liability scenarios should be established. Considering the patchy and sporadic regulatory framework underlying AI and ML in civil liability, the paper aims to serve as a blueprint for an instrumental research study that would target concept and policy building for regulators and legal practitioners alike.

2: Legal regulations, digital usage groups and variety of empirical experiences of platform work

The paper by Zsolt Ződi entitled *A Legal Theory of Platform Law* examines the recent discussions in the field of platform law from a jurisprudential point of view. The essay argues that the main reason for regulation is that platforms, as coordination mechanisms, tend to become unstable without intervention or to become harmful from the point of view of society. The paper lists four features which characterise platform law: its ex-ante regulatory nature, the predominance of technology regulation and self-regulation, and the extensive use of user protection tools, such as complaint mechanisms, the protection of user accounts and explainability obligations. The latter toolbox partly resembles the familiar and well-established methods of consumer protection, but in certain aspects, it also differs from it.

Drawing on a rich empirical analysis, Tuomo Alasoini's article *Digital Tools Usage Groups as Features of the Digital Divide between Finnish Employees* argues that digitalisation relates to the work of different employees in different ways. The paper attempts to make a theoretical contribution by examining how the research results relate to the previous research literature on digital divides. The empirical evidence is not fully in line with the stratification theory argument, according to which the digital world reproduces offline inequalities. For example, many of the employees in the study who have a relatively low level of education, especially young employees, are classed as Skilled Users in terms of their digital skills. As a practical contribution, the paper reveals that there are usage gaps of various types. To bridge them, there are no easy one-size-fits-all solutions.

The paper by Branka Andjelkovic, Tanja Jakobi and Ljubivoje Radonjic *Right Before Your Eyes, Yet Unnoticed: The Growth of Online Labour and Country Differences in Southeast Europe* makes a cross-country analysis of the online web-based platforms in nine selected Southeast European countries. Digital labour platforms, as part of an innovative business model, play an important role in today's labour markets by linking the demand and supply of digital work. The number of online workers increased in all the countries investigated, with creative services and multimedia and software development being the most dominant fields employing online workers in each country. Moreover, men are more commonly represented in these digital markets compared to women. The results of the analysis can provide useful information to national policymakers, as they work to address the novel challenges in the labour market brought by technological advancements.

In *The Consequences of (in) Visibility for Platform Workers,* Laura Seppänen analyses how digital infrastructures can lead to considerable increases in the behavioural visibility of people. This paper aims to examine the consequences of visibility for workers who carry out work tasks via digital labour platforms. Visibility paradoxes of connectivity, performance and transparency are used as methodical lenses. The same features of platform operations can have both empowering and marginalising consequences for workers at the same time. While labour platforms continuously improve visibility for workers, they may also hide, inadvertently or intentionally, central information.

Anna Ürmössy in *Control or Resistance? The Role of Gamification in Algorithmic Work Management* examines the work organisation of *Foodpanda,* and the bicycle couriers' strategies related to the gamification of work in this sector. The games contribute to the formation of consent among the couriers. However, some games can be seen as a form of resistance. Taking part in the games initiated by the platform (from above), the couriers are obliged to accept the rules and the logic of the work organisation. On the other hand, some games initiated by the platform workers (from below) have the potential to make work easier, allowing for strategies that sabotage the system in minor ways. While these practices can be seen as a form of resistance, it remains unclear whether they cause actual financial damage to the company.

Klára Nagy's *article, Body and Mind. Reframing Labour Exploitation and Risk as a Sport among Platform Workers* also focuses on the food delivery service business, which has been one of the most visible sectors in the platform economy in recent years – especially during the Covid–19 pandemic. She explores how bicycle delivery workers accept, normalise, and justify precarious working conditions, labour exploitation and risk. The essay tries to understand the blurring frontiers between sport and work. Based on participant observation and interviewing platform workers, the author examines how food delivery companies create new frontiers, framing labour as a challenging cardio activity. The riders embrace the idea that they get paid for training their bodies, an activity that is otherwise expensive and tiring.

THE WAY FORWARD

The editors – instead of drawing conclusions – wish to enrich the further discussion at a time of the dizzying technological changes, adopting the perspective outlined by Acemoglu & Johnson's recent emblematic book: "The type of government leadership we advocate […] seeks to encourage the development of technologies that are more complementary to workers and citizens empowerment rather than trying to select specific technological trajectories."[2] This powerful perspective highlights the importance of making careful choices in order to balance benefits for employers (i.e. productivity) and employees (i.e. improving quality of life) while reducing the adverse impacts for society.

With this in mind, we intend to draw attention to the following future challenges for both the communities of practitioners and academics. Firstly, it is worth focusing on the development of human-centred AI regulation, and secondly on the need to address some understudied areas of platform-related research.

[2] Acemoglu, Daron – Johnson, Simon (2023): *Power and Progress. Our 1000-Year Struggle over Technology & Prosperity.* New York: PublicAffairs, 410.

Regulatory burden

In 2023, the US Senate launched a series of "AI Insight Forums" hosted jointly by the two dominant political parties. As a part of this initiative, a session held on 1 November was dedicated to the way AI will change the world of work. Coincidently, the European Council and the Parliament agreed in December 2023 on a legal[3] regulation of AI (the AI Act). In this haste to pass AI regulation – on both sides of the Atlantic – it is worth stressing the urgent need for "evidence-based" regulation initiatives in order to avoid the so-called "non-alignment regulatory syndrome". The recent report of the Stanford University Human Centred Artificial Intelligence stresses: "Rather than rushing to poorly calibrated or infeasible regulation, policymakers should first seek to enhance the government's understanding of the risks and reliability of AI systems."[4] Similarly, the employers' organisation in Europe (Business Europe) insists that in the context of "lack of consistent and robust data across different sectors […] any initiative at EU level will need to be assessed carefully and should not take the form of new European legislation".[5] These important observations draw attention to the fact that if we do not allow enough time to understand a phenomenon that is as new as AI is, then hastily enacted regulations can do more harm than good.

Knowledge deficiencies of platform work research

The majority of essays in the Special Issue mapped and assessed the various characteristics (e.g. surveillance, digital agency, visibility, consent, and resistance, etc.) of platform labour both from Southern/Central European and Nordic Perspectives. It is worth noting the asymmetric/unbalanced nature of empirical data collection on platform work and the related European legal regulation efforts. The recent regulation of working and employment conditions is centred on "location-based platform" workers operating in the delivery economy.[6] At the same time, there are rather few and sporadic global initiatives aimed at regulating freelancers' services on the so-called "web-based digital platforms".[7] Finally, the other generally underestimated dimension of platform work research is that, conceptually, researchers have reached a consensus on the key control role of customers/

[3] See: www.techpolicy.press/us-senate-ai-insight-forum-tracker/

[4] Guha, Neel et al. (2023): *The AI Regulatory Alignment Problem*. Stanford: Stanford University Human-Centred Artificial Intelligence, RegLab, 3.

[5] *Algorithmic Management at Work: Improving Transparency to Achieve More Trust in AI* (2023). Brussels: Business Europe, Policy Orientation Note, 2.

[6] European Parliament, Committee on Employment and Social Affairs (2022): *Report on the Proposal for a Directive of the European Parliament and of the Council on Improving Working Conditions in Platform Work*. A9-0301/2022, 21 December 2022.

[7] Charter of Principles for Good Platform Work (2020). World Economic Forum, 4.

clients on the platform workers' behaviour. However, the syndrome of "talking the talk" dominates without fully "walking the walk": besides the theoretical discussion, systematically collected empirical evidence about this key actor's role in the platform work is largely missing.[8]

[8] Until presently, the rare exception of this critic is the following paper – focusing on the practice of the location-based delivery platforms: Schor, Juliet B. et al. (2023): Consent and Contestation: How Platform Workers Reckon with the Risks of Gig Labour. *Work, Employment and Society,* (September), 35.

PRO PUBLICO BONO – Public Administration, 2024/1, 9–51. • DOI: 10.32575/ppb.2024.1.2

Sina Ardabili – Amir Mosavi – Csaba Makó – Péter Sasvári

A COMPREHENSIVE REVIEW AND EVALUATION OF DEEP LEARNING METHODS IN THE SOCIAL SCIENCES

Sina Ardabili, Research Fellow, Ludovika University of Public Service, Institute of the Information Society, s.ardabili@ieee.org

Amir Mosavi, Research Fellow, Ludovika University of Public Service, Institute of the Information Society, Mosavi.Amirhosein@uni-nke.hu

Csaba Makó, Professor, Ludovika University of Public Service, Institute of the Information Society, mako.csaba@uni-nke.hu

Péter Sasvári, Associate Professor, Ludovika University of Public Service, Faculty of Public Governance and International Studies, Department of Public Management and Information Technology, University of Miskolc, Faculty of Mechanical Engineering and Informatics, Institute of Information Science, sasvari.peter@uni-nke.hu

Artificial intelligence (AI) is widely used in social sciences and continues to evolve. Deep learning (DL) has emerged as a powerful AI tool transforming the social sciences with valuable insights across many areas. Employing DL for modelling social sciences' big data has led to significant discoveries and transformations. This study aims to systematically review and evaluate DL methods in the social sciences. Following PRISMA guideline, this study identifies fundamental DL methods applied to social science applications. We evaluated DL models using reported metrics and calculated a normalised reliability score for uniform assessment. Employing relief feature selection, we identified influential parameters affecting DL techniques' reliability. Findings suggest that evaluation criteria significantly impact DL model effectiveness, while database and application type influence moderately. Identified limitations include inadequate reporting of evaluation criteria and model structure details hindering comprehensive assessment and informed policy development. In conclusion, this review underscores DL methods' transformative role in the social sciences, emphasising the importance of explainability and responsibility.

Keywords:
social science, deep learning, big data, machine learning, artificial intelligence, generative artificial intelligence

INTRODUCTION

The integration of artificial intelligence (AI) in the social sciences is expanding rapidly, profoundly shaping the field. AI equips researchers with powerful tools to analyse vast and complex social datasets with greater accuracy and efficiency. AI's application in the social sciences is becoming increasingly prevalent and transformative, offering valuable tools for analysing intricate social data. Machine learning (ML) and deep learning (DL), as the fundamental AI tools are revolutionising the social sciences, providing unprecedented opportunities for analysis and insight. This merging of technologies with social science methodologies represents a pivotal moment in research, enabling scholars to explore complex societal phenomena with enhanced depth and precision. ML and DL provide a robust toolkit for social scientists to uncover meaningful patterns and relationships from diverse datasets. This is the reason we refer to the current decade as the golden age of social sciences.[1] ML algorithms, including deep neural networks, decision trees and support vector machines, can reveal hidden structures and trends within social data, facilitating tasks like classification, prediction, and clustering. By utilising these tools, researchers can gain fresh insights into human behaviour, societal dynamics and cultural trends. DL, a subset of ML, holds particular promise in social science research due to its capacity to automatically learn hierarchical representations from data. DL techniques are increasingly applied in the social sciences to analyse large-scale textual data from social media platforms, revealing sentiment trends, identifying social networks, and understanding public discourse. Additionally, DL models can process multimodal data, integrating text, images, and videos to offer a more comprehensive understanding of social phenomena. Moreover, DL enables the integration of diverse data sources and methodologies in social science research. By merging structured data from surveys and administrative records with unstructured data from textual sources and social media, researchers can gain a holistic view of human behaviour and societal trends. Furthermore, AI-driven methods facilitate the integration of quantitative and qualitative approaches, bridging disciplinary boundaries and fostering interdisciplinary collaboration in social science inquiry. In essence, the application of DL in social sciences ushers in a new era of discovery and innovation, providing unprecedented opportunities to understand and address complex social issues. By harnessing the power of ML and DL, social scientists can advance knowledge, inform policy, and contribute to societal improvement. Social science is experiencing a golden age, marked by explosive growth in new data and analytic methods, interdisciplinary approaches, and a recognition

[1] Miller 2019; Grimmer et al. 2021; Buyalskaya et al. 2021.

of their necessity in solving the world's most challenging problems. Computational social science[2] has risen in prominence over the past decade, with thousands of papers utilising observational data, experimental designs, and large-scale simulations that were once unfeasible or unavailable to researchers. These studies have significantly enhanced our understanding of social sciences.

With abundant data and an increasing reliance on DL, social scientists are re-evaluating applications and best practices. Unlike traditional tasks in computer science and statistics, DL applied to social scientific data aims to discover new concepts, measure their prevalence, assess causal effects, and make predictions. The abundance of data facilitates a shift from deductive social science toward a more sequential, interactive, and ultimately inductive approach to inference. Historically, empirical work in social sciences was constrained by scarcity, where data, surveys, and computational resources were limited. However, the current landscape is defined by abundance, with big data transforming the evidence base. Social scientists are increasingly turning to deep learning methods to leverage this abundance, prioritising performance on established quantitative benchmarks. DL methods offer transformative potential in the social sciences, necessitating a re-evaluation of conventional practices. This involves reapplying deep learning techniques to gain insights into social science big data. The current abundance of data allows for a shift toward a more inductive approach, characterised by sequential and iterative inferences.[3] Using DL is crucial in social science research today. DL contributes in processing and analysing large datasets, uncovering patterns and relationships within social phenomena.[4] These technologies support evidence-based decision-making, improve prediction accuracy, and offer new perspectives on human behaviour and societal dynamics. DL is used in areas such as sentiment analysis, opinion mining, and social network analysis. Big data analytics helps to understand social trends and demographic changes, while DL allows the analysis of unstructured data like text and images. These technologies work together to enhance researchers' ability to understand and predict complex social phenomena. Reviewing the application of deep learning in social sciences can help identify successful applications, evaluate effectiveness, and highlight research gaps and opportunities. Ethical considerations are essential, ensuring responsible use of these technologies.[5] A comprehensive review provides valuable insights for policymakers, informing policies on data privacy, algorithmic transparency, and responsible implementation of deep learning. Consequently, this article provides an overview of how social scientists utilise DL methods and evaluate model performance. Several review studies on the applications of ML and DL have been conducted in various sections of the social sciences. Table 1 summarises these studies. Nevertheless, a review that is systematically following a standard guideline, which includes the evaluation of the method is missing from the literature.

[2] Lazer et al. 2020; Moon–Blackman 2014.
[3] Hofman et al. 2021; Galesic et al. 2021; Zhang et al. 2020.
[4] Poole–Mackworth 2010; Al-Sartawi 2021.
[5] Lecun et al. 2015; Goodfellow et al. 2016.

Table 1: Notable DL- and ML-based review studies in the social sciences

Ref.	Description	Limitations	Systematic review	Review guideline	Evaluational viewpoint
Rani–Sumathy 2022	To analyse DL and ML techniques in Sentiment Analysis	Single field	✓	*x*	*x*
Özerol–Selçuk 2022	To study the ML and AI techniques in analysing the relationship between machines and humans	Single field	✓	*x*	*x*
Bai–Bai 2022	To study the role of ML in Sports Social Networks	Limitation of analysis	*x*	*x*	*x*
Nasir et al. 2021	To analyse the trend of Financial Technology using ML	Single field and limited applications	✓	*x*	*x*
Khan–Ghani 2021	A Survey of DL for Human Activity Recognition	Limitation of analysis	✓	*x*	*x*
Kumar et al. 2021	ML and DL for analysing Online Social Network Security	Limitation of performance analysis	*x*	*x*	✓
Present study	Evaluation of DL in different applications of social science	We did our best to cover the limitations of previous studies	✓	✓	✓

Source: compiled by the authors

METHODOLOGY

Database preparation

The database was created using Scopus and further refined employing PRISMA guideline,[6] and Selçuk (2019) as a guideline. The search syntaxes included the terms deep learning and further deep learning general algorithms, e.g. convolutional neural network, long short-term memory, deep neural network, deep belief network, recurrent neural networks, and deep reinforcement learning, employed for social science (see Table 2). The subfield of DL and its applications in the social sciences was investigated using a comprehensive search filter. Table 2 indicates the search queries within article titles, abstracts, and keywords using AND, OR/AND operators.

[6] Page et al. 2021.

Table 2: Searching queries from databases

Search within	Operators	Keywords
Article title, abstract, keywords	OR	(deep learning, convolutional neural network, long short-term memory, deep neural network, deep belief network, recurrent neural networks, and deep reinforcement learning)
Article title, abstract, keywords	AND	(social science and the related keywords)

Source: compiled by the authors

The PRISMA guidelines have four main phases including 1. identification phase, 2. screening phase, 3. eligibility phase and 4. inclusion. Figure 1 presents a flowchart of the PRISMA guidelines for the present research principles.

The main prospect of this review is to evaluate the DL-based techniques in the different applications of social science. The 1st phase of the PRISMA guidelines (Identification phase) involves identifying the required cases and building the database (Figure 1, 1st Phase). Accordingly, about 511 cases, 482 cases (about 94% of total cases) were exported from the WoS, and Elsevier Scopus, and 29 cases (about 6% of total cases) were exported from the other databases. Figure 2 presents the statistical trend of the records in the field per year. According to Figure 2, the trend of cases published is rising significantly. Figure 3 presents the progress of a decade of DL in social science. Figure 4 presents the geographical

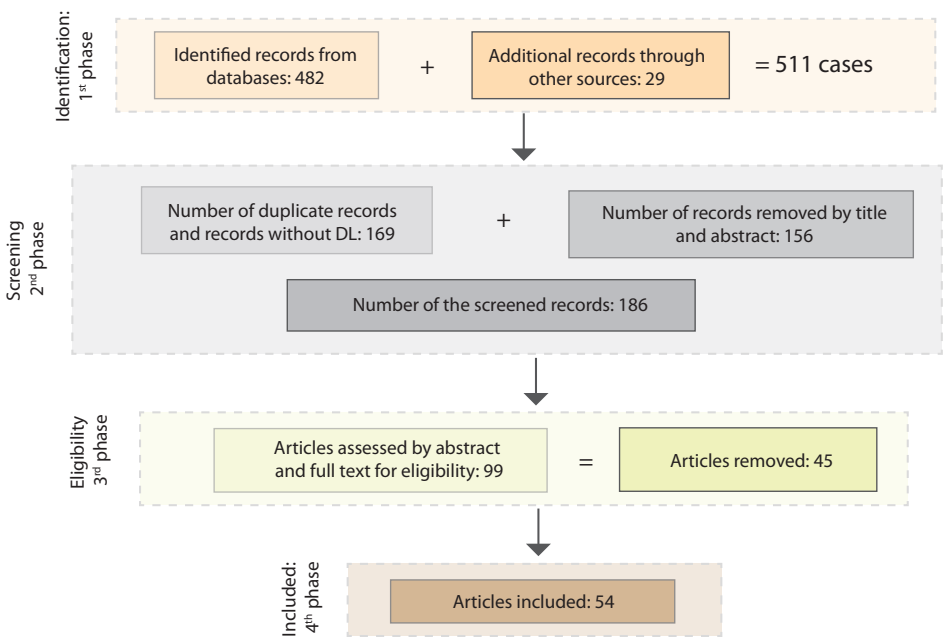


Figure 1: PRISMA guideline for preparing the database of the study
Source: compiled by the authors

distribution of the DL for social science. It is worth mentioning that social science closely interacts with various scientific and applied fields including medical, pharmaceutical and engineering fields. One of the challenges is to exclude the irrelevant studies from the database. However, in many cases due to interaction of various fields, this remains as a challenge and identified as a limitation of this study. Thus, including several irrelevant studies is inevitable.

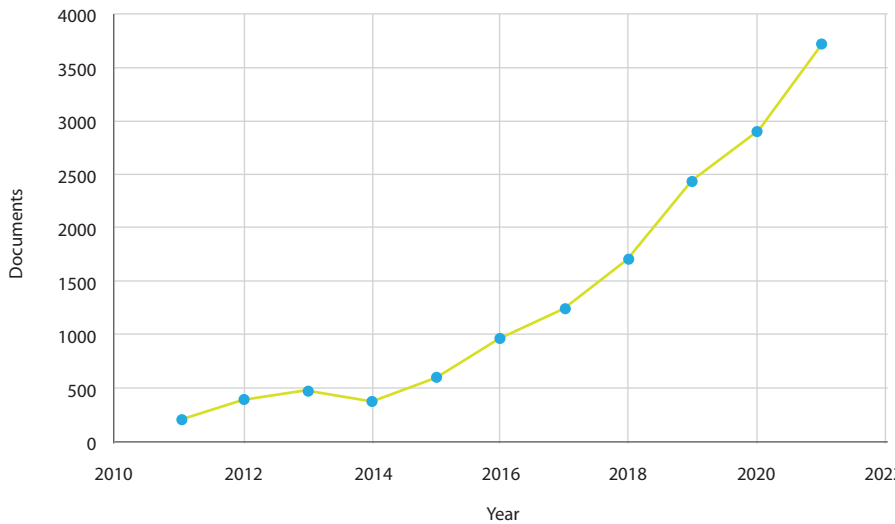


Figure 2: Progress of a decade of AI in social science
Source: compiled by the authors

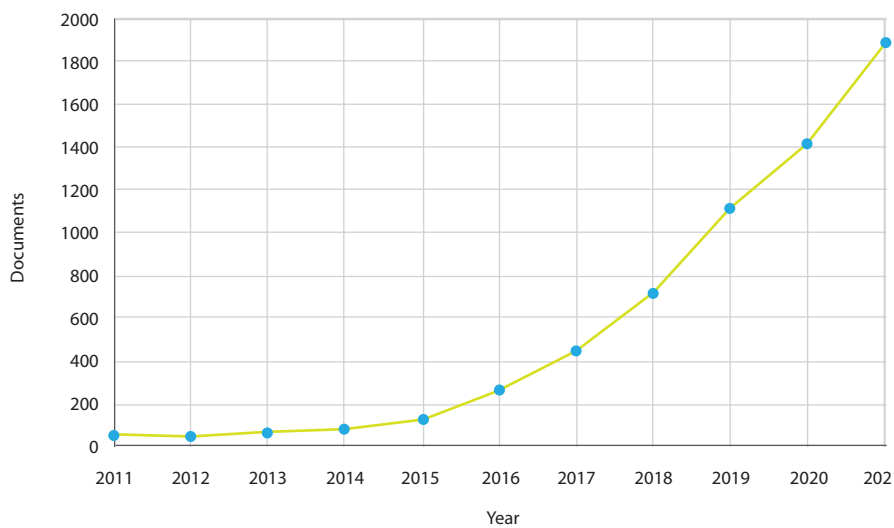


Figure 3: Progress of a decade of DL in social science
Source: compiled by the authors

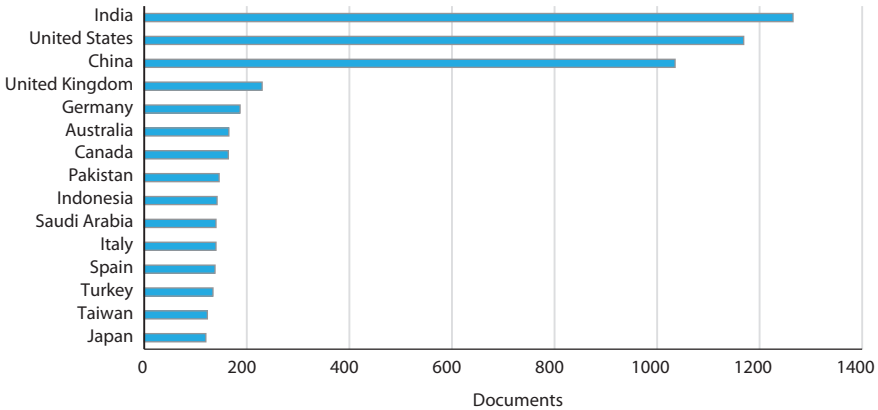


Figure 4: Geographical distribution of DL for social science
Source: compiled by the authors

In the 2nd phase of the PRISMA guideline, i.e. the screening phase, the duplicate cases, irrelevant cases, and cases without any information about DL are eliminated. In the 2nd phase, 169 cases were removed during the screening for duplication and 156 cases were removed by considering the title and abstracts. Figure 5 presents a bibliographic network based on the frequently used keywords after the first phase filtration, which were extracted as a map from bibliographic data by supporting WoS and Scopus databases.

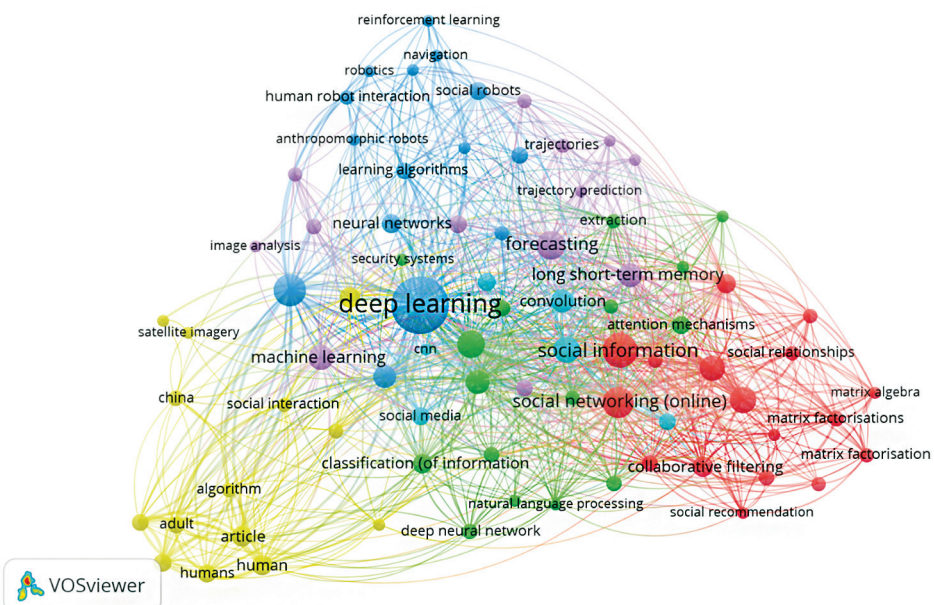


Figure 5: Bibliographic map of frequently used keywords
Source: compiled by the authors

In the following step, 186 cases were considered in the 3rd Phase (eligibility phase). The 3rd phase takes into account eligibility to filter the relevant articles. In this phase, the authors considered the full text of the cases, and the most relevant cases were chosen. Accordingly, 99 cases were selected for further evaluation. In some cases, there were limitations in accessing the full text of the records, especially in conference articles. In the last phase, 54 cases (about 11% of total cases) were selected for possible further evaluation. This "including phase" is the last step in the PRISMA guidelines. Finally, by analysing the included cases, the main taxonomy of the study was prepared. The materials studied were categorised into twelve subsets of the social sciences including social information, social network, social development, social movement, social inequalities, social cooperation, social conflict, social technology, social health, social risk, social environment, and social media (Figure 6).

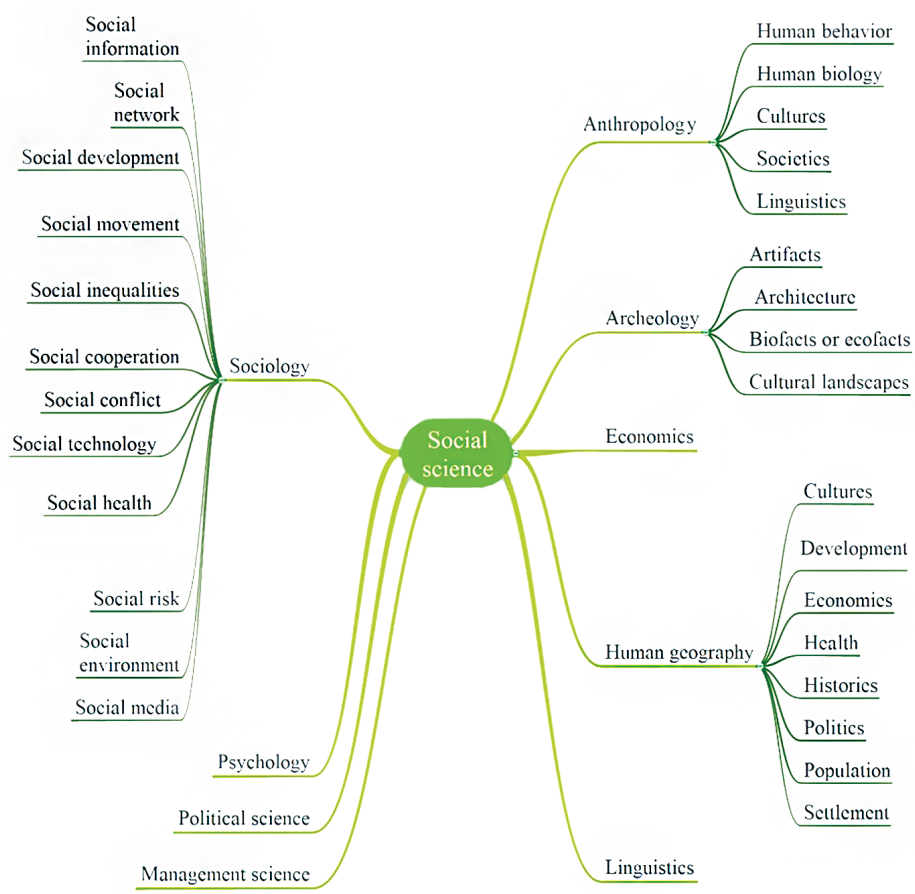


Figure 6: The subsections of social science
Source: compiled by the authors

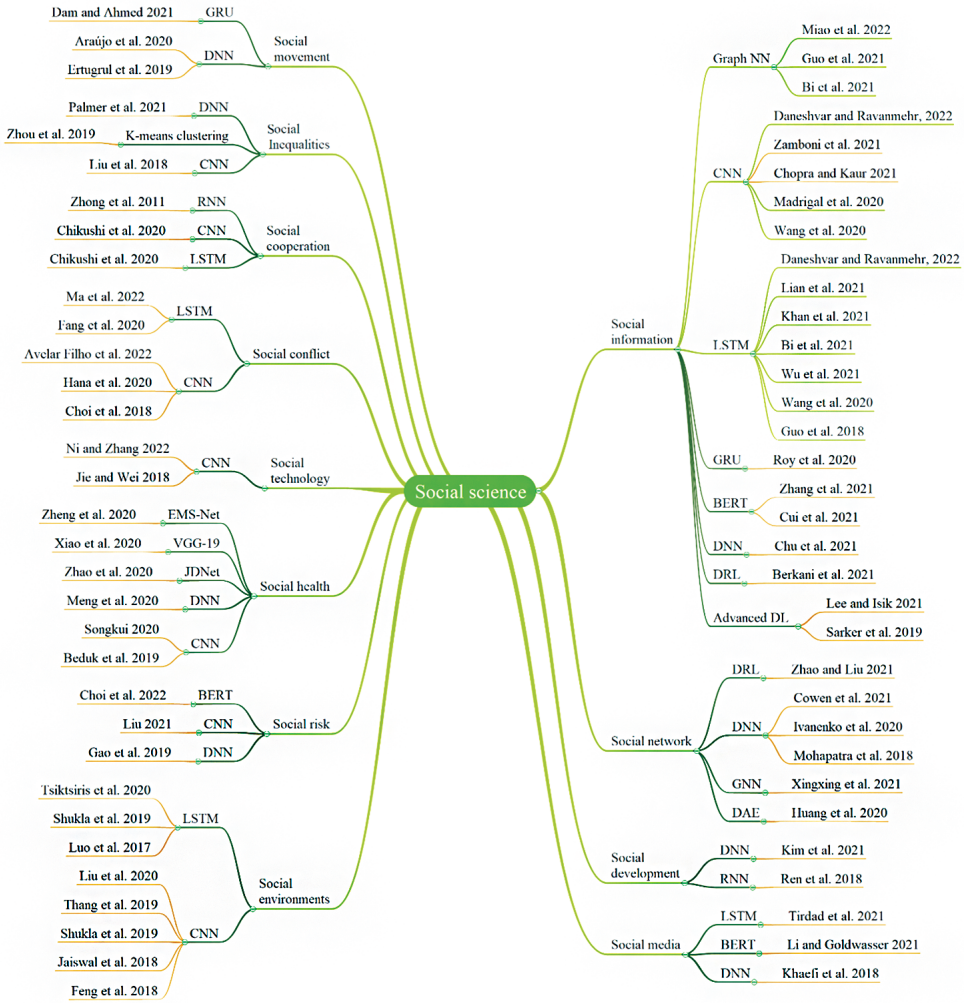


Figure 7: The main taxonomy of the study
Source: compiled by the authors

The next section presents the studies in each application of the social sciences. This section analyses the DL techniques in each section separately to highlight information along with the evaluation of the DL techniques employed (Figure 7).

Social information

Social information is one of the most frequently used keywords in the social science. Information about the notable studies that employed DL in different applications connected to social information is presented in Table 3. It has nine columns, including References, year of publication, description of the study, model characteristics, DL method type, evaluation criteria, application type, and the main keyword. This format for preparing the table description was also applied to the other fields of social science. Table 3 indicates some of the limitations of the studies that were selected. The phrase "NA" refers to non-available content.

Table 3: Notable DL-based studies for social information analysis

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Miao et al. 2022	2022	To model collaborative signals	Meta-path Enhanced Lightweight	GNN	Social graphs	NA	Detection	Social recommendation
Daneshvar–Ravanmehr 2022	2022	To develop a social hybrid recommendation platform	RSLCNet	CNN and LSTM	Data from Movie-Tweetings, Mise-en-scène, and OMDB	MAE and RMSE	Detection	Social recommendation
Zhang et al. 2022	2022	To model factors affecting the social recommendation	NA	SoGNN	Three real-world datasets from book marking, and Last.fm	Precison	Prediction	Social recommendation
Zamboni et al. 2022	2022	To develop a platform for the estimation of the pedestrian trajectory	NA	CNN and RNN	Public dataset	NA	Prediction	Trajectory prediction
Masson–Isik 2021	2021	To propose social interaction perception	Fully connected-kernel size	CNN	Pretrained on the ImageNet	Prediction performancescore	Prediction	Social interaction perception
Zhang et al. 2021	2021	To develop a platform for urban function recognition	Various hidden layers and nodes	BERT	Social sensing data	Kappa index and accuracy	Recognition	Semantic risk

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Cui et al. 2021	2021	To develop an application to provide automatically assistance capabilities of social network applications	NA	BERT	38,970 sellers' information	Accuracy	Classification	Social e-commerce
Chu et al. 2021	2021	Cardiovascular disease prediction	NA	DNN	834 patients from 2017 to 2020	AUC, accuracy, sensitivity, specificity	Prediction	Cardiovascular disease
Chopra–Kaur 2021	2021	To develop a platform for IoT-based group size estimation	Various hidden layers and nodes	CNN	Open source software projects from github	RMSE	Prediction	Recommendation system
Khan et al. 2021	2021	To evaluate the effect of depression diagnosis on Twitter	NA	Bi-LSTM	Twitter database	Accuracy	Detection	Depression analysis
Bi et al. 2021	2021	To model the social recommendation system	Diffnet	GNN	Ciao and Epinions dataset	MAE and RMSE	Detection	Social recommendation
Ludl et al. 2020	2020	To diagnosis of unusual human activities in urban areas	Two-layer LSTM with 32 frames	LSTM	Human movement data	Accuracy	Recognition	Pose estimation
Wu et al. 2020	2020	Popularity-aware content detection in a closed social network	NA	LSTM	300 million records including 2250 webpages spreading in WeChat	Accuracy	Prediction	Autonomous content placement
Cong 2020	2020	A platform to propose film and television culture	Fully connected layers: 200*64*32*32*32*16*16*16	CNN	User data and video data	MAE	Prediction	Personalised recommendation
Diaz et al. 2021	2020	To develop a platform for speaker detection using social information	ResNet3D-34, ResNet3D-18	CNN	Raw pixels (RGB images) and motion (estimated with optical flow)	AUC	Detection	Audiovisual modeling, feature fusion
Bai–Cheng 2020	2020	To propose a multi-dimensional NN for social images classification	NA	3DNN	RGB and depth images from social network images	Accuracy, precision and recall	Classification	Multi-modal deep learning

Source: compiled by the authors

The main aim of the present study is to evaluate DL techniques in relation to social science, therefore, we categorised the analysis by exploring the application type and the evaluation criteria. Figure 9 presents the statistical report of the evaluation criteria. Based on Figure 8, Accuracy (about 36%) followed by AUC (about 18%) provided the highest proportion for evaluating the application of DL techniques in social information. Accuracy was employed for evaluating the Bidirectional Encoder Representations from Transformers (BERT) technique in the urban function recognition using.[7] BERT was also evaluated by the accuracy criteria for analysing the automatic assistance capabilities of social network applications.[8] Accuracy was employed for evaluating the deep neural network (DNN) for cardiovascular disease prediction.[9] The performance of the Bidirectional long-short term memory (Bi-LSTM) was evaluated by accuracy criteria to diagnose the effect of depression diagnosis on Twitter.[10] The performance of LSTM for the diagnosis of unusual human activities in urban areas was evaluated in terms of its accuracy.[11] Accuracy was employed as the criterion for evaluating LSTM in popularity-aware content detection in a closed social network.[12] Accuracy evaluated the performance of 3DNN to propose a multi-dimensional NN for social image classification.[13]

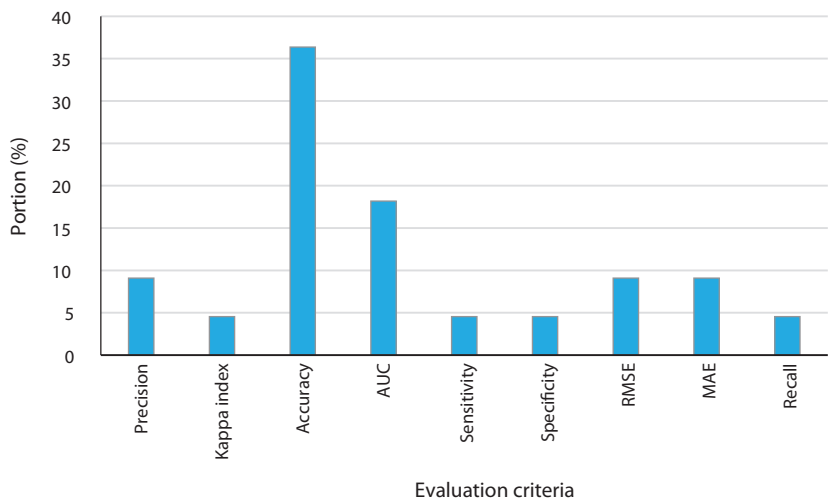


Figure 8: Statistical report of the evaluation criteria
Source: compiled by the authors

7 Zhang et al. 2021.
8 Cui et al. 2021.
9 Chu et al. 2021.
10 Khan et al. 2021.
11 Ludl et al. 2020.
12 Wu et al. 2020.
13 Bai–Cheng 2020.

Figure 9 presents the share of each application, which employed DL in social information. Based on Figure 9, prediction (about 44%) followed by detection (about 31%) were the areas employing DL the most for social information applications. In Miao–Yang (2022), graph neural network (GNN) was employed in collaborative signals detection. In Daneshvar et al. (2022) convolutional neural network (CNN) and LSTM were employed for the detection of situations for social hybrid recommendation. In Zhang et al. (2022) some GNN techniques were employed to predict factors affecting social recommendation. In Zamboni et al. (2022) CNN and recurrent neural networks (RNN) were employed to develop a platform for the prediction of pedestrian trajectory. In Masson–Isik (2021) CNN was employed to predict social interaction perceptions. In Chopra–Kaur (2021) CNN was employed to develop a platform for IoT-based group size prediction. In Bi et al. (2021) GNN was employed to identify situations for proposing the social recommendation system.

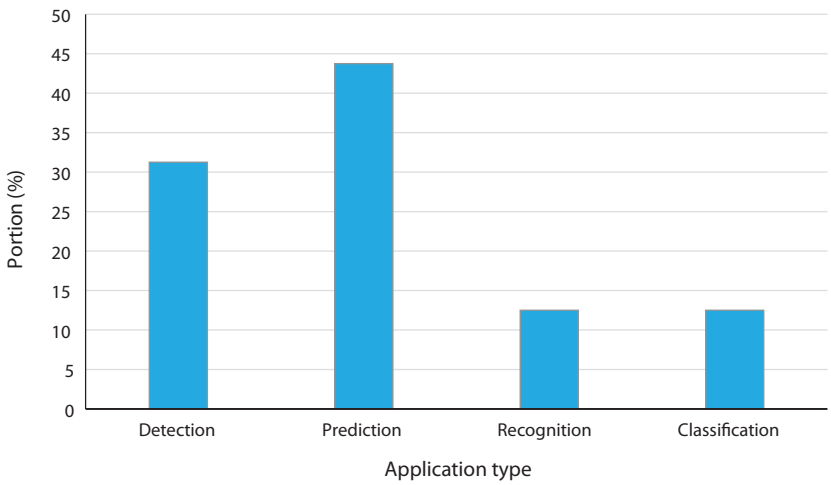


Figure 9: The statistical report of the application type
Source: compiled by the authors

Table 4 presents the evaluation results and the advantages of each DL technique in each application, separately.

Table 4: The evaluation results and the advantages of each DL technique

Ref.	Evaluation criteria		Advantages
Miao–Yang 2022	NA	NA	Captures reliable information
Daneshvar–Ravanmehr 2022	NA	NA	Using DL improved the effectiveness of the model
Zhang et al. 2022	Precision	0.99	The proposed technique was successfully able to cope with the task
Zamboni et al. 2022	NA	NA	More advanced techniques were proposed
Masson–Isik 2021	Performance score	0.48	Reduces the gap between the real world and the experimental approach
Zhang et al. 2021	Kappa index	0.61	The model can successfully be employed to investigate the historical POI data
	Accuracy	0.84	
Cui et al. 2021	Accuracy	0.9	The method provided a real time classification
Chu et al. 2021	AUC	0.91	Provides an automated detection platform for patients
	Accuracy	0.875	
	Sensitivity	0.88	
	Specificity	0.87	
Chopra–Kaur 2021	RMSE	1.18	Issued labels to improve the estimation performance
Khan et al. 2021	Accuracy	0.95	The platform ensured the reliability of real-time depression analysis
Bi et al. 2021	MAE	0.71	Provided a platform to improve the quality of recommendations
	RMSE	0.97	
Ludl et al. 2020	Accuracy	0.98	The proposed technique was successfully able to handle the task
Wu et al. 2020	Accuracy	0.893	The platform enabled efficient placement decisions to be taken in a real-time task
Cong 2020	MAE	0.71	The proposed technique has a suitable application effect on TV films and programs
Diaz et al. 2021	AUC ResNet3D-34	0.81	The proposed platform allowed real-time detection
	AUC ResNet3D-18	0.79	
Bai–Cheng 2020	Accuracy	0.96	Provided valid and accurate outputs in real experiments
	Precision	0.95	
	Recall	0.95	

Source: compiled by the authors

According to Table 4, some of the cases did not provide evaluation criteria. There are several reasons for this. In some cases, the evaluations were performed by graphical comparisons. In some cases, the study was conducted in order to develop a system without an evaluation

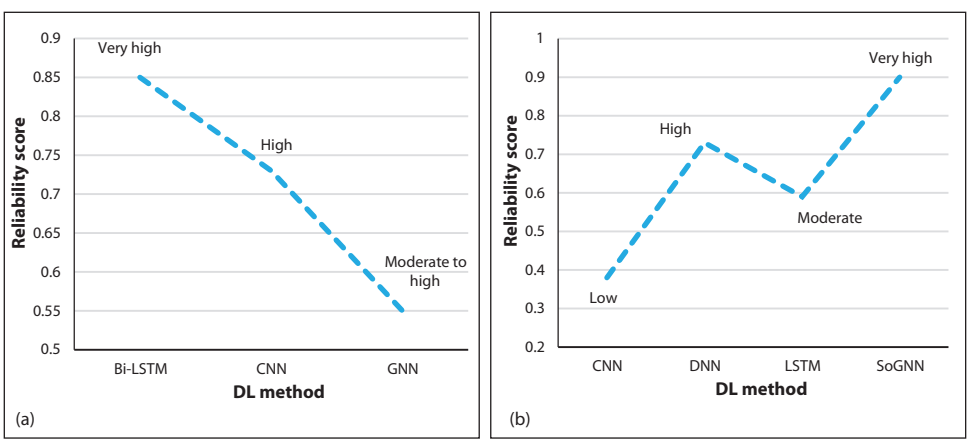
step and in some cases, the full text was not available. In general, most of the cases employing DL techniques were evaluated as promising analytical tools to help address the research problem. Figure 10 presents the general evaluation of each DL in each application based on the strategy employed in our previous study.[14] We performed a relative reliability analysis by normalising accuracy, precision, and recall values (Eq. 1):

$$Z_N = \frac{g(Accuracy, Precision, Recall) - Z_{min}}{Z_{max} - Z_{min}} \quad (1)$$

where Z_N refers to the normalised reliability point, and Z_{min} and Z_{max} are the parameters (depending on the specific metric reported) employed for the limitations of the scores to provide scores between 0 and 1. For better interpretation, we further separated Z values into four categories:

Low if $0 \leq Z_N < 0.25$
Moderate if $0.25 \leq Z_N < 0.5$
High if $0.5 \leq Z_N < 0.75$
Very high $0.75 \leq Z_N \leq 1$

Figure 10 presents the reliability of the DL methods used in social information. The x-axis lists the DL methods, and the y-axis presents the reliability score, which is computed using Equation 1.



[14] Band et al. 2022.

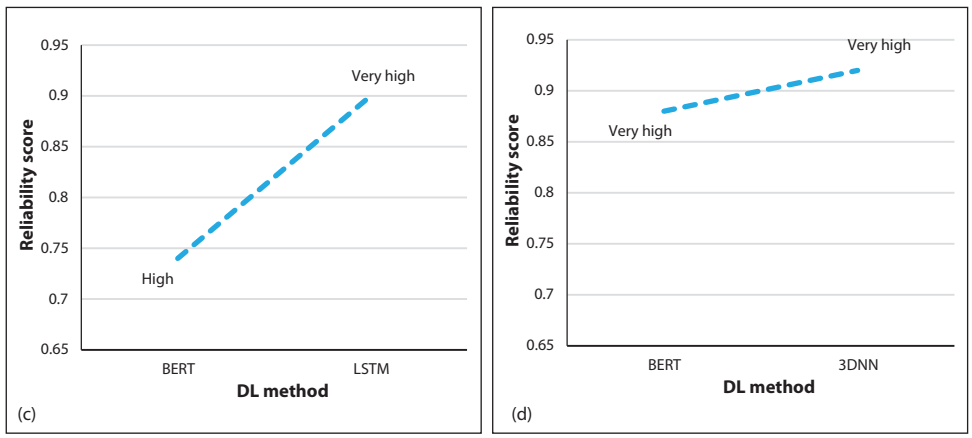


Figure 10: Reliability score for a) detection, b) prediction, c) recognition, and d) classification
Source: compiled by the authors

Bi-LSTM and LSTM displayed very high reliability scores for detection and recognition purposes, respectively, while for prediction, LSTM had a moderate reliability score. CNN achieved high reliability for detection purposes, while it exhibited a low-reliability score for prediction. GNNs achieved moderate to high reliability scores for detection purposes, while some GNNs provided very high reliability scores for prediction. BERT produced high and very high reliability scores for recognition and classification purposes, respectively. It can be observed that the reliability score depends on the application type.

Social network

Table 5 presents the information about the notable studies that employed DL in different applications connected to the topic of social networks. The nature of the content of Table 5 is similar to Table 3. Table 5 indicates some limitations of the studies developed. The phrase "NA" refers to non-available content.

Table 5: Notable DL-based studies for social network analysis

Ref.	Year	Description	Model parameters	Method	Analysing data source	Evaluation criteria	Application	Keyword
Zhao–Liu 2020	2021	To enhance the overall utility of vehicle drivers	Social-aware incentive mechanism	DRL	Model data	Average utility, extrinsic utility, intrinsic utility	Optimisation	Vehicular crowdsensing
Cowen et al. 2021	2021	Investigating human facial expressions with specific social contexts in different cultures for adaptive responses to different emotions	7 × 7 feature map comprising 1,024 channels, 7 × 7 average pooling layer, 1,024-dimensional vector	DNN	Contexts in 6 million videos from 144 countries	Accuracy and std. deviation	Classification	Human facial expressions, naturalistic social contexts
Xingxing et al. 2021	2021	Point of interest recommendation systems	NA	GNN	Feature extraction from graphs	NA	Modeling	Point of interest, nonlinear interaction
Ivanenko et al. 2021	2021	To classify sex and strain	NA	DNN	Recorded dataset	Accuracy	Classification	Ultrasonic vocalisations

Source: compiled by the authors

As is clear from Table 5, in social networks, the number of studies reported, which employed DL technique is low, and this entails some limitations for analysing and evaluating the application of DL techniques in this field. According to the data presented in Table 5, classification is the main application of DL for researching social networks. For this purpose, accuracy was employed as the criterion for the evaluation of DL techniques in these applications. Zhao and Liu (2020) employed deep reinforcement learning (DRL) for optimisation and to enhance the overall utility of vehicle drivers. Cowen et al. (2021) employed DNN to classify human facial expressions with specific social contexts in different cultures for adaptive responses to different emotions. Xingxing et al. (2021) developed a recommendation system for modelling purposes using GNN. Ivanenko et al.

(2020) also developed a classification system for selecting sex and strain. Table 6 presents the numerical findings and the advantages of each model in the social network.

Table 6: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Zhao–Liu 2020	Average utility	0.8–2	Optimal sensing and solution strategy
	Extrinsic utility	0.8–2	
	Intrinsic utility	0.1–1.6	
Cowen et al. 2021	Natural faces	0.84	Neutral classification in terms of region and gender
	Native origin	0.87	
Xingxing et al. 2021	NA	NA	Improved data sparsity and cold start in recommendations
Ivanenko et al. 2020	Accuracy DNN	0.77	To achieve above-chance classification
	Accuracy SVM	0.56	
	Accuracy LR	0.51	

Source: compiled by the authors

By employing Equation 1, it can be concluded that DNN achieved a moderate reliability score for classification purposes. Also, for optimisation purposes regarding social network data, DRL provided a high optimisation capability.

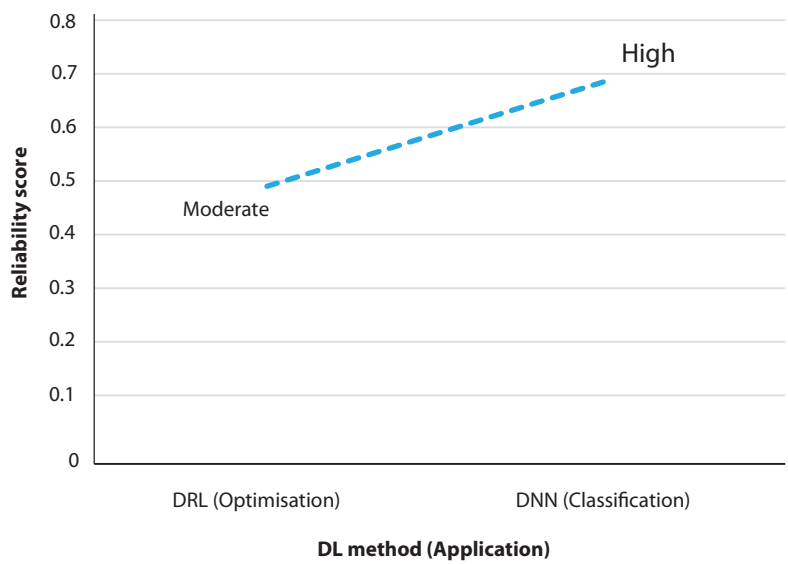


Figure 11: Reliability score for DRL and DNN
Source: compiled by the authors

Social development

Table 7 presents information about the notable studies that employed DL in different applications connected to social development. Table 7 presents the hot points of the studies developed. The phrase "NA" refers to non-available content. However, the main limitation related to this field is the lack of enough studies to investigate.

Table 7: Notable DL-based studies for social development

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Kim et al. 2021	2021	To better understand biases in DL models to identify school development	ResNet18	DNN	3,424 satellite imagery	Accuracy	Identification	International development
Ren et al. 2018	2021	To model the interaction between objects and model every trajectory's moving pattern	NA	RNN	NA	NA	Prediction	Human trajectory

Source: compiled by the authors

Table 7 illustrates how studies on social networks applied DL for identification and prediction purposes. Kim et al. (2021) proposed a DNN-based technique to investigate school development. Moreover, Ren et al. (2018) presented an RNN-based modelling technique to evaluate the interaction between objects and model every trajectory's moving pattern. Table 8 presents the main results and criteria for evaluating the performance of the DL techniques. Using Equation 1, it can be observed that the reliability score of the DNN for identification purposes is evaluated as moderate.

Table 8: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Kim et al. 2021	Accuracy	0.84	Improve the bias detection framework
Ren et al. 2018	NA	NA	The proposed technique successfully copes with the task

Source: compiled by the authors

Social media

Table 9 presents the notable DL-based studies on the subject of social media. As Table 9 shows, DL in social media has been employed for detection,[15] recognition,[16] and prediction[17] purposes.

Table 9: Notable DL-based studies for social media

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Tirdad et al. 2021	2021	For sentiment analysis of medically related texts	Filter size 205 for LSTM	CNN, LSTM, BLSTM	Concussion tweets – 2018 dataset	F1-score, precision, recall	Detection	Sentiment analysis, concussion
Li–Goldwasser 2021	2021	To analyse the text model using signals from the rich social and linguistic context	Stopping patience is equal to 10	Bidirectional encoder nsformers	Allsides and SemEval news dataset	Accuracy	Recognition	Political perspective
Khaefi et al. 2018	2018	To forecast air quality	VGG-16	CNN	Photos shared on social media	Accuracy	Prediction	Haze severity inference

Source: compiled by the authors

To evaluate the use of DL in social media, we employed data presented in Table 10 and calculated the reliability score by Equation 1. Figure 12 presents the reliability scores.

[15] Tirdad et al. 2021.
[16] Li–Goldwasser 2021.
[17] Khaefi et al. 2018.

Table 10: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Tirdad et al. 2021	CNN F1-score	0.621	Provides an understanding of the culture around concussion through sentiment analysis
	CNN Accuracy	0.617	
	LSTM F1-score	0.613	
	LSTM Accuracy	0.612	
	BLSTM F1-score	0.607	
	BLSTM Accuracy	0.622	
Li–Goldwasser 2021	CNN Accuracy	0.84	Pre-training provided an effective improvement in the accuracy of the model
	BERT Accuracy	0.84	
	Ensemble Accuracy	0.86	
Khaefi et al. 2018	Accuracy	0.8724	Using social media datasets improves real-time forecasting of property

Source: compiled by the authors

Figure 12 illustrates that the reliability score of CNN for detection is evaluated as moderate but for prediction, CNN achieved a very high score. For recognition purposes, the Ensemble technique produced a very high score, while BERT and CNN provided High scores. In detection, BLSTM improved reliability in comparison with LSTM and CNN with a score from Moderate to High. In general, it appears that the reliability score of prediction and recognition applications is higher than the score for detection applications.

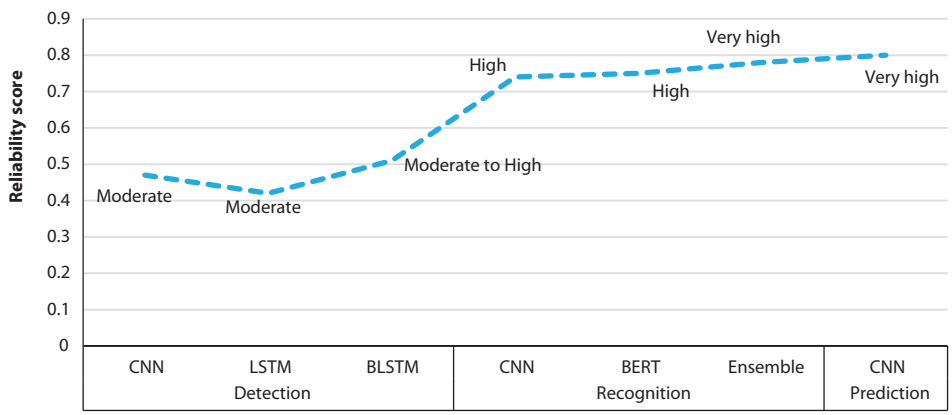


Figure 12: The reliability score
Source: compiled by the authors

Social environments

Table 11 presents the notable DL-based studies on social environments. Figure 13 presents the statistical report on the share of applications of DL. As can be seen in Figure 13, Detection represented the highest proportion (30%) in comparison with other applications. It can be asserted that, in the field of social environment, detection is the main problem that required DL-based techniques. Figure 13 presents the statistical report on the evaluation criteria employed in the social environment.

Table 11: Notable DL-based studies for social environments

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Tsiktsiris et al. 2020	2020	Real-time abnormal event for security improvement	NA	LSTM	3 hidden layers, size (32 × 64), the rectified linear unit (ReLU) activation function	Accuracy, F1-score, recall and precision	Detection	Crimes detection
Liu–Zhang 2020	2019	To evaluate mental health courses	NA	CNN, DBN	Data from colleges and universities	NA	Optimisation	Evaluation feedback
Shukla et al. 2019	2019	Sharing a common house space with humans	Four-layered convolutional with batch normalisation activation ELU	RNN-LSTM, CNN	Combination of public datasets	Accuracy, F1-score, recall and precision	Recognition	Humanoid robots
Thang et al. 2018	2019	Source location and type classification of noise	SB-CNN, VGG-16, VGG-16-PRE	CNN	SNU-B36-50	Accuracy	Classification	Noise between floors

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Feng et al. 2018	2018	To recognise multistage and elastic spam in social media	Convolutional layer of 128 word vector with Max-over-time Pooling method	CNN	Sina Weibo dataset	Accuracy	Detection	Mobile social networks
Jaiswal et al. 2018	2018	To evaluate the command direction by a finger pointing gesture	Kernel size from 3 x 3 to 5 x 5 in each of the units with rectified linear unit (ReLU) activation function	CNN	24,000 images	MSE	Estimation	Gesture based communication
Luo–Hsieh 2017	2017	To evaluate situational context perception	The first convolutional layer convolves 32 filters of 5 x 5 with stride 1 followed by rectifier linear unit (ReLU)	LSTM	Real-world image data	Accuracy	Detection	Human social environments

Source: compiled by the authors

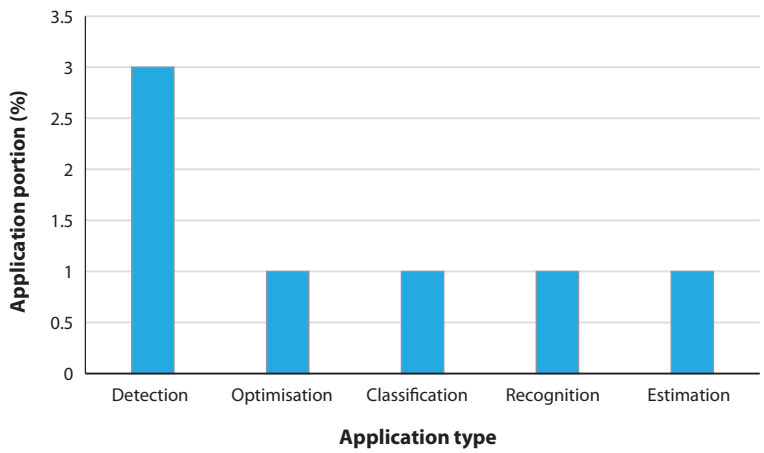


Figure 13: The statistical report of the application type
Source: compiled by the authors

Figure 14 presents evidence supporting the claim that the Accuracy criteria is the most frequently used evaluation criteria for the application of DL in Social environments. Table 12 presents the main findings and advantages of the proposed methods and procedures for each study, separately.

Table 12: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Tsiktsiris et al. 2020	Accuracy	0.996	The proposed method improved timely detection of petty crimes incidents
	Precision	0.98	
	Recall	0.98	
	F1-score	0.98	
Liu–Zhang 2020	NA	NA	Continuously explore in the shallow information
Shukla et al. 2019	Gesture accuracy	0.98	The proposed technique provided real-time detection capability
	Speech accuracy	0.913	
Thang et al. 2018	SB-CNN	0.674	Pre-training provides a higher classification performance
	VGG-16	0.707	
	VGG-16-PREtrained	0.96	
Feng et al. 2018	Accuracy	0.913	The proposed platform improved the utilisation rate of computing resources and realised real-time application
Jaiswal et al. 2018	MSE	< 0.0001	The proposed technique was able to implement humanoid robots in real time
Luo–Hsieh 2017	Encoded image + HOG	0.947	The proposed platform improved the identification of assistance via taking spatio-temporal factor into consideration
	Encoded image + optical flow	0.887	
	Optical flow + HOG	0.981	

Source: compiled by the authors

Accordingly, Figure 15 was prepared to present the reliability score (calculated from Equation 1). Based on Figure 15, it can be stated that CNN plays different roles for different applications. CNN achieved a very high reliability score for detection, while exhibiting moderate and high scores for estimation and classification purposes. Also, RNN-LSTM achieved very high reliability scores for recognition and LSTM for detection purposes.

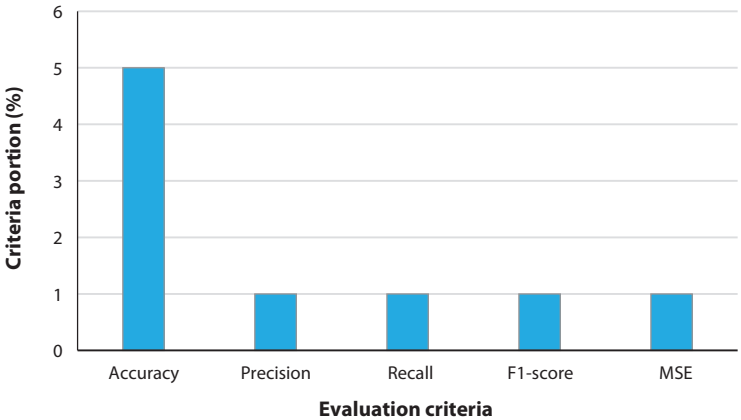


Figure 14: Statistical report of the evaluation criteria
Source: compiled by the authors

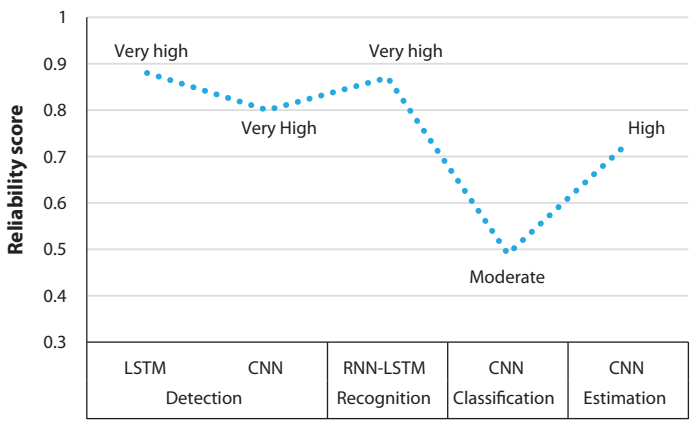


Figure 15: The reliability score
Source: compiled by the authors

Social risk

Table 13 presents several notable DL-based studies on social risk applications. As reported in Table 13, DL has been employed for detection, prediction, and forecasting purposes of the social risk. Choi et al. (2022) employed BERT to "claim a sentence of a rumor" [*sic*] using 7,403 claims from fact-checking sites and evaluated the model using the area under the curve (AUC) and accuracy criteria. Liu (2021) employed a classification and regression

tree (CART) and CNN to forecast risk information of the community in the presence of the community public information. The evaluations were performed by correlation coefficient and mean square error (MSE) values. Gao et al. (2019) employed spatial incomplete multi-task deep learning to predict Spatio-Temporal Event Subtype and evaluated the model by AUC factor. In general, it can be said that accuracy and AUC have been frequently used for the evaluation of DL techniques in social risk.

Table 13: Notable DL-based studies for social risk

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Choi et al. 2022	2022	"To claim sentence of a rumor" *[sic]*	Twelve fully connected layers	BERT	7,403 claims from fact-checking sites	AUC and accuracy	Detection	Rumor spread
Liu 2021	2021	To forecast risk information of the community	NA	CART and CNN	Community public information	CC, MSE	Prediction	Public service information
Gao et al. 2019	2019	To predict Spatio-Temporal Event Subtype	The hidden representation learned by the shared hidden layers	Spatial Incomplete Multi-task Deep learning (SIMDL)	NA	AUC	Forecasting	Subtypes

Source: compiled by the authors

Table 14 presents the evaluation results and the advantages of each DL technique. Figure 16 shows the reliability score calculated by Equation 1.

Table 14: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Choi et al. 2022	AUC	0.7	The pre-trained model can successfully deal with a wide range of applications
	Accuracy	0.72	
Liu 2021	CC, CART	0.862	DL provided better system reliability
	MSE, CART	0.743	
	CC, CNN	0.925	
	MSE, CNN	0.855	
Gao et al. 2019	AUC	0.81	The proposed technique has been successfully coped with the task

Source: compiled by the authors

According to Figure 16, CNN for prediction achieved a very high reliability score, while CART provided high reliability for prediction. Furthermore, SIMDL provided high reliability for forecasting applications. Moderate reliability was achieved by BERT for detection purposes.

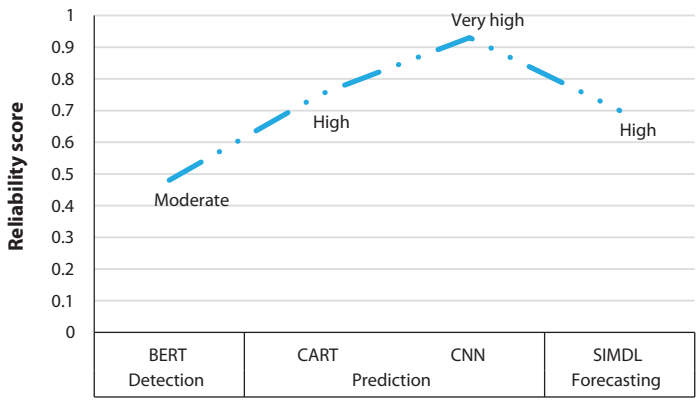


Figure 16: The reliability score
Source: compiled by the authors

Social health

Table 15 presents the notable DL-based studies on topics relating to social health. Figure 17 presents information about the evaluation criteria employed for evaluating DL techniques when applied in investigations relating to social health.

Table 15: Notable DL-based studies for social health

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Zheng et al. 2019	2020	To handle the clinical assessment and treatment planning	Local features alone and global features alone	CNN	300 ms background activity	Accuracy, precision, sensitivity, specificity, AUC, F1-score	Detection	Spike detection

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Xiao et al. 2020	2020	To recognise workers' wearing masks	VGG-19	CNN	3,000 mask images	Precision and recall	Detection	Wearing masks
Zhao et al. 2020	2020	To develop a visual food recognition platform	JDNet	CNN	UECFood256 and Food-101 datasets	Accuracy	Recognition	Mobile visual food
Meng et al. 2020	2020	To evaluate the physical and mental health of the elderly	NA	DNN	Street view images	Accuracy	Detection	Elderly health

Source: compiled by the authors

Figure 17 indicates accuracy provided the highest application portion (about 42%) for evaluating the DL in social health.

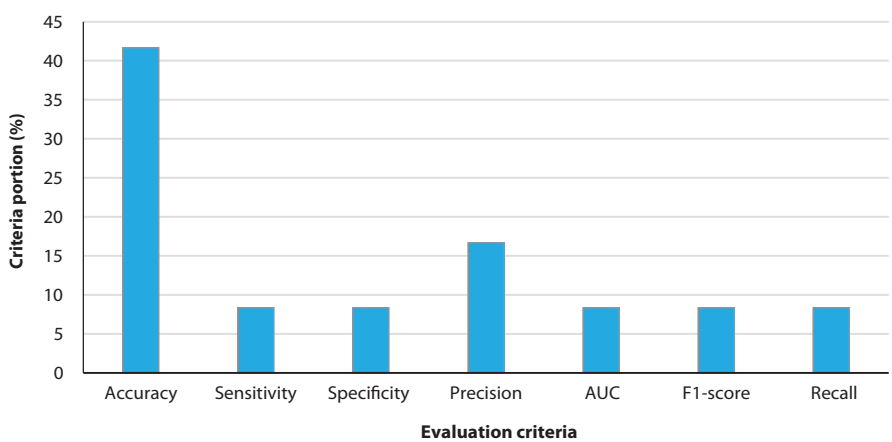


Figure 17: Statistical report of the evaluation criteria
Source: compiled by the authors

Table 16 presents the results and advantages of DL techniques used in studies on social health. Figure 17 was prepared by calculating the reliability score using Equation 1.

Table 16: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Zheng et al. 2019	Accuracy	0.99	General representation of epileptic spikes was successfully identified using the DL technique
	Precision	0.99	
	Sensitivity	0.99	
	Specificity	0.99	
	AUC	0.99	
	F1-score	0.99	
Xiao et al. 2020	Precision	0.97	The proposed technique provided a considerable improvement in reliability
	Recall	0.96	
Zhao et al. 2020	Accuracy UECfood	0.84	The proposed technique achieved high food recognition performance on mobile platforms
	Accuracy Food-101	0.91	
Meng et al. 2020	Accuracy	0.84	The obtained results provided practical significance for city managers and designers

Source: compiled by the authors

According to Figure 17, CNN provided very high reliability for detection purposes while CNN provided high reliability for recognition. In addition, DNN attained moderate and high reliability for detection and estimation purposes.

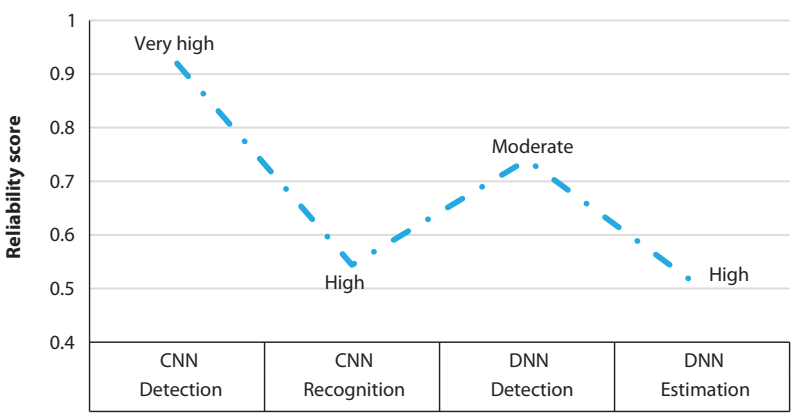


Figure 18: The reliability score
Source: compiled by the authors

Social conflict

Table 17 presents notable DL-based studies related to social conflict. Ma et al. (2022) employed LSTM to estimate pedestrians' trajectories to model crowds hierarchically. The evaluations were conducted by graphical analysis. Hana et al. (2020) employed CNN for the classification of the hate data in a database of Twitter posts. Choi et al. (2018) employed a pre-trained CNN technique to propose a classification platform. According to the analytical results, accuracy is the most frequently used evaluation criteria for evaluating DL in social conflict.

Table 17: Notable DL-based studies for social conflict

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application
Ma et al. 2022	2022	A conflict-avoiding technique to estimate pedestrians' trajectories to model a crowd hierarchically	RNN	LSTM	BIWI and UCY public dataset	Graphical analysis	Prediction
Hana et al. 2020	2020	To classify the hate speech in social media	6 layers, 768 hidden, 12 heads, and 134M parameters	CNN	Tweeter data	Accuracy	Classfication
Choi et al. 2018	2018	To propose a classification platform	VGG-16-PRE	Pretrained CNN	SNU-B36-50 dataset	Accuracy	Classfication

Source: compiled by the authors

Table 18 presents the results and advantages of the DL techniques employed. It is clear, however, that there is a lack of the evaluation criteria for further analysis. This can be considered the main limitation of DL-based studies on social conflict. By calculating the reliability score (using Equation 1), it can be said that CNN and pre-trained CNN provided significant differences in reliability scores (high and very high reliability scores, respectively) for detection purposes.

Table 18: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Ma et al. 2022	NA	NA	Same time prediction of the span using a shorter observation period
Hana et al. 2020	Accuracy	0.64	CNN provided a low accuracy rate
Choi et al. 2018	Accuracy	0.96	Pre-training is a promising technique

Source: compiled by the authors

Social inequalities

Table 19 presents the notable DL-based studies on the topic of social inequality analysis. Palmer et al. (2021) employed CNN to automatically extract and classify unhealthy advertisements. The evaluations were conducted by referring to the precision, recall, and F1-score. Zhou et al. (2019) employed deep convolutional encoder-decoder to provide a framework for understanding street visual walkability. The evaluation was conducted by accuracy criteria.

Table 19: Notable DL-based studies for social inequalities

Ref.	Year	Description	Model character	Method	Analysing data source	Evaluation criteria	Application	Keyword
Palmer et al. 2021	2021	To automatically extract and classify unhealthy advertisements	Stochastic gradient descent to implement complex functions	CNN	Street-level images collected	Precision, recall and F1-score	Classification	Unhealthy advertisements
Zhou et al. 2019	2019	To provide a framework for understanding street visual walkability	SegNet	Deep convolutional encoder-decoder	Images with corresponding ground	Accuracy	Detection	Visual walkability

Source: compiled by the authors

Table 20 presents the evaluation metrics and advantages of the models. Accordingly, the reliability score was calculated by Equation 1 and presented in Figure 18.

Table 20: The evaluation results and the advantages of each DL technique

Ref.	Results		Advantages
Palmer et al. 2021	Precision	0.662	The platform provided identification areas for tackling social inequalities
	Recall	0.787	
	F1-score	0.718	
Zhou et al. 2019	Accuracy	0.785	The proposed platform can be extended to other unfeasible or challenging cases

Source: compiled by the authors

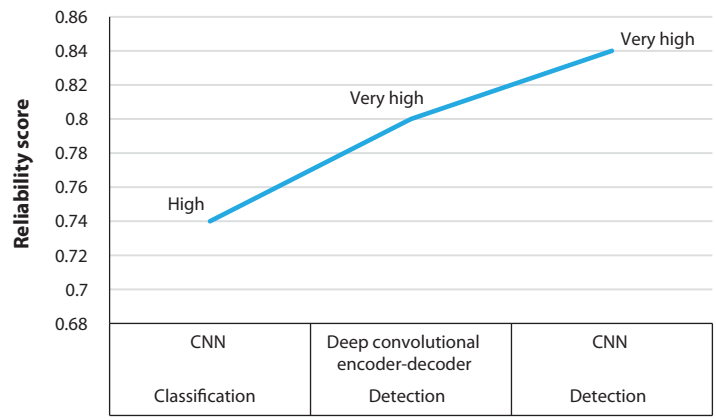


Figure 19: The reliability score
Source: compiled by the authors

According to Figure 19, CNN achieved very high and high reliability scores for Detection and Classification purposes, respectively. Moreover, the deep convolutional encoder-decoder achieved a very high reliability score for Detection purposes.

Other applications

We created a section entitled other applications for those applications, which do not include Social cooperation, Social movement, and Social technology. A limitation of these applications is that there is an insufficient number of such studies and analytical evaluation metrics. In addition, there was a lack of the analytical datasets for analysing Social cooperation, Social movement, and Social technology applications. These limitations hinder the evaluation prospects for these studies and make statistical analysis difficult. This is one of the main disadvantages of the following applications, and is known to be their main limitation. Limited studies have been performed on these applications. Ni and Zhang (2022) employed multi-graph gated graph convolution to develop a platform

for spatial-temporal traffic flow prediction. Zhang (2018) proposed a platform of highly intelligent robots using the CNN technique. Dam and Turzo (2021) employed GRU-RNN for handling a Bangla social media dataset to estimate social movements. Ertugrul et al. (2019) employed LSTM to explore protest events along with the social and geographical contexts. Zhang and Pan (2019) employed CNN for image data and LSTM-RNN for text data to investigate social media activities. In these cases, the lack of enough information in the dataset presented or in analytical results or model description prevented us from obtaining sufficient information to categorise and present reliability scores for evaluating the DL techniques employed in the studies.

DISCUSSION

For evaluating DL methods, it is often essential to review a series of parameters, metrics and criteria provided in the results section of each article. Some articles used evaluation and comparative parameters for assessment. Others used visual and graphic methods to examine and compare DL methods. However, the success rate of these parameters in evaluating deep learning methods in different applications is a general and important question. This study seeks to fill this gap in the evaluation of DL methods by employing the most innovative methods possible. The performance of different methods in different applications was in the focus of the previous sections. However, it is also important to consider whether the presented method is able to provide useful results when applied to all databases, and this reliability must be independent of the database type. With this aim in mind, we used a feature selection method in order to select the most effective parameter in determining the accuracy and performance of a network and, based on this, to determine the most suitable policy for future study. In this technique, we employed the Relief feature selection method to choose the most effective parameters for DL evaluation from each study separately. Accordingly, we emphasised $y = f(x1,x2,x3)$ where y refers to the DL reliability score, x1 refers to the evaluation criteria, x2 refers to the database dimension and the number of the dataset, input variable, and output variables and x3 refers to the application type. This technique may allow us to find the most effective variables related to DL performance in order to formulate the policies based on the selected variable. The use of this technique is the first time that has been employed in the present study for evaluating the DL techniques applied in the social sciences. This method considers a data set with n samples with properties of p. The algorithm starts with a weight vector (W) zero and is repeated m times. Each iteration considers the attribute vector (X) belonging to a random instance, and next to that, the attribute vector indicates the instance closest to X. Based on this, the parameters of the closest instance of the same class are near-hit and the nearest instance of the different class is near-miss.[18] Equation 2 shows the weight vector:

[18] Kira–Rendell 1992.

$$Weight_i = Weight_i - (X_i - near\text{-}tar.)^2 + (X_i - near\text{-}lo.)^2 \quad (2)$$

Accordingly, the weight of properties close to the class increases and decreases in reverse. After m is repeated, each weight vector element is normalised to m. This is called the vector of a relation vector. Relief can also be described as generalisable to polynomial classification by breaking down several binary problems.[19] The relief feature selection technique was applied by Python software. Table 21 presents the output of the relief feature selection for choosing the best factor affecting the reliability score of DL methods in social science.

Table 21: The results of relief feature selection technique

Ref.	Evaluation criteria	Database	Application	Ref.	Evaluation criteria	Database	Application
Cowen et al. 2021	**	*	*	Zamboni et al. 2022	NA	**	**
Xingxing et al. 2021	NA	**	*	Masson–Isik 2021	***	**	*
Ivanenko et al. 2020	**	*	***	Zheng et al. 2019	**	**	**
Kim et al. 2021	***	*	*	Cui et al. 2021	**	*	*
Ren et al. 2018	NA	**	**	Chu et al. 2021	***	**	**
Tirdad et al. 2021	***	**	*	Chopra–Kaur 2021	***	**	**
Li–Goldwasser 2021	***	**	**	Khan et al. 2021	***	**	*
Khaefi et al. 2018	**	**	**	Bi et al. 2021	***	**	**
Tsiktsiris et al. 2020	*	**	*	Ludl et al. 2020	***	**	**
Liu–Zhang 2020	NA	**	*	Wu et al. 2020	**	*	**
Shukla et al. 2019	**	**	*	Cong 2020	**	*	**
Thang et al. 2018	***	*	*	Diaz et al. 2021	***	***	**
Feng et al. 2018	**	**	*	Miao et al. 2022	***	*	*
Jaiswal et al. 2018	***	*	**	Daneshvar–Ravanmehr 2022	***	**	*
Luo–Hsieh 2017	**	*	*	Zhang et al. 2022	***	**	**
Choi et al. 2022	**	*	*	Ma et al. 2022	***	**	*
Gao et al. 2019.	**	**	*	Hana et al. 2020	***	***	**
Zheng et al. 2019	***	***	*	Choi et al. 2018	***	**	**
Xiao et al. 2020	**	***	**	Chikushi et al. 2020	***	**	**
Zhao et al. 2020	***	**	**	Palmer et al. 2021	***	*	*
Meng et al. 2020	***	*	*	Zhou et al. 2019	***	**	**
				Total score	Very High	Moderate	Moderate

Source: compiled by the authors

[19] Kira–Rendell 1992.

The results presented in Table 21 suggest that the most effective parameter of DL reliability is the evaluation criteria. The effect of database and application type is moderate. Accordingly, it can be considered that the best criteria for evaluating the DL techniques are evaluation criteria values. Based on this conclusion, some limitations can be identified in the studies that were surveyed. One of their main limitations is the lack of reporting evaluation criteria values in the evaluation phase. Some studies did not calculate these parameters to examine the model employed. Other limitations include the lack of reporting on the structure and architecture of the models and networks used by some of the studies, which deviate from the descriptive nature of the model and which do not allow the researcher to recommend policies based on these models. Also, some articles failed to provide the studied data and its sources, which can be a deterrent to further studies. This requires a proper policy when selecting and preparing the articles that employed ML and DL techniques for different applications, in order to prevent similar limitations in future.

CONCLUSIONS

This study reviews and presents the performance of DL methods in the social sciences. It finds that accuracy and AUC are the key metrics for evaluating DL techniques in social information. LSTM is reliable for detection and recognition and also popular for prediction. In social networks, the limited number of studies expressed the evaluation, with DNN being moderately reliable for classification and DRL capable for optimisation. Social media analysis rates CNN as moderately reliable for detection and very high for prediction, with Ensemble techniques, BERT, and CNN scoring high for recognition. In the social environment, CNN is very reliable for detection and moderately to highly reliable for estimation and classification. For social risk, CNN shows very high prediction reliability, and CART shows high reliability. In social health, CNN is very reliable for detection and recognition, while DNN is moderately to highly reliable for detection and estimation. In social conflict, evaluation criteria are lacking, limiting analysis, but CNN and pre-trained CNN show high to very high reliability for detection. For social inequalities, CNN scores very high for detection and high for classification, with deep convolutional encoder-decoder also scoring very high for detection. Other applications face limitations due to insufficient studies and metrics for comparison. The review emphasises the importance of transparent evaluation criteria, model structure, and architecture to ensure reproducibility and advancement of DL research in social sciences.

REFERENCES

Al-Sartawi, Abdalmuttaleb M. A. Musleh ed. (2021): *Big Data-Driven Digital Economy: Artificial and Computational Intelligence*. Springer. Online: https://doi.org/10.1007/978-3-030-73057-4

Bai, Junwei – Cheng, Chi (2020): A Social Network Image Classification Algorithm Based on Multimodal Deep Learning. *International Journal Computers Communications and Control,* 15(6). Online: https://doi.org/10.15837/ijccc.2020.6.4037

Bai, Zhongbo – Bai, Xiaomei (2022): Towards Understanding the Analysis, Models, and Future Directions of Sports Social Networks. *Complexity,* 5743825. Online: https://doi.org/10.1155/2022/5743825

Band, Shahab S. – Ardabili, Sina – Sookhak, Mehdi – Chronopoulos, Anthony T. – Elnaffar, Said – Moslehpour, Massoud et al. (2022): When Smart Cities Get Smarter via Machine Learning: An In-Depth Literature Review. *IEEE Access,* 10, 60985–61015. Online: https://doi.org/10.1109/ACCESS.2022.3181718

Buyalskaya, Anastasia – Gallo, Marcos – Camerer, Colin F. (2021): The Golden Age of Social Science. *Proceedings of the National Academy of Sciences,* 118(5). Online: https://doi.org/10.1073/pnas.2002923118

Bi, Zhongpin – Jing, Lina – Shan, Meijing – Dou, Shuming – Wang, Shiyang (2021): Hierarchical Social Recommendation Model Based on a Graph Neural Network. *Wireless Communications and Mobile Computing,* 2021. Online: https://doi.org/10.1155/2021/9107718

Choi, Daejin – Oh, Hyuncheol – Chun, Selin – Kwon, Taekyoung – Han, Jinyoung (2022): Preventing Rumor Spread with Deep Learning. *Expert Systems with Applications,* 197, 116688. Online: https://doi.org/10.1016/j.eswa.2022.116688

Choi, Hwiyong et al. (2018): Classification of Noise between Floors in a Building Using Pre-Trained Deep Convolutional Neural Networks. In *2018 16th International Workshop on Acoustic Signal Enhancement (IWAENC).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8521392

Chopra, Deepti – Kaur, Arvinder (2021): IoT-based Group Size Prediction and Recommendation System Using Machine Learning and Deep Learning Techniques. *Discover Applied Sciences,* 3(2), 1–18. Online: https://doi.org/10.1007/s42452-021-04162-x

Chu, Haiyun – Chen, Lu – Yang, Xiuxian – Qiu, Xiaohui – Qiao, Zhengxue – Song, Xuejia et al. (2021): Roles of Anxiety and Depression in Predicting Cardiovascular Disease among Patients with Type 2 Diabetes Mellitus: A Machine Learning Approach. *Frontiers in Psychology,* 12, 1189. Online: https://doi.org/10.3389/fpsyg.2021.645418

Chikushi, Shota – Kasahara, Jun Younes Louhi – Fujii, Hiromitsu – Tamura, Yusuke – Faragasso, Angela – Yamakawa, Hiroshi et al. (2020): Research and Development of Construction Technology in Social Cooperation Program "Intelligent Construction System". In *ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction.* IAARC Publications, 1536–1540. Online: https://doi.org/10.22260/ISARC2020/0213

Cong, Hongyan (2020): Personalized Recommendation of Film and Television Culture Based on an Intelligent Classification Algorithm. *Personal and Ubiquitous Computing,* 24(2), 165–176. Online: https://doi.org/10.1007/s00779-019-01271-8

Cowen, Alan S. – Keltner, Dacher – Schroff, Florian – Jo, Brendan – Adam, Hartwig – Prasad, Gautam (2021): Sixteen Facial Expressions Occur in Similar Contexts Worldwide. *Nature,* 589(7841), 251–257. Online: https://doi.org/10.1038/s41586-020-3037-7

Cui, Haoliang – Shao, Shuai – Niu, Shaozhang – Shi, Chengjie – Zhou, Lingyu (2021): A Classification Method for Social Information of Sellers on Social Network. *EURASIP Journal on Image and Video Processing,* 2021(1), 1–12. Online: https://doi.org/10.1186/s13640-020-00545-z

Dam, Sumit Kumar – Turzo, Tausif Ahmed (2021): Social Movement Prediction from Bangla Social Media Data Using Gated Recurrent Unit Neural Network. In *2021 5th International Conference on Electrical Information and Communication Technology (EICT).* IEEE. Online: https://doi.org/10.1109/EICT54103.2021.9733681

Daneshvar, Hirad – Ravanmehr, Reza (2022): A Social Hybrid Recommendation System Using LSTM and CNN. *Concurrency and Computation. Practice and Experience,* 34(18), e7015. Online: https://doi.org/10.1002/cpe.7015

Diaz, Jorge Francisco Madrigal – Lerasle, Frédéric – Pibre, Lionel – Ferrané, Isabelle (2021): Audio-Video Detection of the Active Speaker in Meetings. In *IEEE 25th International Conference on Pattern Recognition* (ICPR 2020). Online: https://hal.science/hal-03125600/file/ICPR.pdf

Ertugrul, Ali Mert – Lin, Yu-Ru – Chung, Wen-Ting – Yan, Muheng – Li, Ang (2019): Activism via Attention: Interpretable Spatiotemporal Learning to Forecast Protest Activities. *EPJ Data Science,* 8(1), 5. Online: https://doi.org/10.1140/epjds/s13688-019-0183-y

Feng, Bo – Fu, Qiang – Dong, Mianxiong – Guo, Dong – Li, Qiang (2018): Multistage and Elastic Spam Detection in Mobile Social Networks through Deep Learning. *IEEE Network,* 32(4), 15–21. Online: https://doi.org/10.1109/MNET.2018.1700406

Galesic, Mirta – Bruine de Bruin,Wändi – Dalege, Jonas – Feld, Scott L. – Kreuter, Frauke – Olsson, Henrik – Prelec, Drazen – Stein, Daniel L. – Does, Tamara van der (2021): Human Social Sensing is an Untapped Resource for Computational Social Science. *Nature,* 595(7866), 214–222. Online: https://doi.org/10.1038/s41586-021-03649-2

Gao, Yuyang – Zhao, Liang – Wu, Lingfei – Ye, Yanfang – Xiong, Hui – Yang, Chaowei (2019): Incomplete Label Multi-Task Deep Learning for Spatio-Temporal Event Subtype Forecasting. *Proceedings of the AAAI Conference on Artificial Intelligence,* 33(1), 3638–3646. Online: https://doi.org/10.1609/aaai.v33i01.33013638

Grimmer, Justin – Roberts, Margaret E. – Stewart, Brandon M. (2021): Machine learning for social science: An agnostic approach. *Annual Review of Political Science,* 24, 395–419. Online: https://doi.org/10.1146/annurev-polisci-053119-015921

Goodfellow, Ian et al. (2016): *Deep Learning.* MIT Press. Online: www.deeplearningbook.org

Hana, Karimah Mutisari – Adiwijaya – Al Faraby, Said – Bramantoro, Arif (2020): Multi-Label Classification of Indonesian Hate Speech on Twitter Using Support Vector Machines. In *2020 International Conference on Data Science and Its Applications (ICoDSA).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9212992

Hicks, Diana (2004): The Four Literatures of Social Science. In Moed, Henk F. – Glänzel, Wolfgang – Schmoch, Ulrich (eds.): *Handbook of Quantitative Science and Technology Research.* Dordrecht: Springer, 473–496. Online: https://doi.org/10.1007/1-4020-2755-9

Hofman, Jake M. – Watts, Duncan J. – Athey, Susan – Garip, Filiz – Griffiths, Thomas L. – Kleinberg, Jon – Margetts, Helen – Mullainathan, Sendhil – Salganik, Matthew J. – Vazire, Simine – Vespignani, Alessandro – Yarkoni, Tal (2021): Integrating Explanation and Prediction in Computational Social Science. *Nature,* 595(7866), 181–188. Online: https://doi.org/10.1038/s41586-021-03659-0

Ivanenko, Alexander – Watkins, P. – van Gerven, M. A. J. – Hammerschmidt, K. – Englitz, B. (2020): Classifying Sex and Strain from Mouse Ultrasonic Vocalizations Using Deep Learning. *PLOS Computational Biology,* 16(6), e1007918. Online: https://doi.org/10.1371/journal.pcbi.1007918

Jaiswal, Shruti – Mishra, Pratyush – Nandi, G. C. (2018): Deep Learning Based Command Pointing Direction Estimation Using a Single RGB Camera. In *2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8596762

Khaefi, Muhammad Rizal – Pramestri, Zakiya – Amin, Imaduddin – Lee, Jong Gun (2018): Nowcasting Air Quality by Fusing Insights from Meteorological Data, Satellite Imagery and Social Media Images Using Deep Learning. In *2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM).* IEEE. Online: https://ieeexplore.ieee.org/document/8508698

Khan, Momina Rizwan – Rizvi, Shereen Zehra – Yasin, Amanullah – Ali, Mohsan (2021): Depression Analysis of Social Media Activists Using the Gated Architecture Bi-LSTM. In *2021 International Conference on Cyber Warfare and Security (ICCWS).* IEEE. Online: https://ieeexplore.ieee.org/document/9703014

Khan, Nida Saddaf – Ghani, Muhammad Sayeed (2021): A Survey of Deep Learning Based Models for Human Activity Recognition. *Wireless Personal Communications,* 120(2), 1593–1635. Online: https://doi.org/10.1007/s11277-021-08525-w

Kim, Do-Hyung – López, Guzmán – Kiedanski, Diego – Maduako, Iyke – Ríos, Braulio – Descoins, Alan – Zurutuza, Naroa – Arora, Shilpa – Fabian, Christopher (2021): Bias in Deep Neural Networks in Land Use Characterization for International Development. *Remote Sensing,* 13(15), 2908. Online: https://doi.org/10.3390/rs13152908

Kira, Kenji – Rendell, Larry A. (1992): A Practical Approach to Feature Selection. In Sleeman, Derek – Edwards, Peter (eds.): *Machine Learning Proceedings 1992.* Elsevier, 249–256. Online: https://doi.org/10.1016/B978-1-55860-247-2.50037-1

Kumar, Chanchal – Bharati, T. S. – Prakash, S. (2021): Online Social Network Security: A Comparative Review Using Machine Learning and Deep Learning. *Neural Processing Letters,* 53(1), 843–861. Online: https://doi.org/10.1007/s11063-020-10416-3

Lazer, David M. – Pentland, Alex – Watts, Duncan J. – Aral, Sinan – Athey, Susan – Contractor, Noshir – Freelon, Deen – Gonzalez-Bailon, Sandra – King, Gary – Margetts, Helen – Nelson, Alondra – Salganik, Matthew – Strohmaier, Markus – Vespignani, Alessandro – Wagner, Claudia (2020): Computational Social Science: Obstacles and Opportunities. *Science,* 369(6507), 1060–1062. Online: https://doi.org/10.1126/science.aaz817

Lecun, Yann et al. (2015): Deep Learning. *Nature,* 521(7553), 436–444. Online: https://doi.org/10.1038/nature14539

Li, Chang – Goldwasser, Dan (2021): Using Social and Linguistic Information to Adapt Pretrained Representations for Political Perspective Identification. In Zong, Chengqing – Xia, Fei – Li, Wenjie – Navigli, Roberto (eds.): *Findings of the Association for Computational Linguistics: ACL-IJCNLP* 2021, 4569–4579. Online: https://doi.org/10.18653/v1/2021.findings-acl.401

Liu, Yajing (2021): Research on Community Public Service Information Collaborative Governance Based on Deep Learning Model. *Journal of Mathematics,* 2021. Online: https://doi.org/10.1155/2021/4727617

Liu, Wenhua – Zhang, Yijie (2020): Evaluation Feedback Information for Optimization of Mental Health Courses with Deep Learning Methods. *Soft Computing,* 24(11), 8275–8283. Online: https://doi.org/10.1007/s00500-019-04569-0

Ludl, Dennis – Gulde, Thomas – Curio, Christóbal (2020): Enhancing Data-Driven Algorithms for Human Pose Estimation and Action Recognition through Simulation. *IEEE Transactions on Intelligent Transportation Systems,* 21(9), 3990–3999. Online: https://ieeexplore.ieee.org/abstract/document/9082148

Luo, Ren C. – Hsieh, Chung Kai (2017): Robotic Sensory Perception on Human Mentation for Offering Proper Services. In *2017 IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8170374

Ma, Qiulin – Zou, Qi – Huang, Yaping – Wang, Nan (2022): Dynamic Pedestrian Trajectory Forecasting with LSTM-based Delaunay Triangulation. *Applied Intelligence,* 52(3), 3018–3028. Online: https://doi.org/10.1007/s10489-021-02562-5

Masson, Haemy Lasson – Isik, Leyla (2021): Functional Selectivity for Social Interaction Perception in the Human Superior Temporal Sulcus during Natural Viewing. *Neuroimage,* 245, 118741. Online: https://doi.org/10.1016/j.neuroimage.2021.118741

Meng, Lingchao – Wen, Khuo-Sun – Zeng, Zhijie – Brewin, Richard – Fan, Xiaolei – Wu, Qiong (2020): The Impact of Street Space Perception Factors on Elderly Health in High-Density Cities in Macau – Analysis Based on Street View Images and Deep Learning Technology. *Sustainability,* 12(5), 1799. Online: https://doi.org/10.3390/su12051799

Miao, Hang – Li, A. – Yang B. (2022): Meta-path Enhanced Lightweight Graph Neural Network for Social Recommendation. In *International Conference on Database Systems for Advanced Applications.* Springer, 134–149. Online: https://doi.org/10.1007/978-3-031-00126-0_9

Miller, Tim (2019): Explanation in Artificial Intelligence: Insights from the Social Sciences. *Artificial Intelligence,* 267, 1–38. Online: https://doi.org/10.1016/j.artint.2018.07.007

Moon, Katie – Blackman, Deborah (2014): A Guide to Understanding Social Science Research for Natural Scientists. *Conservation Biology,* 28(5), 1167–1177. Online: https://doi.org/10.1111/cobi.12326

Nasir, Adeel – Shaukat, Kamran – Khan, Kanwal Iqbal – Hameed, Ibrahim A. – Alam, Talha – Luo, Suhuai (2021): Trends and Directions of Financial Technology (Fintech) in Society and Environment: A Bibliometric Study. *Applied Sciences,* 11(21), 10353. Online: https://doi.org/10.3390/app112110353

Ni, Qingjian – Zhang, Mei (2022): STGMN: A Gated Multi-Graph Convolutional Network Framework for Traffic Flow Prediction. *Applied Intelligence,* 2022, 1–14. Online: https://doi.org/10.1007/s10489-022-03224-w

Özerol, Gizem – Selçuk, Semra Arslan (2022): Machine Learning in the Discipline of Architecture: A Review on the Research Trends between 2014 and 2020. *International Journal of Architectural Computing,* 21(1), 23–41. Online: https://doi.org/10.1177/14780771221100102

Page, Matthew J. – McKenzie, Joanne E. – Bossuyt, Patrick M. – Boutron, Isabelle – Hoffmann, Tammy C. – Mulrow, Cynthia D. et al. (2021): The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *British Medical Journal,* 10(1), 1–11. Online: https://doi.org/10.1136/bmj.n71

Palmer, Gregory – Green, Mark – Boyland, Emma – Vasconcelos, Yales Stefano Rios – Savani, Rahul – Singleton, Alex (2021): A Deep Learning Approach to Identify Unhealthy Advertisements in Street View Images. *Nature,* 11(1), 1–12. Online: https://doi.org/10.1038/s41598-021-84572-4

Poole, David L. – Mackworth, Alan K. (2010): *Artificial Intelligence: Foundations of Computational Agents.* New York: Cambridge University Press.

Rani, Meesala Shobha – Sumathy, Subramanain (2022): A Study on Diverse Methods and Performance Measures in Sentiment Analysis. *Recent Patents on Engineering,* 16(3), 12–42. Online: https://doi.org/10.2174/1872212114999201019154954

Ren, Siqi – Zhou, Yue – He, Liming (2018): Human Trajectory Prediction with Social Information Encoding. In *Pattern Recognition and Computer Vision: First Chinese Conference, PRCV 2018,* Guangzhou, China, November 23–26, Springer, 262–273. Online: https://dl.acm.org/doi/10.1007/978-3-030-03398-9_23

Selçuk, Ayşe Adin (2019): A Guide for Systematic Reviews: PRISMA. *Turkish Archives of Otorhinolaryngology,* 57(1), 57–58. Online: https://doi.org/10.5152%2Ftao.2019.4058

Shukla, Priya – Bhandari, Bhanu – Goel, Aditya – Charan, Ravi – Gali, Niharika – Dwivedi, Agam – Mundra, Nikhil – Agrawal, Ruchin – Nandi, G. C. (2019): Fusing Multimodal Human-Robot Communication using Deep Learning. In *2019 International Conference on Electrical, Electronics and Computer Engineering (UPCON).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8980213

Thang, Do Nam – Nguyen, Lan Anh – Dung, Pham Trung – Khoa, Truong Dang – Son, Nguyen Huu – Hiep, Nguyen Tran et al. (2018): Deep Learning-Based Multiple Objects Detection and Tracking System for Socially Aware Mobile Robot Navigation Framework. In *5th NAFOSTED Conference on Information and Computer Science (NICS).* IEEE. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8606878

Tirdad, Kayvan – Dela Cruz, Alex – Sadeghian, Alireza – Cusimano, Michael (2021): A Deep Neural Network Approach for Sentiment Analysis of Medically Related Texts: An Analysis of Tweets Related to Concussions in Sports. *Brain Informatics,* 8(1), 1–17. Online: https://doi.org/10.1186/s40708-021-00134-4

Tsiktsiris, Dimitris – Dimitriou, Nikolaos – Lalas, Antonios – Dasygenis, Minas – Votis, Konstantinos – Tzovaras, Dimitrios (2020): Real-time Abnormal Event Detection for Enhanced Security in Autonomous Shuttles Mobility Infrastructures. *Sensors,* 20(17), 4943. Online: https://doi.org/10.3390/s20174943

Xiao, Jian – Wang, Jia – Cao, Shaozhong – Li, Bilong (2020): Application of a Novel and Improved VGG-19 Network in the Detection of Workers Wearing Masks. *Journal of Physics: Conference Series,* 1518. Online: https://doi.org/10.1088/1742-6596/1518/1/012041

Xingxing, Ye et al. (2021): POI Recommendation Based on Graph Enhanced Attention GNN. In *2021 11th International Conference on Intelligent Control and Information Processing* (ICICIP). IEEE. Online: https://ieeexplore.ieee.org/document/9642167

Wu, Qiong – Wu, Muhong – Chen, Xu – Zhou, Zhi – He, Kaiwen – Chen, Liang (2020): DeepCP: Deep Learning Driven Cascade Prediction-Based Autonomous Content Placement in Closed Social Network. *IEEE Journal on Selected Areas in Communications,* 38(7), 1570–1583. Online: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9107092

Zamboni, Simone – Kefato, Zekarias Tilahun – Girdzijauskas, Sarunas – Norén, Christoffer – Dal Col, Laura (2022): Pedestrian Trajectory Prediction with Convolutional Neural Networks. *Pattern Recognition,* 121, 108252. Online: https://doi.org/10.1016/j.patcog.2021.108252

Zhang, Han – Pan, Jennifer (2019): CASM: A Deep-Learning Approach for Identifying Collective Action Events with Text and Image Data from Social Media. *Sociological Methodology,* 49(1), 1–57. Online: https://doi.org/10.1177/0081175019860244

Zhang, Jie (2018): Theory and Application of Deep Neural Networks in Future Deep Space Autonomous Exploration Mission. *16th IAA Symposium On Visions and Strategies for the Future. Proceedings of the International Astronautical Congress.* Online: https://iafastro.directory/iac/archive/browse/IAC-18/D4/1/47408/

Zhang, Jiyong – Liu, Xin – Zhou, Xiaofei (2022): Towards Non-Linear Social Recommendation Using Gaussian Process. *IEEE Access,* 10, 6028–6041. Online: https://doi.org/10.1109/ACCESS.2022.3141795

Zhang, Jun – Wang, Wei – Xia, Feng – Lin, Yu-Ru – Tong, Hanghang (2020): Data-driven Computational Social Science: A Survey. *Big Data Research,* 21, 100145. Online: https://doi.org/10.1016/j.bdr.2020.100145

Zhang, Yan – Chen, Zeqiang – Zheng, Xiang – Chen, Nengcheng – Wang, Yongqiang (2021): Extracting the Location of Flooding Events in Urban Systems and Analyzing the Semantic Risk Using Social Sensing Data. *Journal of Hydrology,* 603, 127053. Online: https://doi.org/10.1016/j.jhydrol.2021.127053

Zhao, Heng – Yap, Kim-Hui – Kot, Alex Chichung – Duan, Lingyu (2020): Jdnet: A Joint-Learning Distilled Network for Mobile Visual Food Recognition. *IEEE Journal of Selected Topics in Signal Processing,* 14(4), 665–675. Online: https://doi.org/10.1109/JSTSP.2020.2969328

Zhao, Yinou – Liu, Chi Harold (2020): Social-Aware Incentive Mechanism for Vehicular Crowdsensing by Deep Reinforcement Learning. *IEEE Transactions on Intelligent Transportation Systems,* 22(4), 2314–2325. Online: https://doi.org/10.1109/TITS.2020.3014263

Zheng, Li – Liao, Pan – Luo, Shen – Sheng, Jingwei – Teng, Pengfei – Luan, Guoming – Gao, Jia-Hong (2019): EMS-net: A Deep Learning Method for Autodetecting Epileptic Magnetoencephalography Spikes. *IEEE Transactions on Medical Imaging,* 39(6), 1833–1844. Online: https://doi.org/10.1109/tmi.2019.2958699

Zhou, Hao – He, Shenjing – Cai, Yuyang – Wang, Miao – Su, Shiliang (2019): Social Inequalities in Neighborhood Visual Walkability: Using Street View Imagery and Deep Learning Technologies to Facilitate Healthy City Planning. *Sustainable Cities and Society,* 50, 101605. Online: https://doi.org/10.1016/j.scs.2019.101605

Sina Ardabili is a Research Fellow at the Ludovika University of Public Service Institute of the Information Society. He had been among the top 2% scientists based on the Stanford University study since 2021. His research interest include smart systems and artificial intelligence. His research during PhD studies has been on the application of artificial intelligence systems and smart systems. He has several highly cited review papers on the application of machine learning and deep learning systems. His latest book is *Autonomous Agricultural Vehicles: Concepts, Principles, Components, and Development Guidelines.* CRC Press, 2023.

Amir Mosavi is a Research Fellow at the Ludovika University of Public Service Institute of the Information Society. His research interests include applied artificial intelligence. He was an Alexander von Humboldt fellow and the recipient of the Marie Skłodowska-Curie and the European Research Consortium for Informatics and Mathematics fellowships.

Csaba Makó, Professor, Institute of the Information Society, Ludovika University of Public Service, Budapest, Hungary. Research interest: international comparative analysis of the social – economic institutions/regulations of the game-changing technological (digitisation, smart automatisation, artificial intelligence and algorithmic management) and organisational innovations. Special focus of his research interest is related with quality of work, skills formation and employment status. Latest major project: *"Democracy at Work Through Transparent and Inclusive Algorithmic Management"* (INCODING), EU, 2021–2024.

Péter Sasvári, PhD, Associate Professor (2013) of the Department of Public Management and Information Technology, Faculty of Public Governance and International Studies, Ludovika University of Public Service, Budapest, Hungary (Part time: University of Miskolc, Hungary). He obtained his doctoral thesis with the best receivable mark, "summa cum laude". The title of his dissertation was *The Development of Information and Communication Technology: An Empirical Study.* Sasvári is the supervisor of 4 PhD students' theses, has supervised more than 150 bachelor's and master's theses; he is a member of the public body at the Hungarian Academy of Sciences. He is the author of more than 90 international publications, serves as the associate editor for 3 international journals. Scientometrics has been in the focus of his researches, recently. With the co-operation of some local universities, he has conducted a primary research among small and medium-sized enterprises in Austria, Bosnia-Herzegovina, the Czech Republic, Croatia, Poland, Portugal, Hungary, Germany, Italy, Spain and Slovakia.

PRO PUBLICO BONO – Public Administration, 2024/1, 53–83. • DOI: 10.32575/ppb.2024.1.3

Rituraj Rituraj – Dániel T. Várkonyi – Amir Mosavi – József Pap – Annamária R. Várkonyi-Kóczy – Csaba Makó

MACHINE LEARNING IN SMART GRIDS: A SYSTEMATIC REVIEW, NOVEL TAXONOMY, AND COMPARATIVE PERFORMANCE EVALUATION

Rituraj Rituraj, John von Neumann Faculty of Informatics, Óbuda University Budapest, Hungary

Dániel T. Várkonyi, Faculty of Informatics, Eötvös Loránd University Budapest, Hungary

Amir Mosavi, Research Fellow, Ludovika University of Public Service, Institute of the Information Society, mosavi.amirhosein@uni-nke.hu

József Pap, Széchenyi University Doctoral School of Management (SzEEDSM), Győr, Hungary

Annamária R. Várkonyi-Kóczy, Professor, Óbuda University, Institute of Software Design and Software Development, varkonyi-koczy@uni-obuda.hu

Csaba Makó, Professor, Ludovika University of Public Service, Institute of the Information Society, mako.csaba@uni-nke.hu

This article presents a state-of-the-art review of machine learning (ML) methods and applications used in smart grids to predict and optimise energy management. The article discusses the challenges facing smart grids, and how ML can help address them, using a new taxonomy to categorise ML models by method and domain. It describes the different ML techniques used in smart grids as well as examining various smart grid use cases, including demand response, energy forecasting, fault detection, and grid optimisation, and explores how ML can improve these cases. The article proposes a new taxonomy for categorising ML models and evaluates their performance based on accuracy, interpretability, and computational efficiency. Finally, it discusses some of the limitations and challenges of using ML in smart grid applications and attempts to predict future trends. Overall, the article highlights how ML can enable efficient and reliable smart grid systems.

Keywords:
machine learning, smart grids, artificial intelligence, big data, soft computing, data science

INTRODUCTION

The smart grid (SG) is an upgraded type of electrical grid that improves reliability, security, and efficiency using advanced technology, facilitating real-time communication for managing power supply and demand. It promotes the integration of renewable energy sources and supports electric vehicles and distributed energy resources, reducing reliance on fossil fuels. It also enhances grid resilience and security, potentially transforming the electricity sector into a more sustainable and dependable energy system. In Ahmad et al.'s (2007) review,[1] they highlight the unique challenges arising from the growing integration of energy storages and renewable energy sources into the conventional power systems and AI. This shift requires forward-thinking investments in SG technologies, integrating advanced measurement equipments, controllable transmission assets, and software control systems. Kwak and Heo (2007) stress the importance of creating a resilient and adaptable infrastructure capable of responding to both internal and external changes, given the intricate interconnectedness of modern infrastructure systems, which can magnify the impact of local disruptions into broader cascade failures.[2] The vision for the SG, as presented by Bari et al. (2014),[3] is of a profound transformation in the electric power sector. This transformation centres on the integration of bidirectional power and information flows, addressing critical factors like capacity, efficiency, reliability, sustainability, consumer engagement, and the ever-growing energy demand. It promotes a range of generation and storage solutions, and advocates for environmentally responsible practices.[4] Ardito et al. (2013) add that the development of the SG entails enhancing the existing network with new features and services while preserving the core physical infrastructure, marking a significant stride toward a more resilient and adaptable power system.[5] The conventional electricity grid, often referred to as the legacy or analogue grid, functions as a one-way system in which electricity is centrally generated and transmitted to consumers via long-distance lines. In contrast, the SG is a modernised grid that harnesses advanced digital technology to enhance the power system's reliability, security, and efficiency.

1 Ahmad et al. 2022.
2 Kwak–Heo 2007.
3 Bari et al. 2014.
4 Mei–Chen 2013.
5 Ardito et al. 2013.

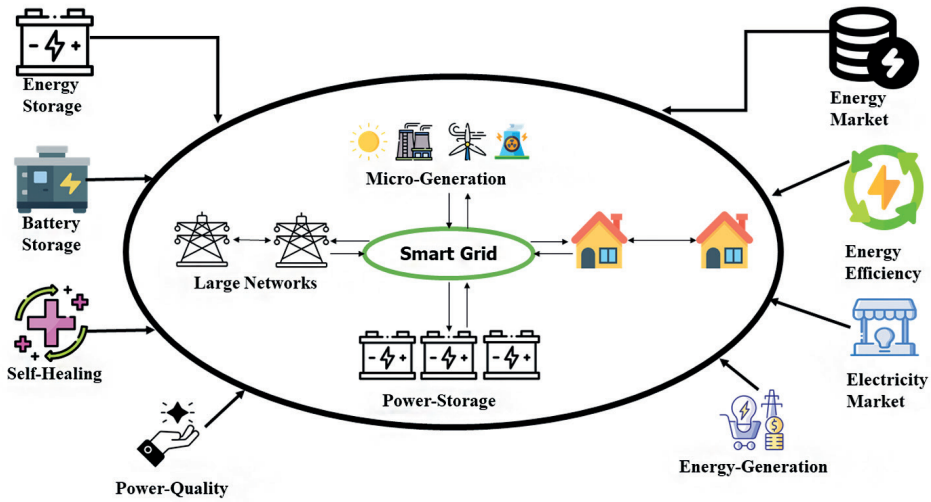


Figure 1: Overview of an SG implementation
Source: compiled by the authors based on an adaptation from Ahmad *et al. 2022.*

The SG stands out due to four key features: bidirectional communication, facilitating real-time monitoring and management of electricity supply and demand; integration of RESs such as solar and wind; support for electric vehicles and distributed energy resources. It reduces dependency on fossil fuels, and enhances environmental sustainability. Moreover, robust security measures provide protection against potential threats. Figure 1 visually demonstrates the information and energy flow within the SG infrastructure, a concept absent in the traditional power system.

In the context of modern SGs, Berghout et al. (2022) emphasise the critical importance of condition monitoring, which is facilitated by cutting-edge computing technology and secure cyber-physical connectivity.[6] ML, and particularly deep learning (DL), has rapidly advanced and demonstrated exceptional performance in various SG-related activities, as highlighted by Xu et al. (2022).[7] The transition from traditional power distribution systems, which relied on human intervention, to more robust SGs has played a crucial role in ensuring reliable power delivery, as discussed by Elbouchikhi et al. (2021).[8] Effectively processing the extensive data within SGs, required for tasks such as power flow optimisation and system monitoring, necessitates dynamic energy management, as elucidated by Hossain et al. (2019).[9] ML and DL techniques offer valuable tools for SG development, encompassing three key phases: the constituting element phase, the process phase, and the power

6 Berghout et al. 2022.
7 Xu et al. 2022.
8 Elbouchikhi et al. 2021.
9 Hossain et al. 2019.

converter stage, as discussed by Behara and Saha (2022).[10] However, developments such as the integration of prosumers into SGs, power system decarbonisation using blockchain and artificial intelligence (AI), and the functionalities of various SG applications represent both challenges and opportunities, as highlighted by Hua et al. (2022).[11] Applications of SG include such aspects as demand response initiatives, automated data processing for SCADA systems, voltage stability assessment, smart city planning, and home automation, as noted by Chaurasia and Kamath (2022).[12] The possible sources of disruption, including harmonic production, load variations, and wiring and grounding issues pose risks to the electricity supply system, as explained by Rangel-Martinez et al. (2021).[13] Widespread implementation of advanced technologies like 5G and specialised algorithms plays a pivotal role in developing ML-based sustainable non-industrial energy management applications, as outlined by Omitaomu and Niu (2021).[14] Security issues in SGs, particularly the threat of false data attacks, have substantial implications and are a subject of concern, as addressed by Cui et al. (2020).[15]

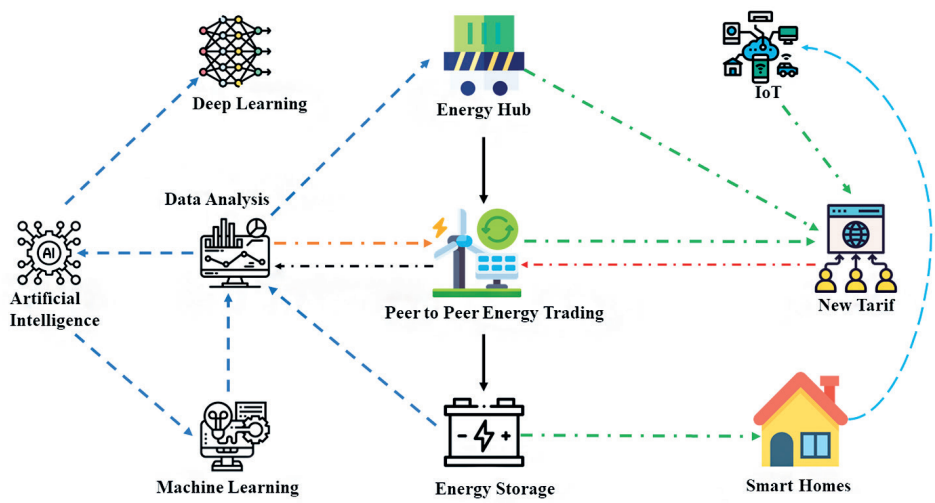


Figure 2: Machine learning's role in SG
Source: compiled by the authors based on an adaptation from Ahmad *et al. 2022.*

[10] Behara–Saha 2022.
[11] Hua et al. 2022.
[12] Chaurasia–Kamath 2022.
[13] Rangel-Martinez et al. 2021.
[14] Omitaomu–Niu 2021.
[15] Cui et al. 2020.

Additionally, concerns about cybersecurity emerge due to the heavy reliance of SGs on communication technologies, while the management of extensive data volumes for privacy and analytical purposes presents an additional obstacle. Enhancing grid resilience to natural disasters, achieving regulatory standardisation, fostering consumer engagement, addressing the high initial infrastructure costs, and seamlessly integrating diverse energy resources constitute critical areas for enhancement. Making sufficient progress in these domains requires collaborative efforts among stakeholders and advancements in technology to facilitate the widespread adoption of sustainable electricity grids. In this regard, Raza and Khosravi (2015) review techniques for developing SGs and building load demand forecasting based on AI, with Figure 2 illustrating the various applications of AI, computational intelligence, and ML across different aspects of SG.[16]

METHODOLOGY

This section presents an overview of the classification and research methodology employed in the comprehensive review study. It first explicitly delineates the primary taxonomy of the article, followed by an explanation of the process utilised for information gathering and conducting related investigations. The section is structured into six main segments, including an introduction, details of the study's execution, its primary objectives, a review of studies focusing on energy demand forecasting, the introduction of evaluation criteria, and a presentation of research findings. The central focus of this review is the examination of machine learning applications in smart grids (SGs). The study follows the PRISMA standard for data collection, which consists of four essential phases: identification, screening, eligibility, and inclusion. Initially, a total of 550 articles were identified, and following a rigorous evaluation, 89 articles were chosen for in-depth analysis, constituting the qualitative and quantitative foundation of the study. Figure 3 offers a visual representation of the flowchart illustrating the PRISMA technique employed in constructing the study's database.

[16] Raza–Khosravi 2015.

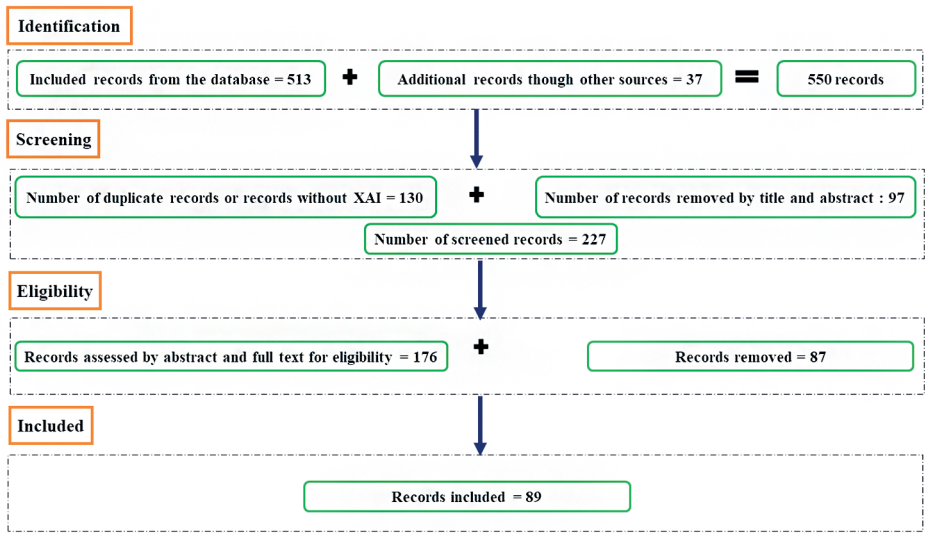


Figure 3: The PRISMA flowchart illustrating the standard search and screening
Source: compiled by the authors

RESULTS

Artificial Neural Network

Artificial Neural Networks (ANNs) are ML algorithms inspired by the structure of the human brain and are thus well-suited for pattern recognition and feature extraction tasks in SGs. They are pivotal in load forecasting, fault detection, and energy management within SGs, and have been widely adopted by researchers and practitioners. ANNs predict electricity demand based on factors such as weather and time, optimising grid operations and reducing the need for additional energy generation or storage. They also excel at identifying power transmission line faults, enhancing grid performance, and preventing outages through sensor data analysis. In energy management, ANNs optimise the operation of distributed energy resources, such as photovoltaic panels and wind turbines, using historical data and predictive analysis, and thus significantly improving SG efficiency, reliability, and sustainability. The creation of ANN networks involves a crucial training process with connections and nodes, detailed in Equation (1).[17]

$$I_j(\mathrm{t}) = \sum_i O_i(t) w_{ij} + w_{oj} \quad (1)$$

[17] Zain et al. 2012.

The equation provided describes the input value (Ij) from neuron i to neuron j, with Oj representing the output value of neuron i. The weight value is denoted as wij, and the related bias for neuron j is woj. A simplified representation of a basic ANN approach in the presence of related components is depicted in Figure 4. The development of an ANN approach typically involves three stages: training, testing, and validation.

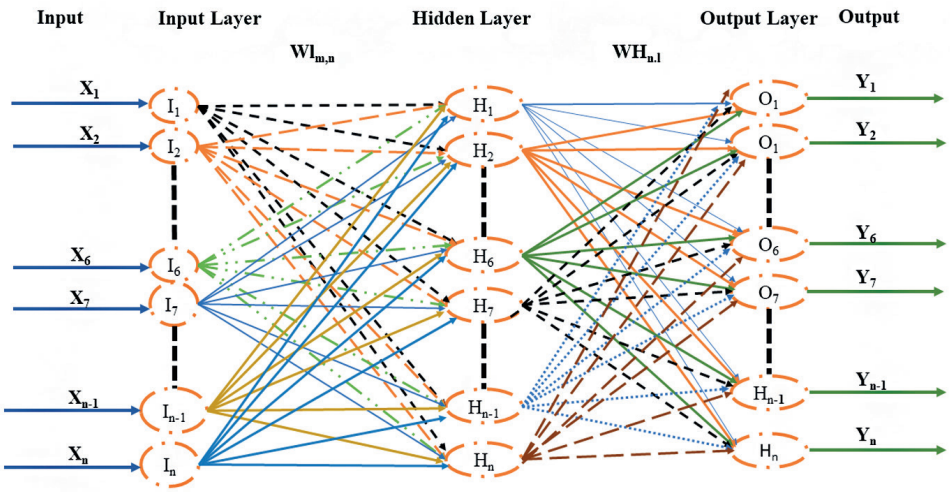


Figure 4: The architecture of ANN
Source: compiled by the authors based on an adaptation of a standard ANN.

ANNs find application in SG contexts, such as material selection for dye-sensitised solar cells, based on Bhagya Raj et al. (2022).[18] These networks have demonstrated their prowess at capturing nonlinear relationships even without prior knowledge and exhibit high degree of accuracy, with metrics like root mean square error (RMSE), high correlation coefficients, and low relative deviation, as exemplified in Li et al.'s (2021) photovoltaic fault detection study.[19] Recurrent Neural Networks (RNN), incorporating feedback loops, excel at tasks such as time-series forecasting but may face challenges with long-term dependencies. Convolutional Neural Networks (CNN) are adept at grid-structured data tasks like image recognition but may be less effective for non-grid-structured data. Autoencoders efficiently handle data compression and noise removal in SG applications, but their effectiveness depends on data quality. Common ANN configurations include multi-layer perceptrons and the implementation of the back-propagation learning technique. ANNs, as described by Jawad et al. (2021), are a ML technique inspired by biological neurons, sharing computational parallels with human brain learning processes.[20] Feedforward Neural Networks are a fundamental type, with unidirectional interconnected nodes

[18] Bhagya Raj – Dash 2022.
[19] Li et al. 2021.
[20] Jawad et al. 2021.

suitable for basic SG tasks like regression and classification. However, FNNs may struggle with complex relationships in nonlinear data. ANNs aim to create links between input and output variables through data-driven learning procedures. Additionally, a study by Dong et al. (2003) underscored the extensive application of radial basis function networks and multi-layer perceptron's in function approximation, contributing to the development of Support Vector Machines (SVMs).

SUPPORT VECTOR MACHINES

SVMs are versatile supervised learning algorithms applied in SGs for both classification and regression tasks, addressing such challenges as load forecasting, fault detection, and power quality event classification. SVMs excel at handling high-dimensional power systems data, being robust to noise, and can perform well even with limited training data. They effectively model nonlinear relationships between features, enhancing system accuracy. SVM integration in SG applications has the potential to improve power system efficiency, reliability, and security when using advanced ML. In SVM, data analysis for regression and classification creates reliable prediction models, assigning new instances during training. The closest data points to the hyperplane, referred to as support vectors, influence both the hyperplane's position and orientation. It is essential to maximise the margin, which is the distance between the support vectors and the hyperplane, when selecting the hyperplane. Even a slight alteration in the position of these support vectors can change the hyperplane. Nu-SVM introduces the "nu" parameter, providing flexibility in controlling support vectors and errors. Despite offering a more intuitive trade-off, selecting an appropriate "nu" value involves difficulties, with interpretations varying across datasets. Equation (2) represents any hyperplane as the set of desired points, as explained by Blanco et al. (2022).[21]

$$\vec{\omega}.\vec{x}_1 - b = 0, \tag{2}$$

Here, $\vec{\omega}$ is the standard vector to the hyperplane. $\frac{b}{\vec{\omega}}$ represents the offset value of the hyperplane from the origin along the normal vector.

Within SVM, two types of margins are considered: soft margins and hard margins. The concept behind the soft margin is to permit SVM to make minor errors, thus enabling the widest possible margin to correctly classify other data points. Linear-SVM seeks optimal class separation through a hyperplane, maximising the margin with support vectors. It excels at high-dimensional spaces for approximately linear relationships but is less effective with complex, nonlinear data and is sensitive to outliers. This approach leads to a distinct optimisation problem, as shown in equation (3).[22]

[21] Blanco et al. 2022.

[22] Ranganathan et al. 2011.

$$[\frac{1}{n}\sum_{i=1}^{n} max(0,1-y_i(\vec{\omega}.\vec{x}_1 - b))] + \lambda||\vec{\omega}^2|| \quad (3)$$

In this context, λ represents the trade-off between the margin size increase and the requirement for xi to remain on the current side of the margin. Nonlinear-SVM with Kernels extends linear SVM, effectively capturing complex relationships through higher-dimensional transformations. It is versatile in scenarios with nonlinear boundaries and its performance relies on kernel selection, which raises challenges and increased computational costs. Support Vector Regression adapts SVM for regression, effectively minimising deviations within a specified margin and handling nonlinear relationships. It is robust to outliers. It demands careful parameter selection, particularly with large datasets. Various studies have highlighted the versatility of SVMs in different applications. Diana et al. (2019) emphasised the adaptability and high accuracy of SVMs for electromyographic signal classification.[23] Multiclass-SVM expands binary SVM for multiple classes, utilising one-vs-one or one-vs-all strategies. It is versatile for scenarios with more than two classes, while its performance is strategy-dependent, with heightened computational costs for additional classes.

EXTREME LEARNING MACHINE

Extreme Learning Machine (ELM) is a widely used ANN in SGs due to its quick training and high accuracy. ELM plays a pivotal role in predicting energy consumption, improving load forecasting, and enhancing grid stability in SGs. ELM functions as a single-hidden layer feedforward NN, featuring randomly assigned input weights and biases, and exclusively learning output weights. It emphasises swift training with a fixed hidden layer. It can optimise grid operations by forecasting energy demand based on weather and time. ELM can also detect system failures, such as power line faults, preventing outages and improving overall grid performance. Additionally, ELMs are valuable for real-time network retraining, although they may not match the accuracy of CNNs, as shown in equation (4).[24]

$$f_l(x) = \sum_{i=1}^{L} \beta_i g_i(x) = \sum_{i=1}^{L} \beta_i \, g(\omega_i * x_j + b_i), j = 1, \ldots N \quad (4)$$

L is the number of hidden or covert units in the NN. N is the number of training samples or data points. β represents the scaled vector between the hidden layer and the output layer, ω represents the scaled vector between the input layer and the hidden layer, g is an activation function applied to the output of the hidden layer, b is a bias vector typically added to the output of the hidden layer, while x is the input vector to the NN. Zheng et al. (2022)

[23] Diana et al. 2019.
[24] Mishra et al. 2022.

conducted a review of ELM in data stream classification, emphasising its effectiveness, universal approximation capabilities, and simplicity.[25] Mohanty et al. (2021) proposed a hybrid model combining kernel ELM and an autoencoder for financial market prediction, which exhibited improved profitability analysis compared to traditional methods.[26] ELM has proven to be computationally efficient for extensive datasets, particularly in big data applications. Its advantages include reduced overfitting through hidden layer randomisation and faster training times compared to traditional neural networks. Yaseen et al. (2019) used ELM for river flow forecasting and water resource management, enhancing prediction accuracy through orthogonal decomposition.[27] ELM has limitations such as potential constraints on model interpretability and potential performance gaps in complex tasks requiring deep hierarchical feature learning. Additionally, the absence of iterative tuning in the hidden layer may restrict its adaptability to specific data types. Kariminia et al. (2016) applied ELM to analyse visitors' thermal comfort in public spaces, achieving precise predictions and reducing training time.[28]

Dou et al. (2022) identified a vulnerability in power system state estimators with a new cyberattack called a false data injection (FDI) attack, using online sequential ELM.[29] Dewangan et al. (2022) proposed an enhanced ELM model for forecasting the stability of cyber-physical systems in SGs, considering technical and socioeconomic factors that could impact their stability.[30] Zhang et al. (2020) improved intrusion detection in SGs by applying a genetic algorithm ELM, enhancing accuracy and reducing false positives.[31] Naz et al. (2019) enhanced the recurrent-ELM model's scalability and prediction accuracy, especially with larger datasets.[32] Duo et al. (2019) employed a hybrid model combining Variational Mode Decomposition and online sequential ELM for FDI attack detection in SGs.[33] Xue et al. (2019) introduced a predictive recovery technique for addressing incorrect data using geographical power data correlation to enhance system resilience.[34] Li et al. (2018) proposed an intrusion detection system using online sequential extreme learning, optimised with the artificial bee colony-differential evolution algorithm, achieving a 95.3% accuracy rate for detecting bogus data injection attacks.[35]

25 Zheng et al. 2022.
26 Mohanty et al. 2021.
27 Yaseen et al. 2019.
28 Kariminia et al. 2016.
29 Dou et al. 2022.
30 Dewangan et al. 2022.
31 Zhang et al. 2020.
32 Naz et al. 2019.
33 Dou et al. 2019.
34 Xue et al. 2019.
35 Li et al. 2018.

DECISION TREE

Decision Trees (DT) are widely used in SGs due to their simplicity, interpretability, and versatility in handling various data types. DTs have diverse applications in SGs, including load forecasting, fault detection, and energy management. They predict electricity demand based on factors such as weather and time, allowing grid operations to be optimised, and reducing the need for extra energy generation or storage. DTs also help detect power line faults, improving grid performance. In energy management applications, DTs optimise the operation of distributed energy resources, maximising their contribution. When used in SGs, DTs can enhance efficiency, reduce costs, and enhance grid reliability and sustainability. Figure 6 illustrates the DT workflow, and DT algorithms apply equations like (5) for classification and (6) for regression.[36]

$$\sum_{i=1}^{c} - f_i \log(f_i) \tag{5}$$

$$\frac{1}{N}\sum_{i=1}^{N}(y_i - \mu)^2 \tag{6}$$

Where, f_i is the frequency of label i at a node and c is the number of unique labels, y_i is the label for an instance, N is the number of instances and μ is the mean given by $\frac{1}{N}\sum_{i=1}^{N} y_i$.

Jena and Dehuri (2020) explored the role of data mining in prediction, encompassing regression and classification.[37] DTs are preferred for their simplicity and effectiveness, but their complexity grows with larger datasets, often requiring advanced algorithms. Zekić-Sušacand and Knežević (2021) investigated the Classification and Regression Tree Algorithm (CART) and its relevance to energy cost.[38] Kadiyala and Kumar (2018) used Python to assess various DT-based boosting algorithms and found extreme gradient boosting to perform best.[39] Subramaniam et al. (2017) compared CARTs and Conditional Inference Trees (CTree) in terms of subgroup identification and prediction accuracy.[40] Peng et al. (2017) emphasised CART's significance in cocaine reward research.[41] Heidari et al. (2013) introduced a hybrid DT and discrete wavelet transform model to facilitate the detection of islanding in distributed systems.[42] DT models have also been applied for the transient security assessment (TSA) of power systems.[43]

Turanzas et al. (2022) introduced an event detection algorithm for the SG focused on identifying the status and location of attacked devices. They employed two DTs to improve event detection accuracy, achieving 80.59% accuracy for status prediction and

[36] Achlerkar et al. 2016.
[37] Jena–Dehuri 2020.
[38] Zekić-Sušacand–Knežević 2021.
[39] Kadiyala–Kumar 2018.
[40] Subramaniam et al. 2017.
[41] Peng et al. 2017.
[42] Heidari et al. 2013.
[43] Niazi et al. 1999.

maintaining 79.39% for location prediction using the nested FDI algorithm.[44] Da Cunha et al. (2022) employed the DT algorithm to analyse power system stability in SGs, achieving a remarkable degree of accuracy of 93% when identifying small signals within the system.[45] Tehrani et al. (2020) utilised DTs, Random Forest (RF), and gradient boosting algorithms to detect non-technical losses in power consumption data, achieving accuracy rates of 87%, 88.1%, and 88.6% for DT, RF, and gradient boosting, respectively.[46] Taghavinejad et al. (2020) stressed the significance of IoT security in SGs and proposed a hybrid DT method with 83.14% accuracy in detecting technical losses, outperforming DT, KNN, and SVM with accuracy rates of 80.90%, 79.12%, and 78.52%, respectively. Eissa et al. (2019) compared DT's role in load optimisation to other methods, noting its efficient management of local heat ventilation and air conditioning units.[47] Radoglou-Grammatikis et al. (2019) introduced an intrusion detection system based on DT for safeguarding advanced metering infrastructure, achieving high accuracy and a true positive rate.[48] Wang and Kong (2019) enhanced air quality predictive modelling in a "weather-smart grid" through DT-based techniques.[49] Singh and Govindarasu (2018) presented an intelligent remedial action scheme for detecting cyber-attacks and physical disturbances in the SG.[50] Steer et al. (2012) demonstrated the effectiveness of DT ensembles, referred to as "forests", in delivering near-ideal control strategies in real-time.[51]

RANDOM FOREST

RF, a widely used ML algorithm, is prominent in the SG industry for its high accuracy and ability to handle complex datasets. In SG-related applications, RF excels at load forecasting, fault detection, and energy management, optimising grid operations and reducing the need for additional energy generation. It also enhances grid performance by detecting and diagnosing power transmission line faults and improving sustainability by optimising distributed energy resources. The integration of DTs into the RF algorithm to make predictions involves the combination of independent DT models through majority voting. Gini Importance, as implemented in Scikit-learn, evaluates feature relevance in each DT, as illustrated in equations (7) and (8). An overview of the RF algorithm is provided in Equation (9).[52]

44 Turanzas et al. 2022.
45 Da Cunha et al. 2022.
46 Tehrani et al. 2020.
47 Eissa et al. 2019.
48 Radoglou-Grammatikis–Sarigiannidis 2019.
49 Wang–Kong 2019.
50 Singh–Govindarasu 2018.
51 Steer et al. 2012.
52 Das et al. 2022.

$$ni_j = w_j c_j - w_{left(j)} c_{left(j)} - w_{right(j)} c_{right(j)} \quad (7)$$

The following formula is used to determine each feature's relevance on a DT:

$$fi_i = \frac{\sum_{j:node\ j\ splits\ on\ features\ i} ni_j}{\sum_{k \in all\ nodes} ni_k} \quad (8)$$

$$normfi_i = \frac{fi_i}{\sum_{j \in all\ features\ of\ fi_j}} \quad (9)$$

At the RF level, the ultimate feature relevance is determined by finding its average over all trees. Calculating the relevance of each attribute for each tree, then dividing that total by the number of trees, yields:

$$RFfi_i = \frac{\sum f_{j \in all\ tress} normfi_{ij}}{T} \quad (10)$$

Where, ni sub(j) = the value of node j, w sub(j) = scaled number of samples reaching node j, C sub(j) = the value of the impurity node j, left(j) = toddler node from the left split on node j, right(j) =+ toddler node from right split on node j, fi sub(i) = the importance of feature i, ni sub(j) = the importance of node j, RFfi sub(i) = the importance of feature i calculated from all trees in the RF model, normfi sub(ij) = the normalised feature importance for i in tree j, T = total number of trees.

Recently, RF has been successfully applied in water resource applications, offering predictive power with simplicity and speed. RF aids in urban surface thermal environment analysis[53] and enhances high-voltage circuit breaker diagnosis through a hybrid RF and stacked Autoencoder model.[54] Its interpretability supports applications requiring understanding, and its efficiency and minimal parameter adjustment make it a valuable tool.[55]

LOGISTIC REGRESSION

Logistic Regression (LR) is a widely employed statistical model in the field of SGs, being particularly well-suited for classification tasks focused on predicting event probabilities based on predictor variables. In SG applications, LR is effective in tasks such as load forecasting, fault detection, and energy management, and has gained favour among practitioners and researchers. For example, LR can predict the likelihood of power outages based on factors including weather and infrastructure age, thus contributing to enhanced grid reliability. Furthermore, LR aids in optimising the operation of distributed energy resources such as solar panels and wind turbines by predicting their capacity to meet

[53] Xu et al. 2021.
[54] Ma et al. 2019.
[55] Tyralis et al. 2019.

electricity demand. In summary, LR enhances efficiency, cost-effectiveness, and grid reliability and sustainability in SG. LR algorithms are applied for both classification and regression techniques, while Equation (11) embodies the core equation for evaluating the LR ML algorithm.[56]

$$y = \frac{e^{(b_0+b_1x)}}{1+ e^{(b_0+ b_1x)}} \tag{11}$$

Where x = input value, y = predicted output, b_0 is bias or intercept term, b_1 is the coefficient for input (x).

Drilling engineering, a crucial aspect of gas and oil exploration, involves significant investments and technological complexities. Deng et al. (2021) used LR algorithms to predict the rate of penetration, contributing to the field.[57] Hewett et al. (2020) proposed a five-factor maximum model for risk prediction with LR in drilling engineering.[58] Sun et al. (2018) focused on environmental ecosystem monitoring, employing an early-warning LR model for timely alerts.[59] Additionally, Bashir et al. (2021) found LR to outperform other classification algorithms, achieving high precision and accuracy in experiments.[60]

ANALYSIS AND DISCUSSION

The reliability of various ML algorithms in SG applications can be assessed using a dependability score based on performance metric normalisation. Equation (12), developed by Band et al. (2022), demonstrates the min-max normalisation process for these metrics, ensuring comparability with scores ranging from 0 to 1.[61]

$$Y_N = \frac{f(Accuracy,Precision,Recall,RMSE,Correlation\ Coefficient)-Y_{min}}{Y_{max}-Y_{min}} \tag{12}$$

The dependability scores have been divided into four zones for easier interpretation:

1. Low if $0 \leq YN < 0.25$
2. Moderate if $0.25 \leq YN < 0.5$
3. High if $0.5 \leq YN < 0.75$
4. Very high if $0.75 \leq YN < 1.0$

[56] Bashir et al. 2022.
[57] Deng et al. 2021.
[58] Hewett et al. 2020.
[59] Sun et al. 2018.
[60] Bashir et al. 2021.
[61] Band et al. 2022.

According to the reliability analysis, the most reliable ML algorithm for SG applications is ANN. Additionally, ELM, RF, and LR exhibit comparatively high levels of reliability within the SG context.

Efficiency analysis

Figure 5 illustrates an efficiency analysis using processing time as a metric for the surveyed ML methods, employing min-max normalisation for score comparability shown in Equation (13).[62]

$$X_N = \frac{\frac{Absolute\ processing\ time(s)}{data\ samples} - X_{min}}{X_{max} - X_{min}} \tag{13}$$

The equation defines the normalisation of processing time scores using the min-max method, yielding scores between 0 and 1, and categorises them into four zones for clarity.

1. Low if $0 \leq XN < 0.25$
2. Moderate if $0.25 \leq XN < 0.5$
3. High if $0.5 \leq XN < 0.75$
4. Very high if $0.75 \leq XN < 1.0$

A lower score signifies faster ML algorithms, with ANN demonstrating the fastest performance, while DL and hybrid/ensemble models exhibit reduced speed due to their intricate computational structure.

Table 1: Novel studies based on ML-based method in SG

Reference	Contribution	Application	Source	ML-based method
Zheng et al. 2021	Addressing the load shifting associated with demand response	Customer incentive pricing	IET SG	Sliding time window technique, genetic algorithm
Jarmouni et al. 2021	Ensuring the safety of electricity for consumers while maximising the integration of RESs	Multiple-source energy management	International Journal of Power Electronics and Drive Systems	Multilayer perceptron network
Liu & Shu 2021	Implementing a hybrid ML model to minimise false attacks in SGs	Security	Computers and Security	Gradient-based and population-based algorithm
Gupta et al. 2021	Suggesting a cyber detection method for recognising cyber intrusions in the SG	FDI system	International Journal of Engineering, Transactions B: Applications	Intelligent Loop Based-ANN

[62] Band et al. 2022.

Reference	Contribution	Application	Source	ML-based method
Teekaraman et al. 2022	Identifying regression losses within the SG	Loss identification in large-scale system	Wireless Communications and Mobile Computing	LSTM, heuristic algorithm, Adaptive ARIMA, Linear regression
Bao et al. 2022	Optimising the dispatch of the SG through a multi-objective approach	Forecasting the actual load	Mobile Information Systems	Multi-particle swarm optimisation
Wang et al. 2022	Real-time assessment of regulatory system risks	Communication and data security	Journal of Shenyang University of Technology	CNN-SVM classification model
Dou et al. 2022	Evaluating the detection accuracy and assessing the impact of attack intensity and environmental noise on the performance of the SG	FDI attack	CSEE Journal of Power and Energy Systems	Variational Mode Decomposition, OS-ELM
Dewangan et al. 2022	Introducing a Genetic Algorithm-ELM for forecasting the stability of cyber-physical systems	Stability prediction	Electric Power Systems Resiliency: Modelling, Opportunity, and Challenges	Hessenberg Decomposition ELM, GA-based ELM
Zhang et al. 2020	Enhances the accuracy, detection rate, and precision of intrusion detection while minimising the false positive rate	Intrusion detection	Energies	Online sequential-ELM, GA-ELM
Singh & Govindarasu 2018	Reducing the impact on both system reliability and economic factors	Anomaly detection	IEEE Power and Energy Society General Meeting	Special Protection Scheme, Intelligent Remedial Action Scheme
Steer et al. 2012	Implementing a receding horizon controller to dynamically adjust the output of the SG in real-time	Online operation of SG	Energy Conversion and Management	C4.5 algorithm, Particle swarm optimisation
Ganesan et al. 2022	Regularly monitoring the operational status of wearable sensing devices in the SG	Human activity recognition	Mathematical Problems in Engineering	K-means ++ algorithm, RF
Chen et al. 2021	Enhancing energy efficiency and promoting the use of clean energy	Energy optimisation	IOP Conference Series: Earth and Environmental Science	RF
Lin et al. 2020	Enhancing the precision, recall rate of fault prediction, and reducing the rate of negative samples	Fault prediction	Enterprise Information Systems	Voted RF algorithm, NSGA algorithm

Reference	Contribution	Application	Source	ML-based method
Moldovan 2021	Categorising the stability status of an SG	Stability	Lecture Notes in Networks and Systems	Improved Kangaroo Mob Optimisation, LR
Manoharan et al. 2020	Identifying optimal solutions for energy consumption, distance, and cost	Monitoring	Energies	Binary LR
Mukherjee et al. 2020	Developing a cost-effective solution for interconnecting electrical and electronic devices	Lightweight sustainable intelligent LF	Sustainable Computing: Informatics and Systems	KNN-regressor model, SVM
Naz et al. 2019	Ensuring the effectiveness of load scheduling and reducing prices	Short-term electric load and price forecasting	Energies	Enhanced-LR, Enhanced Recurrent ELM

Source: compiled by the authors

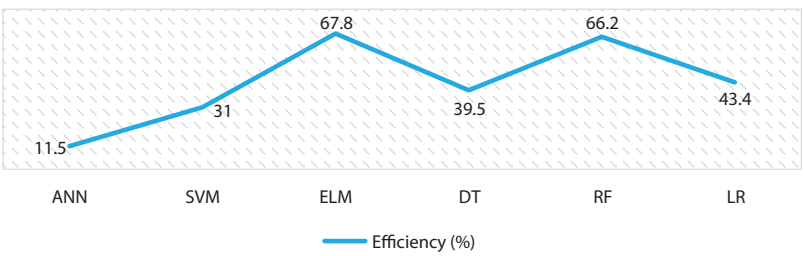


Figure 5: The score for processing speed of ML-based methods used to SG applications
Source: compiled by the authors

Figure 6 shows the evaluation criteria used in the reviewed papers for ML methods, where such metrics as accuracy, precision, recall, correlation coefficient, and various error-related measurements are prevalent, while specialised or complementary metrics are less frequently employed.

Obtaining precise accuracy percentages for different ML algorithms in SG data security is challenging due to factors including application, training data quality, problem complexity, and hyperparameters. Typically, more complex algorithms, such as ANNs and SVMs, tend to achieve higher accuracy compared to simpler ones like DT and KNN. However, actual accuracy varies depending on the specific application and data quality. It is important to consider factors beyond accuracy, including computational resources, model interpretability, and generalisation capabilities. Figure 6 depicts accuracy values, highlighting the lower accuracy produced by single ML models (e.g. ANN, DE, binary LR, Feed Forward NNs) across various SG applications.

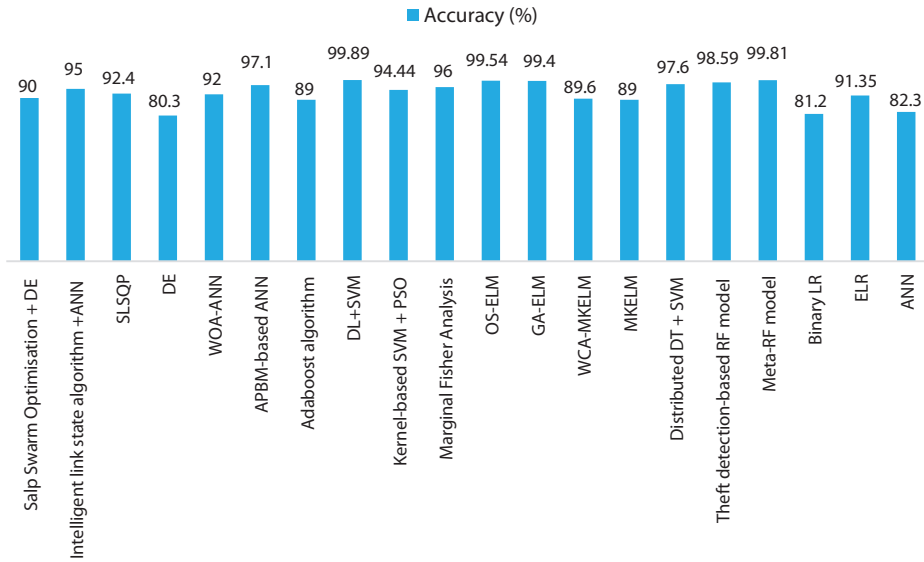


Figure 6: Comparison of the models' accuracies
Source: compiled by the authors

Multiple ML algorithms are useful for SG applications, including LR for continuous value predictions, DTs for adaptable classification, RF for ensemble learning, ANN for various types of parameter forecasting, SVM for its trade-off between high accuracy and processing speed, and ELM for rapid scalability. Selection of the most appropriate algorithm for a task hinges on the specific challenges and data attributes within SG contexts.

Figure 7 depicts the allocation of ML methods across diverse SG applications, with ANN and RF models being prevalent in security. Additionally, ELM and ANN excel at FDI, whereas ELM is predominant in customer incentive pricing, while LR and ANN dominate energy management. RF emerges as a suitable choice for real-time voltage stability monitoring in the SG. ML algorithms play a crucial role in optimising Demand Response by accurately predicting energy demand in the Grid, thereby enhancing program efficiency and grid management. Google's DeepMind utilises ML for renewable energy integration, specifically in wind farms, improving their overall efficiency through advanced wind forecasting and turbine optimisation. Predictive analytics powered by ML contribute to grid stability and predictive maintenance, proactively identifying potential equipment failures. ML is applied for energy theft detection, analysing consumption patterns to prevent unauthorised usage. ML models are employed to improve the grid's resilience to natural disasters, simulating and strategising for potential impacts post-events. ML is also leveraged for electric vehicle integration, by optimising charging infrastructure and alleviating strain on distribution networks. ML is utilised for grid anomaly detection, swiftly identifying and responding to cybersecurity threats and unexpected grid behaviour in real-time.

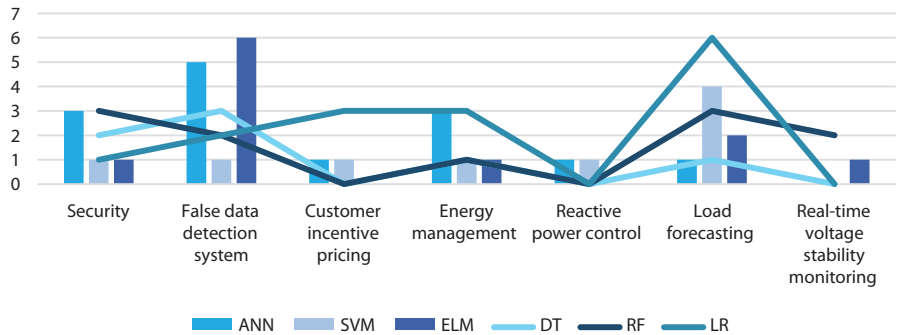


Figure 7: Distribution of the utilisation percentages of various ML techniques in this study among diverse application categories within the field of SG
Source: compiled by the authors

Limitations, challenges, and future trends

The definition of AI varies by time. Therefore, this study instead of reviewing the AI methods, enforced limitation to only investigate standard ML methods. The deep learning methods had been excluded from this study and can be studied in a future research. There are some limitations in the usefulness of ML for SG Applications: a) data quality and variability – ML models face difficulties due to the quality and variability of SG data, affecting their performance as they struggle with inaccuracies and fluctuations; b) interpretability –some ML models exhibit inherent complexity, reducing their interpretability. This limitation hinders a clear understanding of decision-making processes, which is crucial in critical infrastructure like SGs; c) scalability – the growth of SG systems raises concerns about scalability, particularly when handling extensive data processing and resource-intensive ML algorithms. The challenges arising from the use of ML for SG applications included: A) privacy and ethical concerns – striking a balance between the demand for data-driven insights and privacy considerations presents a significant challenge. Careful implementation of privacy-preserving measures and ethical considerations is thus essential; B) regulatory compliance – continuous adherence to evolving regulations and ensuring compliance with legal frameworks governing ML applications in SGs poses an ongoing challenge for system operators and developers; C) cybersecurity risks – ML models and the data they handle are susceptible to cyber threats, demanding the implementation of robust cybersecurity measures to safeguard against potential attacks and breaches. The likely future trends in ML for SG applications may include: A) explainable AI- anticipated future ML models in SGs will prioritise enhancing interpretability through explainable-AI techniques, fostering transparency and trust in decision-making processes; B) edge computing for real-time processing: The integration of edge computing with ML in SGs is set to revolutionise real-time data processing at the edge, reducing latency, and

enhancing overall system responsiveness; C) federated learning – the future may witness the rise of federated learning, emphasising decentralised model training across devices. This approach is expected to address privacy concerns effectively by keeping sensitive data localised; D) hybrid models – an emerging trend is the combination of traditional physics-based models with ML techniques, leading to more accurate and robust SG models that leverage the strengths of both approaches.

CONCLUSION

This article studied the ML applications in SGs, conducted a systematic review, introducing a novel taxonomy, and carried out a thorough comparative performance evaluation. The well-structured taxonomy established a foundation for categorising and comprehending various ML approaches within SG context. The performance evaluation not only illuminates the strengths and weaknesses of the various ML models, but also furnishes invaluable insights for practitioners aiming to implement effective solutions in real-world SG scenarios. Navigating the intricate landscape of contemporary energy distribution, the integration of ML not only becomes a technological imperative but also a transformative catalyst, amplifying efficiency, resilience, and sustainability in SG operations. This research not only contributes to the academic debate, but can also serve as a pragmatic guide for engineers, system operators, and policymakers striving to advance and optimise SG infrastructures. This research found that the applications of ANNs, ELM and RF methods are popular. Looking forward, the findings presented underscore the dynamic nature of the field, fostering continual research, development, and collaboration to propel innovation and tackle the evolving challenges in SG management.

TABLE OF ACRONYMS

RESs	Renewable Energy Resources
SG	Smart Grid
ML	Machine Learning
KNN	K-Nearest Neighbours
DL	Deep Learning
AI	Artificial Intelligence
ANN	Artificial Neural Network
NN	Neural Network
SVM	Support Vector Machine
ELM	Extreme Learning Machines
DT	Decision Tree
CART	Classification and Regression Tree Algorithm
CTree	Conditional Inference tree

RF	Random Forest
LR	Logistic Regression
FDI	False Data Injection attack
LSTM	Long-Short Term Memory
CNN	Convolutional Neural Network
NB	Naive Bayes
IoT	Internet of Things

REFERENCES

Achlerkar, Pankaj D. – Samantaray, S. R. – Manikandan, M. Sabbarimalai (2016): Variational Mode Decomposition and Decision Tree-based Detection and Classification of Power Quality Disturbances in Grid-Connected Distributed Generation System. *IEEE Transactions on Smart Grid,* 9(4), 3122–3132. Online: https://doi.org/10.1109/TSG.2016.2626469

Ahmad, Tanveer – Zhu, Hongyu – Zhang, Dongdong – Tariq, Rasikh – Bassam, A. – Ullah, Fasih – AlGhamdi, Ahmed, S. – Alshamrani, Sultan S. (2022): Energetics Systems and Artificial Intelligence: Applications of Industry 4.0. *Energy Reports,* 8, 334–361. Online: https://doi.org/10.1016/j.egyr.2021.11.256

Ahmed, Saeed – Lee, Youngdoo – Hyun, Seung-Ho – Koo, Insoo (2019): Unsupervised Machine Learning-Based Detection of Covert Data Integrity Assault in Smart Grid Networks Utilizing Isolation Forest. *IEEE Transactions on Information Forensics and Security,* 14(10), 2765–2777. Online: https://doi.org/10.1109/tifs.2019.2902822

Aly, Hamed H.H. (2020): A Proposed Intelligent Short-Term Load Forecasting Hybrid Models of ANN, WNN and KF Based on Clustering Techniques for Smart Grid. *Electric Power Systems Research,* 182, 106191. Online: https://doi.org/10.1016/j.epsr.2019.106191

Ardito, Luca – Procaccianti, Giuseppe – Menga, Giuseppe – Morisio, Maurizio (2013): Smart Grid Technologies in Europe: An Overview. *Energies,* 6(1), 251–281. Online: https://doi.org/10.3390/en6010251

Areo, Oluwafadekemi S. – Gershon, Obindah – Osabuohien, Evans (2020): Improved Public Services and Tax Compliance of Small and Medium Scale Enterprises in Nigeria: A Generalised Ordered Logistic Regression. *Asian Economic and Financial Review,* 10(7), 833–860. Online: https://doi.org/10.18488/journal.aefr.2020.107.833.860

Banga, Alisha – Ahuja, Ravinder – Sharma, S. C. (2022): Accurate Detection of Electricity Theft Using Classification Algorithms and Internet of Things in Smart Grid. *Arabian Journal for Science and Engineering,* 47(8), 9583–9599. Online: https://doi.org/10.1007/s13369-021-06313-z

Band, Shahab S. – Ardabili, Sina – Sookhak, Mehdi – Chronopoulos, Theodore A. – Elnaffar, Said – Moslehpour, Massoud – Makó, Csaba – Török, Bernát – Pai, Hao-Ting – Mosavi, Amir (2022): When Smart Cities Get Smarter via Machine

Learning: An In-depth Literature Review. *IEEE Access,* 10, 60985–61015. Online: https://doi.org/10.1109/ACCESS.2022.3181718

Bao, Man – Zhang, Hongqi – Wu, Hao – Zhang, Chao – Wang, Zixu – Zhang, Xiaohui (2022): Multiobjective Optimal Dispatching of Smart Grid Based on PSO and SVM. *Mobile Information Systems,* 2051773. Online: https://doi.org/10.1155/2022/2051773

Bashir, Ali K. – Khan, Suleman – Prabadevi, B. – Deepa, N. – Alnumay, Waleed S. – Gadekallu, Thippa R. – Maddikunta, Praveen K. R. (2021): Comparative Analysis of Machine Learning Algorithms for Prediction of Smart Grid Stability†. *International Transactions on Electrical Energy Systems,* 31(9), e12706. Online: https://doi.org/10.1002/2050-7038.12706

Bashir, Hayat – Lee, Seonah – Kim, Kyong H. (2022): Resource Allocation through Logistic Regression and Multicriteria Decision Making Method in IoT Fog Computing. *Transactions on Emerging Telecommunications Technologies,* 33(2), e3824. Online: https://doi.org/10.1002/ett.3824

Bari, Ataul – Jiang, Jin – Saad, Walid – Jaekel, Arunita (2014): Challenges in the Smart Grid Applications: An Overview. *International Journal of Distributed Sensor Networks,* 10(2), 974682. Online: https://doi.org/10.1155/2014/974682

Behara, Ramesh K. – Saha, Akshay K. (2022): Artificial Intelligence Methodologies in Smart Grid-Integrated Doubly Fed Induction Generator Design Optimization and Reliability Assessment: A Review. *Energies,* 15(19), 7164. Online: https://doi.org/10.3390/en15197164

Berghout, Tarek – Benbouzid, Mohamed – Muyeen, S. M. (2022): Machine Learning for Cybersecurity in Smart Grids: A Comprehensive Review-based Study on Methods, Solutions, and Prospects. *International Journal of Critical Infrastructure Protection,* 38, 100547. Online: https://doi.org/10.1016/j.ijcip.2022.100547

Bhagya Raj, G. V. S. – Dash, Kshirod K. (2022): Comprehensive Study on Applications of Artificial Neural Network in Food Process Modeling. *Critical Reviews in Food Science and Nutrition,* 62(10), 2756–2783. Online: https://doi.org/10.1080/10408398.2020.1858398

Blanco, Victor – Japón, Alberto – Puerto, Justo (2022): A Mathematical Programming Approach to SVM-based Classification with Label Noise. *Computers & Industrial Engineering,* 172, 108611. Online: https://doi.org/10.1016/j.cie.2022.108611

Chaurasia, Kiran – Kamath, H. Ravishankar (2022): Artificial Intelligence and Machine Learning Based: Advances in Demand-Side Response of Renewable Energy-Integrated Smart Grid. In Somani, Arun K. – Mundra, Ankit – Doss, Robin – Bhattacharya, Subhajit (eds.): *Smart Systems: Innovations in Computing.* Singapore: Springer, 195–207. Online: https://doi.org/10.1007/978-981-16-2877-1_18

Chen, Lingxuan – Xie, Pengyang – Ma, Shuaihua – Yang, Chen (2021): Evaluation of Low-Carbon Benefits of Smart Grid Based on Random Forest Algorithm. *IOP Conference Series: Earth and Environmental Science,* 804(3), 032001. Online: https://doi.org/10.1088/1755-1315/804/3/032001

Chen, Zhenyu – Yuan, Shuai – Wu, Longfei – Guan, Zhitao – Du, Xiaojiang (2022): False Data Injection Attack Detection Based on Wavelet Packet Decomposition and Random Forest in Smart Grid. In *2021 IEEE 23rd International Conference on High Performance Computing and Communications, 7th International Conference on Data Science and Systems, 19th International Conference on Smart City and 7th International Conference on Dependability in Sensor, Cloud and Big Data Systems and Applications,* HPCC-DSS-SmartCity-DependSys Haikou, Hainan, China, 1965–1971. Online: https://doi.org/10.1109/HPCC-DSS-SmartCity-DependSys53884.2021.00294

Cui, Lei – Qu, Youyang – Gao, Longxiang – Xie, Gang – Yu, Shui (2020): Detecting False Data Attacks Using Machine Learning Techniques in Smart Grid: A Survey. *Journal of Network and Computer Applications,* 170, 102808. Online: https://doi.org/10.1016/j.jnca.2020.102808

Da Cunha, Guilherme L. – Fernandes, Ricardo A. S. – Fernandes, Tatiane C. C. (2022): Small-Signal Stability Analysis In Smart Grids: An Approach Based on Distributed Decision Trees. *Electric Power Systems Research,* 203, 107651. Online: https://doi.org/10.1016/j.epsr.2021.107651

Das, Ratnakar – Mishra, Jibitesh – Mishra, Sujogya – Pattnaik, P. K. – Das, Subhalaxmi (2022): Mathematical Modeling using Rough Set and Random Forest Model to Predict Wind Speed. In *2022 9th International Conference on Computing for Sustainable Global Development* (INDIACom), New Delhi, India, 207–213. Online: https://doi.org/10.23919/INDIACom54597.2022.9763275

Deng, Shuang – Wei, Minghui – Xu, Mingze – Cai, Wei (2021): Prediction of the Rate of Penetration Using Logistic Regression Algorithm of Machine Learning Model. *Arabian Journal of Geosciences,* 14(21), 1–13. Online: https://doi.org/10.1007/s12517-021-08452-x

Dewangan, Fanidhar – Biswal, Monalisa – Patnaik, Bhaskar – Hasan, Shazia – Mishra, Manohar (2022): Smart Grid Stability Prediction Using Genetic Algorithm-Based Extreme Learning Machine. In Bansal, Ramesh C. – Mishra, Manohar – Sood, Yog Raj (eds.): *Electric Power Systems Resiliency: Modelling, Opportunity and Challenges.* [s. l.]: Academic Press, 149–163. Online: https://doi.org/10.1016/B978-0-323-85536-5.00011-4

Dou, Chunxia – Wu, Di – Yue, Dong – Jin, Bao – Xu, Shiyun (2019): A Hybrid Method for False Data Injection Attack Detection in Smart Grid Based on Variational Mode Decomposition and OS-ELM. *CSEE Journal of Power and Energy Systems,* PP (99), 118195762. Online: https://doi.org/10.17775/CSEEJPES.2019.00670

Dou, Chunxia – Wu, Di – Yue, Dong – Jin, Bao – Xu, Shiyun (2022): A Hybrid Method for False Data Injection Attack Detection in Smart Grid Based on Variational Mode Decomposition and OS-ELM. *CSEE Journal of Power and Energy Systems,* 8(6), 1697–1707. Online: https://doi.org/10.17775/cseejpes.2019.00670

Durairaj, Danalakshmi – Wróblewski, Łukasz – Sheela, A. – Hariharasudan, A. – Urbański, Mariusz (2022): Random Forest Based Power Sustainability and Cost Optimization in Smart Grid. *Production Engineering Archives,* 28(1), 82–92. Online: https://doi.org/10.30657/pea.2022.28.10

Eissa, M. M. – Ali, A. A. – Abdel-Latif, K. M. – Al-Kady, A. F. (2019): A Frequency Control Technique Based on Decision Tree Concept by Managing Thermostatically Controllable Loads at Smart Grids. *International Journal of Electrical Power and Energy Systems,* 108, 40–51. Online: https://doi.org/10.1016/j.ijepes.2018.12.037

Elbouchikhi, Elhoussin – Zia, Muhammad F. – Benbouzid, Mohamed – El Hani, Soumia (2021): Overview of Signal Processing and Machine Learning for Smart Grid Condition Monitoring. *Electronics,* 10(21), 2725. Online: https://doi.org/10.3390/electronics10212725

Ganesan, Anusha – Paul, Anand – Seo, HyunCheol (2022): Elderly People Activity Recognition in Smart Grid Monitoring Environment Mathematical Problems in Engineering, 2022, 9540033. Online: https://doi.org/10.1155/2022/9540033

Gupta, Praveen K. – Singh, Neeraj K. – Mahajan, Vasundhara (2021): Intrusion Detection in Cyber-Physical Layer of Smart Grid Using Intelligent Loop Based Artificial Neural Network Technique. *International Journal of Engineering, Transactions B: Applications,* 34(5), 1250–1256. Online: https://doi.org/10.5829/ije.2021.34.05b.18

Guyot, Dimitri – Giraud, Florine – Simon, Florian – Corgier, David – Marvillet, Christophe – Tremeac, Brice (2019): Overview of the Use of Artificial Neural Networks for Energy-Related Applications in the Building Sector. *International Journal of Energy Research,* 43(13), 6680–6720. Online: https://doi.org/10.1002/er.4706

Hafeez, Ghulam – Alimgeer, Khurram S. – Qazi, Abdul B. – Khan, Imran – Usman, Muhammad – Khan, Farrukh A. – Wadud, Zahid (2020): A Hybrid Approach for Energy Consumption Forecasting with a New Feature Engineering and Optimization Framework in Smart Grid. *IEEE Access,* 8, 9057473. 96210–96226. Online: https://doi.org/10.1109/access.2020.2985732

Heidari, M. – Seifossadat, G. – Razaz, M. (2013): Application of Decision Tree and Discrete Wavelet Transform for an Optimized Intelligent-Based Islanding Detection Method in Distributed Systems with Distributed Generations. *Renewable and Sustainable Energy Reviews,* 27, 525–532. Online: https://doi.org/10.1016/j.rser.2013.06.047

Hewett, Timothy E. – Webster, Kate E. – Hurd, Wendy J. (2019): Systematic Selection of Key Logistic Regression Variables for Risk Prediction Analyses: A Five Factor Maximum Model. *Clinical Journal of Sport Medicine,* 29(1), 78–85. Online: https://doi.org/10.1097/jsm.0000000000000486

Hossain, Eklas – Khan, Imtiaj – Un-Noor, Fuad – Sikander, Sarder S – Sunny, M. Samiul (2019): Application of Big Data and Machine Learning in Smart Grid, and Associated Security Concerns: A Review. *IEEE Access,* 7, 13960–13988. Online: https://doi.org/10.1109/access.2019.2894819

Hua, Weiqi – Chen, Ying – Qadrdan, Meysam – Jiang, Jing – Sun, Hongjian – Wu, Jianzhong (2022): Applications of Blockchain and Artificial Intelligence Technologies for Enabling Prosumers in Smart Grids: A Review. *Renewable and Sustainable Energy Reviews,* 161, 112308. Online: https://doi.org/10.1016/j.rser.2022.112308

Jarmouni, Eziitouni – Mouhsen, Ahmed – Lamhammedi, Mohammed – Ouldzira, Hicham (2021): Integration of Artificial Neural Networks for Multi-Source Energy Management in a Smart Grid. *International Journal of Power Electronics and Drive Systems,* 12(3), 1919–1927. Online: https://doi.org/10.11591/ijpeds.v12.i3.pp1919-1927

Javaid, Nadeem – Qasim, Umar – Yahaya, Adamu S. – Alkhammash, Eman H. – Hadjouni, Myriam (2022): Non-Technical Losses Detection Using Autoencoder and Bidirectional Gated Recurrent Unit to Secure Smart Grids. *IEEE Access,* 10, 56863–56875. Online: https://doi.org/10.1109/access.2022.3171229

Jawad, Jasir – Hawari, Alaa H. – Zaidi, Syed J. (2021): Artificial Neural Network Modeling of Wastewater Treatment and Desalination Using Membrane Processes: A Review. *Chemical Engineering Journal,* 419, 129540. Online: https://doi.org/10.1016/j.cej.2021.129540

Jena, M. – Dehuri, S. (2020): An Experimental Study on Decision Tree Classifier Using Discrete and Continuous Data. In Mallick, P. – Balas, V. – Bhoi, A. – Chae, GS. (eds.): *Cognitive Informatics and Soft Computing.* Advances in Intelligent Systems and Computing, vol 1040. Singapore: Springer. Online: https://doi.org/10.1007/978-981-15-1451-7_35

Kariminia, Shahab – Shamshirband, Shahaboddin – Motamedi, Shervin – Hashim, Roslan – Roy, Chandrabhushan (2016): A Systematic Extreme Learning Machine Approach to Analyze Visitors' Thermal Comfort at a Public Urban Space. *Renewable and Sustainable Energy Reviews,* 58, 751–760. Online: https://doi.org/10.1016/j.rser.2015.12.321

Kwak, Moon K. – Heo, Seok (2007): Active Vibration Control of Smart Grid Structure by Multi-input and Multioutput Positive Position Feedback Controller. *Journal of Sound and Vibration,* 304(1–2), 230–245. Online: https://doi.org/10.1016/j.jsv.2007.02.021

Li, B. – Delpha, C. – Diallo, D. – Migan-Dubois, A. (2021): Application of Artificial Neural Networks to Photovoltaic Fault Detection and Diagnosis: A Review. *Renewable and Sustainable Energy Reviews,* 138, 110512. Online: https://doi.org/10.1016/j.rser.2020.110512

Li, Huifang – Li, Yidong – Dong, Hairong (2017): A Comprehensive Learning-Based Model for Power Load Forecasting in Smart Grid. *Computing and Informatics,* 36(2), 470–492. Online: https://doi.org/10.4149/cai_2017_2_470

Li, Xiaonuo – Yi, Shiyi – Cundy, Andrew B. – Chen, Weiping (2022): Sustainable Decision-Making for Contaminated Site Risk Management: A Decision Tree Model Using Machine Learning Algorithms. *Journal of Cleaner Production,* 371, 133612. Online: https://doi.org/10.1016/j.jclepro.2022.133612

Li, Yuancheng – Qiu, Rixuan – Jing, Sitong (2018): Intrusion Detection System using Online Sequence Extreme Learning Machine (OSELM) in Advanced Metering Infrastructure of Smart Grid. *PLoS ONE,* 13(2), e0192216. Online: https://doi.org/10.1371/journal.pone.0192216

Lin, Rongheng – Pei, Zixiang – Ye, Zezhou – Wu, Budan – Yang, Geng (2020): A Voted Based Random Forests Algorithm for Smart Grid Distribution Network Faults

Prediction. *Enterprise Information Systems,* 14(4), 496–514. Online: https://doi.org/10.1080/17517575.2019.1600724

Liu, Fen – Yu, Zheng – Wang, Yixi – Feng, Hao – Zha, Zhiyong – Liao, Rongtao – Zhang, Ying (2020): Falsified Data Filtering Method for Smart Grid Wireless Communication Based on SVM. *International Journal of Internet Protocol Technology,* 13(4), 177–183. Online: https://doi.org/10.1504/ijipt.2020.10028657

Liu, Tian – Shu, Tao (2021): On the Security of ANN-Based AC State Estimation in Smart Grid. *Computers and Security,* 105, 102265. Online: https://doi.org/10.1016/j.cose.2021.102265

Liu, Xinchun (2021): Empirical Analysis of Financial Statement Fraud of Listed Companies Based on Logistic Regression and Random Forest Algorithm. *Journal of Mathematics,* 2021(Special Issue). Online: https://doi.org/10.1155/2021/9241338

Ma, Suliang – Chen, Mingxuan – Wu, Jianwen – Wang, Yuhao – Jia, Bowen – Jiang, Yuan (2019): High-Voltage Circuit Breaker Fault Diagnosis Using a Hybrid Feature Transformation Approach Based on Random Forest and Stacked Autoencoder. *IEEE Transactions on Industrial Electronics,* 66(12), 9777–9788. Online: https://doi.org/10.1109/tie.2018.2879308

Manoharan, Hariprasath – Teekaraman, Yuvaraja – Kirpichnikova, Irina – Kuppusamy, Ramya – Nikolovski, Srete – Baghaee, Hamid R. (2020): Smart Grid Monitoring by Wireless Sensors Using Binary Logistic Regression. *Energies,* 13(15), 3974. Online: https://doi.org/10.3390/en13153974

Mei, ShengWei – Chen, LaiJun (2013): Recent Advances on Smart Grid Technology and Renewable Energy Integration. *Science China Technological Sciences,* 56(12), 3040–3048. Online: https://doi.org/10.1007/s11431-013-5414-z

Mishra, Manohar – Nayak, Janmenjoy – Naik, Bignaraj – Patnaik, Bhaskar (2022): Enhanced Memetic Algorithm-Based Extreme Learning Machine Model for Smart Grid Stability Prediction. International Transactions on Electrical Energy Systems, 2022. Online: https://doi.org/10.1155/2022/8038753

Moldovan, Dorin (2021): Improved Kangaroo Mob Optimization and Logistic Regression for Smart Grid Stability Classification. In Silhavy, R. (ed.): *Artificial Intelligence in Intelligent Systems.* CSOC 2021. Lecture Notes in Networks and Systems, vol 229. Cham: Springer, 469–487. Online: https://doi.org/10.1007/978-3-030-77445-5_44

Mukherjee, Amartya – Mukherjee, Prateeti – Dey, Nilanjan – De, Debashis – Panigrahi, B. K. (2020): Lightweight Sustainable Intelligent Load Forecasting Platform for Smart Grid Applications. *Sustainable Computing: Informatics and Systems,* 25, 100356. Online: https://doi.org/10.1016/j.suscom.2019.100356

Mohanty, D. K. – Parida, Ajaya K. – Khuntia, Shelly S. (2021): Financial Market Prediction under Deep Learning Framework using Auto Encoder and Kernel Extreme Learning Machine. *Applied Soft Computing,* 99, 106898. Online: https://doi.org/10.1016/j.asoc.2020.106898

Nayak, Janmenjoy – Vakula, Kanithi – Dinesh, Paidi – Naik, Bighnaraj – Pelusi, Danilo (2020): Intelligent Food Processing: Journey from Artificial Neural Network to Deep Learning. *Computer Science Review,* 38, 100297. Online: https://doi.org/10.1016/j.cosrev.2020.100297

Naz, Aqdas – Javed, Muhammad U. – Javaid, Nadeem – Saba, Tanzila – Alhussein, Musaed – Aurangzeb, Khursheed (2019): Short-Term Electric Load and Price Forecasting Using Enhanced Extreme Learning Machine Optimization in Smart Grids. *Energies,* 12(5), 866. Online: https://doi.org/10.3390/en12050866

Niazi, K. R. – Arora, C. M. – Surana, S. L. (1999): Transient Security Evaluation of Power Systems Using Decision Tree Method. *Journal-Institution of Engineers India Part El Electrical Engineering Division,* 76–79.

Omitaomu, Olufemi A. – Niu, Haoran (2021): Artificial Intelligence Techniques in Smart Grid: A Survey. *Smart Cities,* 4(2), 548–568. Online: https://doi.org/10.3390/smartcities4020029

Radoglou-Grammatikis, Panagiotis I. – Sarigiannidis, Panagiotis G. (2019): An Anomaly-Based Intrusion Detection System for the Smart Grid Based on CART Decision Tree. *2018 Global Information Infrastructure and Networking Symposium* (GIIS), Thessaloniki, Greece, 1–5. Online: https://doi.org/10.1109/giis.2018.8635743

Ranganathan, Raghuram – Qiu, Robert – Hu, Zhen – Hou, Shujie – Pazos-Revilla, Marbin – Zheng, Gang – Zhe, Chen – Guo, Nan (2011): Cognitive Radio for Smart Grid: Theory, Algorithms, and Security. *International Journal of Digital Multimedia Broadcasting,* 2011. Online: https://doi.org/10.1155/2011/502087

Rangel-Martinez, Daniel – Nigam, K. D. – Ricardez-Sandoval, Luis A. (2021): Machine Learning on Sustainable Energy: A Review and Outlook on Renewable Energy Systems, Catalysis, Smart Grid and Energy Storage. *Chemical Engineering Research and Design,* 174, 414–441. Online: https://doi.org/10.1016/j.cherd.2021.08.013

Raza, Muhammad Q. – Khosravi, Abbas (2015): A Review on Artificial Intelligence-based Load Demand Forecasting Techniques for Smart Grid and Buildings. *Renewable and Sustainable Energy Reviews,* 50, 1352–1372. Online: https://doi.org/10.1016/j.rser.2015.04.065

Roger, Coleen – Lasbleiz, Adèle – Guye, Maxime – Dutour, Anne – Gaborit, Bénédicte – Ranjeva, Jean-Philippe (2022): The Role of the Human Hypothalamus in Food Intake Networks: An MRI Perspective. *Frontiers in Nutrition,* 8, 1191. Online: https://doi.org/10.3389/fnut.2021.760914

Singh, V.K. – Govindarasu, M. (2021): Cyber Kill Chain-Based Hybrid Intrusion Detection System for Smart Grid. In Haes Alhelou, H. – Abdelaziz, A. Y. – Siano, P. (eds.): *Wide Area Power Systems Stability, Protection, and Security.* Cham: Springer. Online: https://doi.org/10.1007/978-3-030-54275-7_22

Steer, Kent C. B. – Wirth, Andrew – Halgamuge, Saman K. (2012): Decision Tree Ensembles for Online Operation of Large Smart Grids. *Energy Conversion and Management,* 59, 9–18. Online: https://doi.org/10.1016/j.enconman.2012.01.010

Sun, Li-Yan – Miao, Cheng-lin – Yang, Li (2018): Ecological Environmental Early-Warning Model for Strategic Emerging Industries in China Based on Logistic Regression. *Ecological Indicators,* 84, 748–752. Online: https://doi.org/10.1016/j.ecolind.2017.09.036

Taghavinejad, Seyedeh M. – Taghavinejad, Mehran – Shahmiri, Lida – Zavvar, M. – Zavvar, Mohammad H. (2020): Intrusion Detection in IoT-Based Smart Grid Using Hybrid Decision Tree. *2020 6th International Conference on Web Research* (ICWR), Tehran, Iran. 152–156. Online: https://doi.org/10.1109/ICWR49608.2020.9122320

Tahir, Aroosa – Khan, Zahoor A. – Javaid, Nadeem – Hussain, Zeeshan – Rasool, Aimen – Aimal, Syeda (2019): Load and Price Forecasting Based on Enhanced Logistic Regression in Smart Grid. In Barolli, L. – Xhafa, F. – Khan, Z. – Odhabi, H. (eds.): *Advances in Internet, Data and Web Technologies. EIDWT 2019.* Cham: Springer, 221–233. Online: https://doi.org/10.1007/978-3-030-12839-5_21

Teekaraman, Yuvaraja – Kirpichnikova, Irina – Manoharan, Hariprasath – Kuppusamy, Ramya – Angadi, Ravi V. – Thelkar, Amruth R. (2022): Diminution of Smart Grid with Renewable Sources Using Support Vector Machines for Identification of Regression Losses in Large-Scale Systems. *Wireless Communications and Mobile Computing,* 6942029. Online: https://doi.org/10.1155/2022/6942029

Tehrani, Soroush O. – Moghaddam, Mohammad H. Y. – Asadi, Mohsen (2020): Decision Tree based Electricity Theft Detection in Smart Grid. *Proceedings of the 4th International Conference on Smart Cities, Internet of Things and Applications* (SCIoT), Mashad, Iran, 46–51. Online: https://doi.org/10.1109/SCIOT50840.2020.9250194

Tomar, Divya – Agarwal, Sonali (2015): Twin Support Vector Machine: A Review from 2007 to 2014. *Egyptian Informatics Journal,* 16(1), 55–69. Online: https://doi.org/10.1016/j.eij.2014.12.003

Turanzas, J. – Alonso, M. – Amaris, H. – Gutierrez, J. – Pastrana, S. (2022): A Nested Decision Tree for Event Detection in Smart Grids. *Renewable Energy and Power Quality Journal,* 20, 353–358. Online: https://doi.org/10.24084/repqj20.308

Tyralis, Hristos – Papacharalampous, Georgia – Langousis, Andreas (2019): A Brief Review of Random Forests for Water Scientists and Practitioners and Their Recent History in Water Resources. *Water,* 11(5), 910. Online: https://doi.org/10.3390/w11050910

Venkatasubramaniam, Ashwini – Wolfson, Julian – Mitchell, Nathan – Barnes, Timothy – JaKa, Meghan – French, Simone (2017): Decision Trees in Epidemiological Research. *Emerging Themes in Epidemiology,* 14(11), 1–12. Online: https://doi.org/10.1186/s12982-017-0064-4

Wang, N. – Tian, J.-Y. – Dong, N. – Han, M. – Chen, Y. (2022): Real-Time Risk-Assessment and Early-Warning Technology of Smart Grid Regulation System Based on Improved SVM. *Journal of Shenyang University of Technology,* 44(1), 7–13. Online: https://xb.sut.edu.cn/EN/10.7688/j.issn.1000-1646.2022.01.02

Wang, Yuanni – Kong, Tao (2019): Air Quality Predictive Modeling Based on an Improved Decision Tree in a Weather-Smart Grid. *IEEE Access,* 7, 8917641. 172892–172901. Online: https://doi.org/10.1109/access.2019.2956599
Xu, Chongchong – Liao, Zhicheng – Li, Chaojie – Zhou, Xiaojun – Xie, Renyou (2022): Review on Interpretable Machine Learning in Smart Grid. *Energies,* 15(12), 4427. Online: https://doi.org/10.3390/en15124427
Xu, Nuo – Deng, Fan – Liu, Bingqi – Li, Caixia – Fu, Hancong – Yang, Huan – Zhang, Jiahua (2021): Changes in the Urban Surface Thermal Environment of a Chinese Coastal City Revealed by Downscaling MODIS LST with Random Forest Algorithm. *Journal of Meteorological Research,* 35(5), 759–774. Online: https://doi.org/10.1007/s13351-021-0023-4
Xue, Dongbo – Jing, Xiaorong – Liu, Hongqing (2019): Detection of False Data Injection Attacks in Smart Grid Utilizing ELM-based OCON Framework. *IEEE Access,* 7, 31762–31773. Online: https://doi.org/10.1109/access.2019.2902910
Yang, Liqun – Li, Yuancheng – Li, Zhoujun (2017): Improved-ELM Method for Detecting False Data Attack in Smart Grid. *International Journal of Electrical Power and Energy Systems,* 91, 183–191. Online: https://doi.org/10.1016/j.ijepes.2017.03.011
Yaseen, Zaher M. – Sulaiman, Sadeq O. – Deo, Ravinesh C. – Chau, Kwok-Wing (2019): An Enhanced Extreme Learning Machine Model for River Flow Forecasting: State-of-the-art, Practical Applications in Water Resource Engineering Area and Future Research Direction. *Journal of Hydrology,* 569, 387–408. Online: https://doi.org/10.1016/j.jhydrol.2018.11.069
Zain, Azlan M. – Haron, Habibollah – Qasem, Sultan N. – Sharif, Safian (2012): Regression and ANN Models for Estimating Minimum Value of Machining Performance. *Applied Mathematical Modelling,* 36(4), 1477–1492. Online: https://doi.org/10.1016/j.apm.2011.09.035
Zekić-Sušac, M., Has, A., & Knežević, M. (2021): Predicting energy cost of public buildings by artificial neural networks, CART, and random forest. Neurocomputing, 439, 223-233. https://doi.org/10.1016/j.neucom.2020.01.124
Zhang, Ke – Hu, Zhi – Zhan, Yufei – Wang, Xiaofen – Guo, Keyi (2020): A Smart Grid AMI Intrusion Detection Strategy Based on Extreme Learning Machine. *Energies,* 13(18), 4907. Online: https://doi.org/10.3390/en13184907
Zhang, Yanyu – Zeng, Peng – Zang, Chuanzhi (2014): Review of Home Energy Management System in Smart Grid. *Power System Protection and Control,* 42(18), 144–154.
Zheng, Xiulin – Li, Peipei – Wu, Xindong (2022): Data Stream Classification Based on Extreme Learning Machine: A Review. *Big Data Research,* 30, 100356. Online: https://doi.org/10.1016/j.bdr.2022.1003566
Zheng, Yingying – Celik, Berk – Suryanarayanan, Siddharth – Maciejewski, Anthony A. – Siegel, Howard J. – Hansen, Timothy M. (2021): An Aggregator-Based Resource Allocation in the Smart Grid using an Artificial Neural Network and Sliding

Time Window Optimization. *IET Smart Grid,* 4(6), 612–622. Online: https://doi.org/10.1049/stg2.12042

Zidi, Salah – Mihoub, Alaeddin– Mian Qaisar, Saeed – Krichen, Moez – Abu Al-Haija, Qasem (2022): Theft Detection Dataset for Benchmarking and Machine Learning Based Classification in a Smart Grid Environment. *Journal of King Saud University – Computer and Information Sciences,* 35(1), 13–25. Online: https://doi.org/10.1016/j.jksuci.2022.05.007

Zubia, I. – Arrambide, I. – Azurza, O. – García, P. M. – Ugartemendia, J. J. (2013): Rural Smart Grids: Planning, Operation and Control Review. *Renewable Energy and Power Quality Journal,* 1(11), 1099–1104. Online: https://doi.org/10.24084/repqj11.544

Rituraj Rituraj is a PhD candidate at the Óbuda University Doctoral School of Applied Informatics and Applied Mathematics. His research focuses on the applications of AI in smart grids. He proposed methodologies and surveys to improve predictive maintenance, load forecasting, and renewable energy integration in smart grids, which were published in various IEEE venues.

Dániel T. Várkonyi is employed as a Research Assistant Fellow at the Eötvös Loránd University (ELTE), Department of Data Science and Engineering. He has an MSC Degree in Computer Science at ELTE, and a specialised degree in economics at the University of Szeged. His industrial work experience for more than 12 years is connected to BI, Data science and database management in the banking, ICT and heavy industry sector. He changed to the academic in 2019, and is working as a researcher. He is specialised in Datamining on audio signal, in the field of precision livestock farming (PLF). As a university researcher, he is involved in many research projects addressed to audio research, PFL and IoT, and has an interest in biomedical engineering. His research activity and publications are connected to the fields of industry and PLF.

Amir Mosavi is a Research Fellow at the Ludovika University of Public Service Institute of the Information Society. His research interests include applied artificial intelligence. He was an Alexander von Humboldt fellow and the recipient of the Marie Skłodowska-Curie and the European Research Consortium for Informatics and Mathematics fellowships.

József Pap is a PhD candidate at the Széchenyi István University, Győr, Hungary and Head of Supply Chain Excellence & Process Management at Nokia Solutions and Network/Cloud Network Solutions. His research interest is the future of work in the new hybrid reality, from the perspective of organising, managing and enhancing work

by the outcomes of the digital revolution. His latest major project is 'Democracy at Work Through Transparent and Inclusive Algorithmic Management' (INCODING, EU, 2021–2024).

Annamária R. Várkonyi-Kóczy, PhD, DSc, Fellow of the IEEE, Elected member of the Hungarian Academy of Engineers, Vice President of the Hungarian Doctoral Council, formal Vice President of the Hungarian Fuzzy Association. Professor of the Institute of Software Design and Software Development at Óbuda University, Hungary. Since 2013, she is also a full professor of the Department of Informatics at Selye János University, Slovakia. Her research interests include digital image and signal processing, uncertainty handling, machine intelligence and intelligent computing. She is author/contributor of 50 books, 79 journal papers, and more than 260 conference papers. She was founding chair of the IEEE-WISP and IEEE-SOFA symposium series, general chair of Interacademia'2004, 2008, 2012, and 2019, IEEE MeMeA'2012, IEEE CIVEMSA'2016, IPC chair of SAMI'2004, SAMI'2005, SAMI'2006, IEEE-ICCA'2005, ICONS'2008, I2MTC'2010 and 2012, and MeMeA'2021.

Csaba Makó is a Professor at the Ludovika University of Public Service Institute of Information Society. His research interest is international comparative analysis of the social – economic institutions/regulations of the game-changing technological (digitisation, smart automatisation, artificial intelligence and algorithmic management) and organisational innovations. His special focus is related to quality of work, skills formation and employment status. His latest major project is 'Democracy at Work Through Transparent and Inclusive Algorithmic Management' (INCODING, EU, 2021–2024).

PRO PUBLICO BONO – Public Administration, 2024/1, 85–99. • DOI: 10.32575/ppb.2024.1.4

Tamás Fézer

UPSIDE DOWN: LIABILITY, RISK ALLOCATION AND ARTIFICIAL INTELLIGENCE

Tamás Fézer, Professor of Law, University of Debrecen Faculty of Law, fezer.tamas@law.unideb.hu

The dynamic evolution of artificial intelligence (AI) and machine learning (ML) tools poses challenges to the existing liability concepts. This paper aims to examine some of the fields of tortious liability that are most affected by these developments to analyse whether the existing legal standards in civil liability can still be used, with slight reinterpretation, when approaching liability scenarios related to AI and ML, and whether fine tuning of the existing liability regimes is needed, or novel liability scenarios should be established. To answer this question, the paper begins by examining the nature of the regulation of AI and ML: whether it should be a regulatory regime neutral to technology or whether, instead, a sector specific approach is essential. The study considers the already existing legal authorities of the EU and the U.S. as starting points for the analysis, and briefly examines the interpretations municipal courts apply when deciding in AI and ML related tort cases.

Keywords:
data protection, machine learning, privacy law, product liability, tort law

Liability is a central element of any legal system. Liability is the legal consequence of breaching norms and it also indicates the attitude of the lawmaker and the judiciary toward expected social behaviours. In civil law legal systems, the internal structure of liability reflects the dichotomy of the legal system, and is thus divided into two important categories that often overlap with each other or, in certain cases, complement each other: liability for breach of contract and liability for breaching non-contractual obligations. The former body of civil liability is less driven by social standards as it is concerned with ensuring the enforceability of contractual promises, and therefore bolsters the ancient contractual principle of *pacta sunt servanda*. The latter category of civil liability, liability for breaching non-contractual obligations, has more of an influence on policy, and may also effectively establish behavioural standards in a society. In common law, liability for breach of non-contractual liability is known as tortious liability and, lacking the dichotomy of civil law

legal systems, it focuses more on the compensation angle of liability.[1] Irrespective of the form of legal system in an analysis of civil liability, a battle of principles can be identified through the maze of tortious liability. In the search for the functions of tortious liability, several theories compete with each other and, depending on the type of tortious liability and on the circumstances of a given case, these theories may supplement each other, or they may collide. Prevention, compensation, punishment, education, and satisfaction can all be traced back to the application of the rules on tortious liability. At the same time, in civil law legal systems, lawmakers must keep in mind the need for abstract legal provisions when determining the path of liability law. This apparent chaos must all be harmonised by judges when abstract norms are applied to real life scenarios. Unsurprisingly, the borders between civil law and common law become somewhat blurred when one examines tortious liability, as in both systems, judges use civil liability as the starting point for policy-making.[2]

As technology has evolved, it has become clear how powerful judicial decisions can be when judges are called upon to adapt existing legal principles or doctrines to a new social phenomenon. In the 19th century, across Europe, the courts were the first to regulate the use of steam engines and their massive potential for damage. Strict liability forms and virtually all special types of tortious liability were first developed by judicial practice that eventually forced the lawmaker to respond to the developments in the society. By the mid-20th century, civil liability underwent a decline in maintaining its original nature of being a negative legal consequence that responds to breaches of legal norms and legal duties.[3] Courts recognised that the dynamically developing technologies of that era and the consequent rapid changes this development induced in society required a new approach that is less focused on responding to a breach of duty, instead shifting into a concept of risk allocation. This change in the attitude of the courts and later of lawmakers in many countries across Europe also stemmed from the growing importance and use of the insurance sector that was practically pushing individuals and businesses toward an economy-driven concept of prevention: if maintaining an insurance policy is reasonably cheaper than bearing the expenses of covering loss for the injured parties of a potential damaging event, insurance can become a type of preventive tactic that ultimately takes the insured as someone who has accepted that the risk is in his control.[4] Lawmakers also realised the potential of linking tortious liability scenarios to the concept of insurance, and started to introduce more and more obligations for persons who conduct a potentially harmful activity to take out an insurance contract. In some European countries (e.g. Sweden, Finland), by the end of the 20th century, the legal system had experienced an almost complete decline in tortious liability, which was supplanted by the risk allocation theory.[5] The society, including private individuals and businesses, soon learned the lawmaker's approach to novel technologies

1 Benli–Şenel 2020: 297.
2 Cyman et al. 2021: 93.
3 Martin-Casals 2010: 16.
4 Robinson 2022: 341.
5 Miklič 2021: 71.

and new activities through the altered approach to liability standards. A new equilibrium was established that promised to last for a long time. The 21st century, however, brought new challenges, and was accompanied by perhaps the most rapid development of technologies that humankind has ever seen. The use of artificial intelligence (AI) and machine learning (ML) systems, on the other hand, also started to erode tortious liability from another angle, as these technologies have raised questions over the concept of who should bear liability and, ultimately, who should be held liable to cover the loss of the injured party. While the decline of civil liability in the 20th century was induced mainly by the need to reinterpret some of the details of the classical model of liability, the advent of artificial intelligence and machine learning has initiated a full-scale assault on virtually all aspects of liability, throwing into question the identification of the wrongdoer, the need for liability standards (fault), the potential defences available to the tortfeasor, and the scope of liability.[6] The approaches of risk allocation and insurance may not function as efficiently as they did earlier when responding to the new challenges this century has brought. Moreover, AI and ML are growing so rapidly that not only the lawmaker but the courts are evidently lagging far behind the evolution of modern technologies. Policy-making first requires the identification of the phenomenon the law is expected to react to, then it also is expected to map the morality of the majority of the society to ultimately establish provisions or doctrines that can be considered to meet social standards. None of this is available for the lawmaker and for the judiciary due to the rapidness of technological development and also due to the increasingly divided nature of societies across the globe. Without sufficient time lacking an ethical consensus, lawmakers and judges must rely on concepts that already exist in the legal systems and are called upon to ask questions that address the very core of their legal systems. Is there a need for a change in the current tortious liability scenarios to respond to the challenges emerging from AI and ML? Should we still use the existing norms, principles and doctrines, but with slight reinterpretations? Is it reasonable to retain the idea of abstract legislation and abstract policy-making in tort law when responding to the development of new technologies? Would a sectoral or a horizontal approach serve the needs of the society best? Can legal systems think globally and take into account the responses of other countries when deciding what attitude to adopt toward the use of AI and ML? Can the civil law dichotomy of private law and public law survive the rapid evolution of technologies, or should civil law merge the two branches of the law to respond to the new phenomenon? While these questions may sound philosophical, answering them is essential to move forward and to define the role of tortious liability in the new environment. This study attempts to respond to these questions by offering views on how tortious liability can adapt to challenges that have arisen from the application of AI and ML. As the subject of the study is complex and is in constant motion, a mixed methodology is followed throughout the paper that merges black letter methods and an analysis of the law in action. The former focuses on the analysis of existing norms, doctrines and theories

[6] Benli–Şenel 2020: 314.

that may derive from old concepts of tortious liability, while the latter deliberately selects court decisions from various legal systems, on the assumption that the topic is universal enough to seek solutions that are less focused on individual jurisdictions. The general presumption is that the challenges described above are global challenges, and hence, before adopting actual norms or communicating behavioural standards through individual court decisions, legal systems must recognise the globality and the complexity of the task, and look for fundamental theories that can serve as starting points for law- or policy-making. To support this ambitious enterprise, the black letter approach to legal analysis will be understood in a broader sense, embracing not only the letter of the law (i.e. binding legal documents) but also action plans and white papers of both governments and international governmental organisations that call for action and may contain ideas for finding a solution. As taking a cross-jurisdiction approach runs a clear risk of becoming chaotic, the paper will focus on the fundamental theories and doctrines of the law of liability rather than criticising or proposing specific texts or drafts for future legislation. For the sake of clarity, some legal terms are simplified, and in the attempt to find a global response, the terminology of English law is used to cover liability for breach of non-contractual obligations. Therefore, tort law and tortious liability are used to describe this category of civil liability irrespective of the fact that civil law and common law legal systems take a slightly different approach to this form of liability. The emphasis is on the distinction between tortious liability and the other branch of civil liability, contractual liability: a form of liability which this study has no intention of analysing, as the latter has been less affected by the development of new technologies.

PROPOSALS, POLICY DOCUMENTS AND GUIDELINES ON AI AND ML SYSTEMS AND APPLICATIONS IN THE EUROPEAN UNION AND IN THE UNITED STATES

Artificial intelligence and machine learning are dynamically developing technologies that have already led to a significant transformation, with further change expected, in several sectors, including finance, transportation, tourism, and healthcare. While these technologies have the potential to improve people's lives, they also raise significant legal and ethical questions due to their adaptability and continuously changing knowledge. The latter is especially disturbing, given the fact that human interaction is the most important source of knowledge for AI and ML applications and it provides the basis for their evolution. To some extent, these technologies may behave like humans. In the past, by contrast, most smart applications were only able to make people's lives easier by simplifying tasks which human beings had previously performed or by facilitating the organisation of these tasks. These now old-fashioned applications were all based on algorithms, which made them predictable and easy to understand. AI and ML tools, however, use human interaction and their own "experiences" to learn and improve, and therefore, in many instances, it is we, human beings, who provide the algorithm to allow their operation and functioning.

Recently, the European Union has taken steps to address the legal and ethical challenges and implications of AI- and ML-operated technologies. These steps have included making legislative proposals and producing several policy documents that envisage a new approach to these modern technologies. While none of these measures can be considered to have constituted a coherent and consistent approach that clearly shows how the European Union will approach AI and ML, the various considerations and the challenges identified in the policy documents certainly indicate some potential directions for the future that may form the basis of future legislation at the EU level.

In April 2021, the European Commission published a proposal for a regulation on AI that intends to introduce a harmonised base legal framework for AI related technologies in the 27 Member States of the Union.[7] The proposal recommends establishing different levels of risk for AI systems and sets out specific requirements for each level. The classification is based on a kind of risk assessment, whereby high-risk AI systems, such as those used in healthcare or in the transportation sector, would be subject to stricter requirements than technologies otherwise applied in these sectors, such as obligatory human oversight and proper testing. The latter may be a crucial point for future considerations in liability law as the thorough testing requirement alone suggests that the European Commission does not prioritise concepts which would entrust AI technologies with personhood; instead, tortious liability would be based on the already existing legal schemes which, in all cases, identify an existing person, natural or legal, through either factual or risk allocations considerations, as being liable for the loss and harm AI technologies could potentially cause to third parties. The proposal also includes provisions on transparency, data protection, and liability. The proposed regulation has been subject to debate and criticism, however. Some stakeholders argue that the proposal is too restrictive and may stifle innovation in the EU that could be hugely disadvantageous in the world market for the EU. This fear is certainly legitimate, as a "wait and see" mentality can be observed in other parts of the world. In practice, most governments are waiting to see how the other states react to modern technologies and awaiting the outcome of these reactions.[8] Other critics of the proposed regulation have argued that it does not go far enough in addressing all the major risks AI tools may pose. These commentators also highlight the lack of a clear legal framework on tortious liability.

Beyond the proposed regulation of the European Commission, several other policy documents have also been developed by the EU that address some of the legal and ethical implications of AI and ML. The European Strategy for Data,[9] which was published in February 2020, is probably the most noteworthy of these attempts. This strategy aims to create a single market for data in the EU, while also ensuring that data is used in a way that respects privacy, security, and other fundamental rights. While the strategy exclusively focuses on protecting the privacy of people using AI and ML tools, it continues to emphasise the importance of data protection as a key element of an individual's privacy in the EU.

7 European Commission 2021.
8 Heiss 2021: 207.
9 European Commission 2020a.

The General Data Protection Regulation (hereinafter: GDPR) of the EU[10] was intentionally formulated to be neutral to technology, to allow the GDPR to provide for the rights of data subjects in a uniform way, irrespective of what technology was used to control and process the personal data of individuals, and in which sector. As part of the data strategy, on 23 February 2022, the European Commission proposed a Regulation on harmonised rules on fair access to and use of data (hereinafter: Data Act).[11] This proposal completed the harmonisation of data laws in the digital era that had started with the Data Governance Regulation the Commission proposed in November 2020.[12] This regulation established processes and structures to facilitate data, while the Data Act determines who can create value from data and under what conditions. The Data Act includes provisions dedicated to the use of data generated by "Internet of Things" (IoT) devices. The Commission, through the Data Act, proposes that data generated by IoT should be under the full control of the user rather than the manufacturers of the IoT devices. While the Data Act does not specifically address AI and ML tools and the challenges they pose to data protection laws, it indicates that the European Union, in all forms of digital applications and tools, intends to establish safeguards for the users to take full control over their data. This may lead to AI and ML also becoming subject to stricter rules, as the Commission intended, and may entail the imposition of serious data protection obligations on developers.[13]

Another important policy document in the European Union is the Ethics Guidelines for Trustworthy AI, which was developed by the European Commission's High-Level Expert Group on AI.[14] The document was published on 8 April 2019. The guidelines lay down a set of principles for the development and deployment of AI systems, calling for transparency, accountability, and respect for privacy and human rights. In connection with the accountability principle, the guidelines recommend that mechanisms be put in place to ensure the responsibility and accountability of AI tools and systems and of the outcomes the operation of such systems generate. Auditability is a requirement which the Guidelines set to enable the assessment of algorithms, data and design processes. Details of the steps the manufacturer or developer take to ensure auditability should also be made available to the user as part of the transparency principle. Another consequence of auditability is that accessible and efficient redress mechanisms should also be ensured for cases where users face negative consequences when interacting with AI systems.

The development and deployment of AI and ML have had significant legal and ethical implications, and the EU has developed some initiatives that reveal a great deal about how the European Union intends to address these issues. Legislative proposals such as the proposed regulation on AI and policy documents such as the Ethics Guidelines for Trustworthy AI provide a framework for the responsible development and deployment of

10 Regulation (EU) 2016/679, 1.
11 European Commission 2022.
12 European Commission 2020b.
13 Mireille 2020: 75.
14 European Commission's High-Level Expert Group on Artificial Intelligence 2019.

AI systems in Europe. However, significant challenges remain, particularly with regard to bias, privacy, and liability despite the fact that almost all policy documents identify these risks. It is obvious, however, that these policy documents and even the proposed AI regulation in the EU are currently only at the level of establishing principles and making declarations that do not reach the core of the problem: the broader questions of (tortious) liability. While the proposed AI regulation, following a categorisation and risk assessment of the AI system, imposes a strict, no-fault liability on the service providers (developers) for any harm the high-risk AI system may cause to users, it remains a question whether this would constitute a new form of tortious liability or whether it can be cited as an example of the already existing strict liability scenarios in the Member States such as product liability or liability for highly dangerous activities. Another area of concern is how high-risk AI systems can be identified and whether the relatively loose criteria on classification and risk assessment for these systems will lead to incoherent interpretation by the national courts across the EU.[15] This would certainly undermine the attempts at harmonisation and at establishing a uniform approach across the EU. Given the fact that tort liability is not harmonised in the Member States, as the basis of liability is still within the competence of the individual national legislations, a mere declaration of strict liability may still lead to different applications in practice due to the diverse approaches to the burden of proof, the available defences for the wrongdoer, the statute of limitations and other factors that may be relevant in the enforcement of claims arising from liability.

An interesting aspect of the proposed AI regulation of the EU is that providers of high-risk AI systems would be required to maintain mandatory liability insurance or provide some other form of financial guarantee (deposit) that would be able to cover the potential damages the developers are obliged to pay for loss or harm caused by their high-risk AI systems. This is a remarkable idea, as the mandatory insurance obligation shows signs that public administration law and tort law are interacting in this area. To enforce the insurance obligation or other forms of a financial guarantee, a licensing requirement would most likely have to also be attached to the legal framework, which suggests a preset classification of what constitute high-risk AI systems. While this is a promising idea, the classification rules for high-risk AI systems, as proposed in Article 6 of the draft AI regulation, are still loose and flexible, and thus it remains uncertain who would implement these rules, and how, in the national legal framework.

The Ethics Guidelines for Trustworthy AI also addresses the issue of liability. The guidelines state that the developers and operators of AI systems should be held accountable for the behaviour of their systems, and that they should be able to demonstrate that they have taken steps to prevent harm or damage. The guidelines also states that in cases where harm or damage does occur, the developers and operators of the system should take steps to mitigate the harm and prevent similar incidents from occurring in the future. These requirements also assume the existence of some kind of oversight

[15] Cyman 2021: 103.

mechanism in the Member States, and that follow-up processes after incidents will also be in place to ensure that the already identified faults and malfunctions do not cause loss or harm to people again.

While the present study mainly focuses on the European continent and the basis of tort law in Europe, it is also worth briefly considering the developments in the United States in relation to AI and ML systems. The United States has not yet enacted comprehensive federal legislation addressing the liability issues related to AI and machine learning, although there have been proposals and discussions on the topic, similarly to the efforts in the European Union. Currently, the legal framework in the U.S. is largely shaped by common law principles of tortious liability that allow private individuals and legal entities to claim damages for loss or personal injury caused by another party's negligence or intentional misconduct. This means that if an AI system causes harm or loss, it may be possible for the injured party to lodge a lawsuit against the developers, manufacturers, or operators of the AI system based on classic tort law principles.[16] However, because AI and machine learning are still relatively new technologies, some uncertainty remains around how existing legal frameworks will apply to these systems. In addition, there is an ongoing debate about how liability should be assigned in cases where an AI system causes loss or damage, particularly in cases where the system has some degree of autonomy.[17] Some legal scholars and industry experts have already called for the adoption of clear guidelines and legal frameworks for assigning liability in cases involving AI and ML technologies in order to provide clarity for both developers and the users of such systems. Another idea that has been floated is that the existing legal frameworks should be sufficient and that common law courts must be able to apply the classic legal principles to novel cases involving AI and ML systems and the incidents they cause. In the absence of comprehensive federal legislation, states across the U.S. have begun to adopt their own laws related to AI and ML. These initiatives also embrace laws related to data privacy and security.

California is an example of a U.S. state that has passed legislation related to AI and ML, focusing mainly on the data privacy and security angles. In 2018, California adopted the California Consumer Privacy Act (CCPA),[18] which grants Californian residents the right to know what personal information businesses collect about them. The CCPA also ensures Californian citizens the right to request that their personal information be deleted, and the right to opt out of the sale (trade) of their personal information. Under the CCPA, businesses that use AI and ML to make decisions about consumers must disclose this fact and must provide a general description of the underlying logic (algorithm) that is used to make those decisions. Businesses must also ensure that consumers are able to request information about the specific types of personal information that were used to make decisions about them, and that they can correct any errors in that information (right to rectification). The CCPA also requires businesses to implement reasonable security measures to protect the

16 Robinson 2022: 335.
17 Bathaee 2020: 117.
18 California Consumer Privacy Act of 2018 (1798.100 – 1798.199.100).

personal information of consumers, including data that is used in AI and ML tools and applications. Businesses must also disclose the categories of personal information that they collect, as well as the type of third parties with whom they share this information. The CCPA is considered one of the most comprehensive data privacy law in the U.S., and it has proved influential in shaping data privacy legislation in other states.[19] It does not, however, focuses on issues of tortious liability, which suggests that the concept of the applicability of classic tort law principles by the courts is the leading approach in the U.S.

THE APPLICABILITY OF THE EXISTING LEGAL FRAMEWORK ON TORTS TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING SYSTEMS

Since AI and ML emerged as a global problem for tort law, many authors have argued that regulation, legislation or at least a change in policy is urgently needed in the courts. It is, however, crucial to understand that the law has always been shaped by its reaction to challenges, emerging social phenomena and hot new topics. At the same time, delayed reactions or lack of reaction on the part of the lawmaker have never resulted in a total collapse or failure. Tort law and its century old doctrines and principles have always managed to adapt to new circumstances. Bending, reinterpreting or twisting these rules should not be regarded as blasphemy; instead, this is the normal use of tort law that was designed to respond to and to correct civil wrongs through providing for some form of satisfaction or compensation for the injured party. This means the lack of AI- and ML-specific legislation or the lack of clear policies from the lawmaker or from the courts does not mean no law is in place to handle tortious scenarios involving AI and ML. It is even questionable whether the emerging new technologies of AI and ML are groundbreaking enough to warrant the introduction of new legal concepts, doctrines or principles in the world of tort law. We have witnessed the birth of new tort law formations several times in the past (e.g. strict liability during the industrial revolution, vicarious liability in the 19th century), and all those novelties in tort law emerged from judicial practice and were later enshrined in statutes in civil law legal systems.[20] When no specific laws could be applied to what were then new social phenomena, courts could still fashion a response by interpreting the toolkit of tort law that already existed to resolve disputes and communicate an attitude to society on how to approach novel technologies. The application of AI and ML tools, therefore, may not seem to be real gamechangers that must necessarily induce a drastic change in the existing legal framework of tort law.

Importantly for this question, tortious liability relies on concepts about the identification of the tortfeasor, the person who is liable for the unlawful act, unlawfulness, causation theories, various standards of fault and defences available for the wrongdoer. The typically

[19] Robinson 2022: 359.
[20] Martin-Casals 2010: 18.

abstract rules and theories on these elements of tort law were designed to enable judges to shape them and adapt them to various and diverse tort scenarios. Some authors believe that AI and ML tools are gamechangers, as the technology is capable of mimicking the acts of a reasonable human being, therefore, the technology – the "robot" – itself should be given some kind of a personhood to make it accountable and, therefore, liable for its actions.[21] In common law legal systems it is probably much easier for the courts to personalise a machine and furnish it with personhood, given the flexible and somewhat open nature of civil liability law.[22] In civil law legal systems, however, this would lead to a shift of the most important paradigm of liability law: only human beings and their organisations and associations are accountable for their actions and everything else is just a *res* that is not capable of making decisions. While artificial intelligence may seem like a whole new entity, with free will and the capacity to make decisions, in some ways it does not seem very different from some animals that are also equipped with skills and abilities to make decisions and act based on such decisions. In tort law, civil wrongs committed by animals are accounted to a human being of legal entity who is their owner or handler at the time of the commitment of the tortious act. In a similar vein, torts committed by artificial intelligence, in my opinion, should also be accountable to the person in whose interest or under whose control the artificial intelligence acted. I cannot see how artificial intelligence can be considered a legal person without all the attributes that the law requires from legal persons, most importantly assets independent of the legal person's founders, members or shareholders. Although the developer of the technology may not always be the fairest choice to bear liability for the actions or malfunctions of an artificial intelligence, given the somewhat autonomous nature of the machine it created, several other existing theories of tort law may be of help in this. An obvious solution to the problem is the analogous application of the special form of tortious liability: liability for torts resulting from dangerous activities. The definition of such dangerous activities is typically missing from the statutes, and courts consequently also avoid drawing up an exhaustive list of activities that involve an inherent danger, and therefore, they are at a greater risk of causing loss or harm to others while they cannot be fully controlled by either the developer, manufacturer or the operator. In some legal systems, such dangerous activities include both simple human acts such as digging a hole and very sophisticated technologies like using nuclear power, on the grounds that these activities are similar to the nature of a wild animal that may be domesticated, but which never loses its inherently wild nature and, consequently, can snap at any time. In my opinion, artificial intelligence can be compared to such a wild animal that was raised and taught by human beings to be sociable and kind to others, while the autonomous behaviour of the machine and the machine learning features are probably not capable of truly recognising socially good or bad behavioural standards set by various members of the community, and thus always carry a certain risk

[21] Robinson 2022: 348.
[22] See 2021: 417.

of becoming intrusive and offensive and which, ultimately, may lead to a damaging act against others. The application of AI and ML systems, therefore, may be categorised as a dangerous activity in tort law, hence the designation of the person liable for the actions of the machine can be identical to the one in this special form of tortious liability: either the person who conducts the dangerous activity (the person who uses the application) or the person for whom the machine works. The lawmaker, in a given legal system, may even decide that the person charged with liability for the dangerous activity is the one who makes a profit on the operation and use of the machine. Any one of these theories can be justified by the standards and rationale behind the concept of tortious liability for dangerous activities once we accept the inherent danger coded in the application of AI and ML tools. Personhood, therefore, is no longer a relevant consideration and civil law legal systems do not have to create a brand-new concept in the law of persons, absurdly constructing a unique category of legal persons beyond the existing ones.

ARTIFICIAL INTELLIGENCE UNDER THE PRODUCT LIABILITY LAWS OF THE EUROPEAN UNION

Today, AI and ML technologies and tools are increasingly being integrated into various products and services. As a result, product liability laws are one of the focal points for discussions on possible reactions to modern technologies in the European Union. The main focus of a potential amendment and reform to the existing legal framework is currently on autonomous vehicles, medical devices and drones equipped with AI and ML. A proposal for a reform of the EU's Product Liability Directive recommends extending the current product liability laws to also cover AI-enabled products.[23] While the Directive already requires manufacturers to compensate consumers for damages caused by defective products, it provides only a restrictive definition of products and a rather vague definition of defectiveness. The definition of products should not be a problem as the Directive embraces tangible movable property, which can cover devices that contain artificial intelligence technology. While it is obvious that AI systems that are not manifested in physical products remain beyond the scope of the Product Liability Directive, and could be integrated only if services were also embraced by the directive, the European legal culture does not really support this idea.[24] Services are typically provided under contractual frameworks where remedies are offered by contract law rather than tort law. This assumes that services should not be merged under the scope of the product liability directive as only the contractual party would suffer loss or harm, whereas anyone may suffer damage in relation to products. The directive defines a defective product as one that does not provide the safety that a person is entitled to expect, taking all the circumstances into account,

[23] Council Directive 85/374/EEC.

[24] Ebers 2021: 208.

including the presentation of the product, the use to which it could reasonably be expected to be put, and the time when the product was put into circulation. The directive does not specifically address AI-enabled products with complex decision-making capabilities that are difficult to predict or control. It would not, however, seem necessary, in my opinion, to explicitly name AI-enabled products as products in the directive, as products are already within the material scope of the directive, irrespective of their smart features and functionality. The only reason why the explicit mention of AI-enabled products might be beneficial would be to clarify that the conditions for determining defectiveness should have a less flexible interpretation in regard to such products than to others. The autonomous and unpredictable decision-making capabilities of AI-enabled products may be misleading when focusing on the expectations about the safety of the product based on the current conditions set in the directive. It should be obvious that the different levels of autonomy of AI-enabled devices should not be decisive factors when determining their defectiveness.

Another proposal is to create a new liability regime specifically for AI-enabled products. This proposal is based on the recognition that AI-enabled products have unique characteristics that require a different liability framework. For example, AI-enabled products can make decisions autonomously, and in such circumstances, it may be difficult to determine who is responsible when something goes wrong.[25] Under this proposal, manufacturers would be required to ensure that their AI-enabled products meet certain safety standards, and they would be strictly liable for any damages caused by the product's decisions or actions. However, liability could be shifted to other parties if they contributed to the defect or if the product was misused by the consumer. I do not support this proposal, as it does not really add anything to the product liability regime in the EU. The possibility of shifting liability to other parties already exists in the product liability directive, since the concept of joint tortfeasors is already known in the application of the directive. Moreover, the identification of the manufacturer is broad enough to provide some freedom to the courts when determining which party had control over the function that caused the defect of the product.

Another idea would be to oblige manufacturers of AI-enabled products to implement certain safety measures to prevent harm being caused to consumers. Manufacturers could be required to implement algorithms that prevent the product from making decisions that are likely to cause harm, or to provide consumers with clear instructions on how to use the product safely.[26] This would require the explicit mention in the product liability directive that inadequate instructions and warnings also constitute a sign of defectiveness. This would be a godsend to the users of non-AI enabled products, as currently it depends on the interpretation of the national courts whether inadequate warnings and instructions alone can be understood as defects that give grounds for product liability. It would also be beneficial to require manufacturers to provide consumers with transparent information about the AI-enabled product's decision-making capabilities. This would enable consumers

[25] Ebers 2021: 214.
[26] Ebers 2021: 211.

to understand how the product works and to make informed decisions about whether and how to use it, in the hope that they would be more likely to avoid damaging scenarios. The real concern about this idea is that it presumes the consumer is seeking information and that the consumer understands the operation of the product. This may be doubtful, as many consumers do not dedicate any time to getting to know the product better, and even if they do, the description of its functionality may not be comprehensible for many.

CLOSING REMARKS

The above discussion of one of the challenges which the application of AI and ML tools pose for tort law is only one example of how the existing legal standards in tort law can be adapted relatively easily to new technologies without the need to create something entirely new and without the necessity of seriously reinterpreting existing doctrines by the courts. Although this approach may sound old-fashioned, conservatism, especially in civil law legal systems, is a sign of predictability and certainty, which also reinforces the constancy of the legal norms. Moreover, at the moment when the emergence of new technologies immediately triggers a hysterical reaction from the lawmaker or from the courts to change or amend the existing legal framework and to react to the new phenomenon in a highly targeted manner, the way toward a sectoral approach in regulation becomes the only solution for the future. Given the rapid development in AI and ML, it is impossible to predict what the future holds for us and what the timeline for the evolution of such technologies will be. Therefore, the lawmaker or the courts can easily be stuck in a spiral of chasing novelties and responding to them in a piecemeal, sector-specific manner. Ultimately, this approach leads to fragmented and sporadic laws that lack predictability, certainty and constancy, causing inconvenience in the society and eroding the general law-abiding behaviour of users and developers alike.

It is obviously a different problem if any of the new technologies is found to be problematic enough that public administration law drags it into its circle of regulation. Licensing obligations for the manufacturing, marketing, sale, import or export of certain technologies may seem a world away from tort law, but there is an obvious connection between them. If we accept the conservative approach and rely on the existing legal framework of tort law, resisting the urge to take a sectoral approach, the courts will carry the torch and find suitable analogies between new technologies and existing legal standards in tort law. Courts, especially in civil law legal systems, however, are cautious players and crave guidance coming from the lawmaker. Any legal norm that shows some attitude of the lawmaker toward the new technologies would reassure or even guide judges' decisions. Naturally, if a judge sees that the lawmaker introduced a licensing obligation for the marketing of a technology, he could interpret it as a highly dangerous technology that the lawmakers pay special attention to, rather like other acts, which are also carrying some inherent damaging potential. Therefore, the courts may strive to make deeper reinterpretations of tort law norms simply to be in line with the attitude of the

lawmaker, even if it was communicated in another branch of the law, public administration law. This demonstrates that the various branches of the legal system form a real matrix, where, from some perspectives, everything is connected to everything. In search for unlawfulness as a precondition for tortious liability and in search of the classification of the new social phenomenon, the reactions of the lawmaker, even if communicated through amendments of novel norms in other branches of the law (e.g. public administration law), will be considered by the civil courts as hints, if not direct orders, on how to approach torts committed by (the use of) artificial intelligence. Based on this presumption, I would recommend taking the path of conservatism even for the lawmaker when approaching new technologies, and I believe that licensing obligations should be carefully examined prior to their introduction into any legal system.

REFERENCES

Bathaee, Yavar (2020): Artificial Intelligence Opinion Liability. *Berkeley Technology Law Journal,* 35(1), 113–170. Online: https://doi.org/10.15779/Z38P55DH32

Benli, Erman – Şenel, Gayenur (2020): Artificial Intelligence and Tort Law. *Ankara Sosyal Bilimler Universitesi Hukuk Fakultesi Dergisi (ASBU Law Journal),* 2(2), 296–336. Online: https://doi.org/10.47136/asbuhfd.713190

Cyman, Damian – Gromova, Elizaveta – Juchnevicius, Edvardas (2021): Regulation of Artificial Intelligence in BRICS and the European Union. *BRICS Law Journal,* 8(1), 86–115. Online: https://doi.org/10.21684/2412-2343-2021-8-1-86-115

Ebers, Martin (2021): Liability for Artificial Intelligence and EU Consumer Law. *Journal of Intellectual Property, Information Technology and Electronic Commerce Law,* 12(2), 204–220.

European Commission's High-Level Expert Group on Artificial Intelligence (2019): *Ethics Guidelines for Trustworthy AI.* Brussels: European Commission.

Heiss, Stefan (2021): Towards Optimal Liability for Artificial Intelligence: Lessons from the European Union's Proposal of 2020. *Hastings Science and Technology Law Journal,* 12(2), 186–224.

Lai, Alicia (2021): Artificial Intelligence, LLC: Corporate Personhood as Tort Reform, *Michigan State Law Review,* 2021(2), 597–654.

Martin-Casals, Miquel (2010): Technological Change and the Development of Liability for Fault: A General Introduction. In Martin-Casals, Miquel (ed.): *The Development of Liability in Relation to Technological Change.* New York: Cambridge University Press, 1–39.

Miklič, Samo (2021): Non-Contractual Liability and Artificial Intelligence, *Pravni Letopis,* 2021(1), 67–82.

Mireille, Hildebrandt (2020): The Artificial Intelligence of European Union Law. *German Law Journal,* 21(1), 74–79. Online: https://doi.org/10.1017/glj.2019.99

Robinson, Keith W. (2022): Enabling Artificial Intelligence. *Houston Law Review,* 60(2), 331–362.

See, Benedict (2021): Paging Doctor Robot: Medical Artificial Intelligence, Tort Liability, and Why Personhood May Be the Answer. *Brooklyn Law Review,* 87(1), 417–443.

Legal sources

California Consumer Privacy Act of 2018 (1798.100 – 1798.199.100)
Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products
European Commission (2020a): *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A European Strategy for Data.* COM(2020) 66 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0066
European Commission (2020b): *Proposal for a Regulation of the European Parliament and of the Council on European Data Governance (Data Governance Act).* COM(2020) 767 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52020PC0767
European Commission (2021): *Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts.* COM(2021) 206 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0206
European Commission (2022): *Proposal for a Regulation of the European Parliament and of the Council on Harmonised Rules on Fair Access to and Use of Data (Data Act).* COM(2022) 68 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A68%3AFIN
Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

Tamás Fézer PhD is a Professor of Law at the Faculty of Law of the University of Debrecen. He holds a PhD in law from the University of Miskolc and is habilitated at the University of Debrecen. He is a Fulbright Alumnus, an awardee of the Hungarian National Excellence Program, and a beneficiary of the János Bolyai Research Grant of the Hungarian Academy of Sciences. His main area of research is civil liability and business law. His work covers various aspects of liability that arise from the infringement of privacy laws, from a comparative perspective, including models of awarding damages for non-pecuniary loss to injured parties.

PRO PUBLICO BONO – Public Administration, 2024/1, 101–125. • DOI: 10.32575/ppb.2024.1.5

Zsolt Ződi

A LEGAL THEORY OF PLATFORM LAW

Zsolt Ződi, Senior Researcher, Ludovika University of Public Service, Institute of the Information Society, zodi.zsolt@uni-nke.hu

This paper discusses the recently emerging platform law from a jurisprudential point of view. After defining the platform as a general coordination mechanism, it deals with topics such as the rationale for regulation, its main goals, and its general characteristics. According to the study, the main argument for regulation is that the platform, as a coordination mechanism, tends to become unstable without intervention, or to become harmful from the point of view of society. Above all, it tends to abuse the asymmetric power situation that exists between the platform and its users. These conditions must be prevented from occurring, and platform users must be protected in certain situations. The study lists four features that characterise platform law: its ex ante regulatory nature, the predominance of technology regulation and self-regulation, and the extensive use of user protection tools, such as complaint mechanisms, protection of user accounts, and explainability obligations. This toolbox partly resembles the long-established methods of consumer protection, but it also differs from it in certain ways.

Keywords:
online platforms, legal theory, theory of code, Digital Services Act, user protection, coordination mechanisms

INTRODUCTION

This paper aims to examine the characteristics of the emerging platform regulation from a legal theoretical (jurisprudential) point of view.

Internet platforms became widely used in the wake of the 2008 crisis and soon became the main protagonists of the Internet. However, until the mid-2010s, the legal regulation of platforms was scarce. Most platforms were regarded as an "internet intermediary" (and within that a "hosting" service), which has no direct liability for the activity performed

on it.[1] By the end of the decade, it had become clear that the great economic and social significance of platforms demanded a different, and in many respects, much more detailed and strict regulation.[2]

A body of rules to address this regulatory need was created very quickly by the European Union[3] in the period between 2018 and 2022. On the one hand, the EU amended a series of directives to align them with the new phenomenon of platforms (AVMSD,[4] Copyright Directive[5]), and then created new ones (mainly in the form of Regulations) specifically aimed at platforms (P2B,[6] DSA,[7] DMA,[8] Platform work directive draft[9]). The norms reveal a picture of a new European platform law, which has some well-described characteristics. This paper aims to analyse these characteristics on a higher abstraction level, with theoretical ambitions.

The structure of the study is as follows. In the first, methodological part, I clarify some theoretical starting points, such as the rationale, purpose, and justifying principles of platform law and the place of platform law within the legal system. The second part analyses platform law in terms of four characteristics. Three of these are typical of any legal field which deals with technology. These are: the *ex ante* nature of the law, the extensive use of self- and co-regulation, and the fact that rules are enforced with the help of technology ("regulation through technology"). The fourth, longest subsection will attempt to characterise a concept that is unique to platform law, because it is its main justifying principle. This is the *user protection*.

---

1 See e.g. the main regulatory tool of the EU between 2000 and 2022, Directive 2000/31/EC ('Directive on electronic commerce').

2 A different approach was employed in 2017 with the German "Network-enforcement law" (Netzwerkdurchsetzungsgesetz – NetzDG), which imposed certain transparency and procedural obligations on the social media platforms.

3 In the second half of the decade, similar initiatives appeared in other parts of the world. Thus, in the USA, several federal and state-level legislative drafts have been published aimed at regulating the platform scene. These are very similar to their European counterparts in terms of their goals, and sometimes also in their details, so the theoretical considerations described here also apply to them.

4 Directive 2010/13/EU (Audiovisual Media Services Directive – old AVMSD) and its revision, Directive (EU) 2018/1808 (Audiovisual Media Services Directive).

5 Directive (EU) 2019/790 (Copyright Directive).

6 Regulation (EU) 2019/1150 (Platform-to-Business Regulation – P2B).

7 Regulation (EU) 2022/2065 (Digital Services Act – DSA).

8 Regulation (EU) 2022/1925 (Digital Markets Act – DMA).

9 Information page: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6605; Text of draft: Proposal for a Directive of the European Parliament and of the Council on improving working conditions in platform work COM(2021) 762 final (Platform work proposal).

METHODOLOGICAL CONSIDERATIONS

The difficulties of doctrinal analysis

This paper seeks to characterise platform law on a more abstract level. Its main purpose is therefore not to summarise the regulations currently in force, but to outline the rationale and connections behind the rules, identify their common elements, to organise the rules into meaningful groups, and to demonstrate the organising logic, goals, and justifying principles behind them. It is also not my aim to write primarily about *platform theories*. This paper is about the theory of platform *law* and not about the theory of platforms – though I use one of these theories to conceptualise the platform-phenomenon. Another disclaimer is that this legal theory does not operate at the same level of abstraction of the classical jurisprudential tradition (which deals, for example with issues such as the problem of normativity, the values behind the law, the concept of law, or the relationship between law and morality). I have thus chosen a lower level of abstraction for the analysis.

At the same time, despite the fact that it is not my intention to develop a "grand" theory here, the task is still not straightforward. Most of the rules that are specifically tailored to platforms were created only in the last few years, and therefore have no case law to interpret them, along with their so-called ex ante nature. Both characteristics make the task of developing a theory more difficult, because they weaken the organising role of judicial argumentations, which is the usual starting point for doctrinal and jurisprudential explanations.

At this point, it is worth explaining the difficulty caused by ex ante regulation. Since ex ante type (or compliance-type, preventive) regulation was not created primarily as a "decision norm", i.e. as "lawyer's law" (Entscheidungsnormen or Juristenrecht[10]), with the intention of being used by the courts, but instead primarily to *prevent* problems by regulating the actions of the participants or of the technology developed by them, its operation in many cases remains invisible. Indeed, the very fact that everything is unproblematic and it functions without difficulties, adds little to the exploration of the nature of a rule, because this is more apparent in borderline situations, or in complex cases. Furthermore, ex ante regulation is typically considered by the courts only if someone has violated an obligation, so the legal dispute immediately turns into a question of *(ex post)* liability. In such cases, the court examines compliance with the ex ante law, and may even come to doctrinal, systematising conclusions, but very often in such situations, the courts

[10] These are the Austrian legal sociologist, Eugen Ehrlich's expressions. He was the first to point out that in addition to the "decision law" (Entscheidungsnormen) applied in (and by) the courts, there is another huge body of law, the "living law", which is used by economic participants and private individuals in their everyday (economic) life. This living law has something to do with ex ante regulation, but it is not identical to it. At the same time, ex ante law can also be well contrasted with the ex-post (lawyers') law. See Ehrlich 2022: 210, 240; Rehbinder 1986: 50.

appoint an expert witness to interpret the ex ante regulation. In short: from a theoretical and dogmatic point of view, ex ante law is much more difficult to grasp than "lawyer's law".

The rationale for regulation – platform is an unstable coordination mechanism

What triggers the need for the regulation of platforms, and what causes the crisis of the "old" law? There is both a more general and a more specific answer to this.

To understand the general answer, some simple theoretical assumptions must first be clarified. In this study, I regard the platform – following the theory of János Kornai[11] – as *a coordination mechanism*. The coordination mechanism is an impersonal order that allocates resources and channels human activities. In addition to some less important types, Kornai identified three main types of mechanism: bureaucracy, the market, and ethical coordination.[12] While the market and bureaucracy are impersonal in nature, ethical coordination is deeply embedded in the everyday life of people. The main drivers of market coordination are money and profit, and it channels information through prices. The functioning of bureaucracy is based on explicit rules, (very often legal rules) or direct orders. Although ethical coordination is also aided by rules (ethical rules), it is largely based on human emotions and expectations such as recognition, love, respect, and the feeling of belonging to a community.

The functioning of platforms, as a coordination mechanism, differ from both of these main mechanisms, although they have certain characteristics that make them similar to the impersonal types (market and bureaucracy). The most important feature of the platform is that it can successfully *replace* the other three main mechanisms, by *emulating* them. The two impersonal mechanisms, without intervention, tend to become socially harmful, or inherently unstable. Platforms also tend (without continuous corrections) to end up in a dysfunctional state (not fulfilling their original social function, or acting directly against it). Markets have a propensity towards the formation of monopoly markets and cyclical crises,[13] while bureaucracies end to operate with their own interests in mind, which manifests itself partly in expansion and partly in abuses of power and arbitrariness.[14] Platforms build up a special type of inequality, known as "platform power", which makes the user of the platform extremely vulnerable. The relationship between ethical coordination ("the life-world") and platforms is much more subtle. In this regard, a platform transforms realities to data and algorithms that otherwise cannot be quantified,

[11] Kornai 1992.

[12] Kornai 1992: 91–109. Kornai's main source of inspiration was Karl Polanyi, (Polanyi 2001: 45) who called these mechanisms "integration schemes". Julie Cohen (Cohen 2017: 15) and Stark and Pais (Stark–Pais 2020) depart also from Polanyi's theory when explaining platforms. Both authors come to conclusions that are very similar to the ones here. In the same vein: Mises 1944.

[13] According to Keynes (Keynes 1936: 313–332), the inherent property of the market is that it operates in trade cycles and occasionally drifts into crises. See also Vicarelli 1984.

[14] This is the core of Montesquieu's theory.

such as love, attachment, or recognition. In this manner, on the one hand, the platform creates a dependency in its users, and on the other hand, since it monetises these goods, it has an interest in maintaining this dependency.

Sophisticated techniques were developed in the past century to eliminate the instability and dysfunctions of "traditional" coordination mechanisms. The correction of the markets is performed partly by economic, (anti-cyclical economic policy) and partly by legal methods (anti-monopoly, antitrust and consumer protection legislation and authorities). For example, in the last century, competition law created a complex system for dealing with monopolies. Consumer protection law also developed a series of well-proven rules in the last 50 years or so to compensate for the asymmetric situation of the consumer and to curb the power of large companies. Rules such as the expectation of comprehensibility of boilerplate contracts, or the prohibition of unilaterally beneficial conditions for the service provider are examples of such law. The coordination mechanism of the market was thus curbed, not by a single set of rules, but by a combination of antitrust and consumer protection rules. The former aims at the "ideal" and "equilibrium" state of the market, while the logic of the latter is more similar to constitutional and administrative law, which seeks to correct abuses of power. It is not by chance that a lively discussion continues amongst specialists in constitutional law about the "horizontal effect of constitutional law",[15] (a somewhat similar issue in the U.S. is known as "state action"[16]) which means the use of certain constitutional principles and fundamental rights in the sphere of private relations between two, legally equal non-state actors.

Constitutional law and, to some extent, administrative law have become the main means of correcting the dysfunctionalities of bureaucracy. Constitutional law and its international counterpart, international human rights conventions humanise political power and the bureaucratic sphere[17] by placing them under the rule of law. The related guarantee rules, from the separation of powers to the obligation to provide reasons for individual decisions, expand and enforce this ideal in certain sub-areas. The entire corpus is interwoven with the means of protecting fundamental rights, which protect the freedom and decision-making autonomy of individuals, and reduce their vulnerability.

Since the platform is a new coordination mechanism in the virtual space, it can be present in almost all spheres of life and can replace bureaucracy, the market, or even "ethical coordination" – the normal "offline" private interactions. At the same time, control mechanisms similar to those developed to counteract the dysfunctionalities of the various coordination mechanisms in these fields are not in place for platforms: the platform as a coordination mechanism has not yet been subjected to these rules. The new platform law, which will be discussed here, is essentially an effort by the legislators now trying to create these mechanisms, based on the closest analogues: constitutional law, data

15 Some examples from the rich literature: Gardbaum 2003; Phillipson 1999; Tushnet 2003.
16 Shelley v. Kraemer, 334 U.S. 1 (1948).
17 Bibó 1986: 120.

protection law, and consumer and (possibly investor) protection rules.[18] These rules were codified by the European legislator in line with the current fashion for ex ante rules with their own agency and sanctions, which make extensive use of self- and co-regulation tools, along with technology-based regulation (using the technology-oriented and technology-regulated method).

Areas, structure and place of platform law in the legal system

The other question that should be explored before discussing the individual characteristics of platform, is its place in the legal system as a whole, within the legal corpus.

Platform law is always Janus-faced, because it not only has to deal with effects arising from the characteristics of platforms such as datafication, algorithmic control, and network effects, but must also be adapted to the specific areas of life in which the given platform functions. A work platform must take into account the specific risks arising in the world of work (e.g. compliance with rest periods) together with the effects arising from the fact that it is basically a marketplace platform connecting supply and demand. An accommodation platform must also take into account the characteristics of the field of tourism and accommodation rental. At the same time, sectoral logics never completely dominate the logic of platforms: it is possible to refer to platform law *precisely because the effects arising from the characteristics of platforms are so strong that they prevail in all areas.* Certain approaches (especially certain means of "user protection") permeate all facets of platform law. Of course, this duality often appears in practice in the reverse order: the regulators start from the logic of the given sector (e.g. from the logic of media law or of labour law in the case of the AVMSD or the Work-Platform Directive), but are usually subsequently also forced to take into account the logic of platforms.

This duality produces a situation where the law very often uses long-established approaches in a given field to regulate platforms operating that sector, and some of these well-established rules can of course be effective. The advent of platforms does not make it necessary to set aside all the old legislative goals (or other justifying principles). The AVMSD is an excellent example of how the goal of protecting minors, for example, should also apply to video-sharing platforms. The other issue is whether specific measures will have a different effect on a platform. In linear television, the placement of content harmful to children in late-night broadcast slots, for example, has proven to be quite effective for several decades, while in the case of on-demand content, this approach is so far not applicable (this is not yet a platform feature) to the recommendation algorithms operating on the platforms and their responses to user behaviour, although the risks of using data require specific, platform-legal solutions.

[18] Hildebrandt 2018.

In platform law, three basic nodes or sub-areas are emerging in the regulation: on the one hand, there is the "general platform law", which mainly includes the definition of platforms and issues related to their responsibility and transparency. "Specialised" platform law is again divided into two parts, one of which is closely related to fundamental rights, and the other more infused with economic logic. The former views platforms from the perspective of online dangers and the risks of violations of fundamental rights.[19] Competition law, copyright law, consumer protection and labour law rules can be grouped around the economic node. These are more similar to consumer protection and antitrust rules. (The copyright directive is an exception to this, where the protection of the rights of authors and publishers is dominant.)

The regulations of the EU and the USA may be very similar at the level of individual detailed provisions and certifications, but they differ greatly in their overall approach. First of all, the U.S. did not create a "horizontal" or "general" platform law, as the EU does with the DSA.[20] The EU's general platform law, and the effort to address the platform phenomenon in general, is probably based on the comprehensive aspirations of European codification traditions. At the same time, generalisation also results in the fact that there must be a "special part" related to it, reflecting the Janus face described above. It must fit both the concepts and the regulatory environment specific to the sector and the "general platform law".

More importantly, however, the justifying principles and arguments applied in the USA differ in general and in individual sub-areas. U.S. law, for example, is more hesitant when it comes to the "precautionary principle" than Europe, where this is one of the most important justifying principles, [21] and one to which I will return. Some examples of the differences in sub-areas include: the topic of "illegal content" in the EU, is most often referred to as the topic of the *"first amendment", i.e. freedom of speech,* in the U.S. What is a data protection issue in the EU, in the USA either simply does not exist as a problem, or it is listed as a *"privacy"* issue that only partially overlaps with data protection. Competition law problems are often mentioned as *"common carrier"* issues, which is also a specifically American concern, unknown in the EU. Finally, comparing the situation of the USA and the EU is made very difficult by the fact that the legislation of the USA is fragmented both horizontally and vertically, and is very often "situational" legislation. Beyond vertical

[19] The opening sentence of the official website of the European Commission introducing the DSA package is: "The Digital Services Act and Digital Markets Act aim to create a safer digital space where the fundamental rights of users are protected and to establish a level playing field for businesses." https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package Schlesinger characterises the British situation in the following way: "The British policy agenda and regulatory response are presently encapsulated in two portmanteau rallying points: remedying 'online harms' (which mainly encompass social and political issues) and pursuing a 'pro-competition' approach (by addressing malfunctioning markets to promote consumer interests and business innovation)" Schlesinger 2022.

[20] Recently, the main legal source of the platform regulation is the Communication Decency Act, Section 230, and approximately one dozen federal and state bills are on the table of legislators across the U.S.

[21] Sunstein 2005: 14.

(federal and state) segmentation, horizontal fragmentation means that, for example, the federal legislation reflects on certain partial problems and does not seek to deal with the issue of platforms as a whole. A good example of this is the ACCESS Act, which aims to solve the problem of data portability[22] (which in Europe is not part of platform regulation at all, but of data protection law[23]).

Taking all of this into account, I characterise platform law with reference to four concepts or pairs of concepts that have sparked legal discourses in recent decades in other fields. What they have in common is that they try to describe and capture the set of rules that is often contrasted with "law", which is the "matter" of lawyers, as "regulation".

Among these, the first three concepts characterise not only platform law, but also the rules created for the technology-embedded world in general, and EU legislation in particular.[24] These aspects are: the predominance of ex ante regulation, the intensive reliance on co- and self-regulation, as well as the increasing role of technology regulation and regulation *with the help of technology*. These characteristics are therefore those that characterise modern legislation anyway, but they are of outstanding importance in platform law too.

The fourth feature is a feature of platform law that is unique to it. This is the justification and purpose of platform law: *user protection*.

FOUR CHARACTERISTICS TO DESCRIBE PLATFORM LAW

The precautionary principle: platform law as an ex ante regulation

One of the key features of platform law is that it is largely ex ante in nature, or in other words, compliance regulation.[25] This characteristic has been brought up many times in this book, but here I would like to discuss it on a slightly more abstract level.

The mass appearance of these rules began in the 1960s and 1970s. The paradigmatic case of ex ante law is environmental protection and pharmaceutical regulation, in which the justification of ex ante rules also received a special name: the precautionary principle,[26] a kind of legal version of the folk wisdom "better safe than sorry".[27]

The ex ante – ex post distinction itself appeared mainly within the discourse of law and economics starting in the 1990s, usually in the context of how far it is reasonable to go in ex ante regulation, (in contrast with the ex post – liability – rules), and what the

22 H.R.3849 — 117th Congress (2021–2022), see: www.congress.gov/bill/117th-congress/house-bill/3849/text

23 Regulation (EU) 2016/679, (General Data Protection Regulation–GDPR) Article 20.

24 Walker 2005.

25 Fried 2003.

26 An overview of the history of the precautionary principle: Harremoës et al. 2001 and O'Riordan 2002.

27 Sunstein 2005: 13. Some say the principle has a different origin: according to Christiansen, the principle originates from the German Vorsorgenprinzip of the 1930s. Boehmer 2002.

advantages and disadvantages of both forms are and how can they complement each other in a good regulatory mix.[28]

Since the 1970s, it has therefore become increasingly accepted that the purpose of the law is not to respond to some kind of illegal activity, but to facilitate the avoidance of certain risks, by providing participants in a given risky area with behavioural or direct technological specifications. This right is often called regulation, or compliance, in order to contrast it with law.

A very straightforward and easily understandable example of the distinction between ex post and ex ante rules is the system of norms regulating traffic on public highways. In this field, on the one hand, there are the traffic rules, which is a classic ex ante regulation, as they coordinate road users with a series of specific regulations, and their main goal is to prevent accidents. However, traffic is also regulated by ex post rules: liability for accidents in the civil law, or traffic offences in the penal law. Further notable differences exist between the two systems of rules, such as the fact that traffic rules must be constantly followed, while the liability rules only come into play in the event of an accident. Moreover, traffic rules are constantly applied and interpreted by civilians, while the rules of responsibility are primarily interpreted by lawyers, and within this, especially by the courts.

Ex ante law is not homogeneous, and this also characterises platform law. Some rules regulate *processes,* assess and manage risks, and possibly contain certain quality assurance elements. This can be characterised as *risk-preventing ex ante law.* On the other hand, other rules deal with inequalities, injustices, and power asymmetries, very often in a consumer protection setting. While the key concept of the latter field of law is "power" and its correlative "vulnerability", the focus of the former is "risk", "health", "security". Even more simply, some *ex ante* law protects a person's *health,* and some protects one's *dignity and other values arising from it* (e.g. decision-making autonomy, freedom of speech, etc.). The majority of the ex ante rules of platform law naturally fall into the latter category.

How the centre of gravity of the law has shifted towards *ex ante* rules is best demonstrated by the change in one of the central constructs of platform law, the *notice and takedown rule*. The notice and takedown rule described in the E-commerce directive was clearly an ex post rule: it determined when a platform *is not* responsible for violating content and when it is.[29] The obligation of the platform *(hosting service)* clearly began *after the publication of the illegal content*. Compared to this, the first sentence of the new *notice-and-action* regulation

[28] Kolstadt et al. 1990.

[29] Directive 2000/31/EC of the European Parliament and of the Council, Article 14: "Hosting/ 1. Where an information society service is provided that consists of the storage of information provided by a recipient of the service, Member States shall ensure that the service provider is not liable for the information stored at the request of a recipient of the service, on condition that: (a) the provider does not have actual knowledge of illegal activity or information and, as regards claims for damages, is not aware of facts or circumstances from which the illegal activity or information is apparent; or (b) the provider, upon obtaining such knowledge or awareness, acts expeditiously to remove or to disable access to the information."

stipulates that the providers of hosting services "put mechanisms in place to allow any individual or entity to notify them of the presence on their service of specific items of information that the individual or entity considers to be illegal content".[30]

It is important to add that the distinction between ex ante and ex post rules is relative in many respects. Some also argue that the ex ante function of criminal law (to prevent people from committing crimes) is actually more important than its ex post function (to punish those who commit crimes).[31] Based on this argument, the distinction between ex ante and ex post regulation actually makes no sense, since one of the most important goals of all ex post rules is to avoid problems, and the (secondary) goal of ex ante regulation is also that in the event of a problem occurring, it can help guide in the determination of responsibility. At the same time, this argument is flawed, in that the ex ante and ex post distinction does not (only) apply to the *purpose* of the law, but also to the *method* of regulation. Ex ante traffic rules describe an "ideally safe", "accident-free" flow of traffic, and because of this, it is no longer up to the driver to decide how to drive safely. Henceforth, he can be punished even if he simply breaks the traffic rules; this no longer requires the occurrence of a specific accident, or injury, or even a dangerous situation arising. This phenomenon, whereby the law pre-empts other (moral or practical) arguments is one of the leitmotifs of modern legal positivism.[32] However, as will be discussed below, this *ex ante* nature, together with the embedding of rules in technology, creates a new quality that limits rather than promotes the unfolding of human freedom.

The relationship between the two regulatory methods has been accompanied by heated debates, on points such as which type of regulation is more effective and how far it is reasonable to extend the generally heavy administrative burdens that are typically associated with regulation, such as registration and reporting obligations, the operation of separate monitoring systems, employing officials, and setting up regulatory and enforcement authorities.[33] In this regard, the (not very telling) argument is acceptable that beyond a certain point, ex ante regulation is counterproductive and it should therefore not be exaggerated, because the transaction costs will be too high, or because it is not worth to deal with risks that have a very low probability of occurrence.[34] The most appropriate form of regulation is a "mixture" of *ex ante* and *ex post* regulation. At the same time, other affected parties (including many legislators) argue in favour of strengthening *ex ante* regulation,[35] and it seems that this position is also more dominant in the field of European platform law. Tracing the textual changes made during the drafting of the DSA, it was clear

30 DSA Article 16.
31 See Darley et al. 2001.
32 Raz 1990: 16.
33 Cass Sunstein argued convincingly against excessive ex ante (precautionary) regulation. Sunstein 2005.
34 See Kolstadt et al. 1990.
35 Galle 2015.

that it was continuously being enriched with new ex ante elements. It were not primarily completely new obligations that were being added, but rather an increasingly detailed description of the fulfilment of already defined ones.[36]

Co-regulation and self-regulation: platform law as "outsourced" law

Platform law, like European law as a whole, makes extensive use of co- and self-regulation. The idea of co- and self-regulation, which partly overlaps with the notion of "soft law",[37] gained ground in EU law at the end of the 1990s. At that time, a debate about the institutional efficiency of the EU began, which ultimately led to the introduction of co-regulation as one of the most important recommendations of the White Paper on European governance.[38] According to the White Paper, the essence of co-regulation is that the EU establishes only the general rules, the details of which must be worked out by the industry participants. The findings of the White Paper were incorporated into the action plan on better regulation.[39]

Platform law makes extensive use of self-regulation, as well as the outsourcing of regulation to private organisations.[40] Thus, for example, according to the text of the DSA, the Commission supports and promotes the development of various industry standards, e.g. for the electronic reporting of (perceived) illegal content, the creation of templates, designs and procedural standards that make it easier for users to understand the restrictions included in contract terms, for an electronic reporting system of reliable whistle-blowers, etc. The same applies to codes of conduct: the Commission wishes to encourage the creation of voluntary codes of conduct. Similar self-regulation provisions can also be found in the AVMSD and other platform law norms.

It may seem that in certain respects the notion of co- and self-regulation runs counter to the trend of ever-increasing ex ante regulation. As noted above, the trend has been towards a growth in the amount of increasingly detailed ex ante rules. At the same time, the detailed description of obligations narrows the room for manoeuvre of legal entities rather than expand it. This seems to be a paradox, at least in platform law, but this is only on the surface. The vast majority of ex ante regulations in platform law are *of a formal and procedural nature,* as I will detail in the subsection entitled "user protection". At the same time, this also means that the legislation mostly leaves substantial issues to be decided by the platforms. The definition of the specific forms of expression of "speech that can

[36] For example, Article 9 of the draft DSA, which regulates the transfer of information to the authorities, in its final version is almost double the length of the original text of the proposal, partly due to the increasingly detailed obligations placed on the authorities, and partly of the intermediary service providers. The same is also true for Articles 12, 17 and many other texts.

[37] Senden 2005.

[38] European Commission 2001.

[39] European Commission 2002.

[40] This expression is used by Caroline Cauffman and Catalina Goanta in connection with the DSA. Cauffman–Goanta 2021.

no longer be tolerated" or of the specific forms of practices that are considered detrimental to consumers (to mention only two very important content issues) is essentially completely left to the platforms. From this point of view, I also classify it as a matter of content when the platform rules refer to "appropriate technical measures". In such cases, it is up to the platforms to determine what services they operate in order to achieve a given goal, what functions they implement, and what user interfaces they design for them.

This logic actually suggests that "it doesn't matter what kind of regulation there will be, as long as there is something and it is predictable". Although, we leave its precise content to the profession that previously cultivated it based on its internal rules. However, unlike medicine, driving a car, or the banking profession, platform operation is not an independent profession that had previously established rules which only need to be translated into legal form. The platform is only an "empty" mechanism that coordinates social life, certain markets, etc. In other words, banking law can be outsourced in such a way that prudential obligations are codified as new rules of banking, and within the framework of this, the rest can be entrusted to the bankers, but – I would argue – the same method will not work smoothly if applied to platforms.

Regulation of technology and regulation by technology: platform law as a technology

One of the most important parts of platform regulation is the direct regulation of technology and/or regulation with the help of technology.[41]

To establish a broader context, it is worth recalling Brownsword's recently published book. In this work, he identifies three ways of discussing the law, or three legal mindsets: law 1.0, 2.0, and 3.0.[42]

The correct application of the rules is at the heart of the Law 1.0 way of thinking. A lawyer's special knowledge concerns how to apply the general rules to individual cases. Such application can be quite easy, a little more complicated and quite difficult. Sometimes difficulties arise due to technological development. For example, such difficulties were caused by the railway, electricity (in private liability), photography (in criminal law) and the rise of tabloid newspapers (in the field of privacy), or the VHS tape recorder (in copyright law). These difficulties may mean that the old legislation has become unusable, or that there are "gaps" in its application.

Law 2.0 is a type of discourse and an approach, according to Brownsword, somewhat similar to what was characterised above as "ex ante" regulation, but with some important additions. The aim is therefore to avoid risks, but this burdens the regulation with a series of new dilemmas and tasks. Finding the optimal point between under-regulation and over-regulation[43] is a new dilemma, and a new task is presented by this type of regulation

41 Brownsword 2011 and Brownsword 2005.
42 Brownsword 2021.
43 Brownsword 2021: 23.

requiring control and enforcement mechanisms (procedures, authorities). Finding the right balance between ex post liability rules (representing Law 1.0), and new type of ex ante compliance rules (representing Law 2.0) also poses a great dilemma.

Technology plays a different role in the thinking of law 3.0. If the goal is to avoid certain risks, then sometimes these risks can simply be handled better by employing certain technologies. Brownsword cites the 2009 Västberga robbery in Sweden as an example. In this case, a group carried out a helicopter robbery at a cash collection point. Some of the money was never recovered, prompting the Swedes to radically reduce their use of cash. It is easy to see that electronic money cannot be stolen using traditional methods: technology can practically completely filter out a specific type of risk. The same is true, for example, of copyright protection. Although, it is possible to stipulate in the user agreement that it is forbidden to transfer an electronic file to another person, it is much more effective to prevent this by technical means and make the file uncopiable. In fact, in this case, it is a matter of embedding either the ex post (liability rules if the person has copied them) or even the ex ante rules into a specific technology, which in the majority of cases takes the form of some code, software, and (less often) even a physical device.[44]

It is not difficult to discover the similarities between Brownsword's theory and Lessig's theory, as well as the American "lex informatica"[45] discourse, or even Richard Susskind's idea of "embedded legal knowledge".[46] The essence of all these is that legislators use the direct description of technology in order to control the behaviour of people.[47]

In platform law it is extremely common for a technology to be defined to achieve certain legislative goals. Basically, in the DSA, these regulatory (behavioural control) technologies are present in two ways. Either they are provisions where technology is specifically referred to, the DSA is full of such regulations, such as the internal complaint handling system,[48] and the adjustable or non-profiling recommendation system,[49] or they do not refer to them directly, but the given obligation can essentially only be implemented by technological means. (The DSA often uses the term "mechanism" or "necessary technical and organisational measures"[50] in this case as well, which of course can also take the form of a tightly regulated procedure without technological support, but most of the time,

44 Brownsword 2021: 32

45 Originally by Joel R. Reidenberg (Reidenberg 1997), which was later adopted by others (e.g. Mefford 1997), but the idea – the increasing role of codes in influencing behaviour in cyberspace – really became widely known with Lessig's theory. Interestingly, Karen Yeung and Martin Lodge are giving an entirely different origin story for the regulation by algorithms in their writing (Yeung–Lodge 2019: 4), stating that algorithmic regulation "was popularized by Silicon Valley entrepreneur Tim O'Reilly in 2013" but "the idea that computational algorithms might be understood as a form of social ordering was proposed some time earlier by sociologist A. Aneesh".

46 Susskind 2009: 141.

47 Brownsword et al. 2016.

48 DSA Article 20.

49 DSA Article 27(3) (adjustability of recommendation systems) Article 38 (selectability of recommendation systems not based on profiling).

50 E.g. DSA Article 9(2) a) "redress mechanisms", Article 40(8) d) "technical and organizational measures".

these rules involve a specific technological solution. The notice-and-action "mechanism" itself is a good example.[51] It is no coincidence that the preamble of the DSA specifically mentions that the efficient and uniform application of the obligations contained in the Regulation requires technological tools, so it is important to encourage the development of voluntary standards.)[52]

Behaviour control through technology raises countless theoretical and practical problems, which cannot be comprehensively discussed here. Instead, I will outline four of them. First, since the law is most often manifested in the form of language, ordinary people can easily access it if it is formulated in an understandable way.[53] At the same time, understanding the rules wrapped in technology can be difficult. Second, and closely related to this, if we perceive only the outputs of a given regulatory technology, this leads us into the complicated area of algorithmic transparency and explainability. Third, the unclear relationship between legal rules and technological rules also raises questions of legitimacy: who and how are these rules created, and does the political community have a say in the process? Finally, fourthly, technical rules typically have a direct coercive effect on us and cannot be broken, or infringed, which is not always good. Legal rules sometimes need to be broken, not only on the basis of, for example, value considerations, but also for practical reasons.[54]

The three regulatory characteristics mentioned above (ex ante, self-regulation and regulation with technology) may all be present, and may be related to each other. Regulation may thus be both ex ante type, directed at a particular technology (which otherwise complies with a rule), and at the same time, the specific form this regulation takes is entrusted to the self-regulation of the platforms. As I mentioned above, these three characteristics are not only specific to platform law. They characterise, for example, the latest draft legislation related to artificial intelligence[55] or the data economy,[56] which is related to platform law in many ways.

USER PROTECTION AND ITS ELEMENTS

Why user protection?

I argued above that the main problem with platforms is the same as that which bedevils the other two large coordination mechanisms: that they tend to become dysfunctional in

[51] DSA Article 14.
[52] DSA Article 44.
[53] Ződi 2022.
[54] Joh 2016.
[55] Artificial Intelligence Act.
[56] There are two drafts, the Data Governance Regulation and the Data Sharing Regulation: European Commission 2020; European Commission 2022.

the absence of intervention. I also indicated that dysfunctional operation can mean several things in the case of platforms.

First, since the role of gatekeepers (news outlets) has ceased or weakened due to "cheap speech" on platforms, users are very easily able to post illegal or harmful content. Second, the abuse of "platform power"[57] can put users in an unjustifiably vulnerable situation. Of course, such "abuse" is sometimes in quotation marks. Often there is no real abuse, – which describes the actual behaviour of a human being towards another human being. It is very often the case, instead, that algorithms "abuse" their "power" on the platform, and even when there is human intervention, it is not directed against someone personally. However, the power imbalance and the vulnerability are still present.

The interaction between the platform as a coordination mechanism and other mechanisms also raises several problems. Sometimes the platform takes the place of other coordination mechanisms, but it is also possible that it plays a complementary and sometimes distorting role. In such cases, the key issue of the regulation of platforms will be how much interest is attached to preserving (conserving) the original functioning of the replaced (emulated, or distorted) mechanism. How important is it for the market to function as it did before the emergence of algorithms? The fact that the customer does not make a decision in an information-deficient environment while only having a very restricted overview of what is on offer is obviously not a value that necessarily has to be protected: the platforms are able to show the customers the entire offer when appropriate, and this is precisely their biggest advantage. This, however, gives rise to a new problem, the question of *ranking.* In the information-deficient world before platforms, if a consumer wanted to buy a used car, he/she went to the nearest used-car dealer, or bought an advertising newspaper. Now, it is possible to search for the given car type and see the cars for sale in a certain order, defined by algorithms. This abundance of information – it seems – gives birth to a new regulatory need: the need to make the ranking fair and sometimes understandable.

At the same time, the elimination of the information deficit situation is not a positive development in other cases, and intervention may be necessary to maintain it. For example, the seller does not need to have the right to access all the information about the users, such as the consumer's searches before making a purchase decision, or purchase and payment histories. On the seller's side, in some cases, there is more of an interest in preserving the information deficiency.

An even more exciting area is the interaction between the "world of life" (or life world),[58] coordinated by "ethical coordination" and algorithmic coordination. Social media tries to replace and emulate traditional human interactions in many respects, but in other places it instead complements and enhances it. However, the substitution does not work in the original form either. Posting news of a family event (e.g. "my daughter got married") had no equivalent in traditional interpersonal interactions. A person could tell a small group of

[57] Van Dijck et al. 2019.

[58] Jürgen Habermas's expression. Habermas 1987 [1981].

friends, or could tell one person at a time the good news, but she could not tell 500 people at the same time. Moreover, the question from then on is whether the law has anything to do with this, and whether traditional forms of interaction should be protected.

As discussed above, one of the manifestations of the dysfunctional operation of impersonal coordination mechanisms is that algorithms are capable of "oppression", i.e. creating asymmetric power situations, almost without any human intervention. The law, however, is not set up to deal with this impersonal (algorithmic) power. The law can only deal with asymmetric situations that have been created by people, or by institutions (legal entities), albeit not necessarily always intentionally. Initially, these asymmetric situations occurred, and were handled in relation to political power, and later also in the context of private powers (labour law, consumer protection), and now the platforms have also created the context of impersonal mechanisms ("repressive algorithms").

The problem is twofold: the law is perfectly suited to curbing the exercise of human power and to mitigating human vulnerability, and very sophisticated mechanisms have been developed to address this in recent centuries. The intertwined systems of the legal systems of nation states and of international treaties, along with the sophisticated doctrines surrounding the human rights system, the polished system of institutions and legal protection mechanisms, and the solutions of individual branches of law are part of a huge, well-functioning system. For example, the system of collective labour law in the field of labour law, international human rights conventions and constitutional law and the legal protection activities of international courts, ombudsmen and constitutional courts, as well as consumer protection law, the extensive system of rules related to boilerplate agreements and consumer protection,[59] competition law and sectoral (e.g. financial supervisory) authorities are mechanisms that have been operating for decades.

These legal instruments are not suitable for curbing the power "exercised" indirectly by technical means, and also not suitable for dealing with the dysfunctional operations caused by algorithmic coordination replacing ethical coordination. In the system of constitutional law, the mechanisms that are capable of truly limiting political power and preventing tyranny, from general elections through independent courts to parliamentary motions of no confidence, have been developed over the past 200 years. At the same time, technology *has not yet possessed power-related dimensions,* or to put it more precisely, technology itself has not been able to "exercise" power independently and autonomously, and thus to make people vulnerable. Technology has always had the capacity to endanger human lives and physical integrity, but it could not make people vulnerable, and above all, it could not, for example, manipulate, change, divert, or provoke large social processes on a mass scale. Although the mass media, for example, has had a huge impact on the public for a long time, and is able to seriously influence people's thinking, actions and mental state, this influence is not wielded by the *technology itself,* but by the people, editors, and journalists

[59] "[P]urchasers of goods and users of services must be protected against abuse of power by the seller or the service provider." Council Directive 93/13/EEC – Consumer Protection Directive, Recital 9.

who are in possession of the technology. For this reason, all previous media regulation was naturally aimed at these people (the people behind the media providers, the people hiding behind the mask of the "employer", the "big company"). However, other options present themselves when it comes to technology. The dangerousness of a drone can also be reduced through *technological regulation* by uploading airspace restriction data to drones before their flights, causing the drone to simply not fly into certain zones.[60]

However, when it comes to regulating platforms (and artificial intelligence), the law is facing something completely new. There is already a debate about whether the technology itself causes or creates vulnerable or powerful situations, and not, for example, the people behind it. This raises the question of whether this new narrative is valid, or is it just an old one appearing in new clothes. The problem is very complex, but the answer may basically be that people and technology are intertwined, and form one system. The operation of the algorithm that makes decisions about workers on a work platform is affected by how it is "tuned" by the operators of that work platform, as well as how the "employers" offering the jobs on it behave, or what qualifications they expect from employees. The same is true for other algorithms. The items that Facebook puts on an individual's news feed depend, of course, on the settings of the news feed, but also on other people's and on the user's behaviour.

There are two main legal sources of inspiration for user protection: consumer protection and investor protection, but platform law introduces many modifications to the legal solutions from these two areas of law. For example, the focus of European consumer protection is unfair general contract terms, which is a kind of blacklist of provisions that should not be used in these contracts.[61] Platform law does not operate with a negative list of this kind, but instead positively lists what must be included in the contracts. Among these mandatory elements, the platform's decision-making powers related to user profiles, and user content play a very important role. Platform law stipulates that the terms and conditions of platforms must include restrictions on the use of their services or complaint handling procedures.[62]

In short: the ultimate goal and justification of the platform law, then – along with some other, equally important, but perhaps subordinate goals, such as preserving the healthy structure of the public sphere or maintaining competition – is primarily the protection of users from the dominance of platforms or sometimes from the harmful and dangerous behaviour of other users. How is this power manifested? It can primarily be found in the way that individual freedom and (decision-making) autonomy may be impaired due to the specific operation of the platforms.[63] Platforms are able to invade an individual's private sphere to an unprecedented extent, learn about their behaviour, collect data about people and transactions, and manipulate users with the help of

60 See Commission Delegated Regulation (EU) 2019/945 Annex, part 3, paragraph (15), point a).
61 Council Directive 93/13/EEC.
62 DSA Article 14.
63 Dumbrava 2021.

microtargeting. The situation is made worse by the fact that the monitoring and data collection are mostly carried out by algorithms, i.e. impersonal mechanisms, which even make a series of decisions. This is compounded by the fact that in the meantime, in certain spheres of existence (social public and some market segments), the platforms have gained an overwhelming significance, and have become unavoidable, so that it is very difficult or even impossible to get by without them.

Legal elements of user protection

Online safety and the protection of users, especially minors, is constantly emphasised by communication related[64] to the Digital Services Act concerning illegal (and harmful) content. The underlying logic is similar to the corresponding institutions of media law, and in the case of the AVMSD, the rules for electronic media must also be applied to video-sharing platforms in this regard. What makes platforms' obligations regarding illegal content very different from that of the media is the (theoretical) lack of prior screening and general monitoring obligations. The E-commerce Directive only codified the notice-and-takedown procedure in relation to illegal content where the hosting service provider only has to deal with the illegal content ex post if it becomes aware of it. This main rule, in an ex ante form, was also retained by the DSA, but with an extremely large number of exceptions and limitations.

One of the limitations is that the absence of a monitoring obligation does not involve a monitoring *ban,* and the platforms have monitored the content published on them from the outset.[65] The other is that the various platform law norms and the case-law have established a series of exceptions to the general lack of obligation.

The legal toolbox of user protection consists of five major areas: 1. protection against illegal content, 2. prescribing the mandatory content of user contracts, 3. protection of the user's digital identity, i.e. accounts and digital freedom of speech, 4. transparency of algorithms, and 5. complaint handling rules for operating mechanisms.

Firstly, the sui generis approach of platform law *to illegal content* is a preventive (ex ante) system consisting of three lines of defence. The first element is the provision and detailed regulation of user-friendly, easily accessible interfaces for reporting illegal content.[66] The second is the system of trusted flaggers.[67] Finally, the third set of rules prescribes protection against abuse.

[64] "The DSA and DMA have two main goals: […] to create a safer digital space, […] and to establish a level playing field for businesses." See: https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package

[65] See for example Facebook's policy on dangerous individuals and organisations: https://transparency.fb.com/hu-hu/policies/community-standards/dangerous-individuals-organizations/

[66] DSA Article 20.

[67] DSA Article 16.

The second means of user protection is the *mandatory provision of certain content elements in the contracts* concluded with users (or their general terms and conditions).[68] The DSA had already stipulated that intermediary service providers (i.e. a broader category than the platform), must provide information in their contracts about the restrictions introduced in connection with the use of their services, such as details of the content moderation employed, including algorithmic decision-making and human review.[69] Compared to intermediary service providers, platforms have even more serious obligations. For example, in their contracts with user platforms must clearly describe, in detail, what kind of policy they pursue in relation to users who publish blatantly illegal content and who notoriously unreasonably report others.[70] Platforms additionally have to indicate the main parameters used in their recommendation systems,[71] as well as the alternatives that may be available to users of the service to modify or influence such parameters. This must also be included in their contract terms and conditions,[72] so that the transparency of the algorithms is ensured in the contracts.

The minimum requirements for contracts between the platform and the user can also be found in the Platform-to-Business (P2B) regulation. The first set of rules regulates some of the characteristics of the contracts between platforms and entrepreneurs. One such rule requires the clear and comprehensible wording of contracts. The provision appears in almost the same form in Article 5 of Directive 93/13/EEC. The P2B regulation requires that the reasons for a decision to suspend, terminate or otherwise restrict a user's account be indicated as a mandatory element of the contract.[73] The same article concerning contracts includes a provision on how to notify the user of changes to contracts and what grace period is required for them to take effect.

The third group of user protection rules concerns the protection of *digital identity and freedom of speech*. This curbs and controls the platform's decisions that affect users most deeply (primarily exclusion from the platform, suspension, or restriction).[74] For example, as we have seen, the DSA requires the operation of an efficient and easily accessible internal complaint management system,[75] which can be used in these cases. P2B, in addition to imposing certain formal requirements on these decisions (communication on a "durable medium", 30 days prior notification in the event of termination),[76] imposes an obligation to justify disciplinary measures (in addition to the internal complaint handling mechanism included in the DSA, the platform work directive requires[77] that they be in written form

68 DSA Article 14, P2B Article 3.
69 DSA Article 14(1).
70 DSA Article 23.
71 DSA Article 27.
72 P2B Article 5.
73 P2B Article 3(1) c).
74 DSA Article 17, P2B Article 4.
75 DSA Article 20.
76 P2B Article 3.
77 P2B Article 4.

and the possibility of human review of (algorithmic) decisions that result in the restriction, suspension or termination of the profile (account) of a platform worker.[78]

The fourth tool of user protection, contained in the provisions of all three documents, attempts *to make the operation of algorithms that affect users more transparent during everyday use.* In connection with the giant platforms, the DSA requires the "main parameters used in the recommendation systems"[79] as well as "any options for the recipients of the service to modify or influence those main parameters"[80] to be included in the contract for the users of the service. The other two norms – since the stakes in both areas are much higher than on a social media platform – are likewise much more detailed in terms of ensuring algorithm transparency. The P2B Regulation, which mainly protects (small) businesses operating on large marketplace platforms, devotes a separate article to provisions related to the transparency of "ranking".[81] According to this article, "intermediary service providers" must record in the contract "the main parameters determining ranking and the reasons for the relative importance of those main parameters as opposed to other parameters". In addition, search engine service providers must also disclose the main parameters that play the most significant role individually or together and their relative importance. Moreover, in the platform work directive, a whole separate chapter deals with issues of algorithmic management.[82] This chapter not only includes rules related to transparency and explainability, but also – in a manner which is otherwise exceptional in platform law – certain substantive rules, that is, regarding what the algorithms of work platforms should not be, e.g. they must not put undue pressure on workers or otherwise endanger their physical or mental health. In addition, as mentioned above, in the case of certain algorithmic decisions, a written justification and the possibility of contacting a person must be provided.[83]

The fifth characteristic tool of user protection is the introduction of various *dispute resolution and complaint handling* mechanisms. As we have seen, this tool is often intertwined with the first two, because it provides the possibility of redress against the most important decisions or decisions made by algorithms, but not always. It seems that the regulations analysed here consider complaint handling mechanisms as general user protection tools. There are two types of such mechanisms, internal and external mechanisms. In the case of external mechanisms, complaint handling or dispute resolution takes place not within the platform, but independently of it.[84] Trusted flaggers can also be regarded as such a mechanism. Internal mechanisms include the complaint handling mechanism of the DSA[85] and the mechanisms regulated in Article 7 of the draft directive

78 Platform work draft Article 8 of the draft directive.
79 DSA Article 27.
80 DSA Article 27.
81 P2B Article 5.
82 Platform work draft Articles 6–10.
83 Platform work draft Articles 6–10.
84 P2B Article 12.
85 DSA Article 20.

of the work platform regulation. The successor of the old notice-removal mechanism, the notification and action mechanism, can also be considered an internal mechanism.

A completely separate area of user protection is the set of rules that primarily prescribe compliance, along with the transparency rules for intermediary services and platforms. This difference is partly related to the fact that the platforms are obliged to continuously disclose their efforts regarding individual user protection, as well as the data related to them. In the DSA, intermediary service providers had already been subject to some transparency reporting obligations, while platforms and VLOPs are subject to even more additional obligations.[86]

The transparency reporting obligation of intermediary service providers mainly involves the communication of information on content moderation. In accordance with this, they must submit an annual report on content that was removed on the basis of external or internal initiatives, according to the type of illegality. Online platforms are obliged to regularly prepare reports on suspensions, matters that were referred to dispute resolution bodies, the functioning of content moderation algorithms, and their number of active users, among other things. Furthermore, the giant online platforms have such a wide set of reporting obligations that there is no space to describe them in full here. By way of illustration only, in addition to the obligations relating to the platforms, they are required to operate a database of online advertisements, provide the Commission with access to essentially all of their data, produce and publish a report on risk assessment and mitigation measures and to undergo and publish the results of independent audits, among other obligations.

REFERENCES

Bibó, István (1986): Az európai társadalomfejlődés értelme [The Meaning of European Social Development]. In *Válogatott tanulmányok 3. kötet* [Selected Studies, Volume 3]. Budapest: Magvető, 7–122.

Boehmer, Christiansen (2002): The Precautionary Principle in Germany – Enabling Government. In O'Riordan, Timothy – Cameron, James (eds.): *Interpreting the Precautionary Principle.* London: Routledge, 31–61. Online: https://doi.org/10.4324/9781315070490

Brownsword, Roger (2005): Code, Control, and Choice: Why East is East and West is West. *Legal Studies,* 25(1), 1–21. Online: https://doi.org/10.1111/j.1748-121X.2005.tb00268.x

Brownsword, Roger (2011): Lost in Translation: Legality, Regulatory Margins, and Technological Management. *Berkeley Technology Law Journal,* 26(3), 1321–1366.

[86] DSA Article 15 Transparency reporting for the intermediary services, Article 24 for platforms, Article 39 for advertising transparency on VLOPs, and Article 42 for transparency reporting of VLOPs.

Brownsword, Roger (2021): *Law 3.0.* London: Routledge.

Brownsword, Roger – Scotford, Eloise – Yeung, Karen (2016): Law, Regulation, and Technology: The Field, Frame, and Focal Questions. In Brownsword, Roger – Scotford, Eloise – Yeung, Karen (eds.): *The Oxford Handbook of Law, Regulation, and Technology.* Oxford: Oxford University Press, 3–38.

Cauffman, Caroline – Goanta, Catalina (2021): A New Order: The Digital Services Act and Consumer Protection. *European Journal of Risk Regulation,* 12(4), 758–774. Online: https://doi.org/10.1017/err.2021.8

Cohen, Julie (2017): *Between Truth and Power. The Legal Constructions of Informational Capitalism.* New York: Oxford University Press.

Darley, John M. – Robinson, Paul H. – Carlsmith, Kevin M. (2001): The Ex Ante Function of the Criminal Law. *Law & Society Review,* 35(1), 165–190. Online: https://doi.org/10.2307/3185389

Dumbrava, Costica (2021): *Key Social Media Risks to Democracy: Risks from Surveillance, Personalisation, Disinformation, Moderation and Microtargeting.* European Parliamentary Research Service. Online: https://doi.org/10.2861/135170

Ehrlich, Eugen (2022): *Grundlegung des Soziologie des Rechts* (5th edition). Berlin: Duncker & Humblot.

European Commission (2001): *European Governance: A White Paper.* COM (2001) 428. Online: https://ec.europa.eu/commission/presscorner/detail/en/DOC_01_10

European Commission (2002): *Communication from the Commission of 5 June 2002, Action Plan "Simplifying and improving the regulatory environment".* COM (2002) 278 final. Online: https://eur-lex.europa.eu/EN/legal-content/summary/action-plan-for-better-regulation.html

European Commission (2020): *Proposal Regulation of the European Parliament and of the Council on European Data Governance (Data Governance Regulation).* COM (2020) 767 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52020PC0767

European Commission (2022): *Proposal for a Regulation of the European Parliament and of the Council on Harmonised Rules on Fair Access to and Use of Data (Data Sharing Legislation).* COM (2022) 68 final. Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A68%3AFIN

Fried, Barbara H. (2003): Ex Ante/Ex Post. *Journal of Contemporary Legal Issues,* 13(1), 123–160. Online: https://doi.org/10.2139/ssrn.390462

Galle, Brian (2015): In Praise of Ex Ante Regulation. *Vanderbilt Law Review,* 68(6), 1715– 1759.

Gardbaum, Stephen (2003): The Horizontal Effect of Constitutional Rights. *Michigan Law Review,* 102(3), 387–459. Online: https://doi.org/10.2307/3595366

Habermas, Jürgen (1987) [1981]: *Theory of Communicative Action, Volume Two: Lifeworld and System: A Critique of Functionalist Reason.* Translated by Thomas A. McCarthy. Boston, Mass.: Beacon Press.

Harremoës, Poul – Gee, David – MacGarvin, Malcolm – Stirling, Andy – Keys, Jane – Wynne, Brian – Vaz, Sofia Guedes eds. (2001): *Late Lessons from Early Warnings. The Precautionary Principle 1896–2000.* Luxembourg: Office for Official Publications of the European Communities.
Hildebrandt, Mireille (2018): *Primitives of Legal Protection in the Era of Data-Driven Platforms.* Online: https://doi.org/10.2139/ssrn.3140594
Joh, Elizabeth E. (2016–2017): Policing Police Robots. *UCLA Law Review Discourse,* 64, 516–543.
Keynes, John M. (1936): *The General Theory of Employment, Interest and Money.* San Diego – London – New York: First Harvest/Harcourt.
Kolstadt, Charles D. – Ulen, Thomas S. – Johnson, Gary V. (1990): Ex Post Liability for Harm vs Ex Ante Safety Regulation: Substitutes guard Complements? *The American Economic Review,* 80(1), 888–901.
Kornai, János (1992): *The Socialist System: The Political Economy of Communism.* Princeton, NJ: Princeton University Press.
Mefford, Aron (1997): Lex Informatica: Foundations of Law on the Internet. *Indiana Journal of Global Legal Studies,* 5(1), 211–238.
Mises, Ludwig von (1944): *Bureaucracy.* New Haven: Yale University Press.
O'Riordan, Tim – Cameron, James eds. (2002): *Interpreting the Precautionary Principle.* London: Routledge.
Phillipson, Gavin (1999): The Human Rights Act, Horizontal Effect and the Common Law: a Bang or a Whimper. *Modern Law Review,* 62(6), 824–849. Online: https://doi.org/10.1111/1468-2230.00240
Polanyi, Karl (2001): *The Great Transformation. The Political and Economic Origins of Our Times.* Boston, MA: Beacon Press.
Raz, Joseph (1990): *Practical Reason and Norms.* Princeton, NJ: Princeton University Press.
Rehbinder, Manfred (1986): *Die Begründung der Rechtssoziologie durch Eugen Ehrlich.* Berlin: Dunckert & Humblot.
Reidenberg, Joel R. (1997): Lex Informatica: The Formulation of Information Policy Rules through Technology. *Texas Law Review,* 76(3), 553–594.
Schlesinger, Philip (2022): The Neo-Regulation of Internet Platforms in the United Kingdom. *Policy & Internet,* 14 (1), 47–62. Online: https://doi.org/10.1002/poi3.288
Senden, Linda (2005): Soft Law, Self- regulation and Co-regulation in European Law: Where do they Meet? *Electronic Journal of Comparative Law,* 9(1). Online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=943063
Stark, David – Pais, Ivana (2020): Algorithmic Management in the Platform Economy. *Sociologica,* 14(3), 47–72. Online: https://doi.org/10.6092/issn.1971-8853/12221
Sunstein, Cass (2005): *Laws of Fear. Beyond the Precautionary Principle.* Cambridge: Cambridge University Press. Online: https://doi.org/10.1017/CBO9780511790850
Susskind, Richard (2009): The End of Lawyers? Rethinking the Nature of Legal Services. Oxford: Oxford University Press.

Tushnet, Mark (2003): The Issue of State Action/Horizontal Effect in Comparative Constitutional Law. *International Journal of Constitutional Law,* 1(1), 79–98. Online: https://doi.org/10.1093/icon/1.1.79

Yeung, Karen – Lodge, Martin (2019): Introduction. In Yeong, Karen – Lodge, Martin (eds.): *Algorithmic Regulation.* Oxford: Oxford University Press. Online: https://doi.org/10.1093/oso/9780198838494.003.0001

Van Dijck, José – Nieborg, David – Poell, Thomas (2019): Reframing Platform Power. *Internet Policy Review,* 8(2). Online: https://doi.org/10.14763/2019.2.1414

Vicarelli, Fausto (1984): *Keynes: The Instability of Capitalism.* [s. l.]: University of Pennsylvania Press. Online: https://doi.org/10.9783/9781512819892

Walker, Neil (2005): *Legal Theory and the European Union European University Institute.* EUI Working Papers, Law 2005/16. Online: https://doi.org/10.2139/ssrn.891032

Ződi, Zsolt (2022): Algorithmic Explainability and Legal Reasoning. *The Theory and Practice of Legislation,* 10(1), 67–92. Online: https://doi.org/10.1080/20508840.2022.2033945

Legal sources

Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and third country operators of unmanned aircraft systems

Communication Decency Act of the USA

Council Directive 93/13/EEC (April 5, 1993) on unfair terms in consumer contracts

Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market ('Directive on electronic commerce')

Directive 2010/13/EU of the European Parliament and of the Council of 10 March 2010 on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive – old AVMSD)

Directive (EU) 2018/1808 of the European Parliament and of the Council of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive) in view of changing market realities

Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC (Copyright Directive)

Network-enforcement law (Netzwerkdurchsetzungsgezetz – NetzDG) of Germany

Proposal for a Directive of the European Parliament and of the Council on improving working conditions in platform work COM(2021) 762 final (Platform work proposal). Online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A762%3AFIN
Proposal for a regulation of the European Parliament and of the Council laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain union legislative acts
Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation – GDPR)
Regulation (EU) 2019/1150 of the European Parliament and of the Council of 20 June 2019 on promoting fairness and transparency for business users of online intermediation services (Platform-to-Business Regulation – P2B)
Regulation (EU) 2022/1925 of the European Parliament and of the Council of 14 September 2022 on contestable and fair markets in the digital sector and amending Directives (EU) 2019/1937 and (EU) 2020/1828 (Digital Markets Act – DMA)
Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 October 2022 on a Single Market For Digital Services and amending Directive 2000/31/EC (Digital Services Act – DSA)
Shelley v. Kraemer, 334 U.S. 1 (1948)

Zsolt Ződi is a Senior Researcher at the Ludovika University of Public Service. He graduated as a lawyer from the University of Miskolc in 1991, where he then taught legal theory until 1995. Then he worked in the legal publishing business for 20 years as an editor, publisher and publishing director in various multinational and domestic legal content providers. In 2012, he was awarded a PhD by the University of Pécs with a dissertation on legal informatics. Since then, he has worked and taught at the Legal Studies Institute of the HUN-REN Hungarian Research Network, Eötvös Loránd University, University of Miskolc, and in Corvinus University of Budapest both legal theory and info-communication law. He habilitated at the Faculty of Law in Eötvös Loránd University in 2021. He is the author of 3 books and more than 110 articles.

PRO PUBLICO BONO – Public Administration, 2024/1, 127–144. • DOI: 10.32575/ppb.2024.1.6

Tuomo Alasoini

DIGITAL TOOLS USER GROUPS AS A DIGITAL DIVIDE AMONG FINNISH EMPLOYEES

Prof. Tuomo Alasoini, PhD, Research Professor, Finnish Institute of Occupational Health, tuomo.alasoini@ttl.fi

Based on Statistics Finland's Quality of Work Life Survey 2018, this paper seeks how Finnish employees' use of digital tools differs from each other, what sociodemographic and work context-related factors these differences are connected to, and how differences in usage are reflected in the effects of digitalisation on employees' work. The research identified five user groups. Nearly half of the employees are classified as Skilled Users, which are typically of a young age. Challenges for other groups include deficiencies in digital skills, problems in learning to use digital tools, routine-like usage, low learning demands at work, and a high workload and learning pressure arising from intensive use of digital tools. The results support the sequential and compound digital exclusion arguments derived from previous literature, but do not fully support the stratification argument. The paper shows that among employees there are digital divides of various types. Narrowing these gaps requires different policies and customised solutions.

Keywords:
digital divide, digital exclusion, digital skill, digital tool, digitalisation, inequality, user group

INTRODUCTION

New technologies have the potential to increase productivity and economic well-being, but their introduction and experimentation phases often bring about tensions and heighten inequality. This tendency seems to also apply to digital transformation.[1] The inequalities resulting from digitalisation are called digital divides. Digital divides have been theorised and studied from many perspectives, including social capital theories, disability theories,

[1] Baldwin 2019; Brynjolfsson–McAfee 2014; Frey 2019.

spatial theories, theories of technological acceptance and diffusion as well as theories of the social construction and shaping of technologies. The research on digital divides started in the 1990s with the spread of the use of the internet. At first, the focus was on the differences between internet users and non-users (first-level divide). Next, the focus shifted to the differences in the ways digital tools are used (second-level divide). In the latest phase, the research has expanded to the differences in how people are able to benefit from digitalisation (third-level divide).[2]

Although Finland appears in international comparisons as a well-developed information society where citizens have high digital skills, digital divides also exist there. Digital divides are manifested, for example, in how well citizens know how to use various publicly available online services.[3] Tens of thousands of adult citizens in the country have insufficient access to digital tools or who have only a poor ability to use them due to insufficient equipment, lack of skills or physical or language limitations. These difficulties apply especially to elderly people and people with a low level of education.[4] Digital divides also plague Finnish working life. According to the Working Conditions Survey 2020 of the Central Organisation of Finnish Trade Unions (SAK), 28% of its union members felt that they were sometimes "at the mercy of technology" at work.[5] Most of the members of SAK unions are blue-collar workers whose digital skills are on average inferior to those of higher-educated white-collar employees. Another recent Finnish study supports this view, revealing clear differences between the digital information skills of production workers and clerical staff among employees of the metal industry.[6]

Digital divides are a socio-politically significant issue both at the global and national levels.[7] In industrialised societies, they can exacerbate social inequality, increase the risk of exclusion from working life and society, hamper opportunities to prolong an individual's career and raise the employment rate, impair well-being at work, slow down the realisation of the productivity gains made possible by digital technologies, and increase criticisms of technology and anti-technology attitudes in society. Despite many studies on the effects of digitalisation on work, there has been little research on the digital divide in the world of work in Finland.

This paper explores three research questions. The first of these concerns how employees' ways of using digital tools differ from each other in Finland. Secondly, the paper asks what sociodemographic and work context-related factors these differences are connected to. The third research question examines how the differences in usage are reflected in the effect of digitalisation on employees' work. The study focuses on the second-level divide, which is referred to here as the usage gap.

---

2 Ragnedda–Muschert 2018.
3 Heponiemi et al. 2023.
4 Korjonen-Kuusipuro et al. 2022.
5 SAK 2020.
6 Saikkonen 2022.
7 Mazzucato 2021.

The study draws on van Dijk's Resources and Appropriation Theory.[8] Specifically, the paper examines the findings in the light of arguments concerning the stratification of inequalities already existing in the offline world of work in the digital world, and the compound and sequential digital deprivation arising from the application of digital technologies at work. As its main source of empirical data, the study uses Statistics Finland's Quality of Work Life Survey 2018. The novelty of the paper lies in its application of research conducted on digital divides among citizens to the context of working life and the creation of the concept of "digital tools user group" as the basis of the analysis. The research was conducted as part of the "Digitalisation for All" research project (2020–22), funded by the Finnish Work Environment Fund and the Finnish Institute of Occupational Health.

The paper first briefly reviews the research on the digital divides and sheds light on the novelty of the study. This is followed by a presentation of the research data, the target group, and the research methods and variables. The paper concludes with the results and discussion.

Digital divides as objects of research

At the beginning of the 2000s, the focus of research on digital divides shifted from differences in access to the internet to differences in the usage patterns of different people, as the use of the internet became more common in industrialised countries. The main objects of research since then have been the determinants of digital skills and the use of digital tools. A third emerging theme has been the determinants of outcomes of use.

In their systematic literature review, Scheerder and her associates identify four types of digital skills.[9] Medium-related skills describe a person's technical ability to use digital tools. Content-related skills describe the ability to use digital tools for strategic, creative, and social purposes. Safety- and security-related skills consist of abilities that help individuals to use digital tools in a safe, socially acceptable and ethically sustainable way. General skills, according to Scheerder and her associates, are both general internet skills and digital competence and digital literacy. Content-related and general skills have been the focus of most studies. The most common variables used to explain skill differences have been gender, education, age, socioeconomic status of the family, and duration of internet use.

Another way of categorising digital divides is to separate operational, information navigation-related, social, and content creation skills.[10] Operational skills refers to the basic technical skills required to use the internet. Information navigation skills involves skills that help to find, select, and evaluate information on the internet. Social skills include the abilities that enable people to communicate successfully with others and function online

[8] Van Dijk 2005.
[9] Scheerder et al. 2017.
[10] Van Deursen – Helsper 2018.

through shared understanding, and the acquisition of social capital. Content creation skills refer to the ability to create content online that others appreciate.

Operational and information navigation skills have been called Web 1.0 skills. Web 1.0 refers to a version of the internet, whose pages are static and based on the server's file system. Social and content creation skills have been called Web 2.0 skills, referring to an internet whose pages are dynamic and enable users to filter or create content themselves.[11] Web 1.0 and Web 2.0 skills thus provide individuals with opportunities to pursue very different types of activities in digital environments, both at work and in life in general.[12]

Another main focus of this research has been the purpose of using digital tools. The divisions connected to the purpose of use have also been the basis for research on the benefits of use of digital technology.

Scheerder and her associates identify four main categories of the purpose of use.[13] Financial purpose refers to use where people aim to influence their employment, education, income, property and wealth. The motivations for cultural use are the strengthening of identity and cultural commitment. The third purpose of use concerns social goals. Guided by these aims, people join various networks and/or strive to participate in and influence administrative, political or other processes. The fourth purpose is personal goals. These are related to, for example, health, well-being, self-realisation, or entertainment. Social and personal uses have been the most frequent subjects of research. The most common variables to explain differences in intended use have been gender, age, education level, family income, labour market status, place of residence, and ethnic background.

The following three arguments that stem from previous research on digital divides form a framework to which the results of this study will be compared below.

According to the first argument, called the stratification hypothesis, a positive link exists between a person's corresponding fields of resources (economic, cultural, social and personal) in offline and digital contexts. In other words, specific areas of social and digital inclusion/exclusion influence each other. Digital divides among people are not randomly distributed, and they are not independent of social divides existing in society.[14]

The second argument, known as the compound digital exclusion hypothesis, assumes that there is a connection between different digital resources. For example, a person who has deficiencies in one type of digital skill, probably also has deficiencies in another. Correspondingly, if a person is unable to benefit from digitalisation in one area, (s)he will not be able to benefit from it in another. The underlying idea is that deficiencies in different types of digital skills accumulate, as does the inability to use digitalisation for various purposes and to benefit from the use of digital technologies.[15]

[11] Van Deursen et al. 2017.
[12] Neff–Nagy 2019.
[13] Scheerder et al. 2017.
[14] Helsper 2012.
[15] Van Deursen et al. 2017.

The third argument, called the sequential digital exclusion hypothesis, assumes a connection between the first-level, second-level and third-level digital divides. A person who is in danger of falling into one of these divides is also in danger of falling into another. In more concrete terms, those who have poor access to digital tools will probably also lag behind in the development of digital skills, will use digital tools in a more routine-like manner, and will not be able to benefit from their use in the same way as those with better access or higher skills.[16]

RESEARCH DESIGN AND ITS NOVELTY VALUE

The study makes use of previous research on digital divides, which focused on citizens in general in order to examine the divides between employees. The surveys aimed at citizens contain many findings that probably also apply to digital divides in the context of work. For example, the claim that even if one possesses good Web 1.0 skills without good Web 2.0 skills, this is not sufficient to create particularly favourable conditions for people to benefit from digitalisation is also true in working life. An increasing number of people are doing knowledge work, which requires critical and analytical thinking, creativity, continuous learning, social intelligence, self-direction, and ethical and cultural awareness.[17] It is hardly possible to acquire or maintain such skills without versatile (Web 2.0) digital skills.

The clearest difference when talking about digital divides between citizens and more specifically between employees is that the use of digital tools by employees is guided by the work context. The term "work context" refers to how the work that employees do is managed, organised and designed. The most important difference resulting from this is that while the use of digital tools as a citizen is affected by an individual's skills and motivation as such (including possible physical, linguistic or financial limitations), the use of digital technologies as an employee is also affected by the fact that the work is done with the employer's tools and under the direction of the employer. In a work context, an employee's use of digital tools is less autonomous than her/his use of them as a citizen. The work context-relatedness of employees' use of digital tools means that the same person, as a citizen and as an employee, may be in different positions in terms of how they use and benefit from digital tools. For example, a person who is an active and skilled user of digital tools in her/his free time may only have a limited access to digital tools at work, or her/his way of use of such tools may be significantly restricted due to the nature of the job. A person who is in the usage gap as an employee does not have to be in the gap as a citizen.

[16] Van Deursen et al. 2017.
[17] Van Laar et al. 2017.

In research aimed at citizens, the focus has typically been on the use of the internet.[18] There are also theoretical grounds for this limitation when studying digital divides in working life, because the use of the internet means a more radical change at work compared to the use of any single digital tool. The use of a digital tool, such as a computer and computer software, is about the reconstruction of the interaction between human and machine. The use of the internet represents a more radical change because it also involves a significant restructuring of the interaction between human beings. Information becomes easier and faster to acquire, share and update. The internet can be characterised as a new, globally available and collective information space for human activity.[19]

However, this study will not be limited to the use of the internet. The research-related justification for this is that in different jobs, the work tasks can differ significantly, for example due to the need and nature of the interaction or information processing required by the tasks. Limiting the investigation to the internet would leave out many of those of the analysis who might still make versatile use of some other digital tools in their work. In Statistics Finland's Quality of Work Life Survey, it is also not possible to distinguish unequivocally between those who use the internet at work and non-users, nor to determine the specific ways in which the internet has affected their work.

Popular literature contains many ways of characterising people based on their relationship to digitalisation. Some of the most well-known characterisations include digital native, digital immigrant, digital nomad, digital addict, digital winner, and digital loser. Many of these concepts are vague in content, and do not have a clear theoretical or research basis. Instead of relying on these categories, this paper aims to form groups based on statistically representative material that describes the way employees use digital tools. The user group consists of employees who have the same competence, motivation and learning challenge regarding digital tools in their work context. By grouping employees, the aim is also to create a more structured picture of the various positions that employees can have in relation to the digital divides, compared to a mere analysis of individual differences.

RESEARCH DATA AND TARGET GROUP

The data used in this research are based on Statistics Finland's Quality of Work Life Survey 2018, the target group of which are employees who regularly work at least 10 hours a week. The survey is well suited as a material for exploring this topic, as its special theme was digitalisation. The research material was collected through face-to-face interviews between September 2018 and January 2019. The sample was selected from those who participated in the labour force survey of Statistics Finland. Of the 6,153 people meeting the sample criteria, 4,110 were interviewed with a response rate of 66.8%. The bias of the

[18] Ragnedda–Muschert 2018.
[19] Boes et al. 2017.

data has been corrected with weighting coefficients to correspond to the target group of employees who work at least 10 hours a week, taking into consideration gender, age, province of residence, educational level and socioeconomic group. The age range of the target group is from 15 to 67 years.[20]

Two questions are in the survey that can be used to distinguish those who use digital tools at work from non-users. To the question "Do you use IT equipment at work?" 8.5% answered negatively. To the second question, which inquired separately whether the respondent uses the eight mentioned digital tools, 10.3% answered negatively to each point. 5.3% answered negatively to both questions, which were eliminated from the study's target group. Of the eight options given in the latter question, the most frequently used tools were real-time instant messaging tools (e.g. WhatsApp and Skype for Business). Such tools also represent the least demanding use of the eight options, which is why those for whom real-time instant messaging tools were the only digital tools applied at work were also excluded. With these limitations, the total proportion of excluded employees raised to 6.7%. Nearly all (94%) of the excluded employees were blue-collar workers, the largest occupational group among them being construction workers.

The size of the target group was thus reduced to 3,835, of which 24% were blue-collar workers, 43% were lower-level white-collar employees and 33% were higher-level white-collar employees (mainly professionals, associate professionals and managers). The group was almost equally divided between men (49%) and women (51%). The median age of the target group was 42 years.

RESEARCH METHODS AND VARIABLES

To form user groups, the questionnaire used in the survey was reviewed with the aim of finding the questions that would best describe the employees' perception of their skills, learning ability and motivation as users of digital tools in their work. The three questions chosen were the following: "Does the inadequacy of your own IT or digital skills slow down the performance of your work tasks?" (yes/no), "Does your work involve the following insecurity: fear of not learning how to use new technology well enough?" (yes/no) and "Which description of these do you think best describes you and your digital skills at work?" In the last question, the respondents were offered four options: 1. you master excellently the digital tools related to your work, you are enthusiastic about them and you also learn more of them in your own time; 2. you master well the digital tools you use at work and you may have the ability to advise others on their use as well; 3. you master exactly those digital tools that you need in your work; and 4. your digital skills do not seem to be sufficient for your work. Those who chose the first or second option were considered to have high digital skills and motivation. The other end of the dichotomised variable was formed from options three

[20] Sutela 2019.

and four (low digital skills and motivation). User groups were formed by cross-tabulation based on dichotomised variables. More complex statistical grouping methods such as cluster analysis were not used, because there were only few grouping variables and cross-tabulation produced theoretically meaningful results for further analyses.

The groups' use of digital tools was examined in relation to five questions. These concerned the use of digital tools as a proportion of total working time, the number of digital tools used at work, the need to learn how to use new digital tools at work, the effect of the slowness or malfunctions of digital tools on the work, and support received for the use of digital tools at work. Here, as in subsequent analyses, cross-tabulation was used, where variables describing differences between groups were tested with the Chi-square test. Differences between user groups were identified by testing statistically significant differences between cells with a post hoc column proportion z-test (IBM SPSS Survey Reporter 6.0.1./Column Proportion Test). The data were analysed using the SPSS statistical program version 25.

The differences between the groups were examined in terms of three sociodemographic background factors (gender, age, and three-level basic education level) and three work context factors. The latter were three-level socioeconomic status, occupation, and industry. To define the occupations, the national Classification of Occupations 2010 by Statistics Finland was used, which is based on the ISCO-08 occupational classification of the International Labour Organization. The classification was done on a 1-digit level, which divides occupations into ten groups. In the industry classification, Statistics Finland's TOL-2008 classification was used, which is based on the European Union's NACE industry classification. The classification was carried out at the main category level of industries.

Finally, we investigated how the groups differ in terms of the effects of digitalisation on work. The Quality of Work Life Survey asks "How do you think the digitalisation of work has affected your own work?" Respondents can choose between nine different effects. In addition, the survey inquires "Has your opportunity to use creativity at work improved with digital tools?" From among the questions, we chose the four that would most clearly describe the benefits vs. disadvantages of using digital tools for the employee. The selected benefits were creativity and, from the first question, work efficiency, and the disadvantages were workload and supervision of work, which we considered to constitute a limitation of work autonomy.

RESULTS

At first, user groups were formed, and their different experiences with the use of digital tools were analysed. Next, the composition of the groups was examined. Finally, the effects of digitalisation on the work of the group members were studied.

Identifying user groups

By cross-tabulating the answers to the questions about the three selected variables, eight groups were obtained. The employees who used digital tools at work were distributed among the groups very unevenly, and the combined share of the three smallest groups was only 5.3%. Those belonging to these three smallest groups were left out of further analysis, because it was not possible to perform a statistical analysis and characterisation based on their data. The remaining five groups were assigned names based on their answers to the three questions (Table 1).

Table 1: Digital tools user groups

Group	Features	n	%
Skilled Users	High digital skills and motivation Not concerned about learning to use digital tools No inadequacies in digitals skills that slow down working	1,754	49.5
Intensive Users	High digital skills and motivation Not concerned about learning to use digital tools Inadequacies in digital skills that slow down working	578	16.3
Routine Users	Low digital skills and motivation Not concerned about learning to use digital tools No inadequacies in digitals skills that slow down working	347	9.8
Coping Strugglers	Low digital skills and motivation Not concerned about learning to use digital tools Inadequacies in digitals skills that slow down working	420	11.9
Concerned Strugglers	Low digital skills and motivation Concerned about learning to use digital tools Inadequacies in digital skills that slow down working	254	7.2
Others		188	5.3
Total		3,541	100.0

Source: based on data of Statistics Finland's Quality of Work Life Survey 2018.

Two of the five groups have high digital skills and motivation. The largest group by far are Skilled Users, who account for nearly half of all employees using digital tools at work. They do not experience problems with having insufficient skills or learning to use digital tools. Intensive Users also have high levels of digital skills, but they still feel that inadequacies in their skills slow down their work. This group is named after the fact that its members use digital tools for a greater part of their working time than all the other groups. They also have more digital tools at their disposal. 65% of the group members use digital tools for at least three quarters of their working time, and 46% use five or more different tools.

Of the three groups with lower skill levels, Routine Users are clearly distinguished from other groups. They use digital tools at work less than all the other groups. This explains why they do not experience problems connected with insufficient skills, or have trouble learning to use digital technologies despite their limited competence and motivation. Concerned Strugglers form the clearest contrast to Skilled Users. They have low-level digital skills, in

addition to which they are concerned about their learning and feel that inadequacies in their skills slow down their work. The group of Coping Strugglers is distinguished from them by their confidence in learning digital skills.

The groups clearly differ from each other in their everyday experience of using digital tools. The answer distributions of the groups in each of the three questions in Table 2 differ from each other in a statistically significant way at a level of $p < .001$. However, for the sake of simplicity, the entire answer distributions are not shown in the table.

Intensive Users are under greater pressure than others to learn how to use new IT systems, applications or devices at work. In their work, they also often encounter usability problems caused by IT systems. Only a third consider the digital support they receive from their organisation to be completely sufficient. Routine Users are their clearest opposite. They are under less pressure to learn than the other groups, and they encounter problems caused by IT systems less often. They are also the most satisfied group with the digital support they receive. The third group that differs most from the other groups are Concerned Strugglers. Like Intensive Users, nearly two thirds of Concerned Strugglers have to wait or interrupt their work weekly or even more frequently, due to problems related to IT systems. They also less frequently consider the digital support they receive from their organisation to be completely sufficient than any other group.

Table 2: Differences between user groups in learning new digital tools, experiencing usability and adequacy of digital support

	Skilled Users	Intensive Users	Routine Users	Coping Strugglers	Concerned Strugglers	Total
Learns new or updated IT systems at work at least once a month	45% (n = 1752)	59% (n = 578)	22% (n = 347)	37% (n = 420)	40% (n = 253)	44% (n = 3350)
Has to wait or interrupt work due to problems of IT systems at least once a week	48% (n = 1754)	62% (n = 578)	30% (n = 348)	50% (n = 421)	64% (n = 254)	49% (n = 3355)
Receives completely sufficient support in the use of IT systems	61% (n = 1746)	34% (n = 576)	65% (n = 346)	33% (n = 421)	20% (n = 254)	50% (n = 3343)

Source: based on data of Statistics Finland's Quality of Work Life Survey 2018.

User groups according to background variables

All the sociodemographic background variables also differ between user groups at the level of $p < 0.001$ (Table 3). Skilled Users are younger on average than the others, but do not greatly differ from the rest in terms of gender or educational level. Intensive Users are more

often women than men, and are the most educated of all. Routine Users are the only clearly male-dominated group. They also differ from others in terms of possessing a lower basic level of education. Concerned Strugglers are the most female-dominated and the oldest group. Coping Strugglers are also more often women than men, and the share of elderly employees among Coping Strugglers is the greatest, after Concerned Strugglers.

Table 3: Differences between user groups by sociodemographic factors

Factor	Class	Skilled Users (%)	Intensive Users (%)	Routine Users (%)	Coping Strugglers (%)	Concerned Strugglers (%)	Total (%)
Gender	Men	52	44	59	44	39	49
	Women	48	56	41	56	61	51
	Total (%)	100	100	100	100	100	100
	Total (n)	1,754	578	347	420	254	3,353
Age	15–24y	12	7	12	4	3	9
	25–34y	33	22	14	13	6	25
	35–44y	28	27	24	22	16	26
	45–54y	18	28	25	31	33	23
	55y–	9	16	24	31	42	17
	Total (%)	100	100	100	100	100	100
	Total (n)	1,753	579	347	420	254	3,353
Education level	Basic	8	5	18	9	8	8
	Second level	40	34	50	43	41	41
	Third level	52	61	32	48	52	51
	Total (%)	100	100	100	100	100	100
	Total (n)	1,755	578	347	421	254	3,355

Source: based on data of Statistics Finland's Quality of Work Life Survey 2018.

The high level of education among Intensive Users is reflected also in their socioeconomic status. A clearly larger proportion of them (46%) work in senior white-collar roles than in other groups. Intensive Users are overrepresented among professionals and managers, typically working in knowledge-intensive service industries. Their clearest contrast, once again, are Routine Users, of whom more than half (51%) are blue-collar workers, many of them employed in manufacturing, construction, transport, and storage. Coping Strugglers and Concerned Strugglers are both slightly overrepresented among lower-level white-collar employees. Their most distinguishing feature is that in both groups, and especially among Concerned Strugglers, a larger proportion than in the other groups work in public health and social welfare services or education. As many as 44% of Concerned Strugglers work in these two fields (29% in the entire material). Skilled Users are the only group which does not have any special distinguishing feature either in terms of socioeconomic status, occupation or industry. Age remains the only factor profiling them.

User groups and the effects of digitalisation on work

Finally, we will investigate how the groups' different usage profiles are reflected in the effects of digitalisation on their work. An increase in work efficiency is the most frequently experienced change (59%). The proportion of those who experience an increase in creativity, workload and supervision of work varies from 35% in the case of workload to 44% for supervision. Several employees are of the opinion that digitalisation has reduced their work efficiency, workload or the level of supervision of their work (Table 4).

Regarding each effect, the answer distributions of the groups differ from each other in a statistically significant way at the level of $p < .001$. In the two user groups with high skills and motivation, positive effects are more apparent than in others and are reflected, for example, in an increase in creativity and work efficiency. However, Intensive Users also experience an increase in their workload and the degree of supervision of their work more often than Skilled Users. Routine Users differ from others by the smallness of the effects, both positive and negative. Concerned Strugglers report fewer positive effects and emphasise the negative aspects, such as an increase in workload. The same is true, but to a somewhat lesser extent, for Coping Strugglers.

Table 4: Differences between user groups in the effects of digitalisation on work

Aspect of work	Class	Skilled Users (%)	Intensive Users (%)	Routine Users (%)	Coping Strugglers (%)	Concerned Strugglers (%)	Total (%)
Creativity at work	Yes	40	45	19	34	28	37
	No	39	32	59	43	52	41
	Can't say	21	24	22	23	20	22
	Total (%)	100	100	100	100	100	100
	Total (n)	1,752	579	347	421	253	3,352
Work efficiency	Increase	64	63	47	50	46	59
	No effect	16	15	37	20	19	19
	Decrease	10	11	8	16	17	11
	Can't say	10	11	8	14	18	11
	Total (%)	100	100	100	100	100	100
	Total (n)	1,753	579	346	419	253	3,349
Workload	Increase	29	41	25	46	62	35
	No effect	40	30	55	32	16	37
	Decrease	20	16	13	14	13	17
	Can't say	11	13	8	8	9	11
	Total (%)	100	100	100	100	100	100
	Total (n)	1,753	578	346	420	253	3,350
Supervision of work	Increase	42	48	33	53	51	44
	No effect	45	37	56	36	37	43
	Decrease	2	1	1	1	3	2
	Can't say	11	14	10	10	9	11
	Total (%)	100	100	100	100	100	100
	Total (n)	1,749	579	345	418	253	3,344

Source: based on data of Statistics Finland's Quality of Work Life Survey 2018.

DISCUSSION

This section will first of all reflect on the findings. Thereafter, the key theoretical and practical contributions of the paper are presented. Finally, the limitations of the study will be highlighted.

Reflection on the findings

Nearly half of those who use digital tools at work did not experience specific challenges in their usage in terms of the three variables considered. It is interesting to note that Skilled Users are only profiled by a younger age compared to the other groups, but not, for example, in terms of gender, education or socioeconomic status, which have also been key variables related to differences in digital skills in many previous studies.[21] Skilled Users also relatively rarely experienced problems with the usability of the tools or felt that insufficient support was available, even though their use of the tools was comparatively intensive. Age seems to be an important factor that divides employees in relation to the usage gap, largely independent of the work context. The results support the view of young people as a "new media generation", at least from the point of view that the internet and digital tools in general seem to be more natural means of communication for them, including in working life, than for older age groups.[22]

The grouping showed that employees have very different challenges of usage. Intensive Users include a lot of highly educated, mostly middle-aged knowledge workers compared to the other categories. Their labour market position is strong, and their work is creative in nature, but, at the same time, many have experienced an increase in workload, constant learning pressure, problems with the usability of digital tools, and the inadequacy of their skills and digital support. The group's usage challenge can be viewed as a more general phenomenon characterising expert work that intensively utilises digital tools, which has been called the growing limitlessness of work, i.e. the blurring of the boundaries between work and the rest of life.[23] This kind of usage, without well-functioning IT systems and the support of one's own organisation, such as peer support or advanced help desk, can erode the work and threaten well-being at work.

The challenge facing Routine Users is not so much the current use of digital tools in itself but the routine-like manner of their actual use at work. This does not promote the development of their digital skills or of their work. Although Routine Users can cope with their current tasks using their current skills, they are on the periphery of digitalisation when its benefits are shared and are at the greatest risk of falling out of the labour market in the long term. Although many industrial blue-collar tasks are still less susceptible to

[21] Scheerder et al. 2017.
[22] Westlund–Bjur 2014.
[23] Field–Chan 2018.

automation at the current level of technological development than many tasks in the most data-intensive sectors of the economy, it has been predicted that the greatest opportunities for automation in the next few years with the development of artificial intelligence and robots will be in sectors that have traditionally involved a lot of industrial work, such as transport, logistics, manufacturing and construction.[24] Almost 40% of Routine Users in the data of this study worked in these industries compared to fewer than 30% in all the other user groups.

The usage challenges for Concerned Strugglers are their generally weak digital literacy and learning difficulties in using digital tools. Women, the elderly, and the health and social welfare and educational sectors were clearly overrepresented in this group. The challenge they face is exacerbated by the fact that they experienced usability problems more often than others, and that their organisation's digital support was considered insufficient. The results support the observation presented above that age seems to be a significant factor structuring digital skills, which should be better taken into account when planning the need for digital support in working life as well. An interesting question is why there is a clear overrepresentation of people working in the health and social welfare sectors and in education in this group. Unfortunately, the Quality of Work Life Survey does not offer an answer to this. Especially, the health and social welfare sector in Finland has massive IT systems, many of which have usability problems identified by previous studies, and many new technologies are in the experimental phase.[25]

Theoretical and practical contributions

The study adds to knowledge on research on digital divides by extending the application of research approaches applied to citizens in general to employees specifically. In this way, the results can be linked to three hypotheses concerning digital inequality proposed in previous literatures. The purpose was not to test these hypotheses in the true sense of the word, but to use them as an aid in the interpretation of the research results.

According to the stratification argument, the digital world reproduces offline inequalities. This argument does not receive unconditional support in the Finnish work context. The distribution of Skilled Users does not differ from the rest, according to, for example, education level or socioeconomic status, but only by age. Blue-collar workers and lower-level white-collar workers with a relatively low level of education include employees, mainly young, who belong to the group of Skilled Users in terms of their digital skills. However, the educational background among employees is connected to their patterns of usage in that those who have completed only basic education are clearly overrepresented among Routine Users, as well as among those who do not use digital tools at all in their

[24] PwC 2018.

[25] Hyppönen–Ilmarinen 2016.

work. Those who have completed secondary education are also somewhat overrepresented among both Routine Users and non-users. In the data, one can therefore find some support for the stratification argument, but not in a straightforward way.

According to the sequential digital exclusion argument, digital skills, the manner of using digital tools and the benefits of using them are strongly linked to each other. This seems to be reflected in the results of our study. The views of the groups with high skills and motivation, i.e. Skilled Users and Intensive Users, on the effects on work efficiency and creativity are more positive than those of others. Routine Users are the least likely to experience an increase in workload and the supervision of work performance. These results are explained by the fact that Routine Users have generally experienced the effects of using digital tools in their work to a lesser extent than the other groups.

The compound digital exclusion hypothesis argues that deficiencies in the types of digital skills, usage and in the various benefits of using digital tools are cumulative in nature. Unfortunately, it was not possible to directly investigate this claim with the data. In the Quality of Work Life Survey, there are no questions about the different types of digital skills, nor about the ways of using digital tools at work for different purposes. However, regarding the accumulation of different types of benefits, it is possible to find a positive association between changes in the level of creativity of employees' work and her/his labour market position. Based on previous research, a job's requirements for creative and social intelligence form the biggest obstacle to the automation of the job.[26] Seen from this perspective, it is possible to consider that the more positive views voiced by Skilled Users and Intensive Users about the effects of digital tools on the use of creativity at work can represent advantages for them as compared to other groups, not only in terms of better quality of work but also of a stronger labour market position.

The two most important practical contributions of the study are to indicate the extent of the usage gap in statistically representative national data, and to demonstrate the diverse nature of the gaps between different groups of employees. The study shows that approximately every second employee in Finland suffers from at least some type of use-related handicap. This can reflect to the magnitude of the social challenge arising from the use of digital tools in Finnish working life. The handicaps manifest as work performance problems, in particular, caused by insufficient digital skills, increased strain at work caused by highly intensive use of digital tools and their rapid development, and a growing risk of exclusion from the labour market (in the long run), which is caused by little or routine work-related use of digital tools or outright non-use of digital technologies. To bridge the usage gap, there is no one-size-fits-all solution; different types of these call for tailored policies and solutions. Highest priority should be given to measures that make the development of digital skills accessible to all employees both at work and outside work, create new procedures and solutions to overcome stress caused by the use of digital technologies, ensure sufficiently easy-access and customised support for employees in the

[26] Frey–Osborne 2017.

event of technology-related problems at work, improve change management skills in work organisations, encourage experimentation with the innovative reorganisation of work, and – last but not least – support employees' own initiative to better master digital tools.

Limitations

An obvious limitation of the study is that the grouping was carried out solely based on the self-assessments of employees. Previous research has shown that people's self-assessments of their competences may be biased; for example, men have a tendency to evaluate their digital skills more positively than women, even at the same level of competence.[27] Unfortunately, it was not possible to measure digital skills in the study with more varied and, above all, validated measures.[28]

The grouping was done simply by cross-tabulation based on the three questions of the Quality of Work Life Survey with the aim of differentiating between the employees on the basis of their knowledge of digital tools, motivation, and learning ability. Although the questions were not originally designed specifically for the purposes of this kind of analysis, they covered what the study was trying to achieve reasonably well, i.e. the aspects of skill, motivation and the ability to learn to use digital tools. The user groups formed based on the three questions also seemed theoretically plausible, and the grouping was clearly connected to many other characteristics that can describe an employee as a user of digital tools. In this way, the grouping – albeit formed in a simple manner – helped to shed light on fundamental differences in the attitudes of employees towards the digitalisation of work.

REFERENCES

Baldwin, Richard (2019): *The Globotics Upheaval. Globalization, Robotics, and the Future of Work.* New York: Oxford University Press.

Boes, Andreas – Kämpf, Tobias – Langes, Barbara – Lűhr, Thomas (2017): The Disruptive Power of Digital Transformation. In Briken, Kendra – Chillas, Shiona – Krzywdzinski, Martin – Marks, Abigail (eds.): *The New Digital Workplace. How New Technologies Revolutionise Work.* London: Red Globe Press, 153–173.

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

[27] Saikkonen–Kaarakainen 2021.

[28] van Deursen et al. 2016; Vuorikari et al. 2022.

Field, Justin Craig – Chan, Xi (2018): Contemporary Knowledge Workers and the Boundaryless Work–Life Interface. Implications for the Human Resource Management of the Knowledge Workforce. *Frontiers in Psychology,* 9(2414), 1–10. Online: https://doi.org/10.3389/fpsyg.2018.02414

Frey, Carl (2019): *The Technology Trap. Capital, Labor, and Power in the Age of Automation.* Princeton: Princeton University Press. Online: https://doi.org/10.1515/9780691191959

Frey, Carl – Osborne, Michael (2017): The Future of Employment. How Susceptible Are Jobs to Computerisation? *Technological Forecasting and Social Change,* 114, 254–280. Online: https://doi.org/10.1016/j.techfore.2016.08.019

Helsper, Ellen Johanna (2012): A Corresponding Fields Model for the Links between Social and Digital Exclusion. *Communication Theory,* 22(4), 403–426. Online: https://doi.org/10.1111/j.1468-2885.2012.01416.x

Heponiemi, Tarja – Gluschkoff, Kia – Leemann, Lars – Manderbacka, Kristiina – Aalto, Anna-Mari – Hyppönen, Hannele (2023): Digital Inequality in Finland. Access, Skills and Attitudes as Social Impact Mediators. *New Media & Society,* 25(9), 2475–2491. Online: https://doi.org/10.1177/14614448211023007

Hyppönen, Hannele – Ilmarinen, Katja (2016): *Sosiaali- ja terveydenhuollon digitalisaatio.* Tutkimuksesta tiiviisti 22/2016. Helsinki: Terveyden ja hyvinvoinnin laitos.

Korjonen-Kuusipuro, Kristiina – Rasi-Heikkinen, Päivi – Vuojärvi, Hanna – Pihlainen, Kaisa – Kärnä, Eija eds. (2022): *Ikääntyvät digiyhteiskunnassa. Elinikäisen oppimisen mahdollisuudet.* Helsinki: Gaudeamus.

Mazzucato, Mariana (2021): *Mission Economy. A Moonshot Guide to Changing Capitalism.* Milton Keynes: Allen Lane.

Neff, Gina – Nagy, Peter (2019): Agency in the Digital Age. Using Symbiotic Agency to Explain Human–Technology Interaction. In Papacharissi, Zizi (ed.): *A Networked Self and Human Augmentics, Artificial Intelligence, Sentience.* New York: Routledge, 97–107. Online: https://doi.org/10.4324/9781315202082-8

PwC (2018): *Will Robots Really Steal Our Jobs? An International Analysis of the Potential Long Term Impact of Automation.* PricewaterhouseCoopers.

Ragnedda, Massimo – Muschert, Glenn eds. (2018): *Theorizing Digital Divides.* London: Routledge. Online: https://doi.org/10.4324/9781315455334

Saikkonen, Loretta (2022): Metallialan työntekijöiden digitaaliset informaatiotaidot – ketkä ovat vaarassa digisyrjäytyä? *Työelämän Tutkimus,* 20(3), 385–410. Online: https://doi.org/10.37455/tt.110005

Saikkonen, Loretta – Kaarakainen, Meri-Tuulia (2021): Multivariate Analysis of Teachers' Digital Information Skills. The Importance of Available Resources. *Computers & Education,* 168(104206), 1–13. Online: https://doi.org/10.1016/j.compedu.2021.104206

SAK (2020): *SAK:n työolobarometri.* Helsinki: SAK.

Scheerder, Anique – van Deursen, Alexander– van Dijk, Jan (2017): Determinants of Internet Skills Use and Outcomes. A Systematic Review of the Second- and Third-Level Digital Divide. *Telematics and Informatics,* 34(8), 1607–1624. Online: https://doi.org/10.1016/j.tele.2017.07.007

Sutela, Hanna – Pärnänen, Anna – Keyriläinen, Marianne (2019): *Digiajan työelämä. Työolotutkimuksen tuloksia 1977–2018.* Helsinki: Statistics Finland.

Van Deursen, Alexander – Helsper, Ellen (2018): Collateral Benefits of Internet Use. Explaining the Diverse Outcomes of Engaging with the Internet. *New Media & Society,* 20(7), 2333–2351. Online: https://doi.org/10.1177/1461444817715282

Van Deursen, Alexander – Helsper, Ellen – Eynon, Rebecca (2016): Development and Validation of the Internet Skills Scale (ISS). *Information, Communication & Society,* 19(6), 804–823. Online: https://doi.org/10.1080/1369118X.2015.1078834

Van Deursen, Alexander – Helsper, Ellen – Eynon, Rebecca – van Dijk, Jan (2017): The Compoundness and Sequentiality of Digital Inequality. *International Journal of Communication,* 11. 452–473.

Van Dijk, Jan A.G.M. (2005): *The Deepening Divide, Inequality in the Information Society.* London: Sage. Online: https://doi.org/10.4135/9781452229812

Van Laar, Ester – van Deursen, Alexander – van Dijk, Jan – de Haan, Jos (2017): The Relation between 21st-Century Skills and Digital Skills. A Systematic Literature Review. *Computers in Human Behavior,* 72, 577–588. Online: https://doi.org/10.1177/2158244019900176

Vuorikari, Riina – Kluzer, Stefano – Punie, Yves (2022): *DigComp 2.2. The Digital Competence Framework for Citizens – With New Examples of Knowledge, Skills and Attitudes.* JRC128415. Luxembourg: Publications Office of the European Union. Online: https://doi.org/10.2760/115376

Westlund, Oscar – Bjur, Jakob (2014): Media Life of the Young. *Young,* 22(1), 21–41. Online: https://doi.org/10.1177/1103308813512934

Tuomo Alasoini is a Research Professor at the Finnish Institute of Occupational Health and has had a long career as a civil servant at the Ministry of Social Affairs and Health, the Ministry of Labour, and the Finnish Funding Agency for Innovation Tekes (now Business Finland). Alasoini has a PhD in Sociology (1990) and Industrial Engineering and Management (2016). He is also an Associate Professor of Sociology at the University of Helsinki. His current research projects revolve around the future of work, digital divides, hybrid work, platform work, and the twin (digital and green) transitions of working life.

PRO PUBLICO BONO – Public Administration, 2024/1, 145–172. • DOI: 10.32575/ppb.2024.1.7

Branka Andjelkovic – Tanja Jakobi – Ljubivoje Radonjic

RIGHT BEFORE YOUR EYES, YET UNNOTICED: A COMPARISON OF THE GROWTH OF ONLINE LABOUR IN VARIOUS COUNTRIES IN SOUTHEAST EUROPE

Branka Andjelkovic, Co-Founder and Programme Director, Public Policy Research Centre, Belgrade, Serbia, b.andjelkovic@publicpolicy.rs

Tanja Jakobi, Executive Director, Public Policy Research Centre, Belgrade, Serbia, t.jakobi@publicpolicy.rs

Ljubivoje Radonjic, Teaching Associate, State University of Novi Pazar, Novi Pazar, Serbia, ljradonjic@np.ac.rs

This paper focuses on the increasing prominence of digital labour platforms in the labour markets of Southeast Europe, and compares the supply of online labour from nine selected countries: Serbia, Romania, Hungary, Croatia, Bosnia and Herzegovina, Montenegro, Albania, North Macedonia, and Bulgaria. Digital labour platforms, as an innovative business model, play an important role in today's labour markets by linking the demand and supply of digital work. Southeast Europe is no exception to this trend, and has become an important supplier of online labour. With the impact of the Covid–19 pandemic, this and other new forms of employment further increased both globally and in Southeast Europe. Despite this trend, online labour often remains invisible and under the radar of national policymakers and regulators, as well as national statistical agencies, due to the globalised nature of online platforms.

This paper aims to shed light on the development of online labour in the countries studied, based on publicly available data collected through Gigmetar, a web scraping tool designed to monitor trends on the number, gender, incomes, and occupations of online workers.[1] *The paper compares online labour from nine countries active on the most significant general digital labour platforms (Upwork, Freelancer, and Guru) from February 2022 to October 2022. The criteria*

[1] See: https://gigmetar.publicpolicy.rs/en/1538-2/

for the comparison include occupations,[2] gender and income. The analysis is based on the data of approximately 80% of the total number of active digital workers on the platforms under investigation.

The paper points out the similarities and differences in online labour between the countries of Southeast Europe. For example, the number of online workers increased in all the countries, with creative services and multimedia and software development comprising the most dominant occupations in each country. Moreover, men are more commonly represented in these digital markets than women. However, these generalities hide remarkable differences between the countries in terms of the number of online workers per capita, the comparative advantages of each country based on the composition of the online labour force in terms of professions, variations in the gender gap in income distribution, and the average hourly labour price demanded by workers.

The results of our analysis may provide useful information to national policy makers as they work to address the challenges in the labour market brought by technological advancements. This information can also be used to develop policies in areas such as labour rights, education and training, and gender equality.

Keywords:
digital labour platforms, online labour, labour markets, Southeast Europe, Gigmetar

INTRODUCTION

Digital platforms can be understood as gigantic machines for organisationally and spatially reshaping the space of economic activity by connecting massive numbers of users/customers with service providers, advertisers, or other users.[3] Among the expanding array of digital platforms, digital labour platforms stand out as those that are primarily responsible for linking workers with businesses and clients to provide a diverse range of services by matching labour demand and supply. This feature distinguishes them from other digital platforms operating in various sectors of the economy.[4]

The literature typically identifies two types of digital labour platforms. The first type is referred to as "online web-based" platforms, which facilitate digitally transferable services like writing, editing, translating, and programming tasks through digital labour platforms.[5] The second type is known as "location-based" platforms, where workers perform various duties such as food delivery, taxi services, and home cleaning at a specific physical location.[6] As a result, workers who perform tasks through these platforms are usually categorised into

[2] Occupations are defined according to the Online Labour Index (OLI) classification, allowing the comparison between the selected countries and others.

[3] Kenney et al. 2023; Kenney–Zysman 2019.

[4] ILO 2021: 43.

[5] Graham–Anwar 2019.

[6] Pajarinen et al. 2018; Mandl et al. 2018: 3; ILO 2021: 31.

two groups: "online web-based" or digital online workers[7] with specialised skills (such as Upwork freelancers) and location-based online workers (such as Uber drivers). Piasna (2020) and other authors refer to these types of workers as "online" and "offline" online workers.[8]

The concept of platform work, regardless of whether it is performed online of offline, often involves the completion of limited and independent units of work. These units are known by various terms such as piecemeal, task-based, gig, or project-based work, as opposed to the continuous work typical of traditional employment contracts.[9] Furthermore, this type of work is characterised by a limitless career perspective, where individuals are responsible for developing their own careers and skills, rather than relying on employers to provide training and career advancement opportunities.[10]

The use of digital labour platforms is projected to grow significantly in the coming years, potentially challenging what is traditionally regarded as a "job".[11] As a result, digital platform work has garnered attention not only from academic researchers, but also from policy makers and the general public, who are concerned about its implications for individuals, and the social dynamics of work. Questions have been raised about the prevalence of digital platform work, its level of informality and the complexity of skills required, gender distribution, and income, among other issues.[12]

While many studies and legislative initiatives have focused on the location-based platform work which is prevalent in Western Europe,[13] this paper aims to shed light on online platform work,[14] which is more common in Southeast Europe.[15] Indeed, in terms of the proportion of their online platform workforce relative to their total population and workforce, Serbia and North Macedonia are continuously among the top-ranking countries in Europe and the world.[16] Furthermore, earlier studies such as that by Kuek et al. (2015) revealed that as early as 2013, Serbia and Romania were among the countries with the highest proportion of the workforce engaged in this type of work. Moreover, neighbouring countries have also begun to bolster their online digital workforce, albeit from a more modest starting point, as evidenced by Andjelkovic et al.'s (2022) research.[17]

This paper examines the growing significance of web-based digital labour platforms in the labour markets of Southeast Europe, and compares the supply of online platform work across nine selected countries, including Serbia, Romania, Hungary, Croatia, Bosnia and Herzegovina, Montenegro, Albania, North Macedonia, and Bulgaria.

7 Aleksynska 2021.
8 Piasna 2020.
9 McDonnell et al. 2021.
10 Forrier et al. 2009; Miles–Snow 1996.
11 Schor–Vallas 2023: 83.
12 Piasna 2020; McDonnell et al. 2021; Moniz et al. 2021; Andjelkovic–Jakobi 2022.
13 Piasna–Zwysen–Drahokoupil 2022.
14 In this paper, we use the term online web-based work and online platform work interchangeably.
15 Čolović–Andjelkovic–Jakobi 2021.
16 See: http://onlinelabourobservatory.org/oli-supply/
17 Kuek et al. 2015; See: https://gigmetar.publicpolicy.rs/en/region-en-2022-2/

To analyse the online platform labour in these countries, we focus on three criteria: occupations, gender, and income. Our aim is to provide national policymakers with valuable data to address various challenges posed by online platform work, such as labour rights, education and training, and gender equality. The paper is structured as follows: first, we provide a description of the methodology used; then, we present an analysis of the country data, highlighting similarities and differences between the countries; and finally, we present our conclusions. In this paper, we use the term online labour/workers to denote online freelancing performed on digital labour platforms.

METHODOLOGY

This paper interprets the results from Gigmetar, an instrument developed by the Public Policy Research Centre (PPRC) in 2019 with the aim of monitoring the number, gender, incomes, and occupations of online workers. Applying web scraping as a data collection method, which takes place at regular six month intervals, Gigmetar screens online workers at Upwork, one of the most popular digital labour platforms globally. Upwork is also the most prevalent platform in Serbia and in the majority of the neighbouring countries: Romania, Hungary, Croatia, Bosnia and Herzegovina, Montenegro, Albania, North Macedonia, and Bulgaria, i.e. the region of Southeast Europe.

The data collected in each period represent a relevant sample, comprising approximately 80% of the total number of active online workers on the platform studied in nine Southeast European countries.[18] The number of workers per capita by country takes into account the whole population of workers on Upwork as a sample.

This paper focuses on four cycles of Gigmetar findings, based on data collected in February 2021, August 2021, February 2022, and August 2022.

Table 1: The number of workers included in the measurements (by country and in total)

Country	Feb-21	Aug-21	Feb-22	Aug-22	Trend
Albania	2,205	2,810	4,522	4,876	
Bosnia and Herzegovina	2,108	2,609	3,604	3,822	
Bulgaria	3,113	3,404	4,343	4,669	
Croatia	1,710	1,950	2,975	3,197	
Hungary	1,806	1,973	2,598	3,402	
Montenegro	530	705	927	1,071	
North Macedonia	3,216	3,589	4,615	5,386	

[18] The analysis of the characteristics of gig work in these countries is based on the sample composed of 80% of the total number of active digital workers on the Upwork in nine Southeast European countries. The data are collected by the web scraping of publicly available information at worker profiles on the selected platform. Around 20% of the workers remain invisible since their profiles are locked for the public.

Country	Feb-21	Aug-21	Feb-22	Aug-22	Trend
Romania	5,881	6,769	9,038	9,691	
Serbia	8,469	8,737	10,126	11,596	
Total	29,038	32,546	42,748	47,710	

Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

The first measurement (February 2021) comprised the data of 29,038 online workers in nine countries. The sizes of the samples per country were as follows: Albania – 2,205, Bosnia and Herzegovina – 2,108, Bulgaria – 3,113, Montenegro – 530, Croatia – 1,710, Hungary – 1,806, Romania – 5,881, North Macedonia – 3,216, and Serbia – 8,469 of online workers.

The second measurement (August 2021) collected the data for 32,546 online workers in nine countries. The samples per countries included: Albania – 2,810, Bosnia and Herzegovina – 2,609, Bulgaria – 3,404, Montenegro – 705, Croatia – 1,950, Hungary – 1,973, Romania – 6,769, North Macedonia – 3,589, and Serbia – 8,737 online workers.

The third measurement (August 2021) comprised the data of 42,748 online workers in nine countries. The samples per country were the following: Albania – 4,522, Bosnia and Herzegovina – 3,604, Bulgaria – 4,343, Montenegro – 927, Croatia – 2,975, Hungary – 2,598, Romania – 9,038, North Macedonia – 4,615, and Serbia – 10,126 of online workers.

The fourth measurement (August 2021) collected the data for 47,710 online workers in nine countries. The samples per countries included: Albania – 4,876, Bosnia and Herzegovina – 3,822, Bulgaria – 4,669, Montenegro – 1,071, Croatia – 3,197, Hungary – 3,402, Romania – 9,691, North Macedonia – 5,386, and Serbia – 11,596 online workers.

FINDINGS

This chapter first presents the total population of online workers and the average number of online workers per 100,000 inhabitants, followed by a breakdown by gender. Finally, results on occupations,[19] average hourly rates[20] demanded, and earnings[21] broken down by gender are presented.

[19] The occupations of the workers are classified according to the Online Labour Index methodology comprising 6 groups of occupations: 1 – Professional services, 2 – Clerical and data entry, 3 – Creative and multimedia, 4 – Sales and marketing, 5 – Software development and technology, 6 – Writing and translation.

[20] The average hourly rate represents a starting value of the price demanded per hour by a freelancer for his/her work on the platform.

[21] Earnings represent the income that online workers have gained during the observed period. The earnings presented are lifetime earnings encompassing the total income that workers have generated from the moment they opened their profile on the platform until the moment of data retrieval. The calculation of average earnings includes workers who had not generated any income at the time of measurement.

Population of online workers

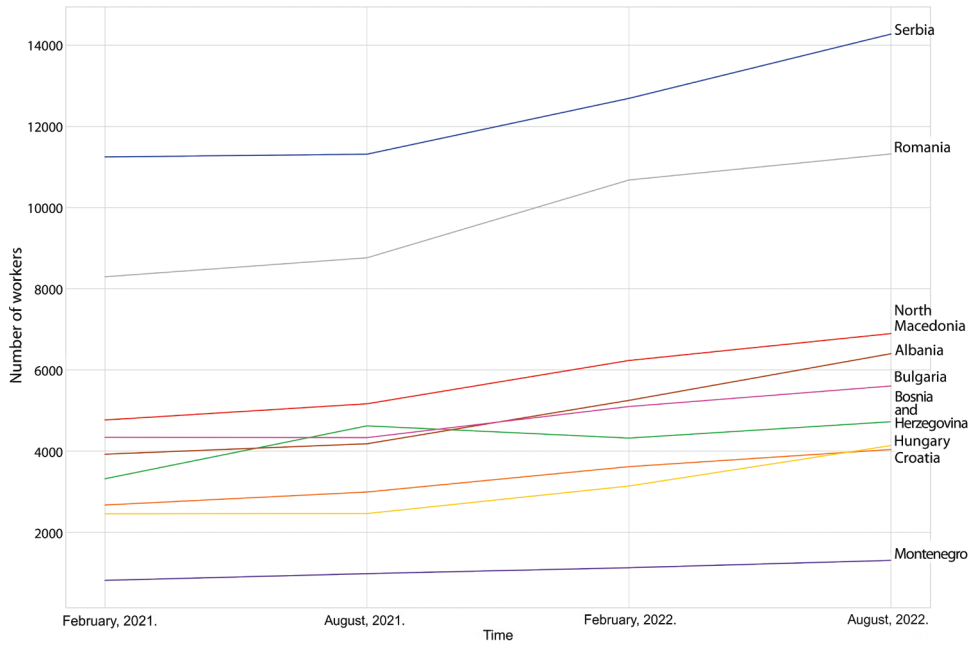
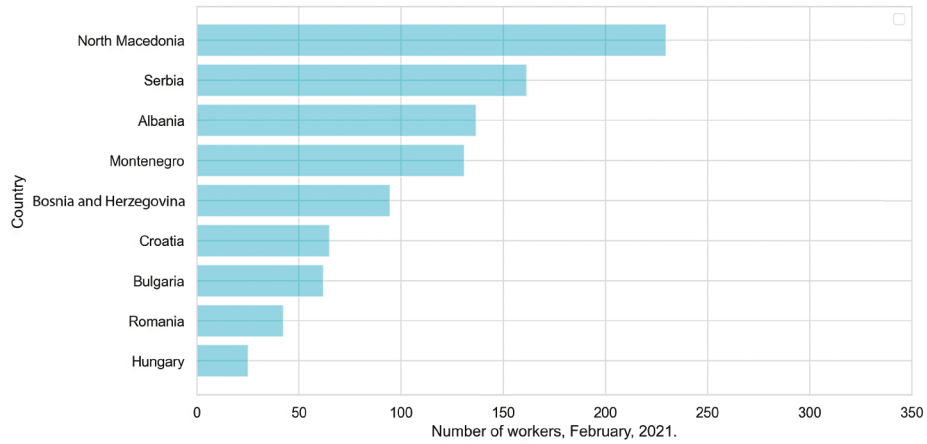
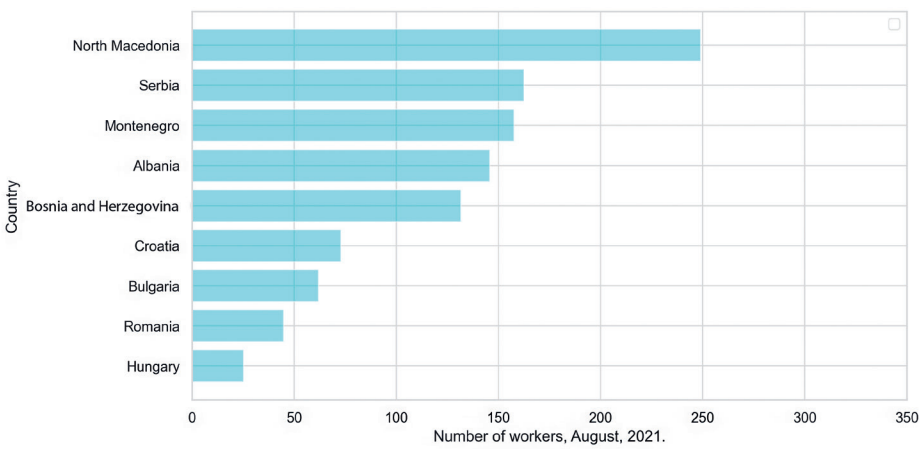


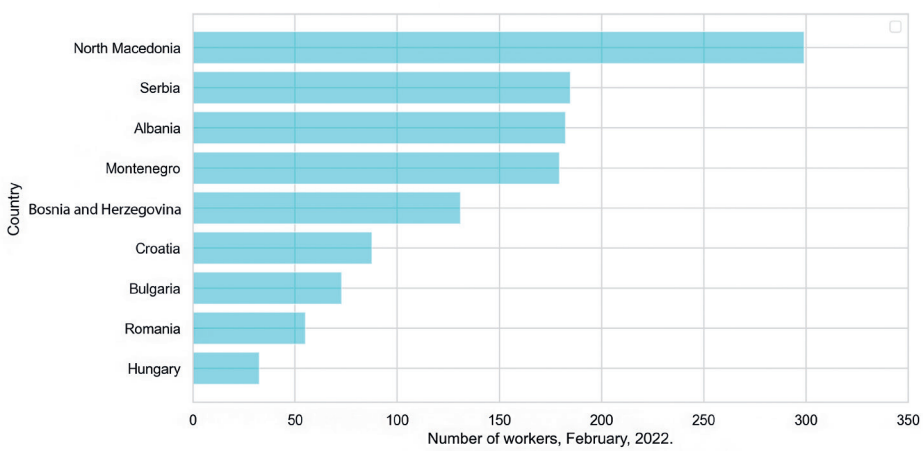
Figure 1: Number of online workers per country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

Figure 1 shows the total online labour force of each country and their trends over two years. Serbia has by far the largest population of online workers in the region, and is followed only by Romania. North Macedonia and Albania are in the third and fourth place, respectively, and have almost the same number of online workers. Bulgaria, Bosnia and Herzegovina, Hungary and Croatia have more modest online labour forces. Montenegro has the smallest population of online workers, with the equivalent of only one-tenth of Serbia's online labour force.

Almost all the countries recorded an increase in the number of workers during the four periods measured, except for Bosnia and Herzegovina, which saw a slight decrease in its number of online workers between the second half of 2021 and the first half of 2022, and Bulgaria, which experienced a slight decrease in the number of online workers during the second half of 2021. In four out of the nine observed countries, the number of online workers doubled between the first (February 2021) and last measurement (February 2022) – in Hungary (+68.5%), Albania (+63.1%), Montenegro (+60.5%), and Croatia (+51.2%). In contrast, Bulgaria (+29.2%) and Serbia (+26.9%) saw a smaller increase in the online labour population between the two periods.


North Macedonia
Serbia
Albania
Montenegro
Bosnia and Herzegovina
Croatia
Bulgaria
Romania
Hungary
Country
0
50
100
150
200
250
300
350
Number of workers, February, 2021.


North Macedonia
Serbia
Montenegro
Albania
Bosnia and Herzegovina
Croatia
Bulgaria
Romania
Hungary
Country
0
50
100
150
200
250
300
350
Number of workers, August, 2021.


North Macedonia
Serbia
Albania
Montenegro
Bosnia and Herzegovina
Croatia
Bulgaria
Romania
Hungary
Country
0
50
100
150
200
250
300
350
Number of workers, February, 2022.

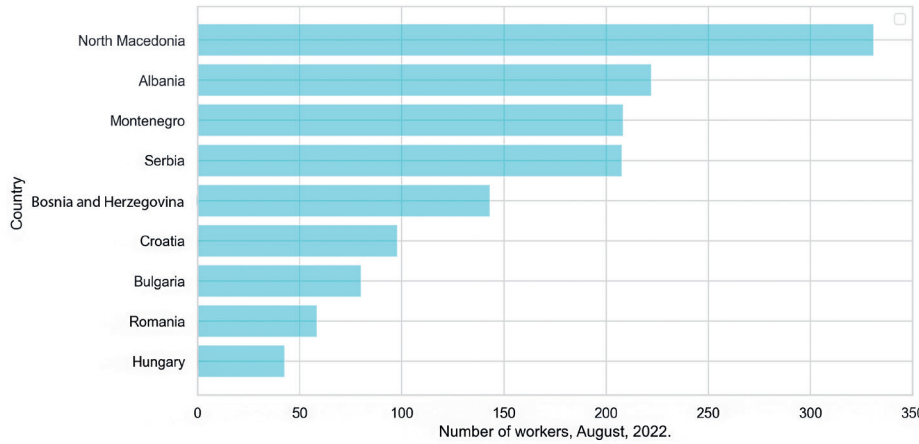


Figure 2: Number of online workers per 100,000 inhabitants per country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

In summary, Serbia boasts the largest population of online workers in the region, while Montenegro has the smallest. With the exception of Bosnia and Herzegovina and Bulgaria, most countries have experienced an increase in the number of citizens doing online labour. These findings point to a growing trend of online work in the region, which could have significant implications for labour markets and policies. However, further research is necessary to fully understand its impact on national markets.

Differences in the total number of online workers between the countries can primarily be attributed to differences in population size and the overall labour market of the observed countries. As such, a more accurate representation of gig work in the region can be obtained by calculating the average number of online workers per 100,000 inhabitants and better reflects the relative share and importance of platform work in a country's economy. As Figure 2 (above) shows, Hungary, Romania, Bulgaria, and Croatia consistently reported the lowest proportion of online workers per capita, despite an increase in the number of online workers over the course of the four measurements. In contrast, North Macedonia had the highest number of online workers per capita, with approximately 230 online workers per 100,000 inhabitants in February 2021 and 331 workers per capita in August 2022. In the first three measurements, Serbia ranked second after North Macedonia, but during the last measurement in August 2022, Albania recorded the second largest population of online workers per 100,000 inhabitants with approximately 222 online workers per capita.

Montenegro ranked third with approximately 208 online workers per capita, while Serbia fell to fourth place with approximately 207 online workers per capita. The findings are corroborated by similar research carried out by the OLI (2022) and the European Training Foundation (2022).

The data presented in this paper suggest that platform work is more popular in less developed countries, as evidenced by the highest number of online workers per capita being recorded in these countries. In contrast, the more developed countries in the observed group, such as Hungary, Croatia, Romania, and Bulgaria, have the lowest number of online workers per capita. However, it is important to exercise caution in drawing conclusions in this regard, since the labour markets in countries such as Hungary, Romania, and Bulgaria are known to have a higher penetration by other general platforms than Upwork.

The significant number of workers per capita in the less developed countries of Southeast Europe suggests that platform work still represents a viable alternative to jobs offered in the traditional labour market.

Gender representation

One of the common features of online platform work in all countries is the overrepresentation of men compared to women in the sector, as Figure 3 shows. Indeed, in some countries, such as Bosnia and Herzegovina, men dominate the online labour to a significant extent. Despite a slight decrease in the proportion of men on the Upwork platform since the first measurement, when men made up about 74.4% of the total workforce, men still represented around 68.3% of the online labour population in Bosnia and Herzegovina in August 2022. Similarly, relatively high participation rates of men can be observed in Serbia (67.2%), Hungary (67.1%), and Croatia (65.8%) based on the latest measurement.

Conversely, Albania is a country where there is a smaller gender gap in the participation of men and women in online gig work. According to the latest measurement (August 2022), women represented 41.4% of the gig worker population in this country. In February 2022, the participation of women in Albania was even higher at 43.1%. Considering that Albania stands out as a country with a significant number of online workers per capita and a relatively higher level of participation of women in the market, it appears that platform work in this country is becoming more attractive for women. This might be related to the World Bank intervention in this country entitled "Digital Jobs Albania" promoting digital entrepreneurship among women.

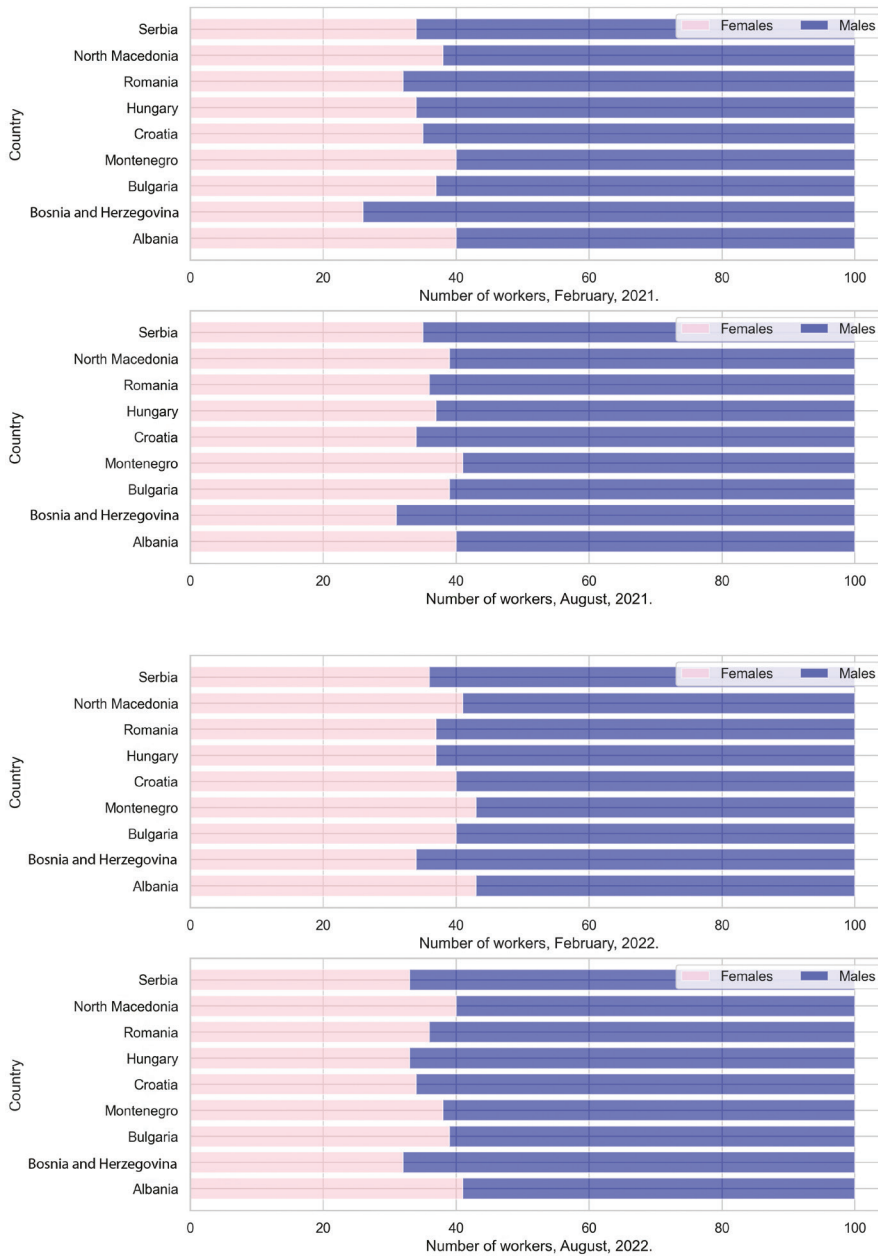


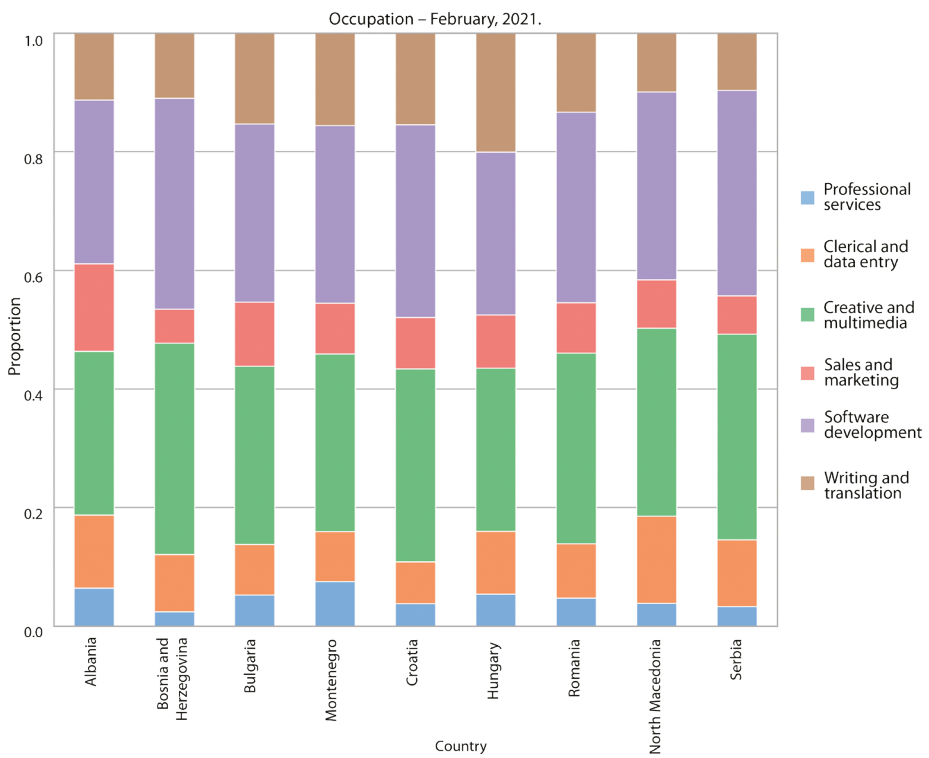
Figure 3: Share of women and men in the "gig worker" population by country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

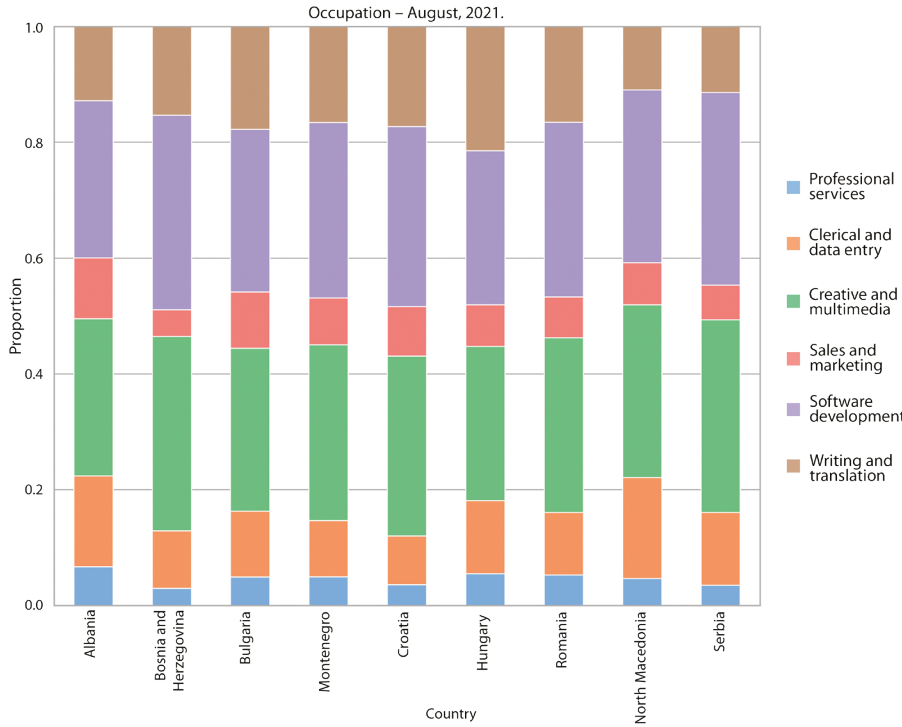
Occupations

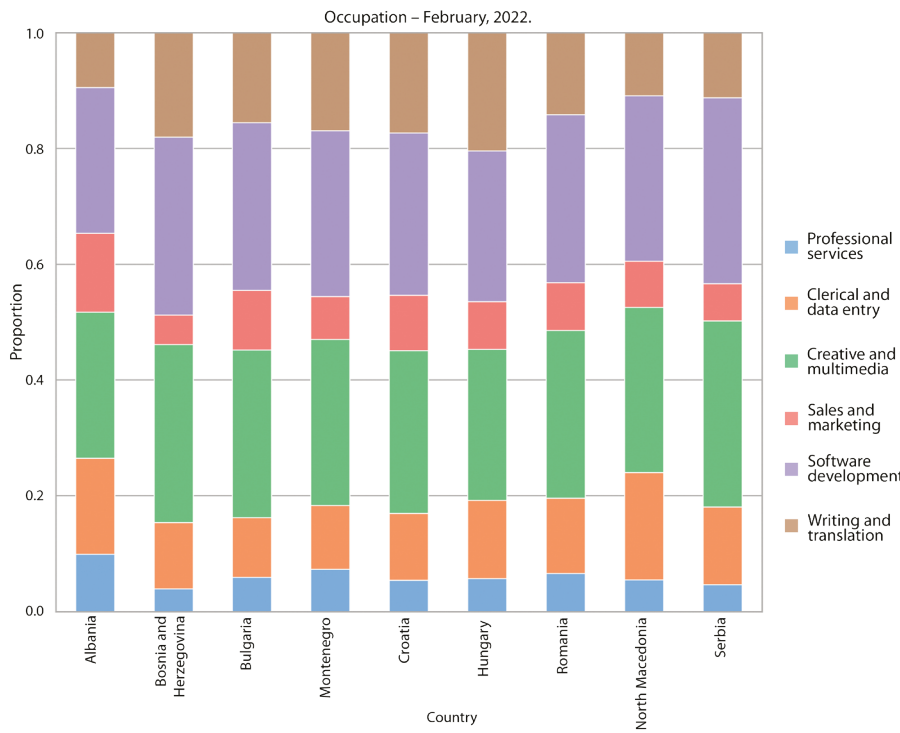
Based on the data in Figure 4 below, it can be concluded that two groups of professions were dominant in the online labour sector throughout the observed period of time in all of the countries. These professions are software development and creative services and multimedia. However, the distribution of certain occupations varies significantly by country, with some countries showing greater proportions in certain fields.

For example, Albania, Montenegro, Hungary, Romania and North Macedonia have comparatively higher proportions of online workers in the field of professional services, which has been maintained throughout the observed period. In the domain of clerical and data entry occupation, Albania, North Macedonia, and Serbia stand out compared to the regional average.

With regards to the highly valued occupations represented in the creative services and multimedia, and software development, workers from Bosnia and Herzegovina, Montenegro, Croatia and Serbia are the forerunners. In the field of sales and marketing, online workers in Albania, Bulgaria, Croatia, Hungary, and Romania comprise a greater proportion than elsewhere. Finally, workers from Bosnia and Herzegovina, Bulgaria, Montenegro, Croatia, Hungary, and Romania stand out in the field of writing and translation.




Occupation – August, 2021.
Proportion
1.0
0.8
0.6
0.4
0.2
0.0
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country
Professional services
Clerical and data entry
Creative and multimedia
Sales and marketing
Software development
Writing and translation


Occupation – February, 2022.
Proportion
1.0
0.8
0.6
0.4
0.2
0.0
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country
Professional services
Clerical and data entry
Creative and multimedia
Sales and marketing
Software development
Writing and translation

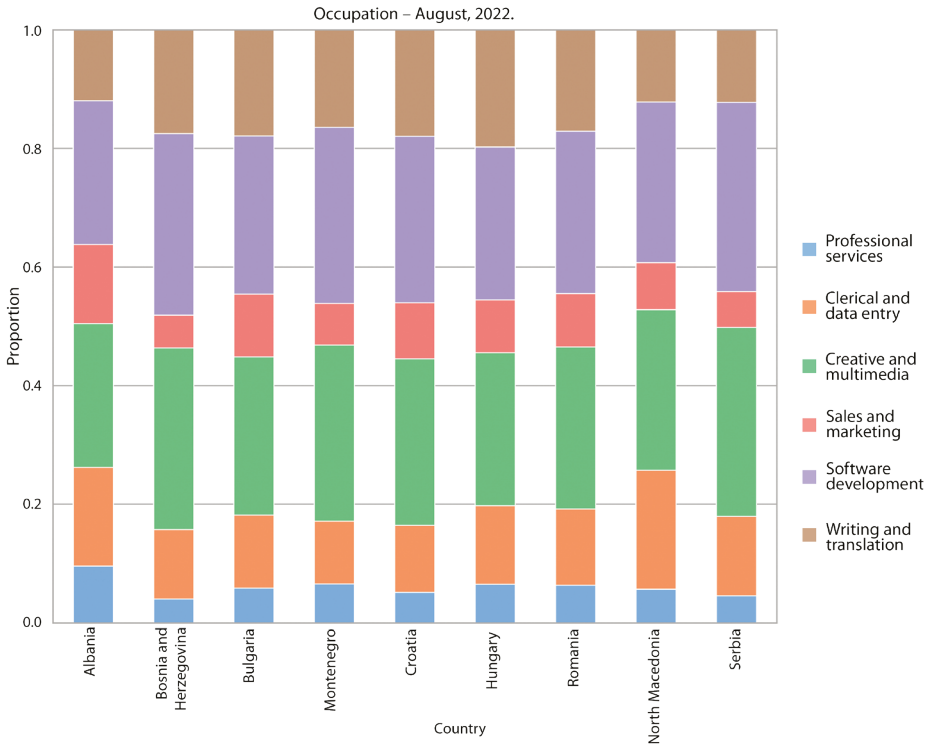


Figure 4: Share of OLI occupation in online workforce, by country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

Overall, the data indicate that certain countries are better represented in specific fields or occupations in terms of online labour than others. These differences may reflect the varying strengths and skills of their workforce, as well as their economic and political environment. Generally speaking, software development, creative services and multimedia, and professional services are considered higher-paid occupations, whereas writing and translation, sales and marketing, and clerical and data entry are regarded as lower-paid professions.[22]

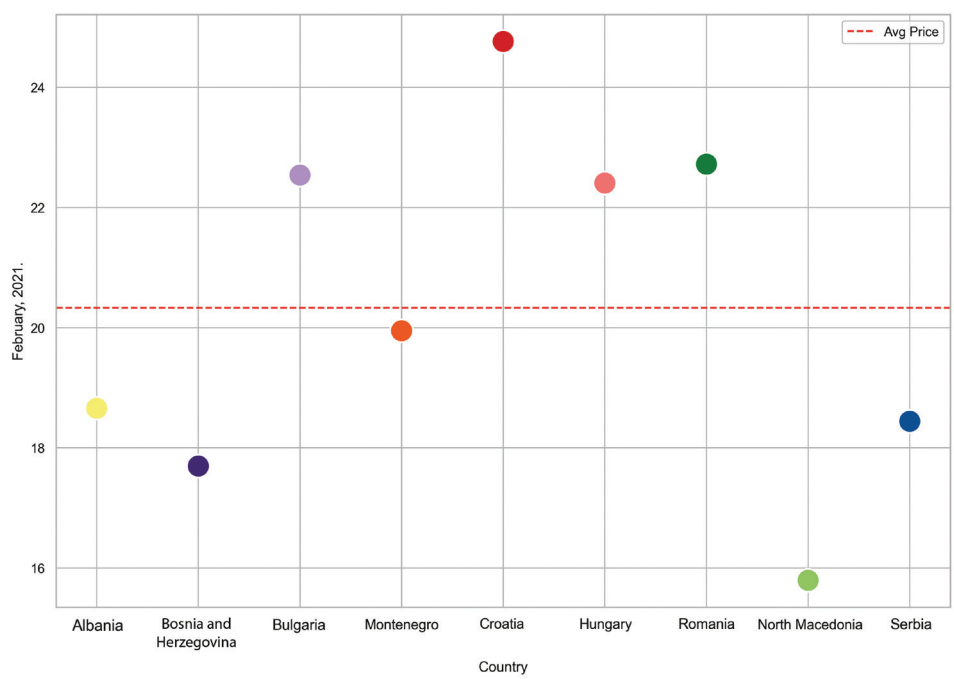
Therefore, having a comparative advantage in lower-paid professions implies more of a disadvantage than an advantage for the labour force in the given country.

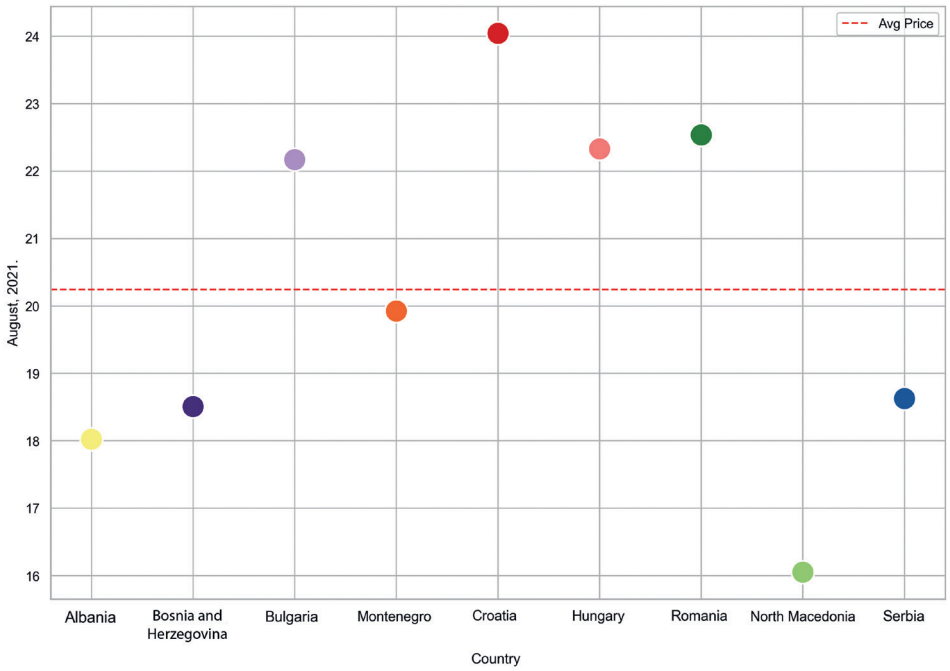
[22] Cedefop 2020.

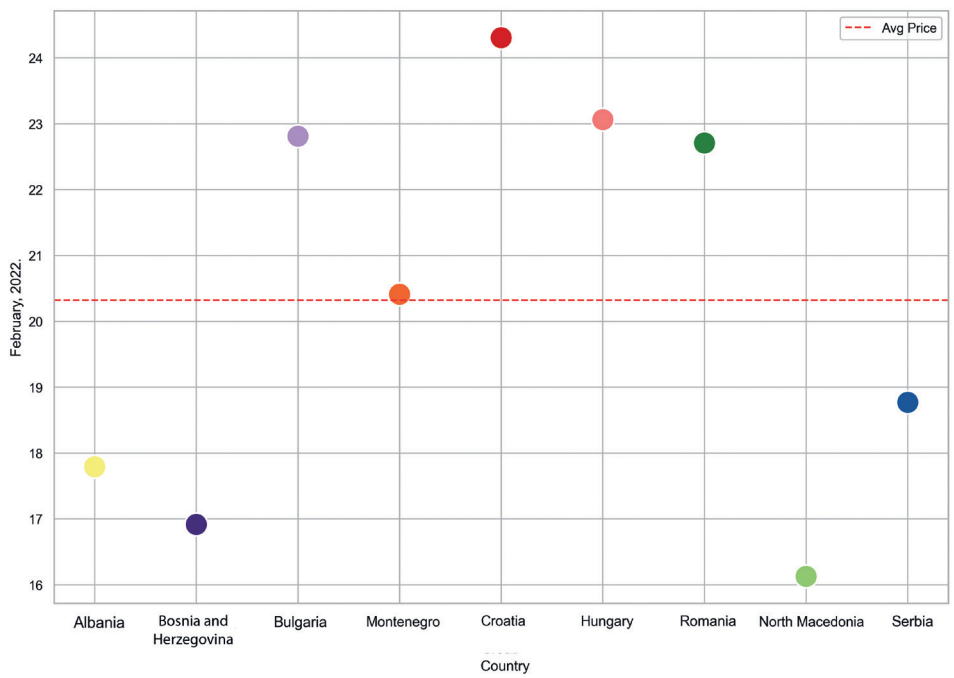
Average hourly rates

Figure 5 displays the discrepancy in the average hourly rates demanded by online workers across the different countries surveyed. On average, Croatia is recognised as having the most expensive workforce, with one exception recorded in the latest measurement when Hungary's average demanded hourly rates were slightly higher. Namely, the web-based platform economy in Hungary experienced an increase in average hourly rates from February 2021 to August 2022. Aside from Croatia and Hungary, two other countries – Bulgaria and Romania – had relatively higher average hourly rates of pay compared to the regional average in all four measurements. There was also indicative growth in Montenegro, with online workers potentially earning higher hourly rates compared to the regional average in the last two measurements. For the first two measurements, the average hourly rates in Montenegro were lower than the regional average.

In contrast, online workers in Serbia, Albania, Bosnia and Herzegovina, and North Macedonia demanded on average lower hourly rates than the regional average during each of the four measurements. Northern Macedonia was found to be the country with the lowest demanded hourly rates for online workers. Hypothetically, if a Hungarian freelancer worked 176 hours in August 2022 (the number of possible work hours in regular employment) and earned an average online worker income, he/she would have earned approximately $1,373 more than his/her counterpart in North Macedonia, assuming both worked on the same task and for the same number of hours.




Avg Price
August, 2021.
24
23
22
21
20
19
18
17
16
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country


Avg Price
February, 2022.
24
23
22
21
20
19
18
17
16
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country

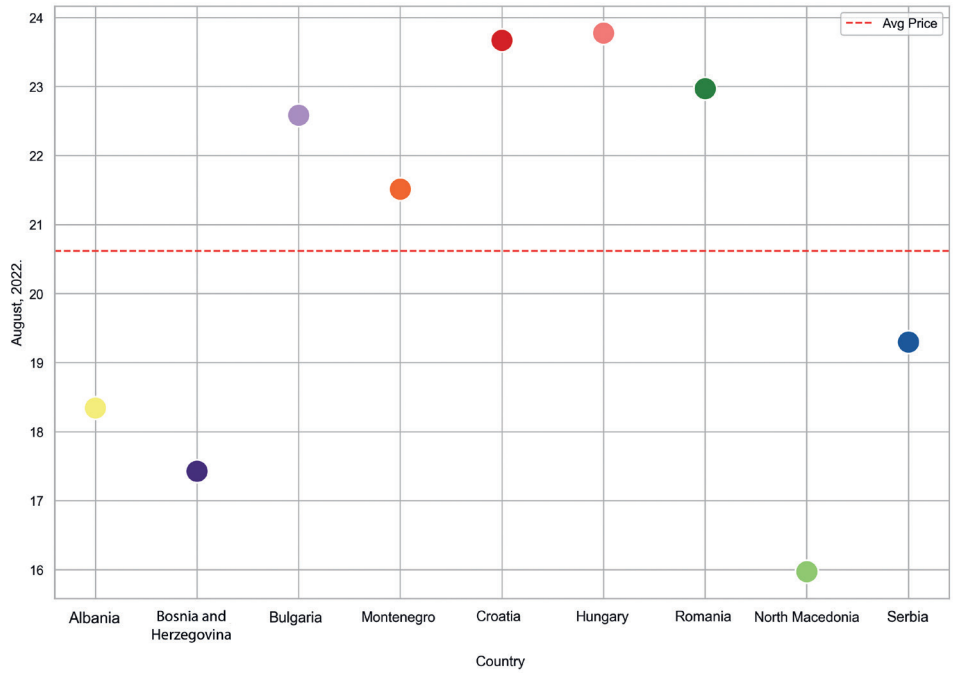
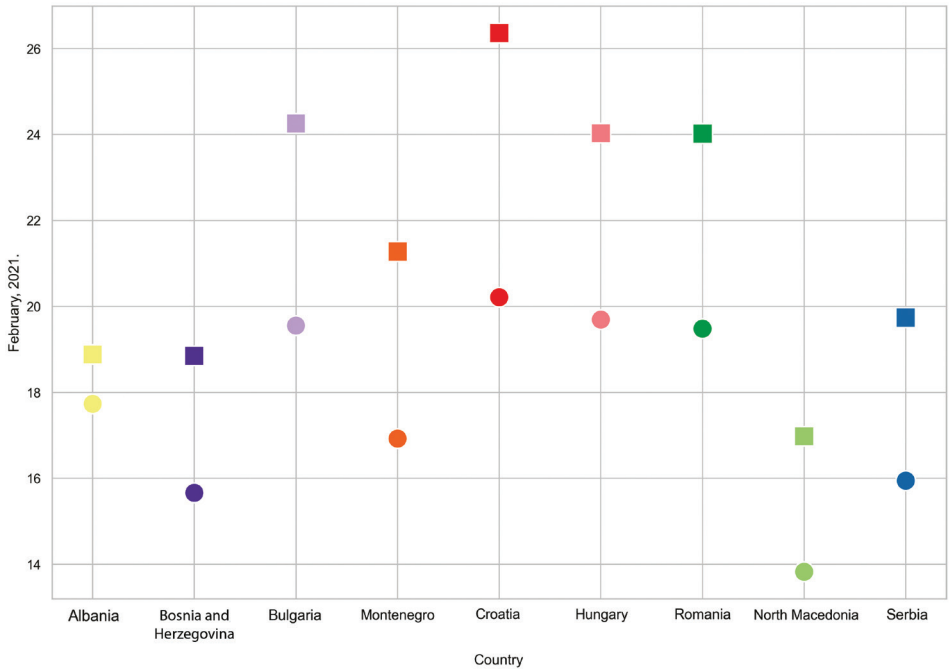
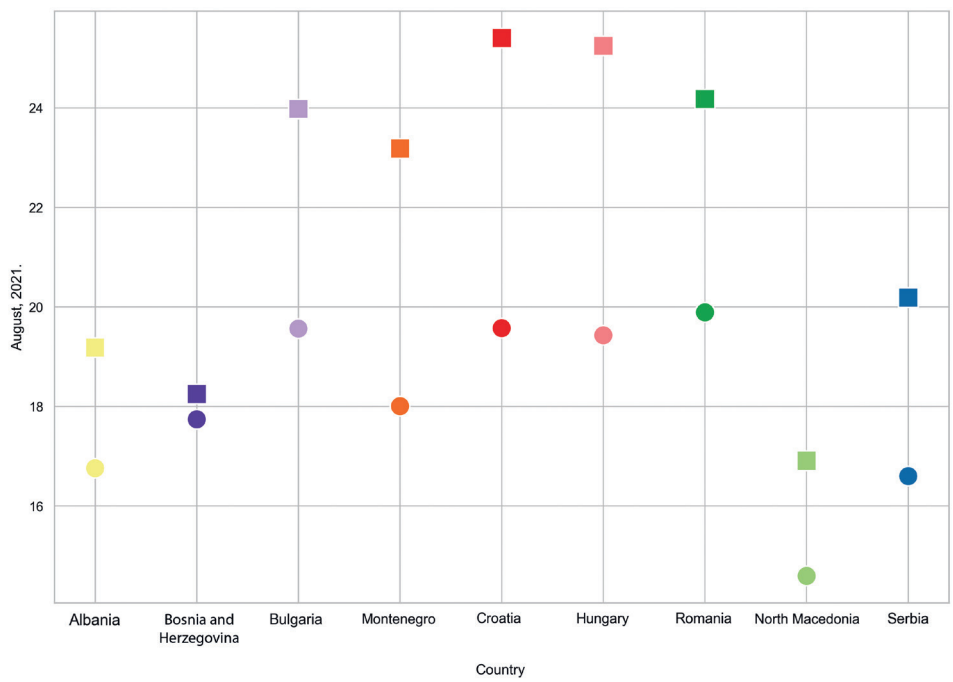


Figure 5: The average hourly rates by country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

Generally speaking, this sharp division between the two groups of countries reflects their position within or outside of the European Union, and suggests that online workers living in countries with higher living standards demand higher average hourly rates. However, it is important to note that requesting a higher hourly rate does not necessarily mean that these rates are actually paid.

Figure 6 illustrates the disparity in average hourly rates between men and women across the observed countries. The largest differences in average hourly rates demanded by men and women are observed in the countries with relatively higher total average hourly rates, including Croatia, Hungary, Bulgaria, Romania, and Montenegro. In contrast, countries such as Albania, North Macedonia, Bosnia and Herzegovina, and Serbia exhibited slightly smaller differences. The greatest convergence in average hourly rates demanded by male and female online workers is observed in Albania, which could be a result of the relatively higher participation of women in the gig economy of that country.


February, 2021.
26
24
22
20
18
16
14
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country


August, 2021.
24
22
20
18
16
Albania
Bosnia and Herzegovina
Bulgaria
Montenegro
Croatia
Hungary
Romania
North Macedonia
Serbia
Country

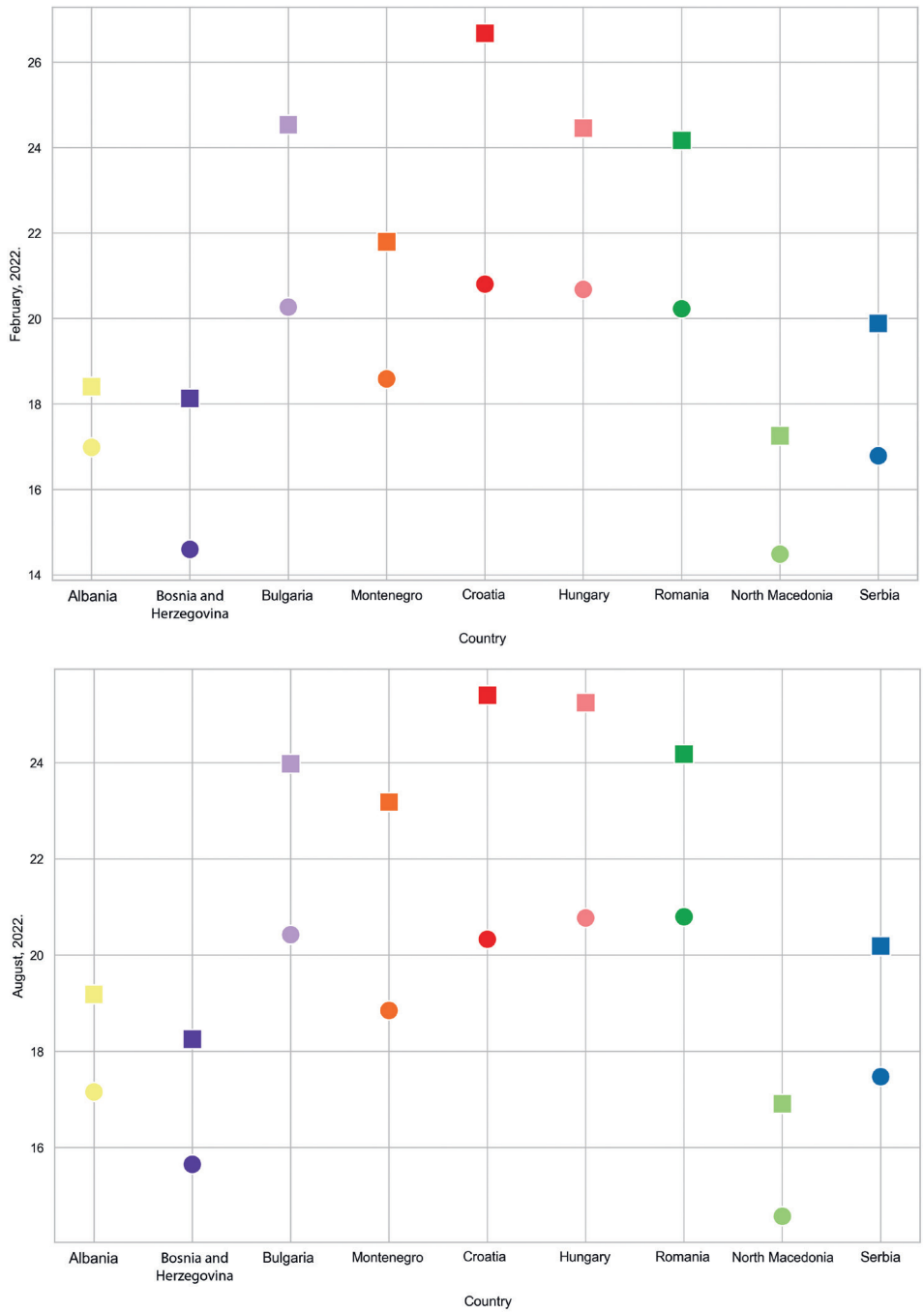


Figure 6: The average hourly rates between women and men, by country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

Earnings

Figure 7 depicts the earnings of online workers across the observed countries for each of the four measurement periods. The level of earnings differs significantly by country. Notably, the largest proportion of income on the platform is generated by online workers from Serbia and Romania, primarily due to the larger numbers of online workers in those countries. Conversely, workers from Montenegro earn the smallest share of earnings on platforms compared to the other countries. To compare the differences between countries, it is worth noting that the incomes obtained by online workers from Montenegro in August 2022 were only around 10% of the earnings achieved by online workers from Serbia in the same period.

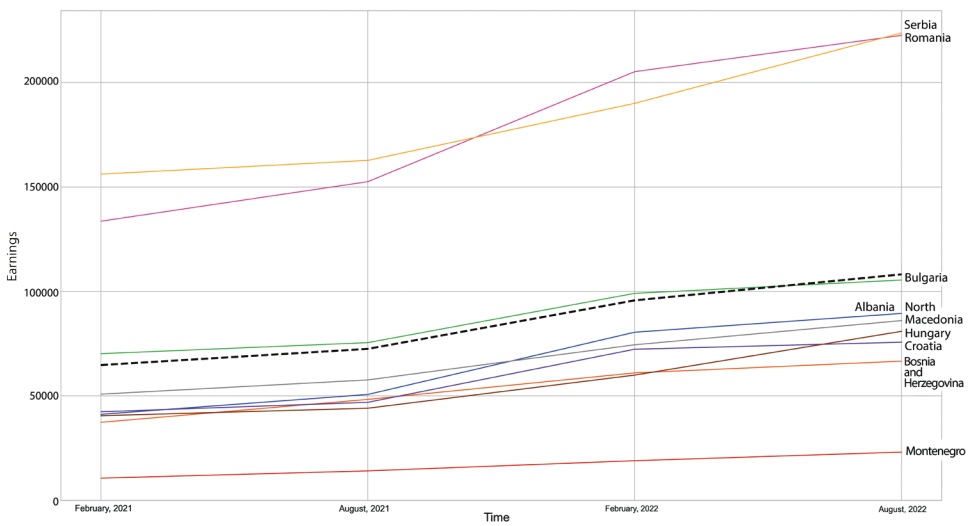
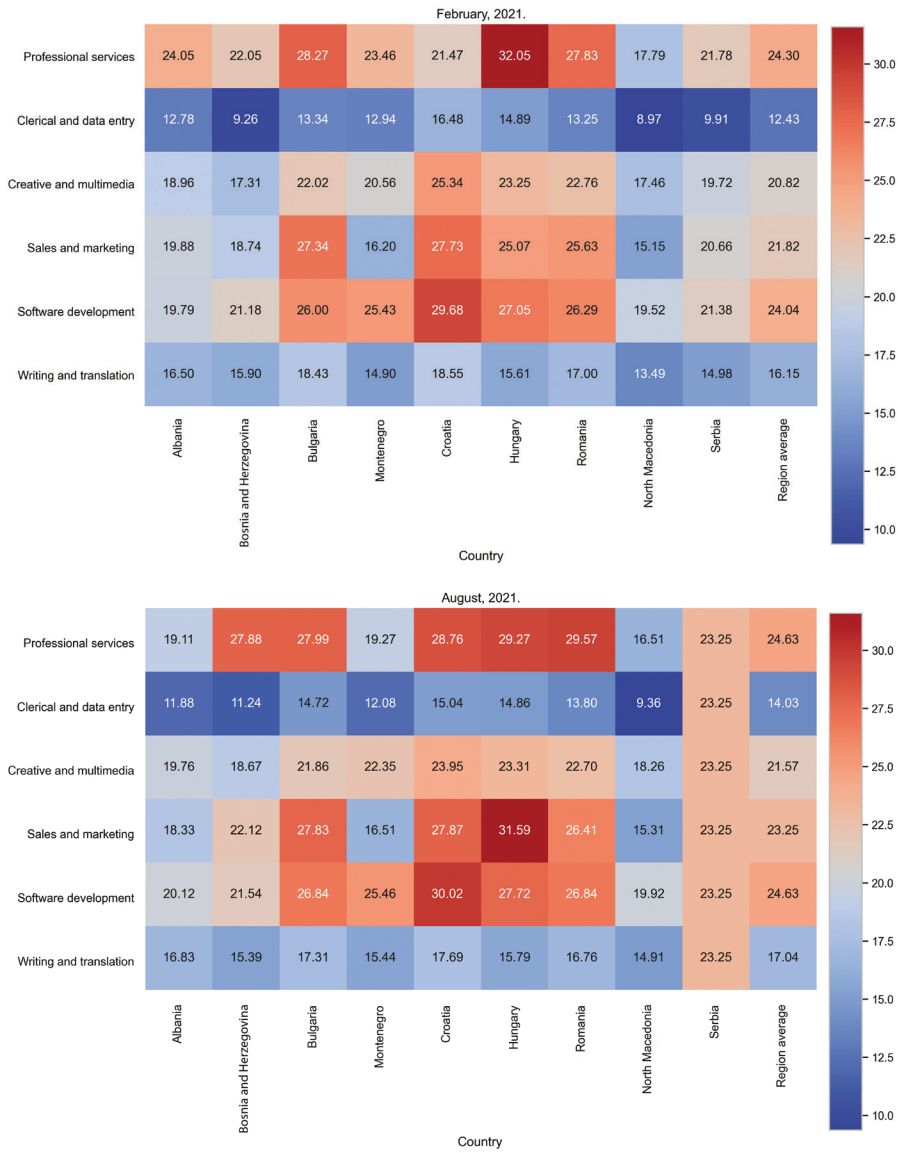


Figure 7: Average earnings of online workers, by country
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

One similarity across all nine countries is that men earn higher incomes than women for performing online labour, as Figure 8 shows. However, the income gaps between men and women vary between these countries. The results over the four periods indicate that the greatest absolute difference in realised incomes between men and women is observed in Serbia and Romania. This difference may be attributed to the greater representation of men in higher-paying professions, such as software development, which have higher average hourly rates. In all the countries surveyed, men were able to earn higher incomes by working on the platform due to the higher average hourly rates they demanded.

Comparing the latest measurement from August 2022 with the first measurement from February 2021, there was an overall increase in the income gap between men and women in

all countries. Data from August 2022 indicate that in five out of the nine countries studied (Bosnia and Herzegovina, Croatia, Hungary, Romania, and Serbia), women cannot earn even half of the income earned by men. According to the latest measurement, women in Montenegro achieved 50.8%, in Bulgaria 54.9%, and in North Macedonia 57.6% of the total income achieved by men. Only in Albania did women earn more than 60% of the income earned by men. It is also important to note that the greatest convergence in average hourly rates between men and women was recorded in Albania, which may significantly affect income distribution.



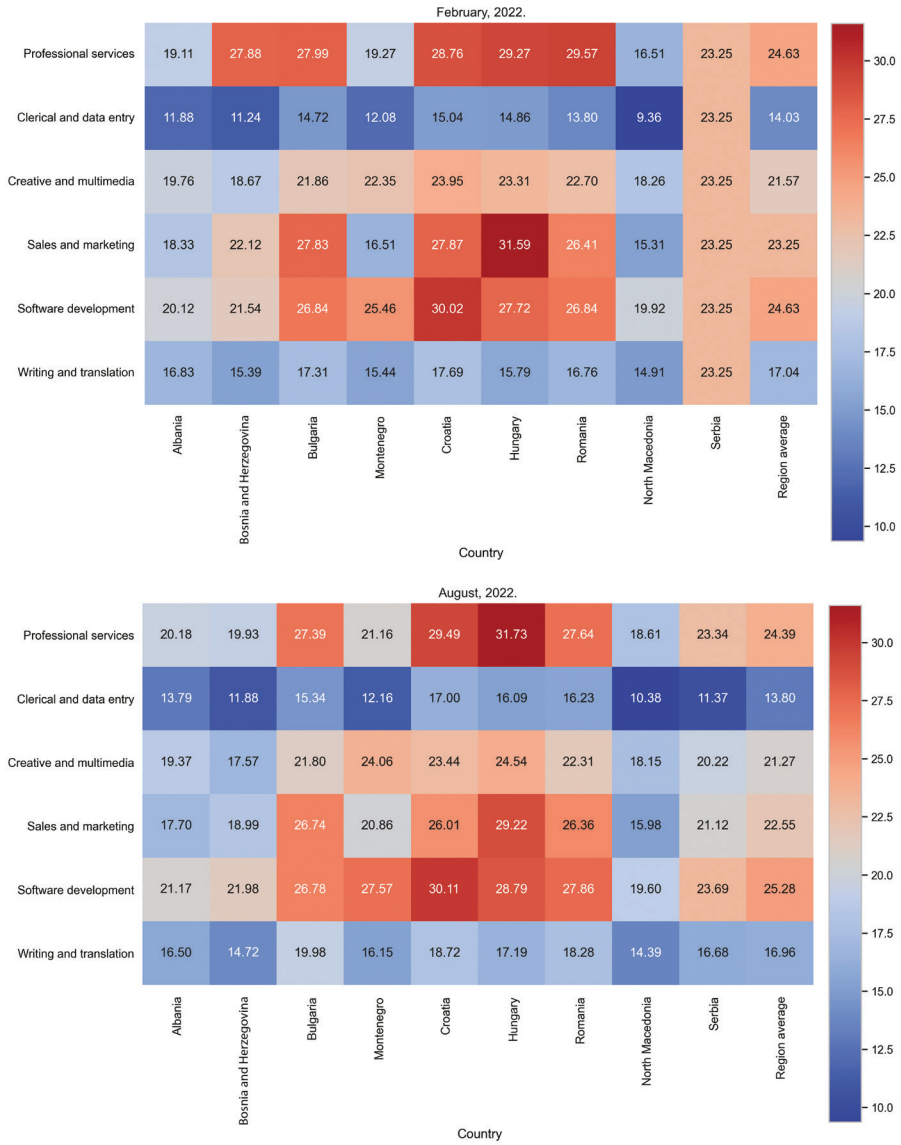
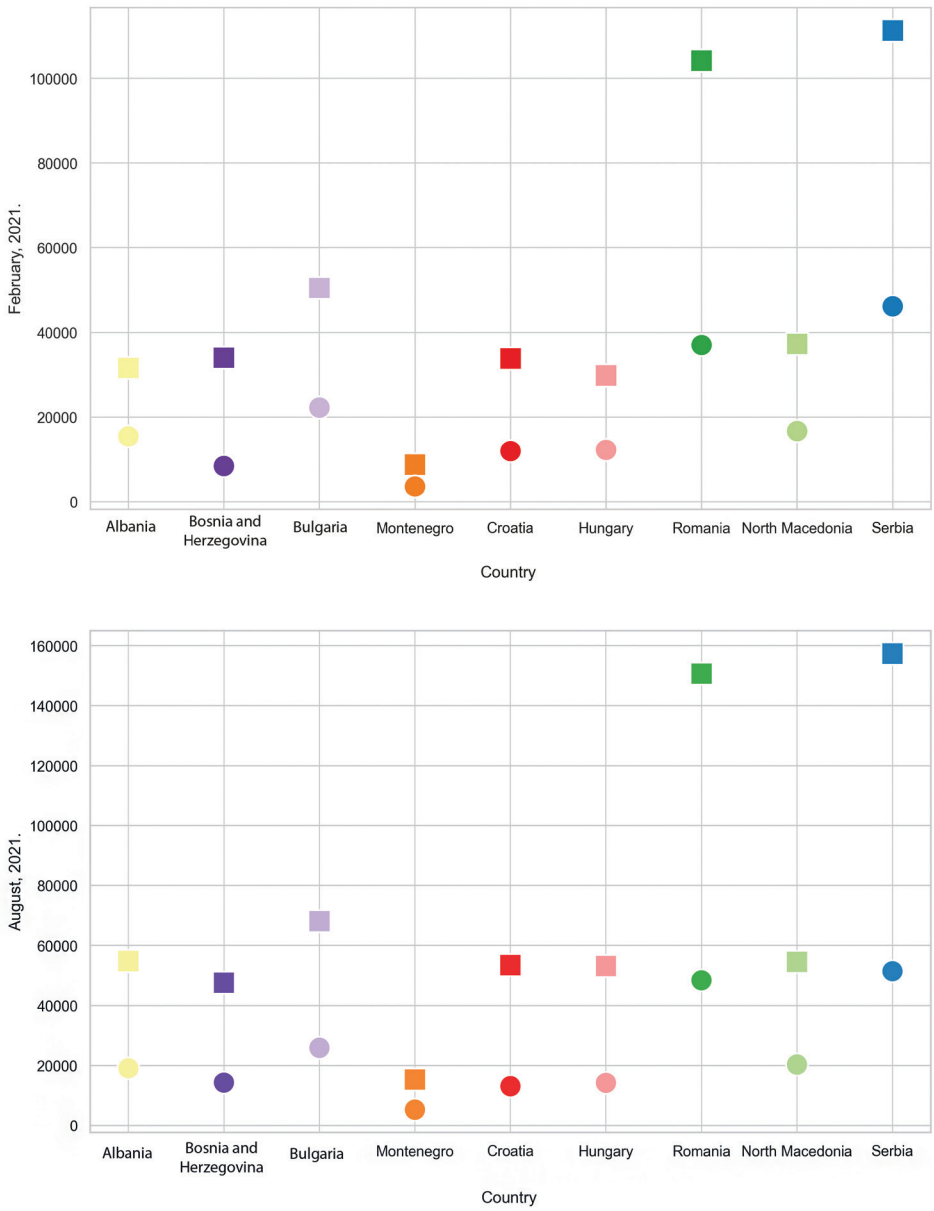
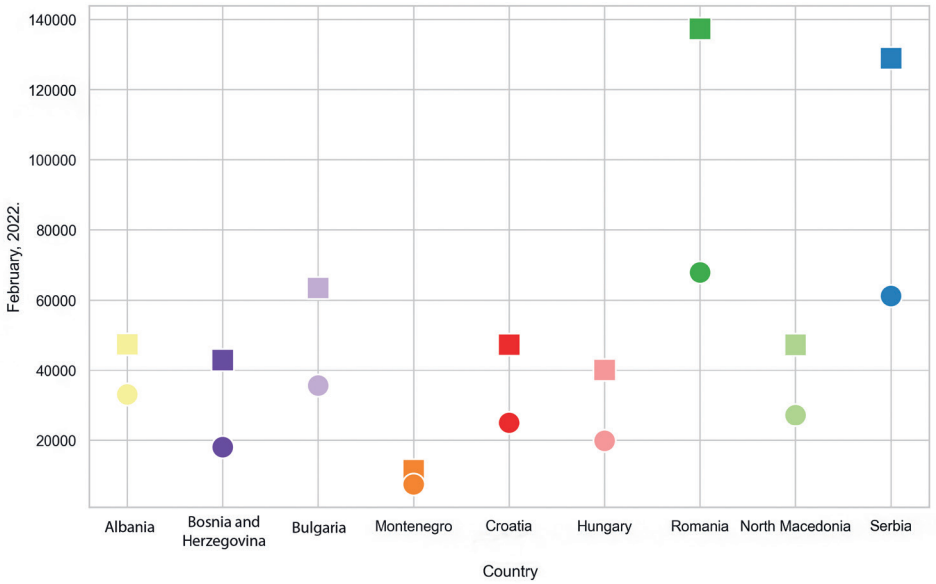


Figure 8: Average earnings of online workers by occupations (by country and regional average)
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

When considering average hourly rates by occupation, workers within certain groups of occupations typically have higher rates regardless of their countries of origin. Indicatively, workers in professional services and software development generally demand

higher hourly rates for their services than workers in other fields. In contrast, the lowest average hourly rates are sought by workers in the fields of writing and translation and in clerical and data entry. From the country perspective, Figure 8 shows that in almost all the observed groups of occupations, workers from Hungary, Croatia, Bulgaria, and Romania have the potential to gain the highest hourly rates for their work on the platform.





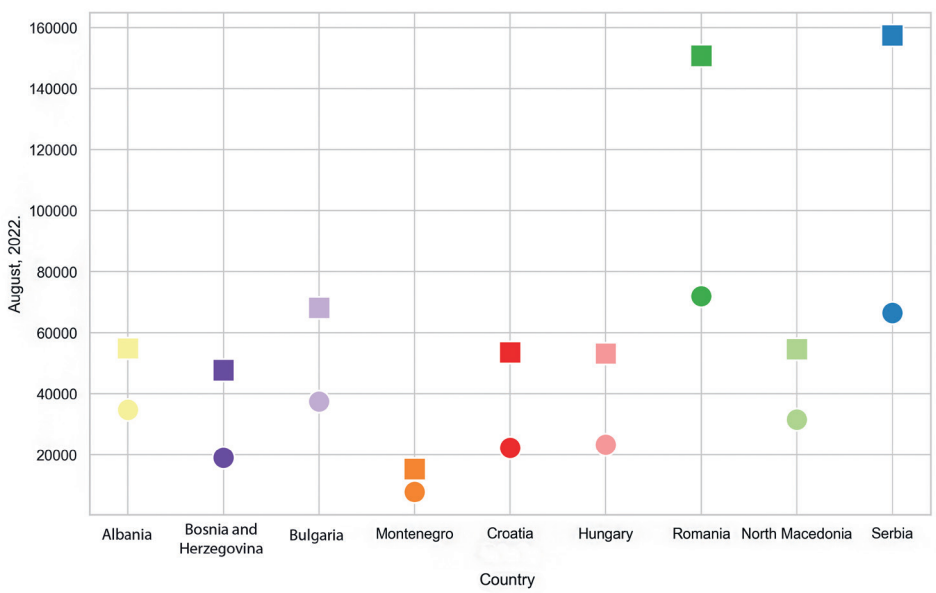


Figure 9: Earnings by women and men in observed countries
Source: Anđelković et al. 2021a; Anđelković et al. 2021b; Anđelković et al. 2022a; Anđelković et al. 2022b.

To summarise, the biggest earning gap between women and men was recorded in Bosnia and Herzegovina, where women made only 38.9% of men's earnings. The greatest convergence was observed in Albania, where women were able to earn 63.8% of the total income achieved by men.

CONCLUSION

The article discusses the trends of online work in 9 Southeast European countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Montenegro, North Macedonia, Romania, and Serbia) over the period of 2021/2022. The data presented in this paper indicate a general increase in the number of online workers in most of the countries studied, with some countries doubling their online labour force in two years. There is also a higher number of online workers per capita in the less developed countries of the region, suggesting that platform work is more popular in these environments. The overrepresentation of men in the online labour workforce is also observed in all countries, with some countries having a larger gender pay gap than others. The article also highlights the dominant fields of professions in all the countries, indicating those that have comparative "advantages" in certain fields.

The results echo findings from other studies that suggest the majority of workers on digital labour platforms are from low- and middle-income countries.[23] It is important to note that the ability of online workers from less developed countries to enter the global labour market through online labour platforms is neither positive nor negative, as other factors such as occupation, average hourly rates, and earnings must also be considered. Furthermore, while studies show that the digital market operates globally, with workers with similar skills and experience considered good substitutes for each other, regardless of location,[24] this paper reveals that earnings for performing similar tasks vary significantly even among the countries within the same geographic region. These differences cannot be explained solely by purchasing power parity and suggest that other economic and political factors also play a role.

The gender pay gap is also clearly demonstrated in the results of this paper. Even in countries like Albania, where there is a smaller difference in earnings between the genders, the divide between men and women is considerable. This indicates that a broad array of factors influence this divide. Improving the level of digital skills among women is only part of the solution to enhancing their representation in the labour market in general.

The observed differences in the nature of online platform work in the region highlight the need for tailored policies that consider the unique characteristics of each country. To do so, and as a next step, there is a need to better understand the interplay between the online and traditional labour markets in these countries. Based on these and similar insights,

[23] Lehdonvirta et al. 2019.
[24] Lehdonvirta et al. 2019.

policymakers can craft targeted interventions and initiatives aimed at fostering inclusivity and levelling the playing field for all members of the labour force.

Finally, it should be acknowledged that this article is not without limitations. The study provided insights into the supply of the online platforms' labour force but it did not investigate the demand for online workers. Future research should find ways to include the demand for workers to compare both the supply and demand of labour on online digital platforms. Additionally, although the analysis is based on data from the most popular online platform in the observed countries, it does not fairly represent other popular platforms that could provide a more detailed picture of online gig work in these markets. Furthermore, the study covers the period of 2021/2022, providing a snapshot of the online labour markets during that time. In this regard, continuous analysis is essential to capture long-term trends in online work, which is highly dynamic and is influenced by factors such as economic conditions, technological advancements, and regulatory changes.

REFERENCES

Aleksynska, Mariya (2021): *Digital Work in Eastern Europe: Overview of Trends, Outcomes and Policy Responses.* ILO Working Paper 32. Geneva: ILO.

Anđelković, Branka – Jakobi, Tanja (2022): Embracing the Digital Age: The Future of Work in the Western Balkans – Serbia. European Training Foundation. Online: https://www.etf.europa.eu/en/document-attachments/embracing-digital-age-future-work-western-balkans-serbia

Anđelković, Branka – Jakobi, Tanja – Ivanović, Vladan – Kalinić, Zoran – Radonjić, Ljubivoje (2021a): *Gigmetar Region. Public Policy Research Center.* Online: http://gigmetar.publicpolicy.rs/en/region4-2/

Anđelković, Branka – Jakobi, Tanja – Ivanović, Vladan – Kalinić, Zoran – Radonjić, Ljubivoje (2021b): *Gigmetar Region. Public Policy Research Center.* Online: http://gigmetar.publicpolicy.rs/en/region5-2/

Anđelković, Branka – Jakobi, Tanja – Ivanović, Vladan – Kalinić, Zoran – Radonjić, Ljubivoje (2022a): *Gigmetar Region. Public Policy Research Center.* Online: http://gigmetar.publicpolicy.rs/en/region-en-2022-1/.

Anđelković, Branka – Jakobi, Tanja – Ivanović, Vladan – Kalinić, Zoran – Radonjić, Ljubivoje (2022b): *Gigmetar Region. Public Policy Research Center.* Online: http://gigmetar.publicpolicy.rs/en/region-en-2022-1/.

Cedefop (2020): *Developing and Matching Skills in the Online Platform Economy: Findings on New Forms of Digital Work and Learning from Cedefop's CrowdLearn Study.* Luxembourg: Publications Office of the European Union. Online: https://doi.org/10.2801/588297

Čolović, Petar – Anđelković, Branka – Jakobi, Tanja (2021): *How Many Online Workers Are There in Serbia? First National Assessment of the Number of the Online Workers on Global Digital Platforms.* Belgrade: Public Policy Research Center. Online: https://publicpolicy.rs/publikacije/bac4e207bba2e8a9fa84e063c954710e02b375ce.pdf

Forrier, Anneleen – Sels, Luc – Stynen, Dave (2010): Career Mobility at the Intersection between Agent and Structure: A Conceptual Model. *Journal of Occupational and Organizational Psychology,* 82, 739–759. Online: https://doi.org/10.1348/096317909X470933

Graham, Mark – Anwar, Mohammad (2019): The Global Gig Economy: Towards a Planetary Labour Market? *First Monday,* 24(4). Online: https://doi.org/10.5210/fm.v24i4.9913

ILO (2021): *World Employment and Social Outlook 2021: The Role of Digital Labour Platforms in Transforming the World of Work.* Geneva: International Labour Office. Online: https://www.ilo.org/global/research/global-reports/weso/2021/WCMS_771749/lang—en/index.htm

Kenney, Martin – Zysman, John (2019): *The Platform Economy and Geography: Restructuring the Space of Capitalist Accumulation.* Online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3497978

Kenney, Martin – Zysman, John – Bearson, Dafna – Carlton, Camille (2023): 13. Spatial Implications of the Platform Economy: Cases and Questions. In Bianchi, Patrizio – Labory, Sandrine – Tomlison, Philip R. (eds.): *Handbook of Industrial Development.* [s. l.]: Edward Elgar, 215–231. Online: https://doi.org/10.4337/9781800379091.00023

Kuek, Siou C. – Paradi-Guilford, Cecilia – Fayomi, Toks – Imaizumi, Saori – Ipeirotis, Panos – Pina, Patricia – Singh, Manpreet (2015): *The Global Opportunity in Online Outsourcing.* The World Bank Group. Online: https://econpapers.repec.org/paper/wbkwboper/22284.htm

Lehdonvirta, Vili – Kässi, Otto – Hjorth, Isis – Barnard, Helena – Graham, Mark (2019): The Global Platform Economy: A New Offshoring Institution Enabling Emerging-Economy Microproviders. *Journal of Management,* 45(2), 567–599. Online: https://doi.org/10.1177/0149206318786781

Mandl, Irene – Kilhoffer, Zachary – Lenaerts, Karolien – De Groen, Willem P. (2018): *Employment and Working Conditions of Selected Types of Platform Work.* Eurofound Research Report. Luxembourg: Publications Office of the European Union. Online: https://doi.org/10.2806/42948

McDonnell, A. – Carbery, R. – Burgess, J. – Sherman, U. (2021): Technologically Mediated Human Resource Management in the Gig Economy. *The International Journal of Human Resource Management,* 32(19), 3995–4015. Online: https://doi.org/10.1080/09585192.2021.1986109

Miles, Raymond E. – Snow, Charles C. (1996): Twenty-First-Century Careers. In Arthur, Michael B. – Rousseau, Dennis M. (eds.): *The Boundaryless Career: A New*

Employment Principle for a New Organizational Era. New York: Oxford University Press, 97–115. Online: https://doi.org/10.1093/oso/9780195100143.003.0006
Moniz, António B. – Boavida, Nuno – Makó, Csaba – Krings, Bettina J. – Miguel, Pablo S. D. (2021): *Digital Labour Platforms: Representing Workers in Europe*. Vila Nova de Famalicão: Húmus'CICS.NOVA. Online: https://doi.org/10.34619/rwrm-3uun
OLI (2018): *Online Labour Index*. Online: http://onlinelabourobservatory.org/oli-supply/
Pajarinen, Mika – Rouvinen, Petri – Claussen, Jörg – Hakanen, Jari – Kovalainen, Anne – Kretschmer, Tobias – Poutanen, Seppo – Seifried, Mareike – Seppänen, Laura (2018): *Upworkers in Finland: Survey Results* (ETLA Reports No. 85). The Research Institute of the Finnish Economy. Online: https://econpapers.repec.org/paper/rifreport/85.htm
Piasna, Agnieszka (2020): *Counting Gigs: How Can We Measure the Scale of Online Platform Work?* ETUI Working Paper. Brussels: ETUI. Online: https://doi.org/10.2139/ssrn.3699350
Piasna, Agnieszka – Zwysen, Wouter – Drahokoupil, Jan (2022): *The Platform Economy in Europe: Results from the Second ETUI Internet and Platform Work Survey (IPWS).* (SSRN Scholarly Paper No. 4042629). Online: https://doi.org/10.2139/ssrn.4042629
Schor, Juliet B. – Vallas, Steven P. (2023): Labour and the Platform Economy. In Heydari, Babak – Ergun, Ozlem – Dyal-Chand, Rashmi – Bart, Jakov (eds.): *Reengineering the Sharing Economy: Design, Policy, and Regulation*. Cambridge: Cambridge University Press, 83.

Branka Andjelkovic is the Co-founder and Programme Director of a reputable think tank, the Public Policy Research Centre based in Belgrade, Serbia. Her research interests encompass labour market institutions, employment relations, and the economy of innovation in the context of digital transformation and Industry 5.0. Branka is the lead author and editor of several pioneering studies about the platform economy and the future of work in Serbia and Southeast Europe. In 2020 she joined the Fairwork project, and has acted as the Principal Investigator for Serbia since then. With extensive experience, Branka has participated as a researcher in various international projects and has also worked as a senior expert in international development for the EU and UN. She holds an MA in public administration from Harvard University (USA), and a BA in the theory of literature from the University of Belgrade (Serbia).

Tanja Jakobi is the Executive Director of the Public Policy Research Center, and a researcher specialising in labour markets, workplace discrimination, and the intersection of technology with work. Her research spans transitioning economies, poverty reduction, and labour market access for marginalised groups. Currently,

her research delves into the impact of new technologies on labour markets, shifts in employment contracts, and the rise of new forms of work. This includes investigating online and on-location platform-based work, remote work arrangements, and addressing concerns related to data privacy in the era of artificial intelligence, as well as the use of workplace monitoring technology. Tanja Jakobi holds an MA in business journalism from Baruch College (US) and a BA in philosophy from the University of Belgrade (Serbia).

Ljubivoje Radonjic is a Teaching Associate at the State University of Novi Pazar. He is also a Research Assistant at the Faculty of Economics of the University of Kragujevac where he is currently doing a doctoral dissertation. In his thesis, he writes on the interrelationship between innovations and economic growth in the European region's context. His research interests are primarily focused on innovation economics and regional inequalities but also span labour economics, platform economy, and platform work. As an author and co-author, he has written on the field of the digital economy, platform work, institutional economics, and economic theory and growth. He has been a research coordinator in numerous national and international projects. He holds an MSc in economics from the Faculty of Economics, University of Kragujevac, Serbia.

PRO PUBLICO BONO – Public Administration, 2024/1, 173–192. • DOI: 10.32575/ppb.2024.1.8

Laura Seppänen

THE CONSEQUENCES OF VISIBILITY AND OPAQUENESS FOR PLATFORM WORKERS

Laura Seppänen, Research Manager, Finnish Institute of Occupational Health, laura.seppanen@ttl.fi

Digital technologies can considerably increase the visibility of people's behaviours and activities, and therefore researchers should pay more attention to visibility and opaqueness in organisations. This paper focuses on visibility in terms of the information given or mediated to workers. The aim of this paper is to examine consequences of visibility for workers who carry out work tasks through digital labour platforms. The research will focus on how visibility or opaqueness in practice promotes or hinders workers' capacity to act and to make informed choices in their work. The visibility paradoxes of connectivity, performance and transparency are used as methodical lenses. The same platform operations can have both empowering and marginalising consequences for workers. While labour platforms continuously improve visibility to workers, they may also hide, inadvertently or intentionally, key information.

Keywords:
autonomy paradox, digital labour platform, performance paradox, platform workers, transparency paradox, visibility, visibility paradox

INTRODUCTION

While digital technologies make people's behaviours and activities increasingly visible to others and themselves, academic research needs to better examine how visibility is manifested in organisations, and with what consequences.[1] Digital labour platforms are a distinctive and growing part of the digital economy, connecting businesses and clients to workers and transforming labour processes, with the organisation of work becoming more

[1] Leonardi–Treem 2020.

decentralised than in traditional employment organisations.[2] Transparency and visibility have rarely been guiding themes in approaches in empirical studies of concrete practices of platform work, however. This is surprising because digital labour platforms are in the vanguard of algorithmic management.[3] This exploratory study attempts to fill this gap.

Visibility can create digital trust[4] between strangers. Through their algorithmic and AI systems, digital labour platforms obviously gain information about platform users (workers and clients), increasing the workers' visibility. This paper, however, examines visibility from the worker's perspective: Visibility here means that a worker, in practice, can visually see (or not see) information or clarifications about platform operations provided by the labour platform. The visibility or opaqueness caused by a labour platform affects workers by enabling or hindering their capacities to act in the platform environments. These workers' experiences of being enabled or hindered are referred to in this paper as the consequences of visibility and opaqueness. Simultaneously, this practice-based study aims to shed light on the social contexts and embeddedness of visibility of digital labour platforms.

By studying workers' experiences in the platforms' algorithmically managed working environments, the aim is to identify and describe visibility and its consequences by using a methodical framework of visibility paradoxes.[5] Our interest in paradoxes is prompted by an attempt to consider both the benefits and harms brought by digital visibility. The data is drawn from interviews of freelancers on a global online platform and couriers working for food delivery companies, all of whom reside and work in Finland. The different sets of data, consisting of interviews with expert workers in online platform work and with food couriers in on-location platform work, enable us to see similarities and differences across platform contexts.

First, the main features of visibility are presented, together with visibility paradoxes of connectivity, performance, and transparency. Similar paradoxes exist in platform work gaining new content and synergies. After describing the data and methods of the study, the core elements of matching and evaluation concerning two of the different labour platforms of the study are presented. The following section describes visibility and opaqueness on the platform as experienced by workers and interprets them in the light of the three paradoxes. Finally, the paradoxes of visibility in platform work are discussed, focusing particularly on their empowering and marginalising consequences – that is, how visibility and its paradoxes may promote or hinder platform workers' agency and learning.

2 Vallas–Schor 2020.
3 Wood 2021.
4 Sundararajan 2016: 60–65.
5 Leonardi–Treem 2020.

VISIBILITY

Visibility is a precondition for seeing and knowing. It involves two sides, that of seeing and of being seen, and it affects and can be controlled by both the observed party and the beholder. Visibility, as a double-edged sword, can be empowering, as is the case with marginalised groups gaining visibility and recognition. However, visibility can also be disempowering, as for example when people who are accustomed to being visible suddenly find themselves haunted by visibility, e. g. in political scandals.[6]

Stohl, Stohl and Leonardi (2016) define visibility as a construct consisting of three interrelated empirical attributes: 1. the availability of information, 2. "approval to share information", and 3. the accessibility of information.[7] Here, availability refers mainly to actions turned into data and storage in some way. Approval refers to legal obligations, norms or social consciousness to make data or information available and public. Besides availability and approval, visibility also requires the receiver of information to have knowledge about relevant directories and classifications, and makes necessary effort to read and understand the information. In other words, visibility or opaqueness is influenced by the actions of many human and non-human actors in social contexts and networks. Even more concretely, visibility in this study means that a worker can see (or not see) (as a text, picture or video, figures or orally spoken) information or clarifications from the labour platform that help them exercise their autonomy and craft their work according to their motives and interests.

When individuals can see people directly, they do not have to make inferences about what activities were conducted and how. However, when activities are made visible through technologies, audiences are often left to infer what kinds of activities the behavioural information is based on.[8] Digital technologies, data, and algorithms, also known as "digital architectures", extract and encode data from social life and work into certain data points, aggregate, compile, and sort data points to more abstract categorisations, and compute them into scores and measures.[9] Reduced to its essentials by digital architectures, information "takes new shapes; their richness and origins may be backgrounded or missing altogether, and the historical, political and other social forces shaping them may be overlooked or taken for granted".[10] The new knowledge, represented as scores, measures, or visualisations, take part in, shape, and influence human and social activities in different ways.

6 Brighenti 2007.
7 Stohl et al. 2016.
8 Leonardi–Treem 2020.
9 Flyverbom 2022.
10 Power 2022.

A paradox, a concept introduced into the literature of management and organisations in the 1980s, is defined as "contradictory yet interrelated elements that seem logical in isolation but absurd and irrational when appearing simultaneously.[11] Based on research, which mainly took a socio-material approach, Leonardi and Treem (2020)[12] identified and described three visibility paradoxes that arise as people's behaviours in traditional work organisations became increasingly visible through digital architectures. With paradoxes, these authors emphasise that increasing visibility can bring both benefits and disadvantages for organisations and actors. In the following section, the connectivity, performance, and transparency paradoxes will be presented.

The connectivity paradox

"The connectivity paradox occurs when actors who fear being disconnected from the organization begin to use new technologies to establish a connection that is so intense that they have to devise practices that enable them to disconnect." Such fear may hampers the benefits of remote work, such as flexibility and the ability to avoid distractions. The connectivity paradox arises because people may feel obliged to remain connected to the organisation due to either a group norm or to meet a colleagues' expectations.[13]

The connectivity paradox is linked to individuals' need for autonomy. In a study of knowledge professionals using mobile email technologies, Mazmanian, Orlikowski and Yates (2013) found that while the professionals viewed the technology as an effective way to enhance their autonomy, they simultaneously were observed to become increasingly engaged with their work and organisation so that they ended up working everywhere and all the time.[14] The authors call this the autonomy paradox.

The performance paradox

The performance paradox means that those who dedicate the most resources to task performance may not make those performances visible to others due to a lack of ability, opportunity, or inclination. This paradox occurs especially in organisational contexts such as knowledge-intensive or professional service jobs where the work carried out does not speak for itself, but actors still need to communicate about work so that organisations or clients can assess their performance. Paradoxically, the resources dedicated to communicating about work lead to less time and effort being spent on active work.

[11] Lewis 2000: 760, REF. in Hardgrave – Van De Ven 2017: 322.
[12] Leonardi–Treem 2020: 1613–1617.
[13] Mazmanian 2013.
[14] Mazmanian et al. 2013.

In a study on IT technicians who used entries into a shared knowledge management system to help determine appropriate job assignments, it was found that those technicians who were more strategic in crafting their communication in the knowledge management system were more likely to be seen as experts in their area of work.[15] The perception of expertise was not based on their actual performance of work tasks, but assessments were made based on shared, visible communication about the work.

The transparency paradox

Both visibility and transparency connote the ability to see,[16] but transparency is often used in a more value-based sense of organisations or actors being accountable to others.[17] The use of digital technologies increases visibility and transparency. However, transparency and visibility do not always imply that things can be seen and known.[18] This is the basis for the transparency paradox.

Opacity through transparency may take place inadvertently or strategically.[19] First, efforts by organisations to provide greater transparency can obscure and obfuscate organisational activities. Increases in transparency can produce a great volume and wide diversity of communication and information, which can make it more difficult to find and understand any single piece of communication. This leads to what is called unintentional or inadvertent opacity.[20] Secondly, strategic opacity means that organisations may espouse transparency, but in fact, they may make information visible in a manner that is ambiguous or difficult to understand. Transparency can also deflect attention from what is kept hidden or obscured.

In strategic opacity, actors who wish to make certain information hidden from view but who are bound by norms and regulations can produce opacity by strategically making so much information visible that unimportant pieces of information will take so much time and effort to sift through that the receivers will be distracted from the central information the actor wants to conceal. For organisations, strategic opacity can be a way to simultaneously comply with expectations and hide important information.[21] While the original transparency paradox is viewed as an issue of organisations, this study examines it and its consequences from the perspective of platform workers.

15 Leonardi–Treem 2020.
16 Stohl et al. 2016.
17 Ball 2009; Christensen–Cheney 2015: 76; Ananny–Crawford 2018: 974.
18 Ananny–Crawford 2018; Stohl et al. 2016.
19 Stohl et al. 2016.
20 Stohl et al. 2016: 133.
21 Stohl et al. 2016: 133–134.

AIM AND RESEARCH QUESTION

Using concepts and insights from the visibility paradoxes described above, the study aims to shed light on the way that visibility is enabled or hindered by labour platforms is manifested in platform work and what the consequences for platform workers are in terms of their work experiences on labour platforms. The expectation is that this exploratory study on worker experiences as consequences of visibility will provide insights into how visibility or opaqueness in practice may shape platform workers' agency and autonomy in carrying out their work and gaining outcomes they want to obtain. The research question is: *How are the connectivity, performance, and transparency paradoxes manifested in platform work from the perspective of visibility or opaqueness to platform workers?* In the next section, the data and methods of the study will be described.

DATA AND METHODS

The data is drawn from 23 qualitative thematic interviews of platform workers that receive tasks or projects through two large-scale labour platform companies. *The expert platform* is a global site, which mediates skill-requiring online projects for freelancers. The *Delivery platform* is operated by an international company, but offers couriers on-location work where food is transported from restaurants to clients by car, bike, or scooter. 14 freelancers were interviewed during the years 2018–2019. Four of the nine courier interviews were carried out in 2017 and five in 2022. The interview guide, although somewhat different in the interview sets, focused on platform workers' experiences in their work, how the platform shapes workers' activities and the role of platform work in their career and life.[22] Previously, these data have been analysed from the perspectives of platform workers' resources, activity concepts, co-creation, fairness and digital agency, and more information on the collection and characteristics of data is available from corresponding publications.[23]

For this practice-based study, the data was first read many times. The aim was to be sensitive and to carry out the analysis in line with the topics and perspectives that the interviewees themselves perceived as being important. The preliminary interest was in fairness issues, and therefore the first coding was done with fairness values expressed in the interviewees' talk. ATLAS.ti software was used in the coding. The value codes used were access, accountability, autonomy, communication, fairness, and transparency, with transparency featuring the most frequently. This prompted me to return to the literature on transparency and visibility. A new coding of "transparency and visibility" yielded 106 episodes. It was expected that workers would experience the visibility of their work and behaviour to the platforms as problematic. However, this was not always the case.

[22] Example for the interview guide was taken from Anderson–Westberg 2015.

[23] Seppänen et al. 2018; Seppänen–Poutanen 2020; Seppänen et al. 2022; Seppänen et al. 2023.

Therefore, the analysis centred on interviewees' accounts on how platforms make (or do not make) things visible to them and with what consequences by using the connectivity, performance, and transparency paradoxes as interpretative lenses. Finally, it was decided that to maintain the practical and contextual nature of visibility manifestations, a narrative description of the findings, rather than a systematic examination of the consequences of visibility, would suit the aim of the study. This required that the operational contents be delimited. The aspects of matching and rating were chosen because they are central in binding together labour platforms' key functions, and simultaneously they greatly affect platform workers' activities. The next part examines the matching and rating operations on Expert and Delivery platforms that are relevant in shaping affordances and resources for workers' action potentials.

MATCHING AND RATING ON LABOUR PLATFORMS

The function of a labour platform is to match workers with tasks offered by requesters or clients. Access to tasks is a central motive for workers' participation on the platform. Through using the platform, workers not only gain income, but also potentially have access to other opportunities that come with work tasks, such as learning new skills or building relationships with new clients. In general, platform workers, with their ability to influence their working time and possibly location, are seen to enjoy greater autonomy than employees,[24] and this is an often-cited motive for pursuing platform work.[25]

Besides matching, labour platforms most often evaluate workers or process worker evaluations to facilitate the matching process and to build digitally the necessary trust[26] between workers, clients, and possibly other actors in their ecosystems. There is a dynamic interaction between the platform and the assessment visibility of the people working on the platform. It should also be noted that Expert and Delivery platforms vary in their matching and rating operations.[27]

After a freelancer is accepted on the *Expert platform,* the freelancer must write a profile visible to everybody on the site. By clicking the profile, clients on the platform can read about the freelancer's competences, projects, and related feedback. After projects have been completed, both clients and freelancers rate each other. Based on the clients' ratings, the freelancer's activeness on the platform, and other parameters, the platform's algorithms assign a score (a percentage of success) for a freelancer that is visible in their profile. If freelancers enjoy success, they can obtain a badge as a visible mark of their good reputation.

On the *Delivery platform,* after receiving a working turn in the platform application, a courier goes to a starting zone and logs in to the app through their mobile phone,

[24] Pichault–Mckeown 2019.
[25] Pesole et al. 2018; Wood et al. 2019.
[26] Sundararajan 2016.
[27] Seppänen 2023.

linked to a GPS-based navigation system. After an order is received, the courier sees the restaurant's name and the customer's location and accepts the gig by clicking. A courier keystrokes into the app both the pick-up and drop-off of the food. When all parts of the task are completed, the courier is ready to receive the next order.

The Delivery platform conducts the matching between food orders and couriers. It collects data about couriers' tasks, the time taken to get from the restaurant to the customer, the couriers' working hours, etc. Based on these data, the company groups couriers into five levels at regular time intervals. Factors affecting the level include the number of deliveries per hour, no-shows or being late from their working turn, planned and actual hours, and other minor factors.[28] The better a courier's performance ranking is, the better the courier's ability to reserve working turns, and thus the ranking heavily affects a courier's access to work and earnings. The couriers on levels three to five have weaker possibilities for deliveries and income than the ones on the upper levels. The following section describes the findings, how visibility paradoxes are manifested on Expert and Delivery platforms, and with what consequences for the workers.

CONSEQUENCES OF VISIBILITY AND OPAQUENESS

The connectivity paradox

Expert platform. By connecting to the Expert platform, freelancers not only see a huge number of invitations for bids but also the histories and ratings of the requesters, which help freelancers in their selection. New freelancers entering the platform face the problem of how to get projects in the first place. As they have no track record on the platform, most requesters are hesitant to hire them. Freelancers often, especially new ones, stay connected and spend a lot of unpaid time making bids in order to be competitive in the platform marketplace. The competitiveness is made visible by the scores and the badge described above. In this study, an extreme case of connectivity was represented by an unemployed freelancer who spent many hours per day searching for projects, with practically no success.

As the Expert platform is global, requesters post their invitations at any time. This means that most freelancers must be attentive to searching for tasks or waiting for automatic emails they have requested from the platform to inform them about invitations for bids. Some freelancers may voluntarily follow up incoming email alarms at any time of day, in order to respond to them quickly enough.

Another narrative concerns connectivity. Freelancer 3 suddenly lost his badge on his profile. He immediately contacted the Expert platform to find out why. The reason, the platform representative told him, was not the poor quality of his work or dissatisfied clients,

[28] *Delivery platform's Induction Material* 2022.

but that some of his open-ended contracts with clients had not shown any activity (projects and transactions) for some time, which made the score go down and the badge disappear.

Excerpt 1

Freelancer 3: "I didn't know that if you have open hourly-based contracts with no projects for a while, it makes the score diminish. And in fact, it is not a score of client satisfaction but a score of job success. So, this makes the score and badge go down, which is totally weird […] Maybe, they have informed us about that in their webpage, but at least I was not aware of that."

Freelancer 3 immediately stopped all his open hourly contracts, and after a while, the badge was returned to him by the platform's algorithmic system. This narrative suggests that the platform, in order to connect freelancers more tightly to its operations, combines a follow-up of freelancers' activeness in their reputation scores. The consequence of the connectivity paradox for freelancers, besides involving them doing unpaid labour, is that if they want to remain competitive on the Expert platform, they must be active and stay connected to it.

Delivery platform. Once accepted, couriers start receiving tasks after entering the starting zone and opening the app. However, couriers who are not highly rated (that is, they are ranked among groups 3–5 out of five) may not receive as many working turns as they would like because the higher-ranked couriers in groups 1–2 have first choice of the turns they want. In this case, the lower-ranked couriers must stay connected to the app and wait for working turns to appear (Excerpt 2). Staying connected in order to get enough working turns is especially important for couriers who are economically dependent on the income from the platform.

Excerpt 2

Courier 20: "So, it is a moment of stress, if you are on level three and you want turns, so you are on call all the time on the phone to see if there are working turns available. And then you start learning that the turns for the next day can be there early in the morning or evening."

The connectivity paradox means that while doing remote work, people establish such an intense connection with the work organisation that they must develop practices to allow them to disconnect because they fear being disconnected.[29] The connectivity paradox arises because people may feel obligated to remain connected to the organisation due either to a group norm or in response to colleagues' expectations.[30] However, on the Expert and Delivery platforms, the "obligation to remain connected" does not stem from these reasons.

[29] Leonardi–Treem 2020: 1613.
[30] Mazmanian 2013.

Platform workers' urge to be connected, and thus their connectivity paradox, stems from their need to access work tasks. The connectivity paradox in platform work seems to be more directly related to the autonomy paradox, that is, it reflects the conflict between platform work's promise for autonomy and the requirement in practice to stay connected and spend a lot of unpaid time trying to find work. If the expectation of autonomy is high, as is often the case in platform work, staying connected, even voluntarily, does not favour such autonomy.

The performance paradox

Expert platform. As we saw above, scores and badges are important for freelancers on the Expert platform. Freelancers are empowered by the possibility of gaining platform-mediated visible scores of their work performance, and freelancers use them to enhance their work and business. The Expert platform seems to be inclined in its own strategy to support freelancers' own reputation and recognition through such visibility.

For freelancers, a consequence of performance visibility through rating is that they not only have to carry out their projects to the required standard: they also need to consciously follow, maintain, or improve their platform reputation (at least when they are not among the very top freelancers in their task categories).[31] However, there is also another side to the evaluation systems. While revealing the main factors leading to the award of badges, such as client ratings, income and freelancers' activeness, the Expert platform does not totally open up the complex and dynamic rating mechanisms to freelancers. Freelancers still face uncertainty stemming from the rating system (Excerpt 3).

Excerpt 3

Interviewer: "So, what would you like to change in Expert platform system?"

Freelancer 13: "It's tricky because I would say… the most difficult thing is the rating system because it's so mysterious, but at the same time, I have a 100 per cent rating and it helps me, so I can get more jobs. But when it doesn't work out in my favour, they lower my score, I don't understand why, it seems very random to me, or unfair."

It appears that Freelancer 13 (Excerpt 3) benefits from the rating system in the form of better access to future project opportunities. The "mystery" can be read as opacity, which is contrasts with visibility. The platform, through a mysterious combination of client ratings and other things, may lower a freelancers' score without her being able to understand why. Without such understanding, freelancers may lack the means to improve their work performance – that is, their ability to respond to the factors that

[31] Seppänen–Poutanen 2020.

determine their success is limited.[32] The consequences for a freelancer can be uncertainty and a marginalising feeling of unfairness.

Delivery platform. As noted earlier, the Delivery platform ranks couriers in five groups according to their performance. Compared to the ratings on the Expert platform, the nature of the task and its outcome are more routine and standardised, and therefore more explicit performance and rating criteria can be formulated and made visible to the couriers. However, couriers face uncertainty about how one is ranked in the groups for reserving working turns (Excerpt 4).

Excerpt 4

Courier 20: "At least when couriering by bicycle, first, you are unable to plan far ahead, if you will be able to obtain working turns or not, especially in summer. Because you don't know, first, what will your level be, because the Delivery platform decides how many workers go into the first and second levels, and it always varies. So, you never know whether you have been good enough for the first level. And you can guess, okay, if I'm on the second level, probably there will not be enough turns for me, because the couriers on the first level will take them all next [time]."

In Excerpt 4, Courier 20 explains why food delivery by bike as a full-time summer job is uncertain and untenable on the Delivery platform. Many bike couriers want to work as much as possible in summer rather than in the cold and snowy Finnish winter time. In summer, the competition between couriers becomes "cutthroat hard". Sometimes even being in group 2 does not guarantee getting enough working turns to obtain a satisfactory level of income, which shows the performance paradox in platform work: better performance does not necessarily lead to a better level and improvement in a worker's social positioning on the platform. There is uncertainty about the amount of demand at any given moment, and the company's tactics to counter this, according to Courier 20, are to flexibly regulate the number of couriers in each group level to balance the supply and demand of deliveries. The upside for couriers is that they can complete tasks ("gigs") during their working turns. The bad side is that they must compete with each other for the turns, and to do so, they must constantly maintain or improve their ranking in the level groups. The consequence of the performance paradox for workers is uncertainty and perhaps an unwillingness to continue doing platform work. It is also important for couriers how "gigs" are distributed during a working turn (Excerpt 5).

Excerpt 5

Interviewer: "Do you know how a gig is selected just for you?"

[32] Rahman 2021: 945.

Courier 23: "No, there's no information about that, we have tried to ask, actually nobody knows what the selection is based on. Obviously, it is related to distance. I have sometimes pondered if it is related to ranking, someone sometimes claimed that, this is all rumour. […] I don't know and probably even those app guys don't know, because that app has been developed somewhere abroad and it can be there in the code somewhere. Maybe nobody knows. But I think it would be fair to clarify it."

Couriers are unaware what the grounds for distributing gigs are. Excerpt 5 reveals how not knowing this basis has produced uncertain claims and beliefs, and the real knowledge is far "abroad" and "in the code somewhere", indicating an opaque, "smokescreen"[33] visibility. Many couriers have tried to ask the delivery company about it, with unsatisfactory results. According to Courier 24, knowing the logic of gig distribution would help couriers choose their optimal location when waiting for new gigs, and thus improve their performance.

Despite their ignorance about these issues, couriers know the basic logic of their evaluation and ranking. They know that speed and activeness – how many gigs they complete in an hour, and e.g. the number of working hours – are important criteria in their ranking into group levels. This pushes them to be quick, to complete as many gigs as possible, and to work long hours, implying haste and stress. Overall, the Delivery platform has considerably improved the visibility of its operations to freelancers through new digital technologies. This is especially clear between interview data sets carried out in 2017 and 2022.

Rating and ranking systems differ significantly between the Expert and Delivery platforms. Freelancers' scores have a great impact on clients, and their main objective in terms of visibility is to *help clients* in their selection of workers. The couriers' ranking, in contrast, is managed by the platform algorithms, and its main function is to allow visibility about a courier's performance *to the platform*. Despite these differences, there are also similarities. Both the Expert and Delivery platforms use ratings to balance the task market, and freelancers and couriers can influence their ranking and scores through their performance. Couriers also need to follow, maintain or improve their platform ranking and reputation, and not only to carry out their tasks properly. A similar consequence, a mystery surrounding rating and ranking, producing uncertainty, exists on both platforms. Labour platforms may need to keep their evaluation systems opaque for business confidentiality reasons or because, otherwise, users might game the system.[34] If systems can be easily gamed, there would be little variation in scores and ranking, which would make it difficult for the platform and clients to differentiate between workers.[35]

The ambiguity and the paradox are that the scores and rankings are both beneficial and harmful for workers. This paradox is certainly related to performance, but it is not quite the same as the performance paradox described by Leonardi and Treem (2020). Instead of the worker having to write down her achievements – and the paradox being between

[33] Harness et al. 2022: 6.
[34] Cedefop 2020:49.
[35] Rahman 2021: 949; Tadelis 2016.

working and writing about that work –, workers can influence their rating more directly through their work, but after that, the scores and rankings fall largely outside the workers' control, being moulded by the platforms' complex algorithms in a way that is partly opaque to workers. The performance paradox in platform work seems to be qualitatively different from that in traditional work.

The transparency paradox

The transparency paradox states that high levels of visibility may decrease transparency and even produce opacity. On the Expert platform, there is an abundance of information about invitations for bids for freelancers, which indeed creates a condition of transparency paradox for platform users. Freelancers are often empowered by the visibility of an expanded horizon of work possibilities. As one freelancer put it: "Now, I have the whole planet as my clientele." Offers are already formulated and visible on the platform, which those freelancers planning to start working as entrepreneurs consider an advantage in saving marketing time.[36]

Due to the large volume of information, relevant knowledge about suitable projects can be difficult to find. Therefore, the platform has created a sophisticated system of categories, filters, keywords, and alarm systems that the freelancers interviewed found relatively easy to use. As platform workers are typically independent, labour platforms must design their visibilities (e.g. user interfaces) and operations to be as easy and user-friendly as possible, which is often not the case in traditional work organisations.[37]

While the Delivery platform carries out matching between couriers and food orders, couriers' visibility to the platform and its market is much more limited than on the Expert platform. The transparency paradox is illustrated by an incident in courier work. The Delivery platform had recently made the fee of a delivery "gig" visible to couriers already in the first announcement before a courier accepts it. This was a welcome improvement to couriers' work, because it helped them to decide if a gig is worth taking.

This novel visibility was available only for couriers who agreed to change their old contract to a new one. The change of contract was offered voluntarily by email to couriers. This new contract included a change in the pricing system: the fee for each gig was higher than before, but an hourly wage paid during a working turn, which had existed in the old contract, was taken away. Couriers responded differently to the possibility of a new contract. The old contract offered more stable pay, while the new one promised better visibility, a courier said. Some couriers opted for better visibility, while others calculated the outcomes of the change in terms of income and decided not to change.

[36] Seppänen et al. 2019.
[37] Vairimaa 2023.

Excerpt 6

Courier 20: "Well, it [the platform through email] recommended changing the contract. It was not a question, more like, hey, now there is a chance to change into this. There was no talk… They made it look like a much better contract. But together with my brother, we calculated and looked at it and thought and talked about this contract change. The new contract is not better, in fact."

Strategic opacity, as part of the transparency paradox, means that organisations may espouse transparency, but they may make information visible in a manner that is ambiguous or difficult to understand. Labour platforms can and do improve visibilities for the benefit of workers. At the same time, they might tie these improvements together with other less beneficial changes, so that the latter may remain hidden, either strategically or inadvertently, from the workers. It is also possible that workers do not have the necessary skills to read or interpret the information, or that accessing the information requires too much effort from them. In these cases, the transparency paradox arises because visibility and transparency are not produced even though the platform uncovers information. The data does not allow this incident to be analysed in more depth, but still, examining it might help us grasp the processual and contextual nature of the transparency paradox formation and consequences in platform work.

The word transparency has connotations of accountability – that an audience can trace the path or process through which a certain decision or outcome was made in an organisation. In the performance paradox above, we have seen how couriers and freelancers in this study express their wish for transparency concerning how worker ratings, ranking, and scores are calculated. This relates closely to the performance paradox of platform work. At the same time, it is an example of a transparency paradox – platform workers need to know the evaluation logic and mechanisms, but platforms still hide them, at least partially. The consequences of the transparency paradox for platform workers are uncertainty and a need to maintain a critical attitude to and to question any suggestions for changes on the part of labour platforms, as Courier 20 (Excerpt 6) did.

Based on the findings, we can now formulate visibility paradoxes from the perspective of platform workers. Unlike the transparency paradox, a performance-transparency paradox is depicted.

The connectivity paradox is related to the autonomy paradox, that is, between workers' high expectations of autonomy and them actually having to spend a lot of unpaid time and to be continuously connected to the platform to find work. As their level of loyalty towards the labour platform is low, platform workers' urge to remain connected stems from their need to put effort into accessing work tasks and not from their commitment to the platform company.

Performance paradox: Platform workers not only have to complete their tasks satisfactorily, but also to observe and cultivate their rating, ranking and scores so that they improve or at least maintain their chances of obtaining work tasks in the future. The special aspect of the performance paradox on labour platforms is that the formation of the

users' reputation, and often also the datafication of their behaviour, is chiefly carried out, mediated, and made visible by the algorithms of the platform.

The performance-transparency paradox is between platform workers' need for visibility about the labour platform operations, and the platforms' difficulty or reluctance to make the information about their operation completely visible.

DISCUSSION AND CONCLUSION

This paper is an exploratory study into the practical consequences of visibility in work that is carried out via digital labour platforms. The visibility paradoxes of connectivity, performance and transparency were used as analytical tools for interpretation. Examining 23 qualitative interviews of freelancers on a global expert platform and couriers on a food delivery platform has demonstrated how these paradoxes, manifested in platform work, very much centre on the algorithmic nature of digital labour platforms.

In this study, a paradox means that something may be both beneficial and harmful for platform workers, producing experiences that can be absurd and irrational from the workers' perspective. The three visibility paradoxes – connectivity, performance, and transparency – were identified based on observations of traditional employment between workers and organisations. While the network-like structure on labour platforms is clearly more complex and distributed than conventional work organisation, the visibility paradoxes found in platform work are also qualitatively different, and performance and transparency paradoxes are closely intertwined. We have seen that platform-enabled visibility helps workers in many ways. This study also suggests that unpaid labour, uncertainty, the necessity of being active on the platform, feelings of unfairness, constant attention by workers to their platform reputation and limited means to improve performance may all be consequences of visibility paradoxes for platform workers.

In this study, visibility paradoxes are considered especially from the perspective of the central and constitutive matching and evaluation operations of labour platforms, because they have consequences for people's access to resources, recognition, and opportunities.[38] The representativeness of the consequences of visibility paradoxes among individual platform workers would require a deeper and more systematic study. The findings suggest that the same features of platform operations can have both empowering and marginalising consequences for workers.[39]

The question of autonomy is central in platform workers' connectivity paradox. The autonomy paradox, involving a tension between the promise of autonomy and an expectation of commitment, imply that workers self-impose restrictions on their autonomy, and these restrictions are tied to various bureaucratic, concertive, cultural, market, or

[38] Kornberger et al. 2017.

[39] See also Deng et al. 2016.

technological mechanisms. Beyond this, the autonomy paradox implies that workers may experience their self-imposed restrictions as enhancing their autonomy.[40] The autonomy paradox may show and explain why platform workers invest and dedicate more time and effort to their work than their expectations of freedom and flexibility would suggest. The rating and ranking systems of labour platforms, evident in performance and transparency paradoxes, seem to push platform workers to this kind of voluntary dedication.

A sense of usefulness is one of the fundamental attributes of worker recognition,[41] and platform evaluations serve as means of recognition and identity building. It is therefore important that workers, on platforms and elsewhere, could be more associated with collective decision-making and action at work. "To be involved and have influence is not only a positive experience but also promotes understanding of the [ICT] systems' complexity and increases their acceptance."[42] Communication from the platform to workers, especially when it provides the grounds for changes, is an important form of involvement.[43] This is one practical implication of the study.

Algorithmic systems, and particularly platforms, can amplify actors' visibility at work. Visibility through platforms' algorithms may provide workers with more capacity to act through better self-knowledge.[44] Visibility paradoxes, in particular the performance-transparency paradox in this study, may enhance agency when workers are pushed to question, learn and act on their scores, opaque features or uncertainties caused by complex algorithmic systems.[45] However, it is also possible that digital visibility or opacity, instead of leading to questioning, will enhance conditions of voluntary servitude where algorithms may tell us how to act or what is a good attitude to have.[46] Complex visibilities in platform work not only fulfil the expectations or leave them unfulfilled, but also shape the formation of expectations of fairness. As the findings in the transparency paradox show, transparency and accountability need critical audiences, both inside and outside organisations.[47] As a practical implication, platform workers and others are encouraged to use available and new means to be critical audiences. When workers contact labour platforms and ask questions or make suggestions, it may seem to have little or no effect, but in the long run, there are examples of labour platforms making changes due to workers' initiatives.[48] The way algorithmic visibilities help or hinder workers' learning, and how visibilities shape their fairness expectations require future research.

Labour platform operations are dynamically changing. Digital culture's preoccupation with new things means that the systems we are engaged with today might be changed to

40 Mazmanian et al. 2013.
41 Dejours 1998.
42 Wurhofer et al. 2018.
43 Seppänen et al. 2022.
44 Bobillier Chaumon 2021.
45 Seppänen et al. 2023.
46 Bobillier Chaumon 2021.
47 Kemper–Klokman 2018.
48 Seppänen et al. 2018.

new ones tomorrow.[49] Platforms are able to draw upon vast quantities of data to learn from, and they optimise many processes and respond to different demands, not least to those coming from their competitors, authorities or shareholders.[50] We can imagine the huge possibilities either for visibility or opacity that labour platforms and other organisations have with their algorithmic and AI management systems.

Acknowledgements: I would like to thank Tuomo Alasoini, Jere Immonen, Marja Känsälä, Seppo Poutanen and Matti Vartiainen for their useful comments. The data and insights were greatly facilitated by research projects funded by the Academy of Finland (SWiPE, 303669) and the Finnish Work Environment Fund (210046).

REFERENCES

Ananny, Mike – Crawford, Kate (2018): Seeing without Knowing: Limitations of Transparency Ideal and Its Application to Algorithmic Accountability. *New Media & Society,* 20(3), 973–989. Online: https://doi.org/10.1177/1461444816676645

Anderson, L. – Westberg, C. eds. (2016): *Voices of Workable Futures. People Transforming Work in the Platform Economy.* Palo Alto: The Institute for the Future.

Ball, Carolyn (2009): What is Transparency? *Public Integrity,* 11(4), 293–307. Online: https://doi.org/10.2753/PIN1099-9922110400

Bobillier Chaumon, M.-E. (2021): Technologies emergentes et transformations digitales de l'activité: enjeux pour l'activité et la santé au travail. *Psychologie de travail et des organisations,* 27, 17–32. Online: https://doi.org/10.1016/j.pto.2021.01.002

Brighenti, Andrea (2007): Visibility. A Category for the Social Sciences. *Current Sociology,* 55(3), 323–342. Online: https://doi.org/10.1177/0011392107076079

Cedefop (2020): *Developing and Matching Skills in the Online Platform Economy: Findings on New Forms of Digital Work and Learning from Cedefop's CrowdLearn Study.* Luxembourg: Publications Office. Cedefop reference series; No 116. Online: https://doi.org/10.2801/588297

Christensen, Lars T. – Cheney, George (2015): Peering into Transparency: Challenging Ideas, Proxies and Organizational Practices. *Communication Theory,* 25(1), 70–90. Online: https://doi.org/10.1111/comt.12052

Dejours, C. (1993): Intelligence pratique et sagesse pratique: deux dimensions méconnues du travail réel. *Éducation Permanente,* 116, 47–60.

Delivery platform's Induction Material (2022). Unpublished.

Deng, Xuefei – Joshi, K. D. – Galliers, Robert D. (2016): The Duality of Empowerment and Marginalization in Microtask Crowdsourcing: Giving Voice to the Less Powerful

[49] Kemper–Klokman 2018.

[50] Van Doorn – Badger 2021.

through Value Sensitive Design. *MIS Quarterly,* 40(2), 279–302. Online: https://doi.org/10.25300/MISQ/2016/40.2.01

Flyverbom, Mikkel (2022): Overlit: Digital Architectures of Visibility. *Organization Theory,* 3(3). Online: https://doi.org/10.1177/26317877221090314

Hardgrave, Timothy J. – Van De Ven, Andrew (2017): Integrating Dialectical and Paradox Perspectives on Managing Contradictions in Organizations. *Organization Studies,* 38(3–4), 319–339. Online: https://doi.org/10.1177/0170840616640843

Harness, Delaney – Ganesh, Shiv – Stohl, Cynthia (2022): Visibility Agents: Organizing Transparency in the Digital Era. *New Media & Society,* online first, November 26, 2022. Online: https://doi.org/10.1177/14614448221137816

Kemper, Jakko – Kolkman, Daan (2018): Transparent to Whom? No Algorithmic Accountability Without a Critical Audience. *Information, Communication & Society,* 22(14), 2081–2096. Online: https://doi.org/10.1080/1369118X.2018.1477967

Kornberger, Martin – Pflueger, Dane – Mouritsen, Jan (2017): Evaluative Infrastructures: Accounting for Platform Organization. *Accounting, Organizations and Society,* 60, 79–95. Online: https://doi.org/10.1016/j.aos.2017.05.002

Leonardi, Paul – Treem, Jeffrey (2020): Behavioral Visibility: A New Paradigm for Organization Studies in the Age of Digitization, Digitalization and Datafication. *Organization Studies,* 41(12), 1601–1625. Online: https://doi.org/10.1177/0170840620970728

Lewis, M. W. – Smith, W. K. (2014): Paradox as a Metatheoretical Perspective: Sharpening the Focus and Widening the Scope. *The Journal of Applied Behavioral Science,* 50(2), 127–149. Online: https://doi.org/10.1177/0021886314522322

Mazmanian, Melissa (2013): Avoiding the Trap of Constant Connectivity: When Congruent Frames Allow for Heterogeneous Practices. *Academy of Management Journal,* 56(5), 1225–1250. Online: https://doi.org/10.5465/amj.2010.0787

Mazmanian, Melissa – Orlikowski, Wanda – Yates, JoAnne (2013): The Autonomy Paradox: The Implications of Mobile Email Devices for Knowledge Professionals. *Organization Science,* 24(5), 1337–1357. Online: https://doi.org/10.1287/orsc.1120.0806

Pichault, François – McKeown, Tui (2019): Autonomy at Work in the Gig Economy: Analyzing Work Status, Work Content and Working Conditions of Independent Professionals. *New Technology, Work and Employment,* 34(1), 59–72. Online: https://doi.org/10.1111/ntwe.12132

Pesole, A. – Urzi Brancati, M. C. – Fernández-Macias, E. – Biagi, F. – Gonzalez Vazquez, I. (2018): *Platform Workers in Europe Evidence from the COLLEEM Survey.* Luxembourg: Publications Office of the European Union. Online: https://doi.org/10.2760/742789

Power, Michael (2022): Theorizing the Economy of Traces: From Audit Society to Surveillance Capitalism. *Organization Theory,* 3(3). Online: https://doi.org/10.1177/26317877211052296

Rahman, Hatim A. (2021): The Invisible Cage: Workers' Reactivity to Opaque Algorithmic Evaluations. *Administrative Science Quarterly,* 66(4), 945–988. Online: https://doi.org/10.1177/00018392211010118

Seppänen, Laura – Hasu, M. – Käpykangas, S. – Poutanen, Seppo (2018): On-demand Work in Platform Economy: Implications for Sustainable Development. In Bagnara, S. – Tartaglia, R. – Albolino, S. – Alexander, T. – Fujita, Y. (eds.): *Proceedings of the 20th Congress of International Ergonomics Association* (IEA 2018). Cham: Springer, 803–811. Online: https://doi.org/10.1007/978-3-319-96068-5_86

Seppänen, Laura – Känsälä, M. – Immonen, J. – Alasoini, T. (2022): *Näkökulmia alustatyön reiluuteen. Reiluuden mallit alustatyössä -hankkeen loppuraportti.* Tietoa työstä. [Perspectives into fairness of platform work. Final report of the Models of fairness in platform work–project].

Seppänen, Laura – Poutanen, Seppo (2020): Cultural Transition in the Sharing Economy? Introducing Platform Work with Activity Concepts. In Poutanen, Seppo – Kovalainen, A. – Rouvinen, P. (eds.): *Digital Work and the Platform Economy. Understanding Tasks, Skills and Capabilities in the New Era.* New York and London: Routledge, 183–202. Online: https://doi.org/10.4324/9780429467929-10

Seppänen, Laura – Poutanen, Seppo – Rouvinen, P. (2019): Millaista yrittäjyyttä alustatyö edistää? Esimerkkinä Upwork Suomessa [What kind of entrepreneurship does platform work enhance?]. *Työpoliittinen aikakauskirja,* (1), 20–28.

Seppänen, Laura – Toiviainen, Hanna – Hasu, Mervi (2023): Workplace Learning for Fair Work on Digital Labour Platforms. In Bound, Helen – Edwards, Anne – Evans, Karen – Chia, Arthur (eds.): *Workplace Learning for Changing Social and Economic Circumstances.* Routledge, 171–184. Online: https://doi.org/10.4324/9781003227946-14

Stohl, Cynthia – Stohl, Michael – Leonardi, Paul (2016): Managing Opacity: Information Visibility and the Paradox of Transparency in the Digital Age. *International Journal of Communication,* 10(2016), 123–137.

Sundararajan, Arun (2016): *The Sharing Economy: The End of Employment and the Rise of Crowd-Based Capitalism.* Cambridge, MA: The MIT Press.

Tadelis, Steven (2016): Reputation and Feedback Systems in Online Platform Markets. *Annual Review of Economics,* 8(3), 21–40. Online: https://doi.org/10.1146/annurev-economics-080315-015325

Vairimaa, Reetta (2023): Digitalisaatiosta toivottiin tuottavuusloikkaa – miksi asiantuntijoiden aika menee tietojärjestelmien kanssa tappelemiseen? [An efficiency leap was expected from digitalization – why experts' time is wasted to fight with information systems?] *Helsingin Yliopisto,* 4/2023. Online: www.helsinki.fi/fi/uutiset/digitalisaatio/digitalisaatiosta-toivottiin-tuottavuusloikkaa-miksi-asiantuntijoiden-aika-menee-tietojarjestelmien-kanssa-tappelemiseen

Vallas, Steven – Schor, Juliet B. (2020): What Do Platforms Do? Understanding the Gig Economy. *Annual Review of Sociology,* 46, 273–294. Online: https://doi.org/10.1146/annurev-soc-121919-054857

Van Doorn, N. – Badger, A. (2021): Dual Value Production as Key to the Gig Economy Puzzle. In Meijerink, J. – Jansen, G. – V. Daskalova (eds.): *Platform Economy Puzzles. A Multidisciplinary Perspective on Gig Work*. Cheltenham: Edward Elgar, 123–139. Online: https://doi.org/10.4337/9781839100284.00015

Wood, Alex J. (2021): *Algorithmic Management. Consequences for Work Organisation and Working Conditions.* Seville: European Commission.

Wood, Alex J. – Graham, Mark – Lehdonvirta, Vili – Hjorth, Isis (2019): Good Gig, Bad Gig: Autonomy and Algorithmic Control in the Global Gig Economy. *Work, Employment and Society,* 33(1), 56–75. Online: https://doi.org/10.1177/0950017018785616

Wurhofer, Daniela – Meneweger, Thomas – Fuchsberger, Verena – Tscheligi, Manfred (2018): Reflections on Operators' and Maintenance Engineers' Experiences of Smart Factories. In *Proceedings of the 2018 ACM Conference on Supporting Groupwork,* Sanibel Island, USA. Online: https://doi.org/10.1145/3148330.3148349

Laura Seppänen is a Research Manager at the Finnish Institute of Occupational Health, who has investigated both online and on-location platform work in a research consortium named Smart Work in Platform Economy (smartworkresearch.fi), and who is now leading a project entitled Fair work on platforms – REITA (2020–2023) – Finnish Institute of Occupational Health (ttl.fi). Besides human issues in digitalisation and labour platforms, her research interests include developmental methods, workplace learning and hybrid work. One of her recent publications is *Co-creation in Macrotask Knowledge Work on Online Labor Platforms* in the *Nordic Journal of Working Life Studies* (tidsskrift.dk). Seppänen is also an Associate Professor at the University of Helsinki, Finland and an editor in the *Journal Outlines: Critical Practice Studies.*

PRO PUBLICO BONO – Public Administration, 2024/1, 193–214. • DOI: 10.32575/ppb.2024.1.9

Anna Ürmössy

CONSENT AND RESISTANCE – THE ROLE OF GAMIFICATION IN ALGORITHMIC MANAGEMENT OF THE WORK PROCESS (THE CASE OF FOOD-COURIERS IN BUDAPEST)

Anna Ürmössy, student, Central European University, anna.urmossy@gmail.com

This research examines the work organisation of the Foodpanda food delivery firm and the experiences of the bicycle couriers who work for it, particularly their attitudes to the algorithmic management of their work. The focus of the inquiry is the gamification of work, both from-above and from-below. Gamification from-above is constructed by the management. Taking part in the games can be a source of pride and satisfaction, but also of addiction and self-exploitation. Gamification from-below includes all kinds of "games" that the couriers initiate. These can be different strategies to earn more money, save energy or sabotage the labour process. The study shows the connection between games and the formation of consent and resistance among the couriers. The analysis differentiates between the games of making do and making out. Games of making do usually bring about consent, as they stay within the boundaries set by the management. In contrast, making out goes against managerial interest and gives agency to the couriers, thus it has the potential to foster resistance.

Keywords:
bicycle couriers, digital capitalism, food delivery, gig economy, making out, platform work

INTRODUCTION

In recent years, especially since the Covid pandemic, the number of food couriers rose exponentially in Budapest, Hungary. The gig economy and application-based, algorithmic forms of management affect more and more people, many of whom work in precarious conditions. Platform work in Hungary has attracted the attention of various scholars.[1]

[1] E.g. Drahokoupil et al. 2022; Kahancová et al. 2020; Makó et al. 2021a.

This paper aims to contribute to the literature on the food delivery sector[2] from a sociological point of view by examining the role of gamification in the management of food delivery companies.

I conducted my research between September 2021 and March 2022 using qualitative methods: semi-structured interviews and participant observation. I investigated the algorithmic management of *Foodpanda* (which was renamed *Foodora* in 2023). My focus was on the experiences of bicycle couriers, and their attitudes towards the gamified aspects of the work. I distinguished gamification *from-above* and *from-below*. In the first case, gamification is created by the management, while in the second form, games are initiated by the workers. I examined the games in terms of *making do* and *making out*. In the first case, games stay within the boundaries set by the management, while in the second, the games go against the interests of the company.

The aim of the research was to explore the different aspects of gamification used by the application-based, algorithmic management. I investigated how they affect the couriers, focusing on the formation of consent and the appearance of resistance. In the study I (1) give a brief theoretical overview of platform work, labour in digital capitalism and gamification; (2) present my methodology; (3) outline the technical details of the work organisation; (4) present my findings on the forms of gamification I encountered during my research; (5) explore the topic of workers' consent to this way of organising their work and the possibilities of resistance against the algorithmic management.

THEORETICAL FRAMEWORK

Platform work

To understand the socio-economic context of the research, it is necessary to introduce the concepts of the gig economy and platform work. Since these are newly emerging and rapidly changing fields, the definitions used in this research represent just one of the many interpretations of these phenomena. The term *gig economy* refers to the form of employment in which workers are contracted for shorter periods of time or on an on-demand basis, usually with a self-employed status. The couriers' work can be classified as *work-on-demand via app*.[3] Work is organised via an application-based platform, which connects the customer to the rider with the help of an algorithm.[4] This means that there is no human mediation during the allocation of the orders. The couriers can only work when there is an active demand for food deliveries, which makes their income unpredictable. This frequently results in precarious living conditions for these workers.[5] In the gig

[2] E.g. Makó et al. 2021b; Nagy 2024.
[3] De Stefano 2015.
[4] De Stefano 2015.
[5] Kahancová et al. 2020; Standing 2011; Szépe 2012.

economy the economic risks are passed on to the workers by the firm, thus workers become extremely vulnerable to market fluctuations. Being self-employed can also mean that the workers have no or limited access to basic social security benefits and they are excluded from labour law protections.[6] Moreover, platform companies often operate in the "grey area" or are exempted completely from state regulation,[7] which makes it difficult to hold them accountable.

Work in digital capitalism

In contemporary capitalism, the development of digitalisation, data storage and algorithms has had a significant impact both on process of production and the organisation of work. A new era of capitalism has begun, which has been termed *digital capitalism*. The rise of platform work is part of this emerging economic system. Staab and Nachtwey (2016) approach the changes in the world of work from two directions.

Firstly, they introduce the concept of *digital Taylorism*. When Taylorism was first introduced in the 19th century, the aim was to increase efficiency and productivity through the increased regulation and rationalisation of the labour process combined with rigorous control over the workers.[8] In digital Taylorism, the rationalisation and supervision are conducted by means of applications and algorithms.[9] The applications allow for the continuous monitoring of the workers. Furthermore, they are capable of storing all kinds of data,[10] which can be used to evaluate the workers' performance later on. This kind of management is characterised by extreme informational asymmetry.[11] In addition, the algorithm can manage the labour process much more efficiently than a human employee, which leads to higher levels of productivity and thus increasing profitability.

Secondly, in digital capitalism, workers become extremely vulnerable to market fluctuations. Under Fordism, and even partly in post-Fordism, rationalisation and supervision were compensated by firms with certain mandatory benefits (social security, labour laws) and protection against market changes. A significant proportion of workers in digital capitalism do not enjoy similar benefits and stability. "Increasingly automated direct control has returned, albeit without the benefits that membership in an organization offers employees in classic job forms. All of this is embedded in a context of highly asymmetric constellations of power and access to information."[12] The platform serves as an isolating layer, making it difficult for workers to contact and communicate with the

6 De Stefano 2015; Drahokoupil et al. 2022; Rácz-Antal 2022: 62–100.
7 Englert et al. 2021; Makó et al. 2022; Makó et al. 2020.
8 Mueller 2021.
9 Staab–Nachtwey 2016.
10 Van Doorn – Chen 2021.
11 Rosenblat–Stark 2016.
12 Rosenblat–Stark 2016.

human management.[13] It is important to note that the case of *Foodpanda* is not an isolated phenomenon, but a representative example of this complex change of our economic system and its organisation of work.

Gamification

The most important concept of the theoretical framework is gamification. Michel Burawoy described the games played by workers he observed during his fieldwork in a factory.[14] For example, each work phase in the factory had a specific output quota; if the worker produced more than 120% of the quota, he received a bonus. If he did not meet the quota, he would still receive the normal wage. The game of *making out* consisted of assessing whether it was possible to perform above 120% or not. The worker divided his work capacity accordingly: he performed tasks better when it was possible to get a bonus, while he held back energy when it was not. Similar games have also been observed among couriers.[15] Burawoy points out that the management is often involved in the development of the rules of the games, and therefore in most cases the games do not go against their economic interests. When the workers stay *within* the rules set by the company, acting towards the same interest, this has been termed *making do*.[16] In contrast, the term *making out* refers to games that go *against* the intentions of the management, by tricking the system in various ways. Differentiating between *making out* and *making do* is often difficult, because in many of the games, consent and resistance are both present at the same time.[17] Nonetheless, these two categories will be used in this analysis to shed some light on the relationship between certain games and the interests of the management, and to examine which games may be seen as modes of (potential) resistance.

Burawoy's findings reveal that workers do not necessarily engage in games solely because of financial incentives. Games can serve to break the monotony of work and reward achievements with *relative satisfaction*. They can provide challenges; success leads to pride and acknowledgement from the colleagues. Triumphing in games can become a form of self-expression at the workplace. Burawoy argues that participation in the game obscures the production of surplus value and the reproduction of the capitalist system. "One cannot both play the game and at the same time question the rules."[18] The rules of the game are imposed from-above and are not to be questioned. By participation "capitalist relations not only become objects of consent but are taken as given and immutable".[19] Any

13 Rosenblat–Stark 2016.
14 Burawoy 1982: 46–94.
15 Perrig 2021.
16 Alasoini et al. 2023.
17 Alasoini et al. 2023.
18 Burawoy 1982: 81.
19 Burawoy 1982: 93.

dissatisfaction on the part of the workers will not be directed against the system itself, but only against the difficulties of participating in it. As Burawoy puts it, "dissatisfaction […] is directed not against capitalism but toward its reproduction".[20] An example of this is when workers criticise elements of the bonus systems, but the aim of the whole work organisation, namely the acquisition of surplus value, is not questioned. Moreover, the game has an individualising effect; it makes the workers focus on their own performance. The game creates competition, which can lead to conflicts between the workers instead of conflict with the management. Thus, the game also obscures the common class interest of the workers. However, in Burawoy's opinion, the workers are not merely the passive objects of this system; they have the agency and capacity to resistance. Games initiated by workers can develop their own dynamics, which can undermine the interest of the management.[21] Burawoy's theory moves away from a static description of society and allows the importance of the workers' agency to be considered. The research builds upon Burawoy's theory because the phenomena he describes are clearly at play in the management of *Foodpanda*. At the same time, digitalisation has evidently affected the design of the games and how the workers developed *digital agency*.[22]

To distinguish between games based on their origins, the study relies on the work of Woodcock and Johnson (2018). The authors make a conceptional distinction between *gamification from-above* and *gamification from-below*. Gamification from-above refers to the games engineered by the management, such as the bonus system. Gamification from-below includes the games initiated by the workers to break the monotony of the job, *make out* or have some fun while at work. Gamification from-below entails the possibility of resistance.[23] It is not always possible to separate the games into these categories, but this distinction can be used to categorise and analyse the games played by the couriers more effectively.

METHODOLOGY

I conducted my research between September 2021 and March 2022. I used qualitative methods; I conducted participant observation and semi-structured interviews. Additionally, I joined many of the Facebook groups of the couriers to gain a general idea about what happens in the community. However, I only used the groups to provide some context, without analysing their content profoundly.

As my fieldwork, I worked as a courier at *Foodpanda* for 25 hours in November 2021. I decided to work as a courier, because I intended to find out as much as possible about the application and the algorithm. This meant that during the interviews, there was no need to

[20] Burawoy 1982: 93.
[21] Burawoy 1982: 85–92.
[22] Alasoini et al. 2023.
[23] Bronowicka–Ivanova 2020; Woodcock–Johnson 2018.

ask about these technical details, and I could focus more on the experiences and opinions of the interviewees. Furthermore, it was essential that I had access to the application so that I could make first-hand observations of the algorithm and carry out some experiments.

I conducted six semi-structured interviews and one interview with two couriers simultaneously. The interviews were between 60 and 90 minutes long, and took place during winter, a factor which needs to be taken into account. During winter, fewer couriers are working, therefore the active workers find shifts more easily and face less competition from others. In this period, they are more relaxed about the rules, as there is a high demand for couriers from the company. It was not difficult to find interview subjects, therefore I aimed to speak to couriers from different backgrounds and with a variety of work experience at *Foodpanda*. I categorised my subjects based on their experience level and mentality. The experienced riders have a better insight into the workings of the algorithm and are more familiar with the games and more integrated into the riders' community. The "obsessed" couriers work long hours, and work basically consumes their whole life. "Laid-back" couriers may also be experienced, but often use their experience to circumvent the system. They work hard, but don't take the job too seriously. The "average" couriers are already familiar with the system that organises the work. Beginners have only just started the work and have little or no knowledge of the algorithm and how to play it. The various subjects, each with different experience levels, all brought unique perspectives to the research.

Table 1: Information about the interview subjects (with modified names)

Name (Gender)	Age	Education	Time spent as a courier	Weekly work-hours	Monthly salary	Type
Gregory (Male)	35	High school diploma	1.5 years	85–100	Above 1,000,000 Ft (~EUR 2,600)	Experienced, obsessed
Benedict (Male)	22	Elementary school (8 years)	2 years	70	400,000–500,000 Ft (~EUR 1,200)	Experienced, laid-back
Archibald (Male)	23	Vocational training	1 year	60–80	450,000–500,000 Ft (~EUR 1,300)	Experienced, laid-back
Otto (Male)	24	Bachelor's degree	9 months	35	350,000 Ft (~ EUR 900)	Average
Julius (Male)	24	Currently university student	1 year (with a 5-months break)	20–25	150,000–200,000 Ft (~EUR 450)	Average
Esteban (Male)	25	High school diploma	1.5 months	5–20	80,000 Ft (~ EUR 220)	Beginner
Khloe (Female)	29	Bachelor's degree	2 weeks	15		Beginner

Source: compiled by the author.

THE ORGANISATION OF LABOUR

In its official communication, *Foodpanda* draws heavily on the ideas of entrepreneurship, freedom and flexibility. "Be your own boss! Work where and when you want. You can always make your own schedule, adapting it to your other commitments." is a typical promise from their recruitment website.[24] The couriers are contracted as self-employed entrepreneurs. During the time of the research, they were KATA taxpayers (a flat rate for lower tax brackets in the Hungarian taxation system). When they signed their contracts with the company, they agreed that courier work will not be their primary source of income, although no one checks this. The couriers' work-hours are not fixed so they can work as many hours as they want, and they can choose their shifts flexibly. The shifts can be chosen one week in advance. The city is divided into zones, with one shift always covering a specific zone. The work is managed via an application, in which couriers can choose shifts, complete orders, and get in touch with dispatchers while working if they need help. At the time of the research the couriers' salary consisted of an hourly wage and a delivery fee, paid after each delivery. The value of the wages varied from zone to zone: for example, some zones did not pay an hourly wage at all but paid higher delivery fees. In addition, the salary was supplemented by tips and various bonuses.

The algorithm which manages the work creates a strong informational asymmetry. When I asked the interviewees how well they were informed about the operation of the algorithm, all of them answered "not at all". When I asked if they had received any information about how the algorithm worked, one courier replied: "They sent me something, but it doesn't really work like that […] the important thing is that we can trick it, but how it works, nobody knows" (B., experienced and laid back). Another courier added: "It's a honeypot story that the bike couriers get the shortest deliveries, bike couriers don't go uphill, the nearest courier always gets the order" (A., experienced and laid back). There was a consensus among the couriers that the algorithm was unpredictable.

> "The system always picks someone, if it's you, you'll suck that day. If you're lucky, it's not you. Whenever you talk to a courier in the evening, three out of five had a good day, two had a shitty day. There is no logic in the whole system" (B., experienced and laid back).

However, at some level, there is a compensating mechanism: if one has a very good hour with 4-5 deliveries, one can expect a longer delivery the next hour and vice versa. My experience was that the average number of deliveries per hour was three.

The delivery process is also characterised by information asymmetry. When a new order arrives, the couriers only see a code. Only when they have already accepted the order are they given the address of the restaurant. Then, only after they have picked up the food are they informed of the address of the customer. This means that the couriers do not know the length of the delivery when they decide whether to accept it or not.

[24] See: https://futar.foodora.hu/

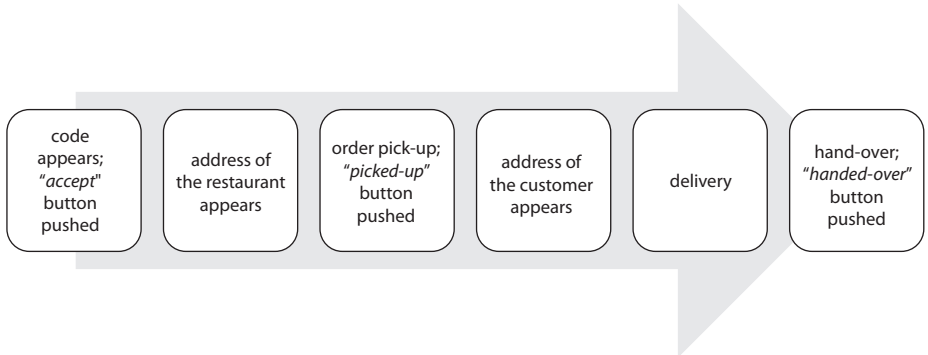


Figure 1: Steps of the delivery
Source: compiled by the author.

GAMIFICATION

This section summarises my findings about the presence of gamification in the couriers' work. I analysed separately gamification from-above and gamification from-below. The concepts of *making out* and *making do* are used to examine whether there was a conflict of interest between the couriers and the management in the different types of games. From this perspective, it is possible to assess whether certain games could be seen as a form of resistance or merely as coping strategies within the boundaries of the system. In addition, the analysis also took into account the group of couriers who are typically involved in a game. Although my interviewees included two "laid-back" couriers, they are generally a distinct minority among the workers.

Gamification from-above

The application and the unpredictability

The most obvious form of gamification from-above is the application itself. Many couriers told me that the workflow (pick-up, route-planning, drop-off etc.) and the interface of the application resembles a (video)game. Due to this, the work feels more stimulating, fun and challenging. Unpredictability is also part of the gamification. Several couriers said that it makes the work similar to gambling, and they pointed out that it can be addictive.

> "And then it's a bit like gambling. […] When you come out, you don't know in advance how many deliveries you're going to have, how long they are, how much you're going to get in tips… When they give you a tip, it's like winning something on a scratch card, so it's a big gamble in the end" (O., average).

The ranking system

The couriers can choose their shifts for the following week sometime between Wednesday and Friday. The exact time depends on the position of the courier in the ranking system. The couriers are divided into a total of 10 groups. The higher a courier is ranked, the earlier they can choose their shifts. According to the information provided on the application: "To create the groups, we take into account the performance of the riders and the system automatically assigns them to their respective groups based on their performance." The system reassesses the groups every two weeks, at which time a courier can rise or descend to another group. In the app there is a table showing the criteria of the assessment. For example, if a courier does not show up for her shift *(No show),* it is weighted at 20% in her ranking. The courier's average number of deliveries per hour (*Utilization Rate,* UTR) is weighted at 10%. Although there seem to be exact criteria for the classification, the workers' experience suggests otherwise. The riders complained both in the interviews and in the Facebook groups that the ranking is inconsistent and unpredictable.

The ranking system is an accurate model of digital Taylorism.[25] The aim of the ranking is to increase the efficiency of the work through impersonal control over the workers. Punctuality, reliability, and the acceptance of the algorithm's rules have a positive impact on the workers' ranking. Being late for a shift, declining orders and ending a shift early leads to punishment. Through the app, workers are constantly visible, and every aspect of their work can be documented.[26] The algorithm is a sophisticated tool for discipline: it makes couriers objectified and comparable. As a result of the permanent visibility of the workers, the work becomes panoptical.[27] Due to the GPS, the system is always aware of where the courier is, and how fast she is moving. The system is able to store and evaluate all kinds of data. However, the couriers are not aware of how these affect their ranking and how the algorithm gives them orders in the future.

> "I'm sure that they know everything, and I'm sure that this ranking system is bullshit, it's not what counts. They must have some sort of a record of every worker. So that when you turn to them let's say with a problem they can tell if you're reliable or not. I'm sure they have some sort of separate record for each courier" (G, experienced and obsessed).

[25] Staab–Nachtwey 2016.
[26] Veen et al. 2020.
[27] Galière 2020.

In addition to its disciplinary function, the ranking system can also act as a positive incentive for workers. The majority of the interviewed couriers find the ranking system to be unpredictable and unfair. However, according to Otto and Gregory, it is a transparent and fair way of ranking, which takes into consideration one's performance and reliability. Gregory is very positive about the ranking:

> "I really need this kind of rigour or strictness, because otherwise I can't really manage my life. […] It's also fine to pick shifts based on something. Obviously, you could make a lot less money if there were no shifts" (G., experienced and obsessed).

At the time of the research (during the winter), the couriers I interviewed did not particularly care which group they were in. However, they pointed out that the number of available shifts is based on market demand and not on the number of active couriers. As Julius put it: "It's not [Foodpanda's] job to make sure that the couriers make a living, they just want to make sure that there are always enough people" (J., average). Thus, it is important to have a high ranking in the summer, because there is huge amount of competition for the shifts in that period.

All of the couriers said that when they started working, they felt that it was really important to be high up in the ranking. At the time of the research, all the interviewees were in groups 6–8, except for Gregory, the obsessed courier, who was usually in groups 2–4. He explained that when he started working as a courier, being in the highest-ranking group was more important to him than anything. His performance became part of his identity, and his achievement in the game boosted his self-esteem.

> "In the beginning it was all about [the ranking]. It's practically how I ruined a relationship. I put everything into this job, I wanted it to work out. […] I find myself within it, but outside of it I really don't. I think the ranking system is not good because you get addicted to it and it's all structured in such a way that you don't really know what you can do outside of it" (G., experienced and obsessed).

When I asked the couriers if it was prestigious among workers to be in a high-ranking group, the answers surprised me. My interviewees had quite a negative opinion about the riders in the high groups. They referred to them as "maniacs", "lunatics" and "greedy", although in many cases they called them "legends" which does suggest some respect.

> "They are maniacs and greedy. They have no life. They'd rather be out there so they can say and boast in the [Facebook] group, 'I've made 59 deliveries today', 'that's nothing, I've made 61', 'I've earned 40k today' 'I've earned 58k'. And they compete on this, and they'd rather have no life and do nothing else" (A., experienced and laid-back).

In conclusion, ranking is important among couriers, but differences in ranking positions often result in being viewed with hostility rather than enjoying prestige. In this respect, the ranking system does have an individualising effect, creating a fracture between couriers in different ranking groups. On the other hand, when push comes to shove, it seems that the competition does not necessarily turn the workers against each other.

> "The system is based on everyone waiting for the other to make a mistake so that they can get in their place. It's all designed to basically kill each other, to live off each other's mistakes. But my experience so far is that everyone helps each other if they can." (G., experienced and obsessed)

Bonuses

The third form of gamification from-above is the bonus system. Based on the interviews, the most important bonus is the *Pandapróba* (Panda challenge). During a *Pandapróba,* after reaching a certain number of deliveries (10, 20, …50) per day, one receives an extra amount of money. For instance, at the time of the research, after 10 deliveries, one got Ft 2,400 (~ EUR 6), while after 50 deliveries, one received Ft 50,000 (~ EUR 130). The announcement of the *Pandapróbas* was quite *ad hoc.* It only happened on certain days and in certain zones, but the company only notified the workers about them the day before they took place. Between 13th of December 2021 and 3rd of January 2022 it was made permanent, but only in certain zones of the city. The aim of *Pandapróba* was clear: to overcome the shortage of couriers during bad weather conditions or holidays.

Experience has shown that the *Pandapróba* is highly addictive. All the interviewees who were actively working during a *Pandapróba* targeted a number of daily deliveries, many of them 50, often despite the bad weather conditions. "I become really rapacious, I got soaked in the rain, but I was motivated by gaining that 50 000 a day," said Otto (average). By challenging the couriers, *Pandapróba* makes the job even more play-like, invoking creative approaches. However, the bonus leads to heavy self-exploitation. It normally takes 10-13 hours to deliver 40 orders, while 50 can be delivered in around 12-16 hours. Besides the money, recognition from other couriers also plays a role in the popularity of this bonus. In Archibald's opinion *Foodpanda* deliberately announces bonuses in an unpredictable way to lure out workers in harsh conditions.

> "Everyone says they can't be bought with money… Oh no, everyone has a price and Foodpanda knows what that price is, to get the simple fools out to work. See, yesterday I was out for 14 hours for that 50 000 Ft? […] Yes, I was out. And not because I'm a greedy idiot. But to outdo a friend of mine, because he did 49 one day, I told him I'd do 52" (A., experienced and laid-back).

According to Archibald, bonuses are a powerful weapon in the company's hands to individualise couriers. In November 2021, an open letter was published in the couriers' Facebook group, urging couriers to boycott work on a given day, putting pressure on the company. When I asked Archibald his opinion about the possibility of a strike, he answered:

> "If 300 people boycott work, okay, Foodpanda notices, but they throw in a 100 Ft bonus per hour and the couriers start working. If they're bastards, they'll announce a Pandapróba for that day, and then even the riders who didn't want to work that day will go out and do it" (A., experienced and laid-back).

In conclusion, gamification from-above can be considered to be engineered so that the workers' and the management's interest coincide. Participation in these games can all be seen as *making do.* The games incline workers to produce surplus-value for the company, while making the work challenging and entertaining. Many elements of gamification can lead to addiction and self-exploitation. Successful participation in the game involves more than the financial rewards. It also creates pride, boosts self-esteem, and in some cases, leads to recognition from other workers.

Gamification from-below

Ways to trick the system

The most common form of gamification from-below is strategising. Before choosing a certain shift, every courier considers the hourly wage and the delivery fee of the zone. They also take into account some less obvious aspects. For example, higher tips can be expected in more affluent areas, although in Budapest that can mean more cycling uphill. The zones differ in size and the number and density of restaurants in them. Other considerations can include traffic and bike lanes. Similarly, one can take into account the ranking system:

> "You can play a bit, let's say, with how many hours you work, how many orders you complete… then you can guess how much it will affect your ranking if you decline an order" (G., experienced and obsessed).

By strategising, couriers feel that they have some autonomy over organising their work. At the same time, strategising is a form of *making do,* since it does not harm the interests of the company at all, as couriers can only manoeuvre within the boundaries set by the business logic.

Another common trick is to learn the codes of the restaurants. This allows experienced couriers (interviews suggest that those who work intensively, get the hang of it in 2-3 months) to mitigate information asymmetry. Experienced couriers have also learned the delivery radius of many of the restaurants. Therefore, when a code appears, they can

decide to decline the order if it could involve a long delivery. By using this trick, couriers can avoid long deliveries and problematic restaurants, making their job easier. This is a game of *making out,* which can be seen as an effective form of resistance to the algorithm, since it goes against the intentions of the management.

"Sprinting" is another popular trick. This is used when the algorithm allocates an address to the courier which is on the edge of a zone, where there are only a few restaurants. In such cases, when the courier hands over the food to the customer, she does not push the "handed-over" button. Instead, she starts to cycle as fast as possible in the direction of the city centre, in hope that by the time the system realises that the delivery is completed, she will get a new order from a restaurant at a better location. It is difficult to fit "sprinting" solely in the category of *making out* or *making do.* By sprinting, couriers *can* trick the algorithm, but not to the extent that it causes problems for the company.

The option of "dropping" orders can also be used to trick the system. It is possible to drop an order when a courier has already accepted an order, but for some reason cannot deliver it. He can get in contact with the dispatchers, who remove the order manually from the courier's profile. Most couriers are aware that if they have to wait more than 15 minutes at a restaurant they can request a drop, while still receiving the delivery fee for that order. This is not ideal for the company, but it is an option offered by their rules, therefore it is a clear case of *making do* on the part of the couriers.

The games mentioned so far are played by the majority of the workers. However, the following ways of *making out* are only used by the "laid-back" couriers. These types of games can invoke the disapproval of their fellow workers. An unorthodox way of dropping an order is to tell a false excuse to the dispatcher.

> "Sure, I'll go up [the hill] to Törökbálinti út […] I picked up [the order], smoked a cigarette […] 'Hi, sorry, I've got a flat tire' [– I told the dispatcher], I had four 'flat tires' in one day. I'm not going to do 5 kilometres, give me a break, it's not worth it. By the time I rode the 5 kilometres, I could have completed two deliveries, maybe three" (A., experienced and laid-back).

By using this method of drop-off, the courier is able to overcome the information asymmetry and, knowing the necessary information, in this case the address of the customer, decide whether or not to accept a delivery. At the same time, as the quotation suggests, the motivating force for dropping is often to enable the courier to deliver more orders, which takes less time. Thus, on the one hand, this trick undermines the organisation of work, but on the other hand, the motivation behind it fits into the profit logic. A "flat tire" can also be a good excuse to end a shift early. Laid-back couriers also strategise with the ranking system to some extent. If they know they will not show up for a shift, they will still check-in on the app a few minutes before the end of the shift, because they know that being late will result in a lower penalty than a *No show.* When closing shifts early and strategising with the ranking, the interests of the courier and the management do not coincide. This behaviour of *making out* is a form of resistance against the algorithm and the informational asymmetry

that it creates. However, considering the high number of active couriers, the company is not significantly affected by one or two of these small tricks, but if used by many workers, it could sabotage its operations more seriously.

Games between each other

Couriers play games among themselves to make their job more interesting. More than half of my interviewees have no lasting relationships with other couriers and are not part of the inner core. However, Benedict, Archibald and Gregory can be described as "integrated" couriers, as they know many other riders and have 4-5 long-term friends among their colleagues. They told me that the bets they place and races they participate in are motivating and "brighten up the day".

> "At the beginning of the month, 10ks, 20 ks, trays of beer are just flying around […] who can take out more orders in a certain amount of time, who can cycle down the road the fastest… Whatever you can bet on, we'll bet on" (A., experienced and laid-back).

The games that workers play with each other provide a way out of the isolation and monotony that comes with the work. From the management's point of view, bets are actually beneficial, as they result in couriers completing more deliveries and faster.

In conclusion, most of the games from-below can be seen as *making do,* coping mechanisms which remain within the rules set by the company. Couriers criticise the algorithm for giving them deliveries that take too long to complete, but by taking part in the games, they must accept that their work is managed by an algorithm whose logic of operation is obscured to the workers. The couriers gain some leeway by their tricks, some of which have the potential to actually sabotage the system. However, the majority of the games do not significantly hurt the interests of the company.

CONSENT AND RESISTANCE

The following section sums up my findings on the issues of consent and resistance. Firstly, I examine how consent is formed, by analysing the role of gamification, the ethos of efficiency and the material vulnerability of the couriers. Secondly, I turn to the question of resistance, presenting the obstacles and the possibilities of fighting the algorithmic form of management.

During the interviews, I asked the couriers how, if they could, they would change the work organisation. Setting a maximum delivery length was mentioned by many of the couriers. In addition, the *ad hoc* nature of the bonuses and the unpredictability of earnings were criticised, although only by two couriers. One of my interviewees pointed out that there

are not enough shifts and the company employs too many workers at the same time. Only one courier out of seven stated that he would change the obscure and highly addictive tendencies of the algorithm:

> "Well, on the one hand, I think it would be good if there was a transparent communication about the algorithm and if we could trace back how it makes decisions. I don't know how it could be possible, but obviously it'd be nice to turn off the addictive, overdriving part of it, that it's always beeping loudly and it's so colourful and it's lit up…" (E., average).

Neither the ranking system, nor the continuous monitoring and data storage were mentioned by the couriers. Only one person said that he would try to decrease the uncertainty that arises from the fact that the number of shifts and active couriers is adapted to market needs and that the company does not feel obliged to ensure that couriers can live on their earnings. There was one courier who would prefer not to change anything:

> "– Do you think it's ok, that you only see a code when you need to decide whether to accept an order or not?
> – That's what's good, why should you strategise? Just do your job, that's it.
> – Would you change something in the organisation of the work?
> – I would somehow make everyone suck the same. Although I suspect that if you divide the average number of kilometres by the delivery lengths, it comes out the same on average. I'm not sure I would change anything. Why should I change it? I think it's obviously organised well" (G., experienced and obsessed).

I left this question until the end of the interviews, to give the couriers space to reflect on the issues raised during the interview. The point was not to test whether they can perceive the problems, because it is clear that they can. My intention was to see what kind of changes they feel could be realistically implemented and to assess which parts of the management seem unchangeable to them.

The role of gamification

Similarly to Burawoy (1982), I conclude that gamification facilitates the development of consent. To participate in the games, one must accept their rules; through participation, the game becomes a natural part of work. Gamification is a positive stimulus during work. Games make the job more fun and be a source of relative satisfaction and pride. In the case of gamification from-above, couriers must remain within the boundaries set by the management, they can only *make do*. In the case of gamification from-below, the games played by many of the couriers are also a form of *making do*. The small opportunities for defiance provide a sense of relative freedom. Strategising and tricking the system makes

the couriers feel that they are at least partly in control of the labour process. However, these manoeuvres mostly stay between the lines drawn by the company. Nonetheless, small acts of resistance do appear. A common form of *making out* is learning the codes of the restaurants. Using false excuses and strategising with the ranking system can also be seen as forms of resistance, although they are practiced by very few of the workers.

Table 2: The appearances of making out and making do

	Making do	**Making out**
Gamification from-above		
All couriers	Game-like interface Ranking system Bonuses	
Gamification from-below		
Many couriers	Strategising "Sprinting" "Dropping" (after 15 min)	Learning the codes of restaurants
Only laid-back couriers		"Dropping" with a false excuse Ending shifts early with a false excuse Strategising with the ranking system
Only experienced couriers	Games among one another	

Source: compiled by the author.

Although the couriers criticise elements of the game, overall, they consent to the organisation of work. Participation in the game distracts the couriers' attention from their exploitation and obscures the fact that they are producing surplus-value for the company.

> "I think the system is made in such a way that you should do what they throw at you. Because if the system wants to fuck with you, it will. It makes sense to me that it's structured so that you do what they put in front of you, and then you pretty much always end up doing fine" (G., experienced and obsessed).

The ethos of efficiency

Consent is strongly influenced by being socialised in an economic system where rationality and productivity are seen as unquestionable, universal values.[28] In almost all the interviews, the topic of productivity came up when the couriers were asked about changing the methods of management. They argued that it would be difficult to alter the organisation of labour without sacrificing efficiency.

[28] Marcuse 1991.

"– Do you think it's inevitable that we don't know how the algorithm works?
– Well, yes. If everyone could outsmart it, then what would happen? I think it's necessary that we can't see into it" (O, average).

When asked about their opinion of the organisation of work, the couriers showed a tendency to incorporate the company's interests as their own point of view. In their answers, the couriers prioritised efficiency over fairness and sustainability.

"– And all this […] the ranking and wages and everything… How fair do you think this work organisation is?
– I think it's a firm organised fucking efficiently" (G, experienced and obsessed).

It is an important element of the formation of consent that the workers see the capitalist economic logic as fundamental and unchangeable.[29] Consequently, questioning a system developed by such a logic seems irrational.

Employment vulnerability

Finally, it is worth examining the material aspect of consent. Couriers are in a vulnerable position, as the company bears no responsibility towards them in terms of labour law. They can be replaced or substituted at any time. Moreover, for many people, being a courier is the only job where they can earn the average wage or more.

"B (experienced and laid-back): I'm always motivated by the fact that it's either this or working three shifts in the factory.
A (experienced and laid-back): In my case, you work 24-48 hours in health care, and you don't get a quarter of the money you make here. Okay, it's burdensome here, but you earn it."

Resistance

When it comes to resistance, there are many obstacles to overcome. Firstly, many of the couriers perceive their work as a temporary form of income. This makes the energy which they would put into fighting the management seem wasted, because change is unnecessary for them in the long term. Secondly, there is a constant fluctuation in the workforce, due to the short-term or part-time workers and depending on the season of the year. Thirdly, the

[29] Purcell–Brook 2020.

isolation of the couriers from one another makes it difficult for workers to organise. Since there is no official community space for them, they usually only meet at the restaurants, while waiting to pick up an order. Finally, one of the main obstacles of resisting algorithmic management is the lack of a central character of power. There is no boss, just a faceless multinational, with whom almost the only physical contact is at the time of contracting. All communication takes place through newsletters and the app, which creates an isolating layer between the management and the workers. If a courier has a question, even reaching somebody from HR is difficult.

> "There's no team here, it's not like a workplace where you go in, there's a team and you can really stand up to the boss together. But for us, we would really need to go out on the streets, I don't know how many thousands of us and say enough is enough" (A., experienced and laid-back).

The couriers encounter an impersonal algorithm. The most obvious form of resistance is to confront this algorithm. However, the algorithm *per se* cannot be confronted, thus the primary method of resistance is confined to finding loopholes.

Nevertheless, by finding these loopholes, the games can become means of resistance. One of the strengths of Burawoy's theory is that it gives agency to workers.[30] Games can transform, spread, and liberate themselves from managerial interests. Although the games I observed are not (yet) capable of sabotaging management significantly, they lead to the development of digital agency.[31] With some organisation, they could be used for resistance against the algorithm.[32] If, for example, the list of the restaurants' codes became known to more workers, this would provide an opportunity to reduce information asymmetry significantly. In this way the game of *making out* could contribute to undermining an important element of the work organisation at the company. These small practices could also lead the formation of more organised form of resistance. There are examples of successful organisation by platform workers in many European countries,[33] including Italy,[34] the UK[35] and Germany.[36]

30 Burawoy 1982.
31 Alasoini et al. 2023.
32 Bronowicka–Ivanova 2020; Woodcock 2021.
33 Vandaele 2021.
34 della Porta et al. 2022; Tassinari–Maccarrone 2020.
35 Cant 2019; Chesta et al. 2019.
36 Bronowicka–Ivanova 2020.

CONCLUSION

The research examined the algorithmic management of *Foodpanda* in the broader context of platform work and digital capitalism. The main concept applied was *gamification,* which was divided into gamification from-above and gamification from-below during the analysis.

Gamification from-above consists of the gambling-like work process, the ranking system and the bonuses offered for completing "challenges" during work. It was found that playing the games can lead to addiction and self-exploitation among the couriers. By taking part in the games, the couriers must accept the rules and the logic of the work organisation. Furthermore, the games provide some scope for relative satisfaction during one's work. In the games from-above, workers can only *make do,* which involves consenting to the algorithmic management system. The formation of consent is also heavily influenced by the internalisation of the economic logic of our age. The ethos of efficiency and productivity dictated by contemporary capitalism makes it seem irrational to question such a remarkably rationalised and efficient organisation of labour. The system seems unquestionable and unchangeable, and the workers are forced to accept this type of management.

Gamification from-below consists of games initiated by the couriers. This includes strategising, tricking the algorithm, and the couriers making bets among themselves. Tricking the algorithm gives the couriers room for manoeuvre, which leads to a sense of relative freedom. The games of *making do* do not harm the interest of the company. The isolating layer created by the platform and the individualised working conditions set up obstacles to other forms of resistance. Nonetheless, gamification can be a double-edged sword. Games of *making out* have the potential to give the couriers agency to resist the algorithmic management, which can lead to them organising to fight for their interests.

Finally, it should be acknowledged that the research has its limitations. Only seven interviews were conducted, based on a snowball-method, therefore it is difficult to assess the findings' representativity. The focus was solely on bicycle couriers; workers using motorbikes and cars were not included in the sample. Only Budapest, the capital city was examined. Experiences and opinions could vary in different areas of the country. In addition, the research was conducted during winter, which differs greatly from other periods of the year both in its working conditions and in the number of active couriers. Further research is needed in order to draw more general conclusions about the topic.

REFERENCES

Alasoini, Tuomo – Immonen, Jere – Seppänen, Laura – Känsälä, Marja (2023): Platform Workers and Digital Agency: Making Out on Three Types of Labor Platforms. *Frontiers of Sociology,* 8(2023). Online: https://doi.org/10.3389/fsoc.2023.1063613

Bronowicka, Joanna – Ivanova, Mirela (2020): *Resisting the Algorithmic Boss: Guessing, Gaming, Reframing and Contesting Rules in App-Based Management.* SSRN Electronic Journal. Online: https://doi.org/10.2139/ssrn.3624087

Burawoy, Michael (1982): *Manufacturing Consent: Changes in the Labor Process under Monopoly Capitalism*. Chicago, IL: University of Chicago Press. Online: https://doi.org/10.7208/chicago/9780226217710.001.0001

Cant, Callum (2019): *Riding for Deliveroo: Resistance in the New Economy.* Cambridge: Polity.

Chesta, Riccardo – Zamponi, Lorenzo – Caciagli, Carlotta (2019): Labour Activism and Social Movement Unionism in the Gig Economy. Food Delivery Workers' Struggles in Italy. *PACO,* 12(3), 819–844. Online: https://doi.org/10.1285/i20356609v12i3p819

De Stefano, Valerio (2015): *The Rise of the 'Just-in-Time Workforce': On-Demand Work, Crowd Work and Labour Protection in the 'Gig-Economy'.* SSRN Electronic Journal. Online: https://doi.org/10.2139/ssrn.2682602

Della Porta, Donatella – Chesta, Riccardo Emilio – Cini, Lorenzo (2022): Mobilizing against the Odds. Solidarity in Action in the Platform Economy. *Berliner Journal Für Soziologie,* 32(2), 213–241. Online: https://doi.org/10.1007/s11609-022-00471-z

Drahokoupil, Jan – Kahancová, Marta – Meszmann, Tibor T. (2022): Falling through the Cracks – Gig Economy and Platform Work in Central and Eastern Europe. In Ness, Immanuel (ed.): *The Routledge Handbook of the Gig Economy.* London: Routledge, 309–323. Online: https://doi.org/10.4324/9781003161875-25

Englert, Sai – Graham, Mark – Fredman, Sandra – du Toit, Darcy – Badger, Adam – Heeks, Richard – Van Belle, Jean-Paul (2021): Workers, Platforms and the State: The Struggle over Digital Labour Platform Regulation. In Drahokoupil, Jan (ed.): *A Modern Guide To Labour and the Platform Economy.* Cheltenham: Edward Elgar, 162–176. Online: https://doi.org/10.4337/9781788975100.00020

Galière, Sophia (2020): When Food-Delivery Platform Workers Consent to Algorithmic Management: A Foucauldian Perspective. *New Technology, Work and Employment,* 35(3), 357–370. Online: https://doi.org/10.1111/ntwe.12177

Kahancová, Marta, Meszmann, Tibor T. – Sedláková, Mária (2020): Precarization via Digitalization? Work Arrangements in the On-Demand Platform Economy in Hungary and Slovakia. *Frontiers in Sociology,* 5. Online: https://doi.org/10.3389/fsoc.2020.00003

Makó, Csaba – Illéssy, Miklós – Nosratabadi, Saeed (2020): Emerging Platform Work in Europe: Hungary in Cross-country Comparison. *European Journal of Workplace Innovation,* 5(2), 147–172. Online: https://doi.org/10.46364/EJWI.V5I2.759

Makó, Csaba – Illéssy, Miklós – Pap, József (2021a): National Context: Hungary. In Moniz, A. B. – Boavida, N. – Makó, Cs. – Krings, B. J. – de Miguel, P. S. (eds.): *Digital Labour Platforms: Representing Workers in Europe.* Vila Nova de Famalicão: Edições Húmus – CICS.NOVA, 23–28. Online: https://doi.org/10.34619/rwrm-3uun

Makó, Csaba – Illéssy, Miklós – Pap, József (2021b): Wolt: A High Growth Platform in the Delivery Economy in Hungary. In Moniz, A. B. – Boavida, N. – Makó, Csaba – Krings, B. J. – de Miguel, P. S. (eds.): *Digital Labour Platforms: Representing Workers in Europe.* Vila Nova de Famalicão: Edições Húmus – CICS.NOVA, 95–110. Online: https://doi.org/10.34619/rwrm-3uun

Makó, Csaba – Illéssy, Miklós – Pap, József and Nosratabadi, Saeed (2022): Emerging Platform Work in the Context of the Regulatory Loophole (The Uber Fiasco in Hungary). *Journal of Labor and Society,* 1(aop), 1–22. Online: https://doi.org/10.1163/24714607-bja10054

Marcuse, Herbert (1991): *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society.* 2nd Edition. Boston: Beacon Press.

Mueller, Gavin (2021): *Breaking Things at Work: The Luddites Are Right About Why You Hate Your Job.* London: Verso.

Nagy, Klára (2024): Body and Mind. Reframing Labour Exploitation and Risk as a Sport among Platform Workers. (The Case of the Food Delivery Sector in Budapest). *Pro Publico Bono,* 12(1), 207–228. Online: https://doi.org/10.32575/ppb.2024.1.10

Perrig, Luca (2021): Manufacturing Consent in the Gig Economy. In Moore, Phoebe V. – Woodcock, Jamie (eds.): *Augmented Exploitation.* London: Pluto Press, 75–86. Online: https://doi.org/10.2307/j.ctv1h0nv3d.12

Purcell, Christina – Brook, Paul (2020): At Least I'm My Own Boss! Explaining Consent, Coercion and Resistance in Platform Work. *Work, Employment and Society,* 36(3), 391–406. Online: https://doi.org/10.1177/0950017020952661

Rácz-Antal, Ildikó (2022): *A digitalizáció hatása a munkajog egyes alapintézményeire.* Jog és Állam, 40. Budapest: Károli Gáspár Református Egyetem Állam- és Jogtudományi Kar Online: https://ajk.kre.hu/images/doc2022/pr/A_digitalizacio_hatasa_a_munkajog_egyes_alapintezmenyeire.pdf

Rosenblat, Alex – Stark, Luke (2016): Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers. *International Journal of Communication,* 10, 3758–3784. Online: https://doi.org/10.2139/ssrn.2686227

Staab, Philipp – Nachtwey, Oliver (2016) Market and Labour Control in Digital Capitalism. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society,* 14(2), 457–474. Online: https://doi.org/10.31269/triplec.v14i2.755

Standing, Guy (2011): *The Precariat.* London: Bloomsbury. Online: https://doi.org/10.5040/9781849664554

Szépe, András (2012): Prekariátus: Miért Pont Most És Miért Pont Itt? *Fordulat,* 19, 10–27.

Tassinari, Arianna – Maccarrone, Vincenzo (2020): Riders on the Storm: Workplace Solidarity among Gig Economy Couriers in Italy and the UK. *Work, Employment and Society,* 34(1), 35–54. Online: https://doi.org/10.1177/0950017019862954

Van Doorn, Niels – Chen, Julie Yujie (2021): Odds Stacked against Workers: Datafied Gamification on Chinese and American Food Delivery Platforms. *Socio-Economic Review,* 19(4), 1345–1367. Online: https://doi.org/10.1093/ser/mwab028

Vandaele, Kurt (2021): Collective Resistance and Organizational Creativity amongst Europe's Platform Workers: A New Power in the Labour Movement? In Haidar, Julieta – Keune, Maarten (eds.): *Work and Labour Relations in Global Platform Capitalism.* Cheltenham: Edward Elgar, 206–235. Online: https://doi.org/10.4337/9781802205138.00019

Veen, Alex – Barratt, Tom – Goods, Caleb (2020): Platform-Capital's 'App-Etite' for Control: A Labour Process Analysis of Food-Delivery Work in Australia. *Work, Employment and Society,* 34(3), 388–406. Online: https://doi.org/10.1177/0950017019836911

Woodcock, Jamie (2021): Understanding Platform Resistance. In *The Fight against Platform Capitalism: An Inquiry into the Global Struggles of the Gig Economy.* Westminster: University of Westminster Press, 67–83. Online: https://doi.org/10.16997/book51.e

Woodcock, Jamie – Johnson, Mark R. (2018): Gamification: What It Is, and How to Fight It. *The Sociological Review,* 66(3), 542–558. Online: https://doi.org/10.1177/0038026117728620

Anna Ürmössy studied at the Eötvös Loránd University, Sociology BA between 2019 and 2022. She was a member of the College of Advanced Studies in Social Theory from 2019 to 2023. In 2022, she was a research assistant at the Hungarian Research Network's Centre for Social Sciences. She is currently doing her masters in Sociology and Social Anthropology at the Central European University. For the academic year of 2021/22, she was awarded the National Higher Education Scholarship. In the same year she carried out her research presented in the following study, as part of the New National Excellence Program. In 2023, the research was awarded first place at the National Conference of Scientific Students' Associations.

PRO PUBLICO BONO – Public Administration, 2024/1, 215–236. • DOI: 10.32575/ppb.2024.1.10

Klára Nagy

BODY AND MIND – REFRAMING LABOUR EXPLOITATION AND RISK AS A SPORT AMONG PLATFORM WORKERS. THE CASE OF THE FOOD DELIVERY SECTOR IN BUDAPEST[1]

Klára Nagy, Periféria Policy and Research Center, Solidarity Economy Center, nagy.klara@periferiakozpont.hu

Cycling food couriers in Hungary tend to normalise and justify for themselves the precarious gig working conditions as a sports activity. To understand the blurring between sport and work, I carried out participant observation, conducted semi-structured interviews and discourse analysis. I worked as a bicycle courier in Budapest in July and August 2021. The successful boom of the cycling-based food delivery platforms depends on the extraction of bodily resources. Food delivery companies create new frontiers as they frame labour as challenging cardio activity.

The riders embrace the idea that they get paid for training their body, which activity is otherwise expensive and tiring. The workers utilise their knowledge from their past sporting activities about nutrition and pain relief to increase their workload. Sporting rivalry and boasting of results are active features of the courier community.

Although my interviewees proudly claimed themselves entrepreneurs, the body experiences reveal the cleavage between gig wage labour and idealised entrepreneurship. The pain and dangers of urban cycling work highlight the unequal relationship and make couriers critical of the company.

Keywords:
body, exploitation, food delivery, pain, platform economy, sport

[1] I would like to express my deepest gratitude to my supervisors, Professors Claudio Sopranzetti and Violetta Zentai, for their support.

INTRODUCTION

The food delivery industry is one of the most visible sectors of the platform economy, which has contracted thousands of people in recent years in Budapest. This research explores how Budapest's bike delivery workers accept, normalise, and justify precarious working conditions, labour exploitation, and risk. The paradox of both criticising and embracing the food delivery sector as a positive work choice is an active feature of the courier community in Hungary. The leading Facebook group of these couriers (Futárok – WOLT – Netpincér 2021) and my preliminary interviews are full of harsh critiques of the delivery companies. However, the delivery workers remain contracted by these firms and proudly assume their common identity of riders. How do the food delivery workers in Hungary accept, normalise, and justify the precarious working conditions, labour exploitation, and risk involved in this field?

Bike food couriers in Hungary tend to normalise and justify to themselves the precarious gig working conditions of their occupation as if it were a sports activity. To understand the blurring between sport and work, I carried out participant observation and conducted semi-structured interviews and discourse analysis. I worked as a bicycle courier in Budapest in July and August 2021. The successful boom of bike-based food delivery platforms depends on the extraction of bodily resources. Food delivery companies create new frontiers, framing labour as challenging cardio activity.

The riders embrace the idea that they get paid for training their body, an activity which is otherwise expensive and tiring. The workers utilise their knowledge of nutrition and pain relief from past sporting activities to increase their workload. Sporting rivalry and boasting about results are active features of the courier community.

Although my interviewees proudly claimed to be entrepreneurs, their physical, bodily experiences reveal the cleavage between gig wage labour and an idealised entrepreneurship. The pain and dangers of urban bike work highlight the unequal relationship between the workers and the company, and make couriers critical of the company.

THE PLATFORM ECONOMY

"Earn money whenever you want to", "You can be free and flexible at the same time", "You decide, how much you earn". The website of the Wolt food delivery company displays promises of this kind for potential couriers.[2] "One of the biggest benefits of Wolt's platform is freedom" – states the general introductory email for new couriers. Flexibility, freedom, and control are central elements of recruitment. Harvey (2007) argues that as the condition and mode of production change in every new phase of capitalism, so too does

[2] See: https://wolt.com/hu/couriers

its culture.[3] The transition from Fordism to flexible accumulation changed the form and ideology of production. The acceleration of accumulation has shaped labour to make it as flexible as possible for the employer by mainstreaming new organisational structures, such as subcontracting and outsourcing. A new way of compressing time and space has emerged, fitting flexible production needs. Work volatility has become increasingly prevalent, and short-term plans and temporary contracts have become widespread. The outsourcing of manufacturing from the core countries has increased the importance of the service sector, where on-demand work is particularly normalised. Since employers strive to minimise the risks and responsibilities arising from the unstable economy, it is in their interest to shift to atypical modes of contracting,[4] for example, via temporary work agencies, or as in our case, via platforms. The number of full-time jobs decreases, and with that, certain benefits also disappear.

Food delivery work is part of the platform economy. The platform economy concept covers temporary, freelance, and flexible jobs organised via digital platforms. After the 2008 crisis, the growth of mass and underemployment, the implementation of austerity policies, and increasing inequality made platform work attractive for the impoverished middle class in the core and some semi-peripheral countries.[5]

Despite the remarkable number of competing scholarly views that have emerged about the platform economy, there is a loose consensus about the four principles of the sphere. Workers in the platform economy have irregular, unsocial work schedules depending on the customers' demands. The workers provide most of the means of production. Most work is paid at a piece rate and organised via platforms.[6] In addition, the platform labour force works more hours for the same income as regular workers on average.[7] The platform economy has been severely criticised, and there is an increasing amount of literature on the way its exploitative and precarious working conditions are framed as freedom and flexibility.[8] It is thus important to research the platform gig economy, as it has introduced new production norms, which affect the whole economy.[9] In 2021, an estimated 12 million people worked in the platform economy in the European Union, while 3 million people are "main platform workers", which means they work at least 20 hours per week or earn more than 50% of their income from this sector. 2.5% of the working-age population in Hungary did platform work, and 0.4% were mainly platform workers in the past year.[10]

3 Harvey 2007.
4 Scholz 2017; van Doorn 2017.
5 Van Doorn 2017: 900.
6 Stewart–Stanford 2017: 421.
7 Rani et al. 2021.
8 Freytas-Tamura 2021; Kučinac 2021; Choe 2020; Zhao 2021.
9 Cant 2019.
10 Piasna et al. 2022: 15.

THE FOOD DELIVERY SECTOR

The food delivery industry is one of the most visible sectors of the platform economy, which has contracted thousands of people in the past few years in Budapest. The sudden boom in the food delivery platform companies partly stems from the Covid–19 pandemic and Hungary's restrictions on visiting public spaces and direct human contact at that time. The growing interest in food courier jobs cannot be explained simply by the increasing unemployment rate, especially the massive layoffs in the hospitality industry, which forced the workers to participate in the sector. Firstly, since the Covid–19 pandemic, Hungary has had a 2.4% labour shortage.[11] Secondly, the increase in newly contracted couriers continued after the reopening of the hospitality sector.[12]

This article focuses on bicycle food delivery platform workers in Budapest. This research uses the distinction between platform work subcategories made by Vallas and Schor (2020) to describe food delivery platform work. They argue that some types of platform work, such as care work, home repairs, ride-hailing, and courier work form a separate category, as they are organised online, via platforms, but performed offline.[13]

The most widespread method of food delivery is by bicycle. Working as a bike courier requires less capital than being a car or moped courier. However, bike couriers are the most exposed to traffic and the weather. Bicycle delivery represents both the most common mode of couriering and the most extreme working conditions in this sector.

Since the post-socialist transition, and especially since the 2000s, cycling has become a mainstream activity in Budapest, which has thus become a trendy, eco-conscious, middle-class pursuit.[14] The subcultural features of cycling delivery jobs[15] have not disappeared with the transition of cycling into the mainstream and the emergence of platform food delivery companies in Hungary. The cycling subculture was even able to preserve and evolve during the pandemic. *Hajtás Pajtás,* the oldest cycling delivery company in Hungary, which has existed since 1993, has creatively adapted to the epidemic situation.[16] Additionally, in March 2020, the *Gólya Futárszolgálat* cycling delivery cooperative was launched.[17]

FOOD DELIVERY PLATFORM SCENE IN HUNGARY

There are three active food platform delivery companies in Hungary, Wolt, Foodpanda[18] (previously operating under the brand NetPincér), and Bolt Food. These companies contract

[11] See: https://www.ksh.hu/stadat_files/mun/hu/mun0159.html
[12] Kiss 2021.
[13] Vallas–Schor 2020.
[14] Tóth 2019.
[15] Tóth 2019.
[16] See: https://hajtaspajtas.hu
[17] See: https://www.golyaszovetkezet.hu/golya-futar
[18] Since this research ended, Foodpanda has been operating under the name of Foodora.

their workers in two ways, as "partners", to avoid taxation and employment obligations. The first form of employment is that the worker can contract as an "entrepreneur" with the food delivery company. The second form of employment is via cooperatives for students and pensioners. Couriers choose whether to work using bicycles, mopeds, cars, or on foot. The workers bear the cost of the bike, phone, and maintenance.

When I contacted Bence, a manager from one of Hungary's leading food delivery companies, he provided extra information on the workers' statistics, which are publicly unavailable. The income from platform work as a percentage of workers' total income is highly variable.[19] The wages that Wolt couriers receive are calculated on the basis of a combination of base fees and distance fees. In some zones, scheduled hours with hourly shifts are also available.[20] Foodpanda organises shifts for its workers. Within these arrangements, base fees and hourly wages are available.[21] Because of the different fee structures, several couriers work at both Wolt and Foodpanda simultaneously. If a worker cannot book suitable or sufficient shifts at Foodpanda, they can always flexibly work via Wolt.

There are several myths about the income of couriers. "Clickbait" headlines claim that a courier can earn 700-800 thousand HUF (1800-2100 EUR).[22] According to the posts by couriers on private Facebook groups, while such earnings are not impossible, they are not common. Some "legends" can even earn a million HUF per month, but that means working from Monday to Sunday, from 8:00 am to midnight and having a minimal personal life.

Admission happens via an online system. In the company which Bence works for, the management is constantly experimenting with the length of the waiting time. At the beginning of the pandemic, the maximum waiting time was up to four months. However, most applicants had already found other work during this time, so the management reduced the waiting time, and new applicants are now taken first in the application process. A crucial element of the application is the referral system, which speeds up the process of recruitment. In principle, couriers can only recommend candidates for whom they can take full responsibility. Although there are no consequences for recommending an unsuitable candidate in practice, the model works well, with active couriers offering the company a reliable workforce. When there are fewer orders over a more extended period, and the company needs fewer workers, they take on fewer new "partners". The couriers do not have a minimum wage, and their income depends on the number of orders they deliver. When there are fewer orders, couriers try to avoid decreasing their income by recommending fewer acquaintances to be couriers. If there are fewer couriers than orders, the management increases the wages with bonuses.

Labour shortages are an ongoing problem for food delivery companies built on continuous growth. Moreover, couriers turn over quickly, so constant recruitment is needed. Due to the shortage of couriers, the quality of training is deteriorating. Courier

[19] Piasna et al. 2022.
[20] See: https://woltfutarok.com/dijazas
[21] See: https://www.foodpanda.hu/en/contents/futardijtabla?r=1
[22] Biró 2021; Veres 2020.

informants reported that there used to be an hour-long interactive in-person training session, which switched to an online training session, then to a 25-minute-long recorded video introduction. Although a formal recruitment test has been used in the past half-year, the results of this test are not taken into consideration. As couriers put it, food delivery companies hire anyone with a pulse. Foodpanda even pays its staff for new couriers. If a courier invites a new one, who works 150 hours, the inviting courier receives 50,000 HUF (130 EUR), plus the new courier also gets a voucher of 20,000 HUF (52 EUR).

According to one informant, Bence, more than ten thousand couriers are registered in his company, while there are around twenty-five thousand delivery workers in the country as a whole. Each month, seven to eight thousand couriers are active, and four to five thousand are active per week. Most of the passive workers treat delivery work as a backup plan. They can always work as couriers and bypass the waiting list with their inactive status if anything goes wrong.

Most couriers work part-time. According to Bence, in March 2022, 13% of the couriers worked at least 36 hours per week, and 23% worked between 20 and 36 hours. This means that more than three-quarters of the couriers at this company work less than half-time. Bence estimated that 27% worked between 10 and 20 hours, and 37% worked less than 10 hours in this company. This trend is in line with EU figures. Delivery work tends to coexist and supplement other, not platform-based precarious incomes.[23]

According to Bence, around 80% of couriers are male. This rate is above the EU average, where 59% of delivery platform workers are male.[24] The core of the workers are 30-40 years old men, who are changing their careers, so they need to find temporary jobs quickly. At first sight, it would seem logical for them to apply for unemployment benefits. However, the Hungarian state is not generous with unemployed people, as they receive 60% of their previous income for no longer than 90 days. Hence, if someone is made redundant, dismissed or resigns from their job, they immediately start looking for a new one.

The rapidly fluctuating trend resonates with the EU average in the delivery sector. 48% of the delivery workers started working in the field last year.[25] However, Bence warned about generalising about the workers, since the people who work the most are the most visible, which renders the other couriers invisible. Interestingly, the company does not have data on the gender and age distribution of its contractors.

The population of the couriers is stratified. Beginners can usually be recognised by their orange, substandard quality bikes rented from the Donkey Republic company, which initially specialised in tourists. In line with Piasna's and Drahokoupil's representative

[23] Piasna et al. 2022: 42.
[24] Piasna et al. 2022: 27.
[25] Piasna et al. 2022: 20.

online survey research,[26] delivery workers with lower social positions and more economic dependency on the platform enjoy fewer flexible conditions in their work.

Wolt couriers in Budapest do not work fixed shifts. Based on the narrative of the newsletter, this increases their degree of freedom. Couriers can theoretically work any time from 8 am until midnight. Orders are the organising factor of the work, so lunch and dinner times are popular. Wolt motivates its couriers to work during busy periods (such as lunch, dinner times, and in stormy weather) by sending frequent chat messages through the app and offering bonuses if this method does not work. It is common for workers to have to wait hours to receive the first order. Anger about waiting for work is commonly voiced in the courier communities. The waiting, uncompensated work time is a core attribute of platform work, which helps companies to keep wages lower.[27] The food delivery workers at the company which Bence works for spend 20-30% of their online time waiting. At Wolt, in the absence of hourly wages, the couriers do not usually spend time together, as they are rivals. The farther away the other couriers are, the more likely one is to receive an order.

In contrast, online communication is highly active in Facebook groups. The official communication of Wolt by newsletters strengthens the stratification of workers by stating that "hanging out" while waiting jeopardises their chances of getting an order, and that couriers should not believe "rumours" circulating on common Facebook groups. Wolt has stated that they have not contracted too many couriers, so everyone has enough opportunity to work.

Besides newsletters, companies also use other methods to avoid or deflect criticism from their couriers. Foodpanda uses the institution of "captains". In Budapest, there are three captains. Every other city in Hungary has one. Captains are the link and the conflict zone between the couriers and the head office. The couriers are given the captain's phone number and told that they can call them if they have a problem. The captains filter their complaints and discuss them with the management every two weeks. Initially, couriers elected the captains. Since the boom of delivery companies, the "fleet" is no longer a community, and the workers rarely know each other, so now the captains are appointed. The captains receive extra pay, and they are always in the first working group, so they have the privilege of having first choice of the shifts.

Even so, there are problems that neither newsletters, bonuses, nor captains can address. Using a courier application is mentally and physically demanding, as it dictates a breakneck pace. The app shows how much time the food must be delivered within. Usually, this is an unrealistic expectation, as the app sometimes even shows minus minutes. The worker's goal is to complete delivery as quickly as possible, maximise their wages, and adapt to the speed generated by the application. The tempo leads to a high rate

[26] Piasna–Drahokoupil 2021.
[27] Pulignano–Piasna 2021.

of accidents, since it is self-evident that to meet it, it is necessary to disregard the basic rules of Budapest traffic. The companies do not pay attention to how the food is delivered in practice, and couriers do not receive any information or training about the official or unofficial rules of the road. Wolt used to organise optional training for couriers, but it is no longer available.

Besides the entrepreneurial and social features of bicycle food courier work, cycling also brings some pride to the workers. Compared to other types of physical labour, bike delivery endows the workers with the prestige of the urban bicycle culture and visibility, and it is even framed as a leisure activity. The recruitment campaigns employed by food delivery companies are implicitly based on a critique of white-collar jobs and highlight the resistant features of the bicycle subculture. The Facebook and Instagram recruiting advertisements placed by the food delivery companies' position bike delivery work as something advantageous.

"Test yourself as a courier."

"Get in shape at Wolt! Apply and join the fittest courier team! Test yourself as a courier"

"Go on an adventure, join NetPincér as a courier."

METHODOLOGY

I divided the research into three approaches: participant observation, discourse analysis, and semi-structured interviews. A significant advantage of participant observation is that I gained insights into the inner logic of "riding", the couriers' working conditions, their dilemmas, and their opinions in detail. I worked as a bicycle courier at Wolt in July and August 2021 in Budapest. Although working as a food delivery courier is mostly a solitary pursuit, there were several situations in which riders had the opportunity to engage in discussions. Joining their conversations while waiting for orders to be prepared or for the algorithm to assign a task, while wearing the company uniform granted me a level of intimacy and access that I would not have otherwise gained.

Like many individuals who want to do a summer job, I fit into the field as a 23-year-old university student. However, I worked in food delivery as a researcher, which is a significant difference. I delivered food out of curiosity, alongside my daily routine, not for money. Hence there were specific layers of the reality of food delivery that I had no access to, even though I did the same job as the others. For instance, I did not gain experience of how a full-time courier creates her work schedule or the physical effects of cycling in Budapest for the entire day. I was able to gain insights into these hidden segments of courier work through the Facebook groups and the interviews.

Communication between couriers happens mostly on social media. While there are open Facebook groups for all the couriers, there are also closed or private groups for the workers of the same food delivery companies. Being an active courier has given me access to these closed forums, which are full of personal experiences, screenshots of texting with support services, advice about riding, opinions, critiques, and debates about food delivery companies. The discourse analysis of these Facebook groups aims to explore the formation of arguments and discussions about working conditions.

The third method I employed is that of semi-structured interviews. I conducted eight online and offline interviews with active and non-active bike couriers, Wolt and Foodpanda, working in Budapest, four women and four men. The youngest was twenty-two years old, and the oldest was thirty-six. I contacted them during my fieldwork, in a bicycle store, via online platforms and through acquaintances. I used these modes to gain access to as heterogeneous a range of interviewees as possible. It was straightforward to find them. The interviewees were keen to share their experiences, as courier work was relatively novel, and a significant experience in their lives.

The interviews lasted between one and two hours. In these interviews, I learned how the couriers position themselves in their work, what their opinion is about the "freedom" and "flexibility" offered by the delivery companies, and how they accept, normalise, and justify for themselves the precarious working conditions. In addition, I conducted two semi-structured interviews with a manager from one of Hungary's leading food delivery companies. I anonymised all my interviews.

The authors of the emerging literature on the platform economy primarily draw on policy reviews, interviews, and survey data. This article contributes to the scholarship by extending these methods with participant observation and access to closed online groups.

Table 1: Main socio-demographic characteristics of the interviewees

Anonymised name	Sex	Age (years)
Alexandra	Woman	25
Anna	Woman	36
Bela	Man	26
Bence	Man	35
Csongor	Man	30
Flora	Woman	24
Jamal	Man	28
Mihaly	Man	22
Zsanett	Woman	29

Source: compiled by the author.

EMBODIED LABOUR

Body and pain

As Donna Haraway accurately expresses it, there is no such thing as a natural body "existing outside the self-creating process called human labour",[28] and "the universalized natural body is the gold standard of hegemonic social discourse".[29] Since the 1970s, the body has become a central topic of the social sciences.[30] Scholars do not explore the body as a natural entity but as "an entirely problematic notion"[31] deeply embedded in social relations and particular historical contexts.[32] Alternatively, as Foucault (2012) formulates it, the body is a political object, and technologies of power and social institutions shape it.[33]

Social inequalities are particularly present in sporting bodies since they reproduce and reward traditional physicality and gender norms.[34] During physical exercise, a person objectifies the values associated with these activities and manages her socially disciplined body. Training is a cultural product,[35] and sport is one of the main sites where one masters her habitus.[36]

[28] Haraway 1990: 10.
[29] Haraway 1990: 146.
[30] Csordas 1994.
[31] Vernant 1989: 10, cited by Csordas 1994.
[32] Csordas 1994.
[33] Foucault 2012.
[34] DePauw 1997: 420.
[35] Howe 2011.
[36] Blake 1996: 23.

Ignoring pain is an essential part of the ethos of elite sports.[37] However, disregarding pain contradicts its purpose: to warn the person that something harmful is happening to her body. Nevertheless, pain is relative, hence it must be located within class, gender, ethnicity relations, and prior experiences with pain. It "may be totally unrelated to the physical parameters".[38] Pain is a solitary, individual feeling, as an individual cannot share her experience. Hence, handling pain can be more challenging than the pain itself. Sporting pain is even more complex due to hormone production. While doing sports, the body produces endorphins and, under dangerous conditions, adrenalin. These exercise hormones cause happiness and euphoria, and reduce pain.

Considering bicycle courier work as a sport is a part of the industry's discourse. The recruitment advertising, as in the posters presented before, portrays bike delivery as a sports challenge. These ads highlight the advantageous features of delivery work as a form of physical training and hide the exhausting reality. One journalist, Reid (2019) cites Jane Wake, a fitness guru, who argues that delivery work is good for the whole body, improving "agility, speed, upper and lower body strength".[39] Reid (2018) even titled his article about his subjective experiences of delivery work, *Confessions of a Deliveroo Rider: Get Fit by Delivering Fast Food*.[40] The intentional blurring between sport and work also appears at the management level. The food delivery company, Deliveroo's head of communications, stated that many couriers work this job partly because of the health benefits. However, the physical reality of courier work is more complex than simply idealising it as cardio activity.

FOOD DELIVERY IS PHYSICAL LABOUR

Before entering the field, I set two rules for myself: to take care of my own and my bike's safety. A couple of hours later, I broke both rules when I cycled between cars on a dangerous road, Rákóczi Street, in order to arrive at Mcdonald's on time. In my ten years of previous cycling experience in Budapest, I had always avoided that street, but riding for Wolt overrode my previous norms. I started my fieldwork on the warmest day of summer 2021, when drinking enough water was an essential task for every courier. The restaurants sometimes helped by offering free water, but sometimes made everything more difficult by not allowing the use of the toilet. Before even starting courier work, my parents had voiced their concern about how the fieldwork would affect my health. The danger of courier work was evident to them. The news reported fatal accidents involving couriers several times that summer. Although these accidents were rare, delivery work had a severe and constant physical effect on me. Permanent tiredness appeared, which lasted even days after work. My body changed, and my legs became more robust. Previously enjoyable physical

[37] Howe 2011.
[38] Tracey 2005 cited by Jackson 2011: 371–372.
[39] Reid 2019.
[40] Reid 2018.

activities such as going on long walks, boxing training, and recreational cycling became arduous. Cycling became a struggle with my own body to urge myself to better physical performance, even with the help of painkillers.

However, I was still in a privileged position as a researcher. In theory, I could always have stopped working if the circumstances were too dangerous. Why did this not happen very often? Firstly, due to my curiosity, I wanted to experience as much as possible of courier work, not just the version when I am well-rested, and the weather is nice. Secondly, I have become slightly addicted to courier work. This loss of control is not unique to myself. Flora also noted her addiction to delivery work. We both felt that we had to spend every minute of our free time on delivery, and when we could not do it, feelings of guilt appeared. The application constantly sent us motivational messages, which exacerbated the craving to work. It was hard to forget that we were able to work every minute. This feeling resonated with the workaholic culture of the Covid–19 pandemic. Fortunately, despite these circumstances, I never had an accident. However, once I almost fell off my bike while I was checking an address during cycling on slippery paving stones in the rain.

DANGER

Bike delivery is inseparable from danger. To make a living, one must cycle for hours in Budapest traffic. In addition, the delivery companies pay riders higher rates when the weather is bad, so working in physically more unsafe conditions is financially more beneficial to the workers.[41] All the interviewees were eager to talk about the dangerous working conditions arising from the harsh weather, the traffic, the light conditions, and the fast tempo dictated by the algorithm. Consequently, many of them had come close to having fatal accidents. Every courier has an internal limit to the amount of risk she is willing to take at work. This is dependent on both their social background and personality factors. Of the interviewees, Alexandra and Anna had the safest rules. When it started to rain, Alexandra went home. However, she was the most privileged, because she did not do this work for financial reasons. Anna also had some economic advantages because she lived in her sibling's flat, so she did not have to pay rent. Moreover, she had worked for a platform delivery company for a longer period of time than the others, and found it the easiest to articulate her views and perceive the limitations in the work. She stated that she does not work when it is raining, or when the temperature is too low. Anna also does not ride too fast since it increases the chance of an accident. "No one's food is worth hurting me or someone else." She also tries to avoid riding at night time when visibility is worse due to the lighting conditions. Although Anna is careful, she has also experienced dangerous situations while doing delivery work.

[41] Popan 2022.

> "In the riskiest situation, I avoided an accident by only a few metres. One evening, another courier was driving a car, and since he could not see any headlights, he drove into the intersection without slowing down. Then he braked hard to stop, and we were able to stop simultaneously, just as we were right in front of each other. Another time, I was not sure if a car would stop in front of me or give me the right of way, so I applied the brakes. It was a wet autumn day, and there were leaves on the side of the road. The bike slipped, and I fell on my bag, thank God. I'm fortunate, or maybe I'm a bit more careful, but I haven't had any big crashes or falls."

The others all worked during severe weather, which increases the chance of accidents. Jamal once could not see a red light in the fog. Fortunately, it was a car which collided with his bike, so he fell off before entering the next lane, where a truck would have crushed him. When I talked with Csongor, he had just had an accident, jeopardising his group position at Foodpanda. Fortunately, the company accepted the medical certificate he showed them, so he was able to stay in group three instead of being demoted to a lower level. When I asked Csongor about this accident and his previous experiences, he replied:

> "I slipped and fell so badly that I twisted my ankle. I could hardly step on it, it hurt like hell, and I had to keep it wrapped for days. There was such a muddy mess on the road, and I was not paying enough attention. If you pay enough attention, it does not happen, and you develop this routine. How many times have I fallen? A lot. One night during winter, there were big bonuses, and I fell five times. The road was icy. But I fell so often that only the bike fell, and I bounced to my feet and caught the handlebars. Like a stuntman, not because I am skilled, but because I had the routine (i.e. in practice). I was falling on my side, sliding, cursing, but it was nothing. I bounced up, I kept going, but I was falling a lot. The most serious accident was when the handlebars came loose; I lost control. I got scared, and my life flashed before my eyes. I lost control, but then I managed to pull it back. It was the most significant accident I've ever had, and I didn't even fall that time."

When Csongor was telling me these stories, there was a particular macho pride behind his sentences; he was almost bragging about the challenges of the work. This pride resonates with the companies' idealised image of couriers, presenting bike delivery as a challenging and advantageous occupation.

The recruitment advertising, like the posters presented above, depicts bike delivery as a sports challenge. These ads highlight the positive aspects of delivery work's and its training benefits, and hide the exhausting reality.

Bela reported similar dangerous experiences. Bela also told an anecdote about how he often fell off his bike on icy or rainy slippery roads in the traffic while he was not wearing a helmet. Bela bought a strap for his pedal so that it would be less slippery when it was raining. The disadvantage of the strap is that at the beginning when he stopped, he would

automatically fall off since he could not pull out his foot. His most significant accident also happened due to this. He had just arrived at a restaurant when a pedestrian looking at her phone bumped into him, so he fell onto the restaurant's terrace. Bela found the winter difficult, which was the first one he had cycled through. In the bicycle subculture, the number of winters cycled is a way of ranking a person. Since the middle of December, his wrist has been hurting. Bela assumed that he had ligament injuries, but he did not go to the doctor and never used his accident insurance because he found it too complicated. He works a lot when the fees are higher due to the severe weather. "The best income I ever had was when I was outside all day in the pouring rain in August. I was soaking wet, and then people tipped me more because they pitied me. I could not put down the phone because new notifications kept popping up."

Bela was resigned to the danger, asserting that. "There is nothing to be done. This job is dangerous. If you're not afraid, it's an excellent thing." He also referred to a "life-threatening" fountain as an inside joke, where every courier falls. In the Facebook groups, people call it the "courier cemetery". For Csongor and Bela, struggling and surviving the unsafe working conditions provided them with a shared identity, which compensated the workers for the clear hierarchy and vulnerability in their work. Both believed that the company does not care about them, for example, by organising training courses for them. There are always enough couriers contracted to deliver. If they do not do it, someone else will. As Bela formulated: "My rival is the other Wolt courier. Anyone who works for Foodpanda is none of my business. I avoid other Wolt couriers when I do not have an order." Competing for tasks is also a central feature of entrepreneurialism.

Mihaly partly quit Wolt because he felt that bike delivery was too dangerous in Budapest. He almost crashed into cars several times. When he was not working, he rode safely in the capital. Alexandra also did not feel safe at work. The people in her milieu warned her about courier work, and when the pride of rebellion passed, she started to agree with them. "There were many times that I did something stupid. I didn't think that I was so careless, and then it turned out that I could get into a dangerous situation, even if I were paying attention, and I'm not driving fast, and not running the red light." When I asked her about the most dangerous situation she had encountered, she mentioned that she had almost hit a pedestrian on the sidewalk. In addition, she lost control of her bike and almost hit a car. After this, she felt that she had caused problems for herself and felt humiliated.

Besides acknowledging the importance of the weather and the other road users, Csongor, Anna and Bela emphasised their skills, which could save them from a (more) serious accident. In Alexandra's case, individualisation was also present, but she internalised the responsibility of the unsafe working conditions as a personal failure.

Even without the dangers of the traffic conditions, bike delivery is severe physical labour, which exhausts the body. Due to the physical burden and monotony, the mind can sometimes "switch off", as the interviewees and I experienced. Csaba explained this feeling in the following way:

> "When I am exhausted, my brain is sometimes paralysed and automatic. It happens to everyone. The brain gets oxygen, just not enough to think, but my reflexes work the same. I can work, avoid cars, not get into accidents, and pick up food the same way, but I do not know where I am. I arrive at an address, and I have no idea whether I have come to pick up food or drop it off. Of course, if I thought about it, I would know, but I do not need to. Instead, I look at the app. The fastest way to determine where I am going is to cycle and look at the little dot on the map, showing if I am going the right way. Honestly, a well-trained monkey could do this job."

Many couriers listen to music to reduce the monotony, which also increases the level of danger.

Contrary to the international norms, both Wolt and Foodpanda provided accident insurance coverage. I asked Bence about this peculiarity, which goes against the strict market interests. He explained that in December 2020, a company courier died while at work. Then the managers started to push the company to provide accident insurance for the couriers. Besides the moral reasons, the company also profits from it, as it facilitates recruitment and shows the company's social responsibility. Moreover, the workers used this option. The couriers reported that, in the case of Foodpanda, the insurance company cancelled its contract because too many workers were having accidents, so it was not financially beneficial for them. Since the end of 2021, the couriers at Foodpanda have not been covered by accident insurance.

The pain and dangers of urban bicycle work highlight the unequal relationship between the workers and the company. The sporting side of bike delivery is emphasised in the company narrative to make this hierarchical relation palatable. I will explore how delivery work and sport are intertwined in the subsequent paragraphs.

SPORT

Experience and knowledge of sport supported my entry into the field, as it has already helped other scholars.[42] Since I have done sports from early childhood, I am familiar with its preparation repertoire, the physical and mental challenges, and the importance of nutrition and recovery, all of which made me a better courier. The interviewees also utilised such knowledge garnered from past sporting activities to enable them to increase their workload. Bike food couriers tend to normalise and justify the disadvantageous circumstances of their jobs by framing it as a sporting activity. All the respondents did sport regularly before working as a courier, especially in childhood. However, they have diverse experiences. Jamal is the most serious about it, as he competes in professional bicycle races in his free time. For Alexandra, sport is part of her family's and her own

[42] Wacquant 2004.

personal identity, and she was a member of the Hungarian sailing team. Anna attended a high school specialising in sports. Others had done sport as a hobby. Flora and Bela used to go to the gym, and Zsanett sometimes jogged. Csongor used to work out to get "shredded" for the summer. Even so, compared to their former sporting experiences, the physical challenge of courier work came as a shock to them, especially at the beginning. When I asked them about it, they framed their answers as sports challenges. For instance, Jamal compared it to the first time he went to the gym.

Fatigue is not only a characteristic of the beginning of courier work, but also remains part of the delivery work even after a lengthy period. As Csongor noted: "I come home, I sit down, I feel like I'm going to faint, I'm so tired after nine hours of work. I didn't even have a break." Even Jamal, the most professional courier, mentioned the tiredness he feels after a ten-hour shift. To explain and compensate for this physical tiredness, the couriers constantly positioned their work in relation to sports. Csongor noted that there are "real sportsmen" who cycle around fifty hours per week. Boasting about results is a regular feature of Facebook groups. Sporting rivalry also appears in the street, where primarily young male bike couriers sometimes compete by sprinting between traffic lights. Seeing delivery work as a sport gives it an ethos, making it acceptable as a middle-class activity. Zsanett formulated this idea: "It was nice to do some physical work because cycling is not like working in construction. Cycling is a constructive activity, which made me more athletic." Anna was glad that while she had stopped doing regular sport due to office work, it returned to her life when she started working in food delivery. This whole activity was more about the sport than making money for Alexandra. Jamal synchronised his hobby with work. When he prepares for a bicycle competition, he sometimes chooses hilly neighbourhoods to work in, so it counts as training, even if it means that he earns less. "I like it when I go up the mountain because that has a good training factor." Riders adored the idea of being paid to train their body, which is otherwise an expensive and tiring activity. As Jamal said: "I don't go to the gym, just because if I'm going to cycle, I make some money as well." Csongor stated that he would otherwise be too lazy to do cardio activities. Bela bragged that working during summer took off all his body fat. However, both Csongor and Bela admitted that they are too tired to build muscle on their upper body after work even though they would like to. Besides their conscious opinions about the advantages of sports, the riders sometimes felt that the work resembled exercise due to hormonal changes. Anna compared it to the experience of long runs. "It's just hard to get started, but once you're in, it's great." Alexandra also mentioned that the flow of sport and the adrenaline made her forget tiredness and hunger.

There is a significant difference between seeing pain as part of labour or as a part of sport. Bike delivery blurs the border between sport and labour, implying that it incorporates sport's physical and ideological rewards into labour. Accepting delivery work as a sport also helps justify the pain it causes. When I felt pain for the first time during the fieldwork, I decided to take painkillers to be able to cycle. I built on my experiences in competitive sports, where quitting was a rarely chosen option. The interviewees also did not stop working due to pain, and the knowledge and ethos of sport supported this decision. Jamal struggled

with pain in his hamstring muscles. He could not stand still and described the pain of the first ten minutes on the bike as torture. However, Jamal continued to work like this until he read about the problem and eliminated it by stretching. Csongor bragged that he never finishes work before the end of his shift. He explained that there is an hour at the most left when he can barely stand, so he always survives somehow. Otherwise, he would have to write to the dispatcher, which is "a lot of time", and he would probably be given a penalty point for it. "It's not worth it." Flora also prioritised work over her health. "Even now, my back hurts like hell, but I want to work." The workers utilise their knowledge from their past sporting activities about pain relief to increase their workload. Zsanett always continued her work even when it was painful or very demanding. If it caused her too much pain, she cured it with a sports cream, which her family had used for decades. Bela's knees and ankles hurt due to cycling, but he never thought about terminating his contract. "I wake up, and oh my God, it hurts. And then I had to sit on my bike the same way and cycle. When I get into it, it is better, and then in the morning, after I rest, it hurts a lot. But I worked the same way then. I knew from my training that the body would get used to it, I just had to give it a little more water and nutrients, and sometimes, when it was very sore, I rested it. But I knew I would get used to it." Another courier recommended collagen protein during this period, widely used for bodybuilding. Bela looked it up online, and after reading good comments about it, he tried it. Collagen tastes terrible, but it worked for him. Just as he persisted through the first work period, he has never stopped during work ever since. "If I get tired, I don't care about it. I work as much as I planned to." Even Alexandra, who had the lowest financial needs but a notable sporting stake in the work, never stopped during lunch periods.

RECOVERY

Sport does not only teach one how to bear pain. Knowledge about recovery, transferred from a sporting context to the context of food delivery also enables participants to increase their workload. I have divided the topic of recovery into three sections: nutrition, stretching, and rest. With regard to nutrition, although exercise and food delivery seem similar at first sight, they have quite different purposes. While in the field of sport, healthy and balanced diets are emphasised, in bicycle food delivery, the consumption of carbohydrates, especially sugar, is the primary consideration. Sugar has been a rapidly available source of energy since the 19th century. It has shifted from being a luxury to a proletarian hunger killer, enabling people to eat fast, high-calorie meals during working time.[43] All the interviewees highlighted the importance of ongoing nutrition as an essential prerequisite of the work. "I don't refuel the car, it won't run, but if it has fuel in it, it goes out of the world" – Jamal noted. The riders' nutrition usually takes the form of junk food during working hours. Jamal ignores food quality, so he usually eats pastries and fast food during the day. In the evenings, he mostly

[43] Mintz 2018.

eats canned products or sausages with bread. Csongor usually eats chocolate at work and brings coffee from home, another typical example of a hunger killer.[44] Bela admitted that he does not care about nutrition as long as he has enough energy. He usually buys something from a supermarket or eats a hamburger or a kebab in a restaurant from where he delivers food. The female interviewees were more concerned about their meals. Anna highlighted that she avoids junk food on purpose. She usually brings energy bars and water from home and prepares a warm meal in the evening. Alexandra also preferred energy bars during working hours, along with some fruits and sandwiches. She tried to remember which food smelled the most appealing when she delivered it, and after work, Alexandra goes back to the place and eats there. Hence, she overstepped the burdens of work and turned it into an opportunity for culinary discovery. Flora paid the most attention to the role of nutrition as part of recovery. She tried to make sure she got enough energy. Flora drank BCAA, which is an amino acid used for bodybuilding. However, it also helps the muscle function of people who do physical work regularly. She tried to be aware of proteins, which she had already borne in mind previously as she is a vegetarian. Sometimes Flora consumes protein powders, soy protein, legumes, vegetable butter, and smoothies.

Stretching is another important part of physical recovery after sport, although it is not indispensable. Therefore, it is not a surprise that most workers ignored it. They all knew that it is necessary for recovery, but most of the answers I received were that they always plan to do it, but it rarely happens. The exceptions were Jamal and Anna, probably because of their institutionalised sporting background. The option of resting depends on the individual's financial dependency on the platform. Csongor and Bela, full-time couriers, work regardless of the amount of rest they could get. Flora works less than them, and she states that a half-day is enough for her to recover. This opinion is contradicted by the permanent back pain she complains about during the discussion. She cures it with regular massages, which she bought at a discount. A secondary market reacts to such needs in the Facebook groups. Hence, masseurs, physiotherapists, and chiropractors offer their services at discounts. Alexandra was in the most privileged position, "If I was tired from the previous days, I didn't work."

CONCLUSION

Based on theories claiming that (sporting) bodies and pain are socially embedded, I argued that bicycle food couriers in Budapest tend to normalise and justify the precarious and dangerous working conditions, labour exploitation, and risk they face in their work by treating it as if it were a sports activity. The riders agree with the claim that they get paid to train their bodies, which is an otherwise expensive and tiring activity. The workers utilise their knowledge from their past sporting activities about nutrition and pain relief to

[44] Mintz 2018.

increase their workload. Sporting rivalry and boasting of results are common features of the courier community. Food delivery companies and journalists support this idea, as they frame labour as a challenging cardio activity. Although the workers proudly claimed to be entrepreneurs, their bodily experiences reveal the cleavage between platform labour and an idealised notion of entrepreneurship. The pain and dangers of urban bicycle delivery work highlight the unequal relationship between the workers and the company, the heterogeneity of differently positioned workers, and the lack of workers' freedom.

REFERENCES

Biró, Attila (2022): 800 ezret is kaszálhat egy Wolt futár: rengeteg embert keresnek a nagyvárosokban. *Pénzcentrum,* 8 March 2021. Online: https://www.penzcentrum.hu/vallalkozas/20210308/800-ezret-is-kaszalhat-egy-wolt-futar-rengeteg-embert-keresnek-a-nagyvarosokban-1112028

Blake, Andrew (1996): *The Body Language: The Meaning of Modern Sport.* London: Lawrence & Wishart.

Cant, Callum (2019): *Riding for Deliveroo: Resistance in the New Economy.* Cambridge: Polity.

Choe, Sang-Hun (2020): Delivery Workers in South Korea Say They're Dying of 'Overwork'. *The New York Times,* 15 December 2020. Online: https://www.nytimes.com/2020/12/15/world/asia/korea-couriers-dead-overwork.html

Csordas, Thomas (1994): The Body as Representation and Being-in-the-World. In Csordas, Thomas (ed.): *Embodiment and Experience.* Cambridge: Cambridge University Press, 1–26.

Csordas, Thomas (2002): *Body/Meaning/Healing.* New York: Palgrave Macmillan. Online: https://doi.org/10.1007/978-1-137-08286-2

DePauw, Karen P. (1997): The (In)visibility of Disability: Cultural Contexts and "Sporting Bodies". *Quest,* 49(4), 416–430. Online: https://doi.org/10.1080/00336297.1997.10484258

Foucault, Michel (2012): *Discipline and Punish: The Birth of the Prison.* New York: Vintage Books.

Freytas-Tamura, Kimiko (2020): Food Delivery Apps are Booming. Their Workers are often Struggling. *The New York Times,* 30 May 2022. Online: https://www.nytimes.com/2020/11/30/nyregion/bike-delivery-workers-covid-pandemic.html?action=click&module=RelatedLinks&pgtype=Article

Gyükeri, Mercédesz (2017): Az éhes vásárlóval nem jó ujjat húzni – a NetPincér-sztori. *HVG,* 4 April 2017. Online: https://hvg.hu/kkv/20170404_netpincer_cegportre_ekereskedelem_szorad_gabor

Haraway, Donna (1990): Investment Strategies for the Evolving Portfolio of Primate Females. In Jacobus, Mary – Fox Keller, Evelyn – Suttleworth, Sally (eds.): *Body/Politics: Women and the Discourses of Science.* New York: Routledge, 139–162.

Harvey, David (2007): *The Condition of Postmodernity: An Inquiry into the Origins of Cultural Change.* Cambridge, MA: Blackwell.
Howe, P. David (2011): Sporting Bodies: Sensuous, Lived and Impaired. In Mascia-Lees, Frances E. (ed.): *A Companion to the Anthropology of the Body and Embodiment.* Wiley-Blackwell, 276–291. Online: https://doi.org/10.1002/9781444340488.ch15
Jackson, Jean E. (2011): Pain and Bodies. In Mascia-Lees, Frances E. (ed.): *A Companion to the Anthropology of the Body and Embodiment.* Wiley-Blackwell, 370–387. Online: https://doi.org/10.1002/9781444340488.ch21
Kiss, Soma Ábrahám (2021): "Nem vállalkozásod van, hanem egy bringád vagy egy Suzukid" – a kényszervállalkozás valósága. *Mérce,* 4 May 2021. Online: https://merce.hu/2021/05/04/nem-vallalkozasod-van-hanem-egy-bringad-vagy-egy-suzukid-a-kenyszervallalkozas-valosaga/
Kučinac, Dunja (2021): Gig Work in CEE's Platform Economy: Delivery Drivers in Croatia. *Lefteast,* 5 May 2021. Online: https://lefteast.org/gig-work-cee-croatian-delivery-drivers
Mintz, Sidney Wilfred (2018): Time, Sugar, and Sweetness. In Counihan, Carole – Van Esterik, Penny – Julier, Alice (eds.): *Food and Culture.* Routledge, 401–413. Online: https://doi.org/10.4324/9781315680347-28
Pálúr, Krisztina (2020): A világjárvány miatt már az ételrendelés sem lesz ugyanaz. *Index*, 15 March 2020. Online: https://index.hu/kultur/eletmod/2020/03/15/etelrendeles_hazhozszallitas_karanten/
Piasna, Agnieszka – Drahokoupil, Jan (2021): Flexibility Unbound: Understanding the Heterogeneity of Preferences among Food Delivery Platform Workers. *Socio-Economic Review,* 19(4), 1397–1419. Online: https://doi.org/10.1093/ser/mwab029
Piasna, Agnieszka – Zwysen, Wouter – Drahokoupil, Jan (2022): *The Platform Economy in Europe: Results from the Second ETUI Internet and Platform Work Survey (IPWS).* ETUI Research Paper-Working Paper. Online: https://doi.org/10.2139/ssrn.4042629
Popan, Cosmin (2022): The Gig Economy's Corporate Crime Problem. *Lefteast,* 9 May 2022. Online: https://lefteast.org/gig-economy-corporate-crime-problem/
Pulignano, Valeria – Piasna, Agnieszka (2021): The 'Freedom' to Work for Nothing. *Social Europe,* 8 December 2021. Online: https://socialeurope.eu/the-freedom-to-work-for-nothing
Rani, Uma – Kumar Dhir, Rishabh – Furrer, Marianne – Gőbel, Nóra – Moraiti, Angeliki – Cooney, Sean – Coddou, Alberto (2021): *World Employment and Social Outlook: The Role of Digital Labour Platforms in Transforming the World of Work.* Geneva: International Labour Organization. Online: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_771749.pdf
Reid, Carlton (2018): Confessions of a Deliveroo Rider: Get Fit by Delivering Fast Food. *The Guardian,* 8 January 2018. Online: https://www.theguardian.com/environment/bike-blog/2018/jan/08/confessions-of-a-deliveroo-rider-get-fit-by-delivering-fast-food

Reid, Carlton (2019): Bicycle Courier is the Job that Burns Most Fat, Finds Fitness Guru. *Forbes,* 14 January 2019. Online: https://www.forbes.com/sites/carltonreid/2019/01/14/bicycle-courier-is-the-job-that-burns-most-fat-finds-fitness-guru/?sh=afb58ef2ee4a

Scholz, Trebor (2017): *Uberworked and Underpaid: How Workers are Disrupting the Digital Economy.* John Wiley & Sons.

Stewart, Andrew – Stanford, Jim (2017): Regulating Work in the Gig Economy: What are the Options? *The Economic and Labour Relations Review,* 28(3), 420–437. Online: https://doi.org/10.1177/1035304617722461

Tóth, Katalin (2019): *"I love Budapest. I bike Budapest?" Urbaner Radverkehr in der ungarischen Hauptstadt, 1980–2014.* Vandenhoeck & Ruprecht. Online: https://doi.org/10.13109/9783666310720

Vallas, Steven – Schor, Juliet (2020): What Do Platforms Do? Understanding the Gig Economy. *Annual Review of Sociology,* 46, 273–294. Online: https://doi.org/10.1146/annurev-soc-121919-054857

Van Doorn, Niels (2017): Platform Labor: On the Gendered and Racialized Exploitation of Low-Income Service Work in the 'On-Demand' Economy. *Information, Communication & Society,* 20(6), 898–914. Online: https://doi.org/10.1080/1369118X.2017.1294194

Veres, Dóra (2020): Rengeteg melóst keresnek most országszerte: 700 ezres nettó, diploma nem kell. *Pénzcentrum,* 7 April 2020. Online: https://www.penzcentrum.hu/egeszseg/20200407/rengeteg-melost-keresnek-most-orszagszerte-700-ezres-netto-diploma-nem-kell-1092314

Wacquant, Loïc (2004): *Body & Soul: Notebooks of an Apprentice Boxer.* New York: Oxford University Press.

Zhao, Lily (2021): Suicide Attempt by Food Delivery Worker in China Exposes Exploitative Working Conditions. *World Socialist Web Site,* 21 January 2021. Online: https://www.wsws.org/en/articles/2021/01/22/chin-j22.html

Klára Nagy is a Researcher and Project Coordinator. Graduated from the Sociology and Social Anthropology MA program at the Central European University, and holds a sociology BA from the Eötvös Loránd University. Since 2021 she has been a member of the Solidarity Economy Centre. Since 2022, she is a co-worker at Periféria Policy and Research Center. She was a member of the College for Advanced Studies in Social Theory between 2017 and 2020. Her main research field is flexibilised labour in the platform economy and the electronics manufacturing sector, and social housing approaches.

PRO PUBLICO BONO – Public Administration, 2024/1, 237–261. • DOI: 10.32575/ppb.2024.1.11

Imre Borisz Páll

FROM VISION TO PRACTICE – OBSERVATIONS ON BUTTARELLI'S PRIVACY 2030 IN THE CONTEXT OF DATA PROTECTION IN HUNGARY[1]

Imre Borisz Páll, LL. M. PhD student, Ludovika University of Public Service, Faculty of Public Governance and International Studies, Doctoral School of Public Administration Sciences; Head of Department, National Authority for Data Protection and Freedom of Information, pall.imre@naih.hu

European Data Protection Supervisor (EDPS) Giovanni Buttarelli's posthumous manifesto, Privacy 2030: A New Vision for Europe, places data protection in a global context. Competition and data protection authorities within the EU cooperate and share information about their official inquiries. If properly enforced, the GDPR may be an effective tool of transparent data processing in the EU, and can serve as a model for the rest of the world. Enforcement is the duty of Member States' DPAs, therefore, it may be worth analysing Buttarelli's views in relation to the issues currently facing Hungarian data protection regulation. The paper critically presents Buttarelli's main views, while discussing them in relation to Hungarian public administration through a specific legal case. As a result of the comparative analysis, it can be concluded that by enhancing the data protection culture and its administrative enforcement, our personal data can be better protected.

Keywords:
data protection, democracy, European Union, GDPR, new technologies, public administration

[1] The manuscript was closed on the 14th of February, 2023.

INTRODUCTION

In this article, I examine which findings of Giovanni Buttarelli's posthumous manifesto, *Privacy 2030: A New Vision for Europe*[2] are relevant to the data protection provided by the Hungarian public administration, and to what extent.

On the one hand, this analysis can be justified by the fact that Hungary is also affected by the global megatrends discussed by the late EDPS's paper, or at least their consequences, so not even this country's public administration can avoid being part of the global discourses on issues related to digitisation, global climate change, or mass migration. On the other hand, no analysis of the ideas presented by *Privacy 2030* has been written in the context of Member States' data protection authorities, including the Hungarian DPA, therefore raising the topic can be considered timely even in 2023, when GDPR has already been applied for five years.

It should be emphasised that this study does not summarise Buttarelli's oeuvre, and is not specifically concerned with privacy protection as such, but instead with various aspects of data protection related to it. Specifically, this analysis focuses on certain currently topical questions closely related to the data protection provided by the public administration.

THE GLOBAL CONTEXT OF THE ISSUES RAISED BY PRIVACY 2030

While reading *Privacy 2030,* it seemed to me as if Buttarelli was attempting to answer the question articulated by Giovanni Sartori long before: "In particular, is democracy an adequate instrument in view of the ambitions of a technological age, an age that ultimately looks forward to the 'planning of history'?"[3]

Marc Rotenberg, in the afterword to *Privacy 2030,* emphasises that the paper reaches beyond the domain of data protection, while focusing on broader questions related to climate change and sustainability, or ethics and human rights.[4] He argues that Buttarelli envisaged two contrasting visions of the futures shaped by new technologies and AI, one that serves to preserve democratic institutions, the rule of law and safeguards for the individuals, and another that would "combine the power of automation and logic of efficiency with a growing scarcity of resources", leaving humans "as little more than data points, subject to systems we do not understand and cannot control".[5]

Malavika Jayaram identifies the key words of the manifesto as: power, inequality, digital underclass, algorithmic bias and colonisation.[6] The uneven allocation of the digital dividend and the disproportionate impact of privacy harms on the poor and marginalised,

[2] Buttarelli 2019.
[3] Sartori 1987: 429.
[4] Rotenberg 2019: 29.
[5] Rotenberg 2019: 30.
[6] Jayaram 2019: 31.

in combination with the results of the climate crisis leads to a scenario where "those who contributed the least to environmental damage" and "those who didn't design technologies that are ubiquitous and insatiable" will suffer the most.[7]

In Jules Polonetsky's evaluation, the main issues addressed in *Privacy 2030* are the excesses of surveillance, the power of tech platforms, the impact of automation and the exacerbation of inequality in the data-driven economy.[8] Polonetsky disagrees with Buttarelli's EU-centric view on the basis that the internet allows the evasion of the application of GDPR, therefore he suggests instead "a global alliance of free societies who can work in international coalitions to counter these threats" with "a vision of global leadership and cooperation".[9] In Polonetsky's opinion, Buttarelli's greatest contribution in the paper and as EDPS, "*is his insistence that we see the impact of data on social welfare*" in the interest of being able "*to ensure technology and data are forces for good in society*".[10]

Maria Farrell agrees that *Privacy 2030* goes far beyond data protection. The radical concentration of power "is not a technocratic concern for specialists but an existential issue for our species", because "data maximisation exploits power asymmetries to drive global inequality".[11] Farrell emphasises that the manifesto presents an EU-version of the internet "that starts with the society we as citizens want to live in", instead of "the oppressive brittleness of China's state sovereignty model" or "the colonialist extraction of Silicon Valley".[12] She points out that *Privacy 2030* is optimistic about the future of technology, because modern technology, when not at the service of a harmful business model, can "banish inequality, repair our environment and support us all in living our best lives".[13]

Rocco Panetta agrees that "[T]his is a European story spreading all around the world."[14] Agreeing with his view on the merits of *Privacy 2030,*[15] he also highlights the importance of the paper's main observations in the context of the upcoming ePrivacy Regulation that is complementary to GDPR.[16] He argues that in Buttarelli's vision "all

7 Jayaram 2019: 31.
8 Polonetsky 2019: 33.
9 Polonetsky 2019: 34.
10 Polonetsky 2019.
11 Farrell 2019: 35.
12 Farrell 2019: 36.
13 Farrell 2019.
14 Panetta 2019: 38.
15 Panetta 2019: 38: "The strength of this posthumous work lies in its slipping in the wounds that most threaten contemporary society: digital inequality and discrimination capable of exponentially increasing the information asymmetry between rich and poor, increasingly marked disparities between the north and south of the world, dramatic environmental crisis, also caused by an uncontrolled production of high-tech devices and an unprecedented energy consumption that these devices require, the will to shape the young and the very young, to the point of affecting the cognitive and relational processes to which the XXI century had accustomed us to it. The accent is further placed on the effects that uncontrolled profiling through algorithms generates money produce on reality as a consequence of a sort of digital colonization."
16 Panetta 2019.

contemporary problems are linked together and led to the threatening of freedom and democracy", in particular "environmental issues, climate change, migration flows, poverty and inequality, sovereignism and white supremacism" that are exacerbated by "a technological fever and data processing bulimia".[17] Therefore, *Privacy 2030* urges that algorithms and AI, whether they are used in the private or the public sector, should undergo an "ethical due process".[18]

As Shoshana Zuboff articulates in her afterword: "Lawmakers have been silent for too long or they have allowed the details of rule making to obscure the emergency that cries out for democratic control over surveillance capitalism."[19]

Regardless of how the various editors interpret Buttarelli's vision, the issues discussed in his posthumous paper seem to have already attracted the attention of other authors. In this sense of the word, the manifesto cannot be considered original, but rather a call for attention to already known global problems, which shares the optimistic view that mankind and its living environment still can have a future as long as certain crucial decisions are made. This view seems to be close to the opinion that "we are deciding, […] which evolutionary pathways will remain open and which will forever be closed".[20]

On the other hand, there are those who argue that: "It is doubtful whether Homo sapiens will still be around a thousand years from now […]."[21] But then again, optimists declare that: "Thanks to its capacity for reinvention, capitalism has overcome its periodic crises and outlived its critics, from Karl Marx on."[22]

THE MAIN ISSUES DISCUSSED IN PRIVACY 2030

The paper argues that data is power (see Figure 1), but relatively few wield this power.[23] Instead of digitisation empowering people, in practice it erodes their freedom. Starting with a discussion of the phenomenon of data maximisation and the uneven distribution of power, the first chapter presents the consequences of these developments. Among other challenges, Balkin highlights the existing issue of "asymmetries of knowledge, power, and control".[24]

17 Panetta 2019: 38.
18 Panetta 2019: 40.
19 Zuboff 2019: 42.
20 Kolbert 2015: 268.
21 Harari 2014: 7.
22 Rodrik 2012: 233.
23 Buttarelli 2019: 6.
24 Balkin 2020: 12.

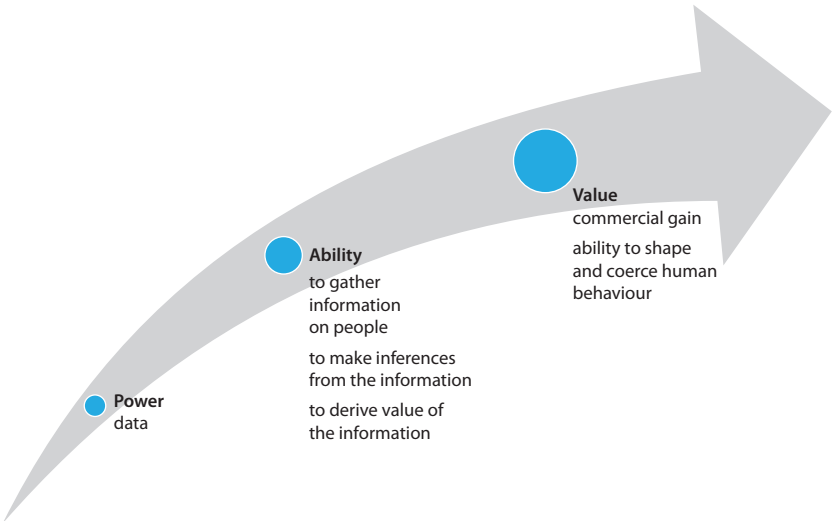


Figure 1: "Data is power"
Source: compiled by the author.

Privacy 2030's key argument contends that the 20th century direction of technological development had changed by the 21st century. While in the 20th century technological innovations were primarily developed for military purposes and became available to civilians later on, in the 21st century, state actors tend to purchase new technologies from the private sector.[25]

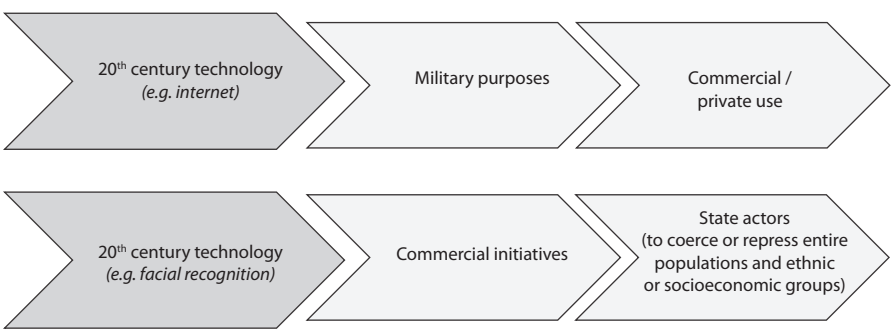


Figure 2: Development of the direction of 20th and 21st century technology
Source: compiled by the author.

[25] Buttarelli 2019: 7.

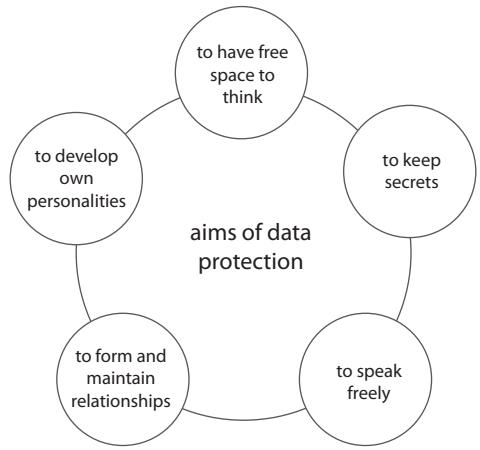


Figure 3: The aims of data protection
Source: compiled by the author.

Meanwhile, the essential principle of data protection (see Figure 3), in the context of privacy conflicts involving the abuse of modern technologies, is that personal data should serve the personal purposes of individuals. However, today "relationships are mediated by revenue-maximising algorithms and providers are not accountable for the risks inherent in their services".[26]

While the consequences might appear to be data protection related issues only, the problems which emerge affect the present and future destiny of our social organisations as a whole.[27] Sartori's attitude appears to be in line with the above, though it is seemingly far more pessimistic: "Technology truly is our deus ex machina; it is the god that keeps us alive, and yet it enslaves us to its machina. For in the end, the deus is no other than ourselves; it is we who have to pay for the miracles we receive."[28]

The first chapter of *Privacy 2030* warns that the lack of data sharing – since data is power – linked to the lack of accountability "has contributed to polarisation and the weakening of the social fabric".[29]

However, the manifesto points out that the "EU's core values are solidarity, democracy and freedom" and the conception of EU data protection "has always been the promotion of responsible technological development for the common good".[30]

[26] Buttarelli 2019.
[27] Rodotá 2004.
[28] Sartori 1987: 432.
[29] Buttarelli 2019: 7.
[30] Buttarelli 2019.

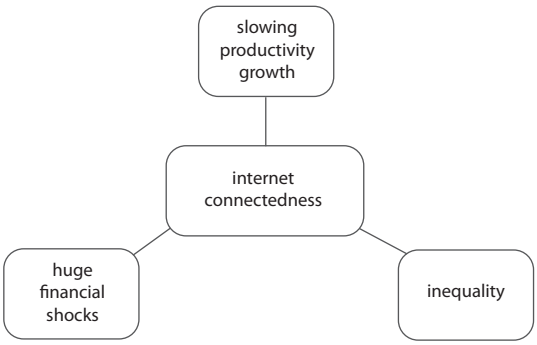


Figure 4: Consequences of internet connectedness
Source: compiled by the author.

The second chapter of *Privacy 2030* argues for a fairer redistribution of digital goods. This part of the manifesto contends that, while the key global controllers of personal data are China and the US, internet connectedness has not resulted in a more proportionate distribution of goods, but instead inequality, declining productivity growth, and a large financial shock (see Figure 4).[31]

Buttarelli believes that this also stems from the ownership structure of the digital markets and AI industry, which is illustrated below (see Figure 5).

The chapter identifies a gap between the power elite and the rest of society, which has led to the creation of a "*digital underclass*", which is not in a position to exercise its fundamental rights (see Figure 6).[32]

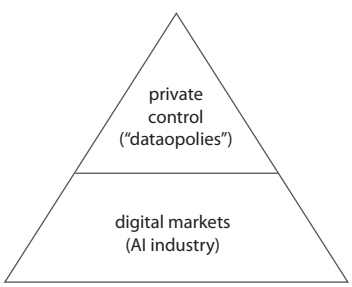


Figure 5: Structure of the digital markets and AI industry
Source: compiled by the author.

[31] Buttarelli 2019: 8.
[32] Buttarelli 2019: 9.

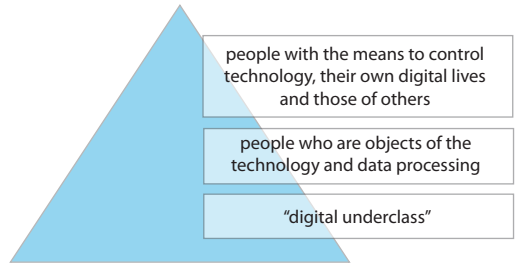


Figure 6: Structure of societies in the digital age
Source: compiled by the author.

The main consequence of this transformed structure is that the business interests of multinational tech giants often enjoy priority over the rights of individuals with less influence. This can also happen because privately-owned platforms act as intermediaries between the state and its citizens (see Figure 7), while those platforms have grown so large that they are not transparent and accountable.[33]

All of this also results in the most vulnerable workers in the private sector being monitored with the latest technologies, while dual-use technologies in the hands of authoritarian regimes are used to repress the human rights of minority groups.[34] Moreover, Balkin convincingly argues that due to the capabilities of the new technologies, the entire society is under surveillance, regardless of the social status of individuals.[35]

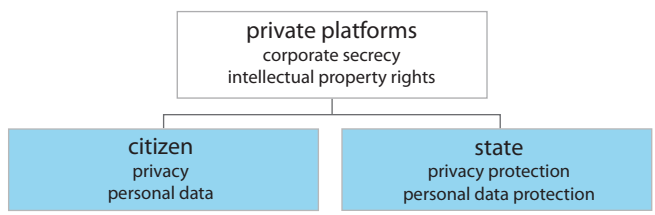


Figure 7: Interests of tech giants against the rights of the individual and role of the state
Source: compiled by the author.

[33] Buttarelli 2019: 11.

[34] Buttarelli 2019: 10.

[35] Balkin 2020: 16–17: "Fifth, the data that companies gather from end users can have significant external effects on third parties who may not even be users of the site. As digital companies know more about a given person, they can also know more about other people who are similar to that person or are connected to that person. In the digital age, everyone is always informing on everyone else. Thus, an individual's response to a notice-and-choice regime may affect the privacy of many other people who have no say in the matter. And when companies manipulate end users' moods and decisions – including their decisions to vote – they affect not only particular end users but many other people as well.
Notice-and-choice models are most inadequate when end users are most vulnerable, and when asymmetries of knowledge, power, and control are greatest. Put another way, notice-and-choice models of privacy are the most inadequate under precisely the conditions that define surveillance capitalism. That is why we need the fiduciary model."

Privacy 2030 warns of the dangers to democracy and the rule of law resulting from the operation of tech giants without democratic accountability, while also drawing attention to the fact that in case of infringement of the GDPR, anyone seeking redress can only achieve this by being represented at the court by expensive lawyers, which is unavailable to the average individual. Meanwhile, DPAs, "along with other enforcers, face enormous challenges in uncovering opaque business practices to uphold the rights of individuals".[36] According to the manifesto, either data protection rights can be enforced in court in a costly way, or the EU Member States' data protection authorities can try to enforce the data protection rules, which may not be in the financial interests of multinational companies.

Meanwhile, instead of solving social problems, tech giants are exacerbating the digital divide. *Privacy 2030* criticises the effects of their business strategies, arguing that societies "become dysfunctional when many people see others having more or better. This is the urgent ethical question of our day."[37]

Thus, the core message of this chapter is that the "EU should address not only digital disenfranchisement and lack of access to digital infrastructure and services but also digital inequality".[38]

The third chapter of *Privacy 2030* argues for a digital green new deal to achieve environmental sustainability.

The core message of this section is that digital technology and privacy regulation should not pose problems for each other, but can be part of the solution to the existing problems. In its current form, data maximisation works against EU law and environmental sustainability (Figure 8) since the "religion of data maximisation" appears unsustainable from an environmental perspective.[39]

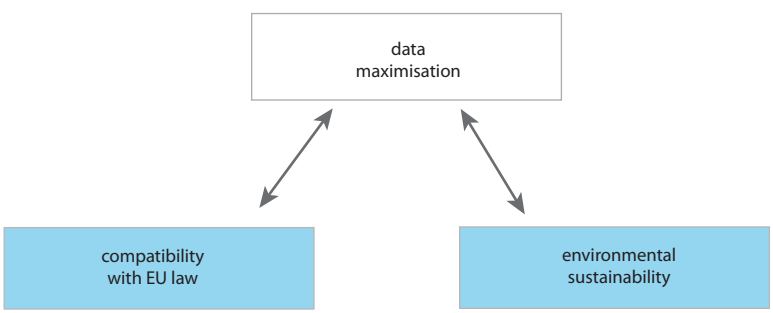


Figure 8: Data maximisation, EU law and environmental sustainability in Privacy 2030
Source: compiled by the author.

[36] Buttarelli 2019: 11.
[37] Buttarelli 2019: 12.
[38] Buttarelli 2019.
[39] Buttarelli 2019: 14.

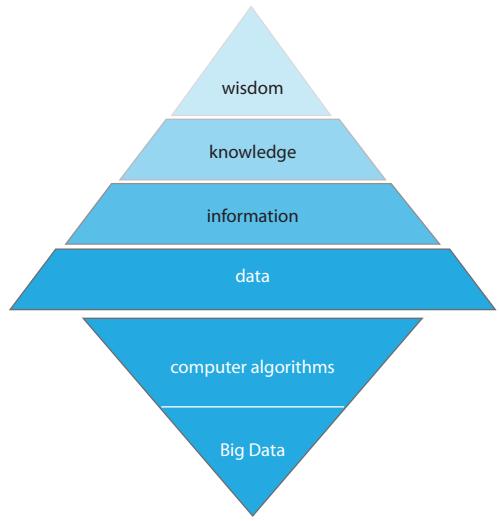


Figure 9: The traditional pyramid of learning – human
Source: compiled by the author.
Figure 10: The modern pyramid of learning – computer
Source: compiled by the author.

Other authors have expressed similar views. Harari, for example, also deals with the phenomenon of data maximisation, calling it "Dataism", or "Data Religion".[40] He points out how "Dataism" inverted the traditional pyramid of learning (see Figures 9 and 10). In his view, "[h]itherto, data was seen as only the first step in a long chain of intellectual activity",[41] but today "Dataists are sceptical about human knowledge and wisdom, and prefer to put their trust in Big Data and computer algorithms".[42]

From a global perspective, Buttarelli's paper presents a possible interpretation and sequence of events, which sheds light on the environmental, social, and human rights effects of the cooperation between tech giants and oil-producing multinationals (see Figure 11).[43]

40 Harari 2017: 428–462.
41 Harari 2017: 429.
42 Harari 2017.
43 Buttarelli 2019: 15.

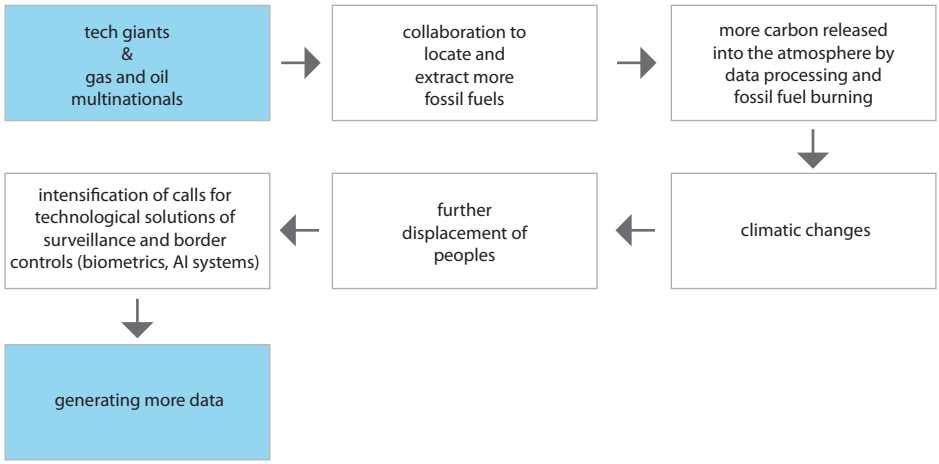


Figure 11: The data generating model of cooperation between tech giants and gas and oil multinationals
Source: compiled by the author.

At the same time, in *Privacy 2030,* Buttarelli notes that technological achievements do not necessarily only have negative effects. From an optimistic perspective, the chapter highlights how big data, AI and IoT can advance environmental sustainability[44] (see Figure 12).

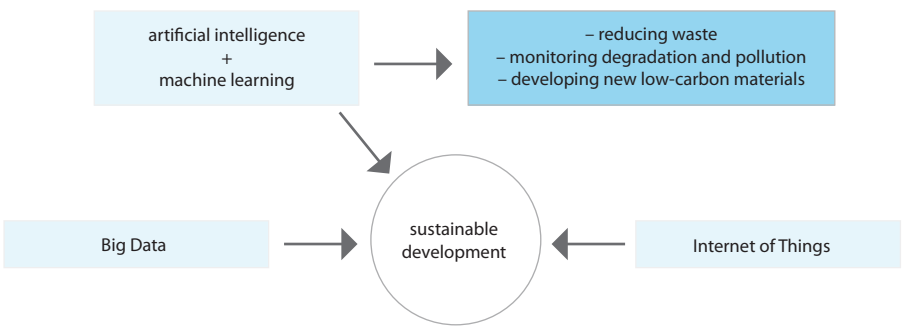


Figure 12: AI's role in advancing environmental sustainability according to Buttarelli
Source: compiled by the author.

[44] Buttarelli 2019: 16.

Privacy 2030 observes that a huge amount of data that has been collected, which is being controlled by 5-10 companies, mostly based in China and the United States. The main concern expressed in this chapter of the paper is how and whether that data is being used for the benefit of the public. The manifesto states that independent researchers and academics have difficulties while attempting to access these data that would be essential "to understanding the full extent of the harm wrought by their business models".[45]

The conclusion of this chapter is that upholding the core principles of the EU's approach to data protection, such as data minimisation and quality on the one hand, and access to large companies' datasets on the other, would also help to fight the expanding carbon footprint of digital technology and environmental degradation.[46]

The fourth chapter of *Privacy 2030* deals with the harmful effects of modern digital technologies as a new business model, which represents the greatest danger from the point of view of the most vulnerable individuals.

The paper convincingly argues that after 2000 the business model changed, in contrast to traditional media and advertising practices, from then on becoming based on the monitoring of users and the collection of their personal data for business purposes. With the development of technology, more and more sensitive personal data is collected by the devices around us, until finally the tech firms and governments are not only monitoring our environment, but also extending their surveillance to people's biometric data, DNA and even brain waves (see Figure 16).[47]

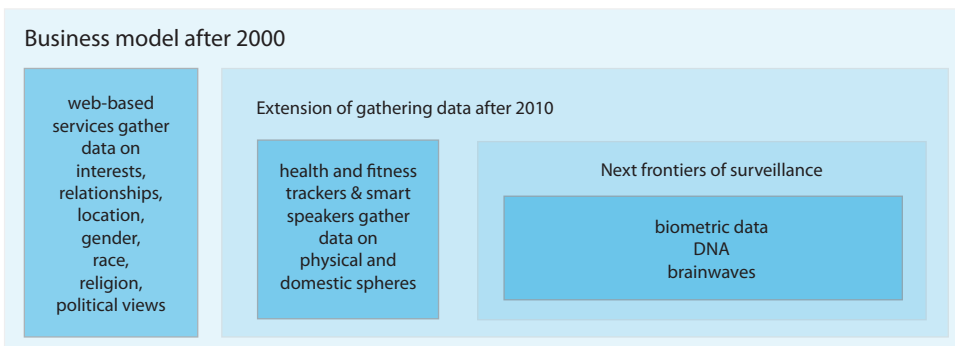


Figure 13: The new business model of web-based services
Source: compiled by the author.

[45] Buttarelli 2019.
[46] Buttarelli 2019.
[47] Buttarelli 2019: 19.

A very fair warning was delivered in *Privacy 2030* by highlighting how easily the "manipulation machine" works since, due to the concentration of the market for mass internet communications, "the big platforms provide an easy target for exploits [sic]".[48]

The paper repeatedly argues that the large tech companies should be held accountable for their actions. The vision, published in 2019, stated that the "EU still has the chance to entrench the right to confidentiality of communications in the ePrivacy Regulation under negotiation, but more action will be necessary to prevent further concentration of control of the infrastructure of manipulation".[49] If this statement was clearly true in 2019, then four years later, in 2023, when the ePrivacy Regulation is still "under negotiation", is no exaggeration to state that the "manipulation machine" has won the first battle against transparency, accountability and sustainable data processing.

The ethically well-grounded main argument in *Privacy 2030* against data maximisation and the misuse of individuals' personal data derives from the right to human dignity that "demands limits to the degree to which an individual can be scanned, monitored and monetised".[50]

The fifth chapter of Buttarelli's manifesto explores the role of the EU in the regulation of new technologies. This categorically refers to the context of democracy and human rights and clearly distinguishes autocracies from democracies, even raising the possibility of a "splinternet", in the event that "certain regions of the world cannot safeguard the values of human dignity and democracy".[51]

The final chapter of Buttarelli's *Privacy 2030* argues that besides the modernised Convention 108, the GDPR is only one possible tool for the protection of personal data and thereby privacy,[52] although the joint application of several other regulations is necessary for effective legal protection[53] (see Figure 14).

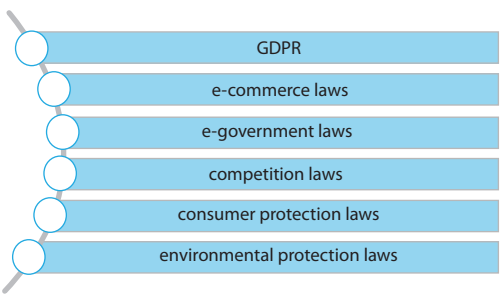


Figure 14: Tools of privacy and data protection in the European Union
Source: compiled by the author.

[48] Buttarelli 2019: 17.
[49] Buttarelli 2019: 18.
[50] Buttarelli 2019: 19.
[51] Buttarelli 2019: 21.
[52] Buttarelli 2019.
[53] Buttarelli 2019: 23–24.

Figure 15: Results of cooperation between competition and data protection authorities
Source: compiled by the author.

This part of the paper urges DPAs and the competition authorities of the Member States to cooperate in order to take effective action against multinational tech giants, where this is justified by the public interest.[54]

According to Buttarelli's vision, such cooperation could have a number of results (see Figure 15).[55] Among those possible effects, participation, or at least its transatlantic interpretation, is treated by Balkin in the context of freedom of expression that is essential for a democratic society: "the right of freedom of expression is not only the right to participate in democracy, but also the right to participate in a democratic culture."[56]

This final part of the manifesto states that these outcomes serve the social and environmental good through the appropriate handling and processing of personal data using new technologies, which can lead to the sovereignty of (European) values and technologies (see Figure 16).[57]

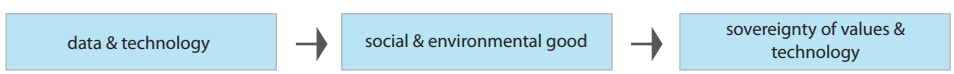


Figure 16: Personal data and digital sovereignty
Source: compiled by the author.

[54] Buttarelli 2019: 24.
[55] Buttarelli 2019: 27.
[56] Balkin 2016: 1212.
[57] Balkin 2016.

This concept of sovereignty of values and technology is expressed in a radical assertion made in this chapter: "Personal data generation that does not serve democratically mandated public interests or empower people should be treated like data pollution that has a real life impact on society and the environment."[58] This conclusion is in line with the previously elaborated issues related to human rights, environmental sustainability, data minimisation and maximisation or corporate accountability.

Therefore, one may conclude that this chapter argues convincingly for the necessity of building a European digital commons, especially if we take into consideration some apparent hostility toward the ePrivacy Regulation that "indicates a backlash of the EU's ambition to modernise its privacy norms".[59]

ON BUTTARELLI'S TRAILS – ACTUAL QUESTIONS OF THE DATA PROTECTION PROVIDED BY HUNGARIAN PUBLIC ADMINISTRATION

Although *Privacy 2030* outlines a mostly EU-level vision, the enforcement of relevant data protection rules, such as the GDPR, remains the task of the Member States, including their data protection authorities, and Buttarelli encouraged these bodies to better cooperate with each other and the competition authorities.

The issue of artificial intelligence (AI), mentioned several times in the manifesto, clearly appeared in the decision NAIH-85-3/2022 of the Hungarian National Authority for Data Protection and Freedom of Information (NAIH).[60] Based on Article 58(2) (d) of the GDPR, the Hungarian DPA ordered the controller, a local commercial bank, to bring its data processing operations into compliance with the provisions of the GDPR, that is, to abstain from analysing emotions during AI-based audio analysis of the clients' conversations with its call centre, and to properly ensure the rights of the data subjects. Since the decision also imposed a 250 million HUF administrative fine, the data controller filed a motion to the Budapest Capital Regional Court, seeking for legal remedy. As of now, the legal process is still ongoing, therefore it is necessary to wait until this is concluded for a further analysis of how effectively the Hungarian DPA protects data subjects' rights when the GDPR is infringed by AI-based data processing.

Privacy 2030 also deals with the issue of the unfair use of personal data as an inherent feature of the new web-based business model. The NAIH, which is the Hungarian DPA, often receives complaints regarding the data processing activities of multinational tech giants established in Ireland. Since the Irish DPA's activity in the field of the protection of personal data did not meet the data subjects', the DPAs' or the EDPB's expectations, Article 65(1) (a) of the GDPR has been applied regarding several cases pending before the

[58] Balkin 2016: 25.
[59] Balkin 2016: 26.
[60] NAIH decision NAIH-85-3/2022. See: www.naih.hu/hatarozatok-vegzesek/file/517-mesterseges-intelligencia-alkalmazasanak-adatvedelmi-kerdesei

Irish DPA, resulting in the EDPB's binding decisions in 2022. This recent turn of events[61] highlights the importance of effective cooperation between the EDPB and the DPAs.

Privacy 2030 states: "The ethnic profile of the typical European data protection authority, perhaps even more than the Silicon Valley coding community, is overwhelming white. Agencies in the EU should diversify their own workforce better to reflect the societies they represent by recruiting more people of colour and ensuring gender balance."[62] If we are to take Buttarelli and the editors of his posthumous paper seriously, it is worth examining the demographics of the Hungarian DPA's personnel more closely.

Since there is no acceptable reason to process personal data about the ethnic profile of the employees [see Art. 9(1) GDPR], it is impossible to provide reliable statistics on the number of members of staff from ethnic minority backgrounds. In addition, it should be pointed out that unlike many European countries, Hungary statistically has no significant proportion of "people of colour" among its inhabitants, therefore only the number of Hungarian Roma population can be examined as such (see Figure 17), while bearing in mind that being Roma means an identity and not necessarily the colour of one's skin.

Based on the official 2011 statistics (KSH), 3% of the Hungarian population declared themselves to be Roma.[63] There is no legal ground for processing a list of the ethnic background of employees, but it seems to be reasonable to conclude that not even 3% of the personnel of NAIH was recruited from among the Roma. According to NAIH statistics from 15 June 2022, of it had 113 employees at that time,[64] meaning the lack of at least 3-4 Roma employees, in terms of the requirements of *Privacy 2030,* would represent room for HR improvement in this area for the DPA.

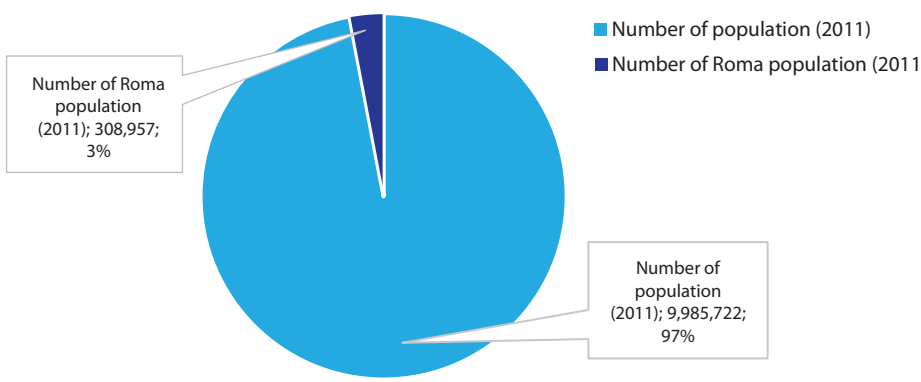


Figure 17: Number of Roma population in Hungary (2011)
Source: compiled by the author.

[61] DPC 2023.
[62] Buttarelli 2019: 24.
[63] See: www.ksh.hu/nepszamlalas/docs/tablak/nemzetiseg/09_01_02.xls
[64] NAIH equal opportunities policy (June 15 2022), 1–2.

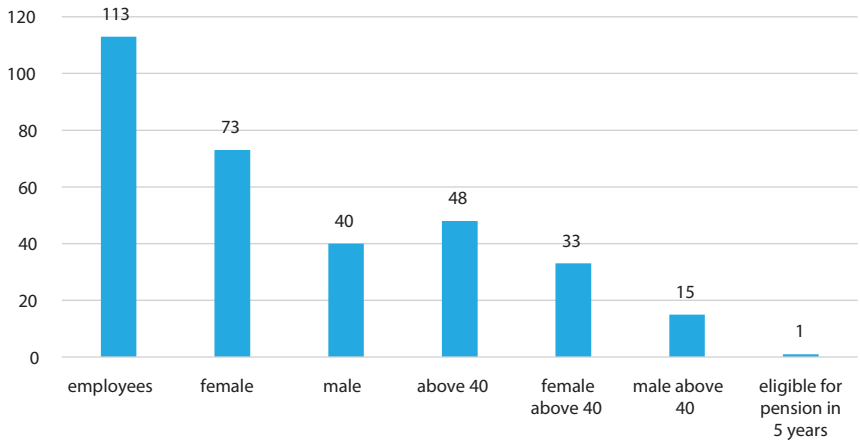


Figure 18: Gender and age balance of employees of NAIH, the Hungarian DPA (June 15, 2022)
Source: compiled by the author.

The gender balance, and the age balance not mentioned in the manifesto, can be better analysed based on the same NAIH statistics, which indicate that 65% of the employees are female and 35% are male.

Further analysing the available NAIH statistics, it can be stated that the gender balance and also the age balance clearly shows that males, and especially those above the age of 40, regardless of whether they are "people of colour" or not, are underrepresented (see Figure 18).

Privacy 2030 with its complex vision requires not only the EU to act, but also expects each Member State's DPA to exercise its enforcement powers. The question of the possible influence of public administration is well-known in the theory of Hungarian public administration. Focusing on the non-hierarchical administration, András Patyi describes Tibor Madarász's model, pointing out that there is necessarily a sphere that falls out of the scope of the influence of the authorities (see Figure 19).[65]

	influence of public administration public authority				activities out of the scope of the influence of public administration	
activity / (legal) situation	acts	prohibits	prescribes	restricts	informs	raises awareness / culture of data protection
all						
most						
many						
certain						

Figure 19: The Madarász model of the scope of influence of public administration
Source: compiled by the author.

[65] Patyi 2017: 56–58.

The theoretical question of the influence of public administration became quite practical, when the NAIH decided in 2020 that, based on Article 58(2) (g) of the GDPR, it has the corrective power to order ex officio the erasure of personal data in a situation where such request was not submitted by any data subject. The legal debate about the corrective powers of the Hungarian DPA finally resulted in the very important 3110/2022 (III. 23.) AB decision.[66]

One of the most significant decisions of the Constitutional Court of Hungary in recent years related to the administrative protection of personal data is the 3110/2022 (III. 23.) AB decision. In 2021, after it lost an administrative lawsuit, NAIH submitted a constitutional complaint to the Constitutional Court to annul judgments 105.K.706.125/2020/12 of the Budapest-Capital Regional Court and Kfv.II.37.001/2021/6 of the Kúria (i.e. supreme court), as it considered the two court decisions to be contrary to the Fundamental Law of Hungary.[67]

Initiated by an individual's notification, NAIH conducted a data protection inquiry, and after the data controller partly disputed the findings, an ex officio authority procedure for data protection was initiated against the data controller who had collected signatures (and other personal data, including e-mail addresses) for his campaign called "Let's join the European Public Prosecutor's Office".

In its final decision NAIH/2020/974/4,[68] the authority found that the data controller had collected the personal data of the data subjects without legal basis for the purpose of maintaining further contact, and did not provide adequate information on all the essential circumstances of the data processing, thereby infringing several articles of the GDPR. The DPA also found that since the data controller had not provided adequate information to the data subjects about the purpose of the data processing, this violated the basic requirement of fair data processing [Article 5(1) (a) GDPR, "lawfulness, fairness and transparency"]. The authority ordered the data controller to erase the unlawfully collected personal data and obliged him to pay a 1 million HUF data protection fine {3110/2022 (III. 23.) AB decision [2]}.

The data controller (plaintiff) filed a suit for legal remedy to the Budapest-Capital Regional Court, reasoning that the authority, in accordance with Act CXII of 2011 on the right to informational self-determination and on the freedom of information (Infotv.), could only have applied the legal consequences (expressly) defined in the GDPR, so the authority would not have been entitled to order the ex officio erasure of the collected personal data. The court of first instance came to the conclusion that "data erasure can only take place upon the request of the data subject, the petitioner [i.e. NAIH] is not entitled to order it ex officio, its provision to this effect is null and void due to the violation of its powers" {3110/2022 (III. 23.) AB decision [2]}.

66 3110/2022 (III. 23.) AB decision.

67 This section is based on the translation of the author. The English texts below are not official translations of the quoted Court judgements and decisions of the Constitutional Court of Hungary.

68 NAIH/2020/974/4, see: www.naih.hu/files/NAIH-2020-974-hatarozat.pdf

For different reasons, both the plaintiff and the defendant appealed the decision to the Kúria. The Kúria rejected the data controller's appeal for procedural reasons, but regarding the authority's appeal against the decision of the court of first instance, confirmed the decision in its effect. Kúria found that

- the disputed part of the authority's final decision was not suitable for review, as the petitioner did not comply with its obligation to provide reasoning; furthermore,
- neither the appeal nor the counter-appeal contested that the court of first instance made the legal basis of an incompletely justified decision [of NAIH] the subject of a legal review, partly ex officio and partly based on the authority's new argument {3110/2022 (III. 23.) AB decision [4]}.

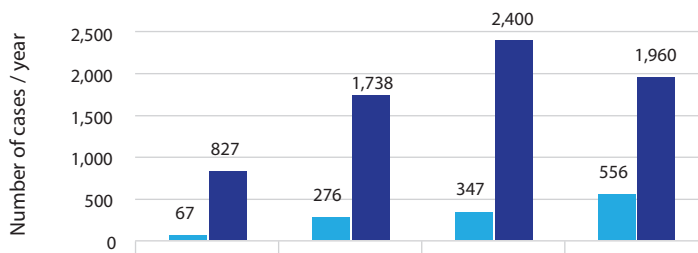
Therefore, the Kúria carried out a substantive inquiry related to the findings of the judgement's further references on its legal bases, and on the grounds of joint interpretation of Articles 58(2) (g) and 17 of the GDPR, it came to the conclusion that "erasure of data can only take place at the request of the data subject, so it was justified for the Regional Court to find that the petitioner [i.e. NAIH] lacks the powers to order the erasure ex officio" {3110/2022 (III. 23.) AB decision [4]}.

Following the judgment of the Kúria, Hungarian DPA submitted a constitutional complaint to the Constitutional Court because, according to its position, the court decisions of first and last instance violated several provisions of the Fundamental Law of Hungary, and the contested judgments limited the powers of the authority laid down in the Fundamental Law that resulted in a "serious disruption" of its operation, and therefore those decisions were contrary to the Fundamental Law. The authority therefore requested that the Constitutional Court declare the two judgements to be contrary to the Fundamental Law and to annul them, as well as submitting a request to suspend the execution of the judgments. {3110/2022 (III. 23.) AB decision [5]}. Regarding the danger of disruption of its operation caused by the two judgments, NAIH alleged that:

- ex officio ordering the erasure of data processed unlawfully has long been within its power
- it would mean emptying the DPA's power of control provided in the Fundamental Law, if the authority only has the option of formal control, without actual means of intervention
- according to the logic of the two contested court decisions, the data subjects must first request the erasure of their personal data from the data controller, and then they can apply to the authority based on Article 77 GDPR, which "in case of unlawful data processing involving hundreds of thousands or millions of data subjects, it can also represent an unmanageable amount of official cases in the operation of the petitioner, the same time it also has a negative effect on the enforcement of data subject rights, while until the end of which the personal data will remain in the – unlawful – processing of the data controller, without effective supervisory control"

– it is contrary to the powers of the public authorities guaranteed in the Fundamental Law, if the DPA "is barred from ex officio erasure of unlawfully processed data, because this deprives the data protection authority of the possibility of substantive, effective and efficient reparation of the infringement of rights, consequently the level of the protection of fundamental rights previously achieved is lowered, and in practice serious dysfunctions occur" {3110/2022 (III. 23.) AB decision [6]}

The NAIH also objected that the two Courts had reached their conclusions by applying a merely semantic interpretation of the GDPR, which is contrary to Article 28 of the Fundamental Law. Moreover, the authority took the firm position that the Courts "came to a conclusion clearly contrary to the Fundamental Law within the scope of the interpretation of the legal norms, and the regulations were not actually interpreted, but overwritten, and they carried out legislative activity contra legem, even contra constitutionem, in a way that violates legal certainty", which on the other hand also raises the issue of the violation of the right to a fair trial, since the two Courts that acted "absolved themselves from the principle of subjection to the law" {3110/2022 (III. 23.) AB decision [7]}.



	2018	2019	2020	2021
authority procedure	67	276	347	556
authority inquiry	827	1,738	2,400	1,960

Figure 20: Data protection procedures 2018–2021
Source: compiled by the author based on NAIH 2021.

In terms of legal certainty, the authority referred to the fact that Recital (129) GDPR also expresses the requirement for consistent and uniform enforcement, within the framework of which other supervisory authorities also recognise the power to order erasure of personal data ex officio.

According to the DPA's argument, both the Regional Court and the Kúria failed to initiate the preliminary ruling procedure in connection with the provisions of the GDPR. In the authority's view, this violated the authority's right to due process and legal remedy, as well as limiting its powers of control, especially given that all the relevant aspects of EU law remained unexplored and the relevant provisions were interpreted differently from

the purpose of the legal norm. "Therefore, this violation of fundamental rights occurred due to the absence of sufficient legal reflection on EU law." The NAIH also found it to be a violation of its fundamental rights that the Courts "did not comply with their obligation to provide reasons, did not examine its arguments regarding the essential part of the case with sufficient thoroughness, and in violation of the obligation to remain within the limits of the request for legal review, the Kúria examined issues that were not the subject of the judicial review" {3110/2022 (III. 23.) AB decision [8]}.

In order to explain her legal position, the Constitutional Court contacted the Minister of Justice, who explained in her reply that

- the constitutional complaint concerns the content of the disputed judicial decisions and not the applied law, therefore she cannot evaluate those
- the Court of Justice of the European Union is authorised to interpret the GDPR authentically
- the corrective powers provided by GDPR also extend to data protection supervisory authorities ordering the data controllers to bring their data processing operations into compliance with the provisions of GDPR, which may even mean an order to erase unlawfully processed personal data, "the Government is not aware of any legal interpretation contrary to this in connection with the enforcement of the GDPR in the Member States"
- a legal interpretation, which prohibited the ordering of ex officio data erasure "would lead to a seriously disadvantageous, constitutionally unjustifiable situation for the data subjects, as a situation would arise in which a multitude of the data subjects would not have access to legal protection in the absence of an expressed will during the application of the GDPR, […] thus this would result in constitutionally unjustified distinct (discriminatory) and different regimes in nature"
- the legislator tried to clarify the legal interpretation giving priority to EU law with the amendment of Infotv. that would come into force on 1 January 2022 {3110/2022 (III. 23.) AB decision [11]}

The Constitutional Court considered the constitutional complaint of the Hungarian DPA well-grounded {3110/2022 (III. 23.) AB decision [25]}.

In its 3110/2022 (III. 23.) AB decision, it explained, among other things, that all the provisions of the GDPR fundamentally serve the purpose of limiting personal data processing within legal boundaries, which can be based on the application of the basic principles {3110/2022 (III. 23.) AB decision [35]}.

The Constitutional Court essentially accepted the authority's argument, but also found that, as its 2/2019 (III. 5.) AB decision had already explained, "the binding force of European Union's law does not originate from itself, but is based on Article E) of the Fundamental Law, and does not override Article R) (1) of the Fundamental Law, according to which the Fundamental Law is the foundation of the legal system of Hungary" {3110/2022 (III. 23.) AB decision [42]}. The decision also explained that following the submission of the motion

by the NAIH to the Constitutional Court, the authority turned to the European Data Protection Board regarding the interpretation of the powers laid out in Article 58(2) (g) of the GDPR.

In its opinion 39/2021[69] adopted on 14 December, 2021, the EDPB explained that Article 58(2) (g) and Article 17 of the GDPR regulate two different cases, so the former one "provides an appropriate legal basis for the supervisory authority to order ex officio the erasure of unlawfully processed personal data in cases where the data subject (érintett) has not submitted such a request" {3110/2022 (III. 23.) AB decision [51]}. The Constitutional Court came to the conclusion that the two disputed judgements are not in accordance with the function and content of the GDPR in terms of the right to protection of personal data as a fundamental right {3110/2022 (III. 23.) AB decision [54]}.

It also noted ironically that the Courts involved in the case "did not perceive that the broad data protection supervisory authority control was ensured based on the obligations arising from the Fundamental Law, EU law and international law, even before the GDPR". Furthermore, it determined that "based on paragraphs (2) and (3) of Article E) and Article VI(4) of the Fundamental Law, and GDPR as a source of EU law ensuring the uniform application of data protection and freedom of information, the Authority is entitled to order ex officio the erasure of unlawfully processed personal data even in the lack of a request to this effect" {3110/2022 (III. 23.) AB decision [56]}.

Consequently, the Constitutional Court established that the "Kúria's judgement No. Kfv.II.37.001/2021/6. and the Budapest-Capital Regional Court's judgement No. 105.K.706.125/2020/12. are contrary to the Fundamental Law", and therefore cancelled them {3110/2022 (III. 23.) AB decision [57]}.

Since the Constitutional Court reached a decision based on the above points, it did not find it justified to examine the NAIH's further arguments.

In this case, Buttarelli's warning came true, as the authority's decision was contested,[70] but the NAIH was also confident about the meaning and role of its corrective powers.

CONCLUSIONS

Although Hungarian law and its theory approaches data protection from different directions than Buttarelli, finally we may conclude, agreeing with him, that public administration is currently facing enormous challenges at a time when our societies are under metamorphosis due to the increasing use of AI, algorithms and many other ICT-related data processing activities.

[69] EDPB opinion 39/2021 (December 14, 2021). Source: https://edpb.europa.eu/system/files/2022-01/edpb_opinion_202139_article_582g_gdpr_en.pdf

[70] Buttarelli 2019: 23.

Hopefully, these changes will not end in a dystopian and authoritarian future, but will instead contribute to a more transparent and democratic world.

While the effective enforcement of the GDPR is expected from DPAs, it is equally important to raise data subjects' awareness of their rights in data protection and to encourage data controllers to implement additional data protection measures. Only public administration, data controllers and data subjects together can build what we may call a "*data protection culture*".[71]

REFERENCES

Balkin, Jack M. (2016): Information Fiduciaries and the First Amendment. *University of California Davis Law Review,* 49(4), 1185–1234.

Balkin, Jack M. (2020): The Fiduciary Model of Privacy. *Harvard Law Review Forum,* 134(11), 11–33. Online: https://harvardlawreview.org/wp-content/uploads/2020/10/134-Harv.-L.-Rev.-F.-11.pdf

Buttarelli, Giovanni (2019): *Privacy 2030: A New Vision for Europe.* Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf

DPC (2023): *Data Protection Commission Announces Conclusion of Two Inquiries into Meta Ireland.* 4 January 2023. Online: www.dataprotection.ie/en/news-media/data-protection-commission-announces-conclusion-two-inquiries-meta-ireland

EDPB opinion 39/2021 (December 14, 2021). Online: https://edpb.europa.eu/system/files/2022-01/edpb_opinion_202139_article_582g_gdpr_en.pdf

Farrell, Maria (2019): Afterword: A Cage Went in Search of A Bird. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 35–36. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf

Harari, Yuval Noah (2014): *Sapiens.* London: Vintage Books.

Harari, Yuval Noah (2017): *Homo Deus.* London: Vintage Books.

Jayaram, Malavika (2019): Afterword: The Future is Already Distributed – It's Not Evenly Just. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 31–32. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf

Kolbert, Elizabeth (2015): *The Sixth Extinction.* London – New Delhi – New York – Sydney: Bloomsbury.

NAIH (2021): *A Nemzeti Adatvédelmi és Információszabadság Hatóság Beszámolója a 2021. évi tevékenységéről.* Budapest: Nemzeti Adatvédelmi és Információszabadság Hatóság. Online: https://naih.hu/eves-beszamolok?download=507:naih-beszamolo-a-2021-evi-tevekenysegrol

NAIH equal opportunities policy (June 15, 2022).

[71] Szabó 2022: 67.

Panetta, Rocco (2019): Afterword: Privacy 2030: To Give Humans a Chance. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 37–40. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf
Patyi, András (2017): *A közigazgatási működés jogi alapjai.* Budapest: Dialóg Campus.
Polonetsky, Jules (2019): Afterword: A Mission Greater Than Compliance. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 33–34. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf
Rodotá, Stefano (2004): *Privacy, libertà, dignità.* Discorso conclusivo della Conferenza internazionale sulla protezione dei dati. Online: www.privacy.it/archivio/rodo20040916.html
Rodrik, Dani (2012): *The Globalization Paradox.* Oxford: Oxford University Press.
Rotenberg, Marc (2019): Afterword: The Future of Privacy and a Vibrant Democracy. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 29–30. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf
Sartori, Giovanni (1987): *Theory of Democracy Revisited I–II* Chatham, NJ: Chatham House.
Szabó, Endre Győző (2022): *A védelmi lépcső elmélete.* Budapest: Ludovika.
Zuboff, Shoshana (2019): Afterword: Many Facets of the Same Diamond. In Buttarelli, Giovanni: *Privacy 2030: A New Vision for Europe.* [s. l.]: IAPP, 41–42. Online: https://iapp.org/media/pdf/resource_center/giovanni_manifesto.pdf

Constitutional Court of Hungary's decisions

2/2019 (III. 5.) AB decision
3110/2022 (III. 23.) AB decision

Court decisions

Kúria's judgement No. Kfv.II.37.001/2021/6.
Budapest-Capital Regional Court's judgement No. 105.K.706.125/2020/12.

NAIH decisions

NAIH/2020/974/4. Online: www.naih.hu/files/NAIH-2020-974-hatarozat.pdf
NAIH-85-3/2022. Online: www.naih.hu/hatarozatok-vegzesek/file/517-mesterseges-intelligencia-alkalmazasanak-adatvedelmi-kerdesei

Imre Borisz Páll is a lawyer, specialised in Data Security and Data Protection (LL. M.). He is currently Head of Department at the National Authority for Data Protection and Freedom of Information. He is a PhD student at Ludovika University of Public Service Doctoral School of Public Administration. His area of expertise is the administrative law issues of data protection subject to the EU General Data Protection Regulation. His research area in the doctoral school is "Public Administration and Governance", his research topic is "The impact of new technologies on the social public sphere and and democracy". Within this framework, "The role of data protection law in the context of protecting human dignity and ensuring social publicity".

Call for papers

Pro Publico Bono is a peer-reviewed journal four-monthly published by the Ludovika University of Public Service, Budapest. It covers researches based on public law, social and political sciences and interdisciplinary approach that explore future alternatives for fostering sustainable and innovative societies, good governance and for strengthening nation states as well as the European and transatlantic cooperation facing technological, ecological and cultural disruption in the increasingly complex and ambiguous 21st century.

The primary objective of the journal is to become an international platform of the highest scientific and professional debate. The international scientific forum is open to high quality scientific publications from worldwide resources, to professional discourses, including a synthesis of scientific opinions and comparative research. The journal would focus on sustainable and innovative societies, good governance and building nation states. In terms of its topics and content, the journal would be primarily theoretical but would also leave room to analytical works on legal, social and political sciences as well as professional forums and book reviews.

Contributions can be submitted through the Open Journal System of the Ludovika University of Public Service, which is accessible via the following link

https://folyoirat.ludovika.hu/index.php/index/login

See the detailed information on publication guidelines, attached to this call for papers which can be found at

https://folyoirat.ludovika.hu/index.php/ppb/ppbjus_style_guide

Sincerely,
Norbert Kis, PhD, Professor
Editor-in-Chief

Editorial Committee

Imprint

PRO PUBLICO BONO – PUBLIC ADMINISTRATION

Editorial Team

Chairman of the Editorial Board: György Kiss, PhD, Professor (LUPS FPGIS)
Co-Chairman of the Editorial Board: András Koltay, PhD, Professor, Prorector (LUPS FPGIS)
Editor-in-Chief: Norbert Kis, PhD, Professor (LUPS FPGIS)
Guest Editors: Hojjat Adeli, PhD, Professor (The Ohio State University)
Csaba Makó, DSc, Professor (LUPS)
Bernát Török, PhD, Head of Institute (LUPS EJRC)
Editorial Assistant: János Dúl, PhD, Assistant Professor (LUPS FPGIS)

Address: Ludovika University of Public Service, Faculty of Public Governance and International Studies
LUPS FPGIS, H-1083 Budapest, Üllői Street 82.
Postal address: H-1441 Budapest, P. O. Box 60
E-mail: ppb.editor@uni-nke.hu
Webpage: https://folyoirat.ludovika.hu/index.php/ppbmk

Imprint

Publisher: Ludovika University of Public Service, Ludovika University Press
Responsible for Publishing: Gergely Deli, Rector
Address: H-1083 Budapest, Ludovika Square 2
E-mail: kiadvanyok@ludovika.hu
Webpage: www.ludovika.hu
Copy editor: Ágnes Resofszki
Layout editor: Angéla Fehér
Print and bind: Ludovika University of Public Service
Cover photo: depositphotos.com

ISSN 2063-9058 (print)
ISSN 2786-0760 (online)

Table of Contents