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Redefining the workplace:
A bibliometric insight into the remote work, digital nomadism and metaverse in the workplace

Dissertation thesis

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Declaration

I hereby declare that my dissertation, entitled " Redefining the workplace: A bibliometric insight into the remote work, digital nomadism and metaverse in the workplace", is my own work and has been prepared independently, except as expressly stated. Where the dissertation includes contributions from a collaborative effort, I have followed the CRediT (Contributor Roles Taxonomy) to indicate my individual contribution to such work.

This document has not been submitted for any other degree or professional qualification at this institution. I confirm that all sources of information used in the preparation of this dissertation have been properly acknowledged and cited. In my dissertation, I used ChatGPT as a virtual research colleague. I used it to discuss and expand my ideas, better structure my dissertation, and develop chapter titles. To the best of my knowledge, as of March 8, 2024, there is no official guideline from our university regarding using ChatGPT in academic research – in the dissertation. There is only Rector's regulation titled "Rules for the assignment, preparation, submission, archiving and publication of bachelor and diploma theses at the Czech University of Life Sciences (5/2019, effective from 24 January 2024)" regulates AI tool use. Although this regulation only addresses bachelor and diploma theses, this dissertation complies with these rules. I also followed international standards for the ethical and transparent use of AI tools in academic work. The use of ChatGPT was explicitly documented and cited within the dissertation to maintain academic integrity. For full transparency and a comprehensive understanding of my interaction with ChatGPT, a chat transcript is available as an attachment - see Annex.

I have adhered to the "as open as possible, as closed as possible" principle. I have followed this approach in sharing my research findings and methodologies, committing to transparency and openness, ensuring that the findings are accessible. I also declare that to the best of my knowledge, the work contained in this dissertation does not breach any copyright or intellectual property rights of third parties.

Acknowledgement

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Abstract

The future of work is a significant challenge facing organisations, policymakers and individuals worldwide. In recent years, particularly in the wake of the COVID-19 pandemic, there has been an increased focus on evolving workplace conditions, mainly by introducing technologies that facilitate effective remote working. This dissertation presents a comprehensive exploration of an evolving paradigm of work characterized by integrating remote work practices, emerging digital nomadism, and innovative use of technologies such as metaverse in the workplace.

The main aim of the dissertation is to explore the future of work - focusing on the dynamics of remote working, the impact of new technologies such as metaverse in the workplace and the concept of digital nomadism. In addition, this dissertation aims to demonstrate the effectiveness of bibliometrics for mapping research, predicting trends and informing evidence-based management in organisations and governments. This dissertation introduces a new methodological framework for open and transparent scientific mapping, promoting a transparent research workflow that includes careful data management and open dissemination of results. This new methodological approach highlights the crucial role of bibliometrics in mapping research trajectories, anticipating trends, and supporting evidence-based decision-making and management in organisations and governments.

The findings of this dissertation illuminate broad trends and shifts in the future of work and reveal how digital transformation - encompassing remote work, digital nomadism, and the integration of metaverse technologies - is changing the shape of employment and organisational structures. The comprehensive bibliometric analysis not only maps the current state of remote work practices but also innovatively conceptualizes digital nomadism and captures its growing influence on lifestyles, work organisation, and policy development. Introducing a metaverse workplace framework suggests a new path for organisations to increase engagement, productivity, and well-being in the virtual workplace. The dissertation results also showcased the use of bibliometrics in evidence-based decision-making and management in organisations and policy. By addressing scientific, managerial, social, political, and environmental challenges, the dissertation's contributions are well suited to influence a wide range of stakeholders, from business executives, policymakers, urban planners, and individuals, to promote a more adaptive, inclusive and sustainable, approach to work in the digital era.

Content

1. Introduction

The future of work has become a significant challenge for organisations, policymakers and individuals worldwide. Indeed, in recent years, not least because of the COVID-19 pandemic, much attention has been paid to changing conditions in the workplace. Particularly in the use of technology to support effective remote working. However, the use of technology to improve the working environment is much older. As Allen (2017) noted, in the first half of the nineteenth century, labour-saving machines were invented in most sectors of the economy. One of the earliest uses of technology for work improvement can be seen in "Principles of Scientific Management," published in 1911 when Frederick Winslow Taylor introduced a set of steps to develop assembly lines and other innovations that reshaped industrial labour (Taylor, 2016). A few years later (in 1928), John Maynard Keynes wrote about technologies that would make work easier, allowing us to work for as little as 3 hours a day (Keynes, 2010). Many such examples can be found in the years to come, proving that the future of work has been mainly conceptualised about technological innovation (Bentley *et al.*, 2021). Although technological innovation certainly has a vital role in transforming the workplace, technology is not the only force for change. Other forces influence workplace dynamics - as Bentley et al. (2021) called them 'megatrends' - including new working methods, demographic shifts, globalisation and trade liberalisation, environmental pressures, and new organisational forms (see Figure 1). As the world faces these megatrends, organisations, policymakers and individuals adapt to these new challenges and embrace new opportunities.

Figure 1: Megatrends - critical players in future of work
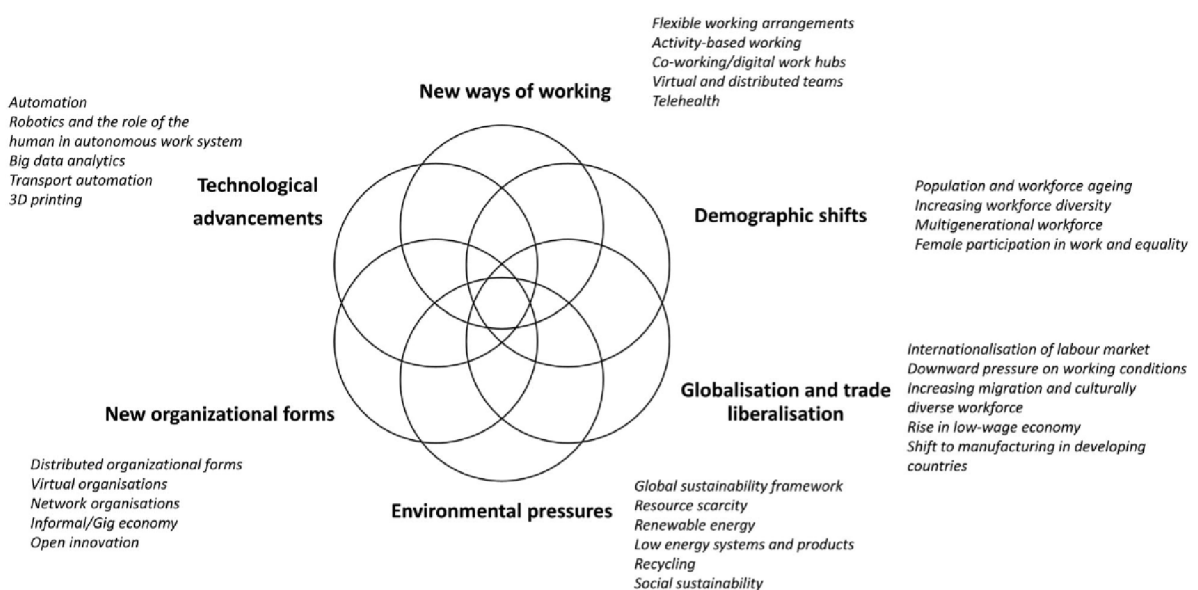
Source: (Bentley et al., 2021, p. 429).

This dissertation studies the forces and factors influencing and changing the workplace environment, focusing on remote work research. Remote work is understood in this dissertation as working from a location other than a traditional office while using technology to complete work tasks (see section 2.1). This research examines factors associated with conventional and less traditional modes of remote work, such as digital nomads and the use of metaverse in the workplace. The dissertation addresses these factors from multiple perspectives - organisational (managerial) and employee (individual and team), governmental, social, and environmental. At the same time, another line runs through the dissertation, which focuses on the research methods used. Specifically, bibliometrics as a tool for better evidence-based management, organisation decision-making, and policymaking. Section 2.3 introduces the concept of remote working and then describes it from the perspectives of different stakeholder groups. Section 2.4 defines the research opportunity. Section 3 describes the dissertation's objectives, outcomes, and significance. Section 4 describes the proposed design methodology for this research, which is based on various bibliometric methods – an innovative workflow for open and transparent science mapping is proposed. Section 5 contains the researcher's conceptual framework of this dissertation and the results in the form of three articles. In section 6, readers can find dissertation contributions, recommendations for stakeholders, concluding remarks, limitations, and directions for future research.

The presented dissertation supports the idea of Open Science, and therefore, the outputs of this dissertation are shared following the principle "as open as possible, as closed as necessary". The dissertation thus includes accompanying materials available on the dissertation project repository on the [Open Science Framework](#) (OSF - Dissertation Project Šímová, 2023). In the project repository, you can find, e.g. the data management plan of this dissertation, scripts, data (on request), or preprints of publications etc.

2. Literature review

Many terms have been used to describe the concept of working outside the traditional office environment. Examples include 'telework', 'telecommuting', 'teleworking', 'working from home', 'flexible working', 'virtual working', 'e-work', 'electronic homeworking', 'distributed work', 'ICT-based mobile work', 'work from anywhere' and 'remote working' (Vartiainen, 2021; Ingusci *et al.*, 2023; Makori and Mauti, 2023). This jumble of terms is not only in the setting of research and the spoken word but also permeates the policies of individual countries. For example, Italy uses the term 'smart working', Ireland and Poland have 'remote working', and the USA uses two terms – 'telework' and 'remote work' (Samek Lodovici, 2021; United States Office of Personnel Management, 2021; Ministry of Family and Social Policy, 2022). The most common distinction is between telework, remote working, and working from home. According to Samek Lodovici (2021), the difference is that remote workers can be both dependent and independent workers who work either partially or entirely outside the traditional workplace. Conversely, telework is linked to the employment relationship, and work is conducted using digital and information technologies (Gray, Hodson and Gordon, 1993; Samek Lodovici, 2021; Vartiainen, 2021). According to Samek Lodovici (2021), work from home is often associated with independent or dependent workers who work from their homes (while not necessarily using digital technologies). But all these terms have a similar fundamental concept. This concept describes employed individuals who are formally committed to specific job tasks; they work in most cases outside the physical space of the company but may communicate with their employer and colleagues remotely. Following Ingusci et al. (2023) and Kłopotek (2017), this dissertation focuses on the common thread linking different typologies of remote work as it is the broadest and least strict definition - i.e., working from a location other than a traditional office and using technology to complete work tasks. Therefore, the umbrella term 'remote work' is used in this dissertation, as explained above.

2.1 History and evolution of remote work in research

The history of remote work began in the 1970s when Jack Niles created a communication system for NASA and named it telecommuting (Joice, 2000; Chiru, 2017). A few years later, Frank Schiff (1979) wrote an article in the Washington Post titled "Working from Home Can Save Gasoline", describing how he started experimenting with remote work. A few years later, Schiff also coined the term "Flexiplace" to cover working from home and other locations from which is possible to work (Joice, 2000). One of the first definitions is by Olson (1982, 1983), where she states that "remote work refers to organisational work that is performed outside the normal organisational confines of space and time" (Olson, 1983, p. 182). During the 90s, many studies about remote work were conducted, which laid the basis for further development of remote work (Burch, 1991; Markby, 1993; Skyrme, 1994). Notably, in the '90s and '00s, most researchers used teleworking or telecommuting (see Figure 2). The remote work term has started to be popular in later years, especially with the emergence of COVID-19. In 2022, 847 Web of Science (WOS) publications were devoted to remote work, 615 to telework, 521 to work from home, and 144 to telecommuting.

Figure 2: Comparison of terms based on the number of publications in Web of Science before COVID-19
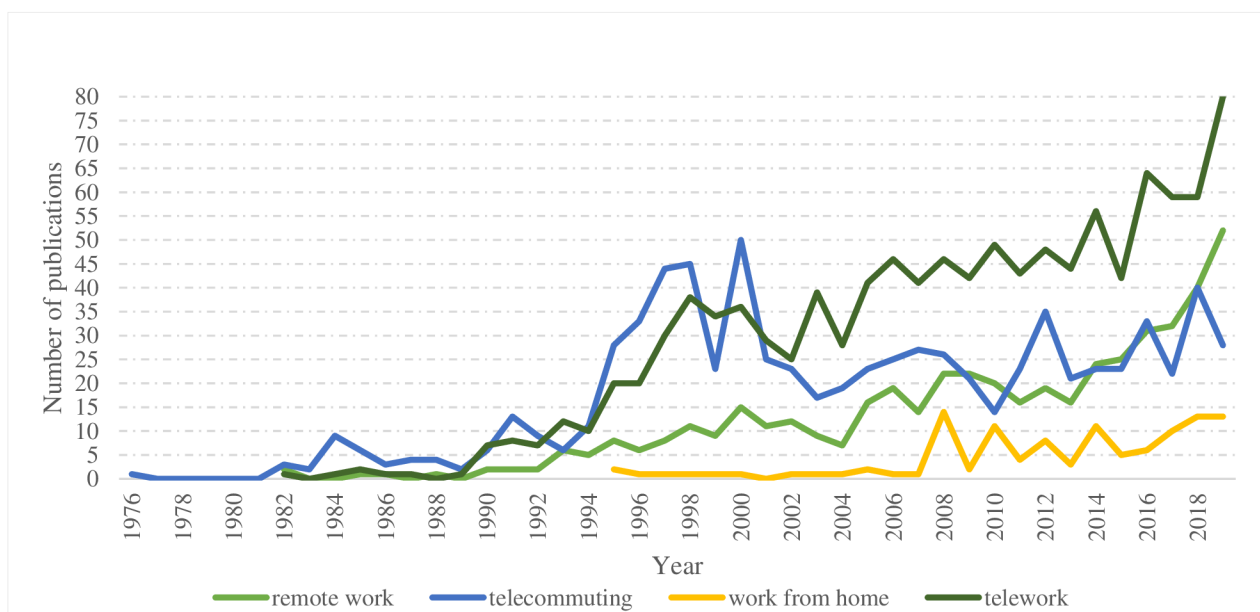
After 2000, thanks to the increasing access to the internet and other new digital technologies, interest in remote working grew (also reflected in the number of publications in Figure 2). These technological advances have also expanded into an increase in the gig economy, characterised

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by independent, typically short-term contracts or freelance work that often uses digital technologies (Vallas and Schor, 2020). Multinational organisations, in particular, began to notice the positives that remote work brought - see, for example, a study of remote work from IBM (Hill, Ferris and Märtinson, 2003). Gajendran and Harrison (2007, p. 1542) wrote, "such a sustained rise in popularity suggests a received wisdom of positive outcomes or clear benefits of telecommuting for firms and their employees". According to Agrawal et al. (2013), the total wage bill of online contract labour was just over $360 million in 2012. However, the real breakthrough for remote work occurred in 2020 with the onset of COVID-19. During COVID-19, companies were forced to digitise the workplace immediately and switch to a virtual environment (Meluso, Johnson and Bagrow, 2020). As a result, companies and employees alike became accustomed to new forms of working environments and remote collaboration (Bailey and Breslin, 2020; Frost and Duan, 2020). COVID-19 is hopefully behind us, but the changes it has caused in workplaces remain. Research on how many companies will continue with the changes they have implemented during the pandemic differs. According to Owl Labs (2021), 89 % of European companies plan to maintain the changes after COVID-19 (for example, keeping a hybrid workforce). In the USA, 58 % of people claim their work allows them to work remotely (Du *et al.*, 2022). The situation is similar in Australia, where a survey showed that managers believe their employees will work remotely more than before COVID-19 (by 77 %) (Hopkins and Bardoel, 2020). Regardless of which of the above estimates is correct, COVID-19 has changed the workplace. Remote work is thus a standard part of the workplace, and it is therefore necessary to identify what factors are related to remote work. It is essential to find out how organisations and management respond to these changes and help them identify the best ways to manage remote work. To determine how it affects employees' work, performance, well-being, and health. And because remote work changes the work style as we know it, it is necessary to find out how it affects society and the environment. Last but not least, for the successful implementation of remote work, it is required to respond at the level of national governments. As these statements show, remote work research raises many questions, and therefore, remote work research is vital for the effective functioning of organisations, nations, and society.

2.2 New phenomena in remote work

This flexibility and innovation in the workplace bring new phenomena to the work environment. One of the phenomena is digital nomadism. Based on Šímová (2022, p. 177), digital nomads are "individuals with a mobile lifestyle that combines work and leisure, requiring a particular set of skills and equipment". Between remote workers and digital nomads, the main distinction is the combination of work and leisure - digital nomads often take advantage of remote working opportunities and work from destinations that suit their lifestyle and/or are exotic (Dal Fiore *et al.*, 2014; Mladenovic, 2016). Digital nomads can also be characterised by digital work, flexibility, identity mobility and community (Hensellek and Puchala, 2021). Digital nomads break down the established traditions of 9-to-5 jobs and create a new lifestyle that is beginning to be reflected by organisations, policymakers, and society. However, the life of digital nomads is not without its challenges. Aside from the problems experienced with other types of remote work, there are more specific issues. For example, the issue of law regulation is inflexible in many cases due to unadopted labour or tax regulations. Integration into society is also complex, especially for entire digital nomad families. From a societal perspective, the challenge is to prepare sufficient support and infrastructure for digital nomads - there are limited studies on specific popular destinations for digital nomads and infrastructure availability (MacRae, 2016; McElroy, 2020; Cruz, Franqueira and Pombo, 2021; de Loryn, 2022). From a scientific perspective, digital nomads are an unexplored area. Knowledge is also often limited or even biased (Reichenberger, 2018), as the source of information is not always academic peer-reviewed papers. Often the sources are online blogs, newspapers, interviews, etc. (Nash *et al.*, 2018). As Šímová (2022) reported, only 48 publications on this topic were in the Web of Science databases.

The metaverse is another example of a phenomenon that could change the workplace as I know it. The metaverse can be described as a 3D virtual space that allows users to engage in real-time interactions with each other and with virtual objects represented by their avatars (Duan *et al.*, 2021; Kim, 2021). Metaverse and virtual reality are often associated with games – for example, Second Life (Arroyo, Serradilla and Calvo, 2009; Davis *et al.*, 2009; Morie, 2010; Kidd, Knisley and Morgan, 2012) and serious games (Nicolaidou *et al.*, 2015; Bozanta *et al.*, 2016; Mystakidis, 2022). But lately, the metaverse has also been associated with the future of work (Choi, 2022). Examples include the support of large companies and their products, such as Omniverse by Nvidia – a platform that connects a 3D world into a shared virtual universe (Petrosyan and Aristova,

2022), or Microsoft Mesh - a mixed reality platform for business (Bian, Leng and Zhao, 2022). Another significant milestone for the metaverse in the workplace was the launch of Meta by Mark Zuckerberg in 2021, which is expected to transform Facebook into the metaverse (Bian, Leng and Zhao, 2022). There are already dedicated platforms (e.g. Gather, Teamflow or Meta) that enable immersive, interactive and collaborative metaverse environments (Park and Kim, 2022). Purdy (2022) stated that the metaverse allows collaboration and communication to be taken to the next level by encouraging networking, informal and spontaneous conversation, and generally promoting the social aspect of teamwork. Metaverse also improves employees' training and skill acquisition using gamification (Nicolaidou *et al.*, 2015; Mystakidis, 2022; Purdy, 2022; Usmani, Sharath and Mehendale, 2022). However, the metaverse is not without some challenges. For example, the physical well-being of users, psychology (such as information overload). Also, the ethics and privacy of users are problematic in the metaverse (Mystakidis, 2022). It is still unclear how communication and collaboration in the metaverse can be improved to achieve even higher performance in remote workers and how organisations and policymakers should approach this issue.

2.3 Stakeholders' perspectives on remote work

Many researchers have studied the use of digital technologies in the workplace and their impact on workplace roles and relationships. As Moradi and Levy (2020, p. 282) stated, "technology has no unified set of effects once deployed in a workplace: it can alter new social dynamics or ossify old ones, depending on the conditions surrounding its deployment—including industry structures, broader economic forces, workplace culture, and institutional mechanisms for governing relations between labour and management." Therefore, the following section of the dissertation is devoted to the different perspectives of the key stakeholders involved in remote working.

2.3.1 Organisational and management perspective

Organisations are rethinking traditional work structures and moving towards flexible work arrangements (Kathleen *et al.*, 2021), greater autonomy (Harborth, 2022; Zychová, Šímová and Fejfarová, 2023) and remote working (Barsness, Diekmann and Seidel, 2005; Frost and Duan, 2020; Kathleen *et al.*, 2021). This shift is driven by digital transformation, redefining what work is, where it takes place and who does it. Digital technology enables businesses to operate across geographies and pushes the boundaries of the conventional 9-to-5 workday and office environment (Demaj 2021). Digital technology is also bringing innovations such as robotics, artificial intelligence (AI), extended reality (XR), augmented reality (AR), mixed reality (MR) and virtual reality (VR). All these changes transform the view of the work task and the place of work, thus changing the understanding of conventional labour.

According to Eurostat (2023b), 50% of enterprises with ten or more employees conduct online remote meetings. Large enterprises had the highest share of remote meetings (93%), more than twice as many as small enterprises (44%). Medium-sized enterprises had 76% of their meetings online. Romania (70.0%), Cyprus (64.7%) and Spain (64.2%) had the highest shares of remote sessions and instructions favouring remote meetings over business trips, while Croatia (14.6%), the Czech Republic (24.7%) and Germany (26.8%) had the lowest shares. The frequency of remote meetings varied depending on the economic activity and the nature of the enterprises' work. In 2022, the highest rates of remote meetings were in the information and communication activities (92.9%), professional, scientific and technical activities (84.4%) and activities for the supply of electricity, gas, steam and air conditioning (82.1%). In contrast, activities in accommodation, food and drink (22.2%), construction (36.8%) and transport and storage (38.3%) had the lowest

rates. Enterprises also provided remote access to emails (77.7%), corporate documents (65.0%), and corporate applications or software (61.8%) (Eurostat, 2023b). Large enterprises were more likely than small enterprises to offer remote access to these resources. Similar results were reported in Australia, where employees of large enterprises (80%) were almost twice as likely as small enterprises (42%) to use remote work (Hopkins and Bardoel, 2020).

Transition to remote work in organisations

Most organisations perceive employee-related reasons, not external or business factors, as the driving force for introducing remote working (KMPG, 2022). These include flexibility and responsiveness of team members (DeRosa, 2009), increased innovation potential (Alsharo, Gregg and Ramirez, 2017), reduced companies´ production costs (Samek Lodovici, 2021), travel or office space costs (Berry, 2011; Eurostat, 2023b), and access to talent around the world (Aldag and Kuzuhara, 2015). Remote working also enables rapid problem identification, resolution and intervention, accessibility and cost-effectiveness (Druta *et al.*, 2021). The KMPG report (2022) shows that the primary motivations for remote working were employees interest/request (25%), COVID-19 measures (21%), employer branding & talent attraction (18%), greater flexibility (13%), talent shortage (12%), cost savings (6%), and for sustainability and CO2 reduction reasons (3%).

Makarius, Larson, and Vroman (2021) suggest that organisations face two critical challenges in transitioning to remote working: company policies and management practices. Therefore, companies are creating guidelines recommending online meetings instead of physical meetings requiring travel (44.2% of EU companies had such a directive in 2022 (Eurostat, 2023b)). Data from Australia (Hopkins and Bardoel, 2020) show that 60% of companies have already before COVID-19 a policy on working from home (after COVID-19 was reported, 78%). For organisations, it is also essential to educate their employees on information communication technology (ICT) security issues such as specific password requirements, end-to-end encryption, approved tools, and private or corporate devices. Of the EU businesses that hold meetings over the internet, 63.7% had ICT security guidelines describing security measures for online meetings, and 65% had guidelines relating to security measures for remote access to company resources (Eurostat, 2023b). According to a KMPG report (2022), 89% of companies globally have already implemented remote control or are considering it. Another organisational policy challenge is tax and legal compliance (KMPG, 2022; Cook, 2023; Sánchez-Vergara, Orel and Capdevila, 2023).

Remote workers may be located in countries other than the company's base. This creates challenges in understanding and complying with tax laws and regulations of multiple jurisdictions, each with its own rules and requirements. Organisations must also update their human resources (HR) policies and provide new training and travelling policies. Some organisations may even consider the so-called "Work from anywhere" policy (Makarius, Larson and Vroman, 2021).

Management of remote workers

From the management perspective, it is difficult for the organisation to establish effective processes and support for remote working, as well as employee monitoring and technology (KMPG, 2022). Samek Lodovici (2021, p. 14) noted that remote work highly depends on the "capacity of managers to engage and motivate teleworkers effectively." There are numerous factors that management must consider in a remote workplace organisation. For example, effective communication, a vital component of any team's success, becomes particularly challenging in a remote environment (Martins and Schilpzand, 2011; Gilson *et al.*, 2015; KMPG, 2022). This is further complicated when team members are dispersed across time zones, making synchronous communication difficult (Aldag and Kuzuhara, 2015; Barry and Kane, 2023). An example of fostering a good organisational climate and communication is IBM's "work from home pledge", which sets rules for communicating and treating colleagues remotely (Makarius, Larson and Vroman, 2021). Also, the lack of personal interaction when working remotely can lead to social loafing, a phenomenon where individuals employ less effort when working in a group (Kirkman *et al.*, 2002; Aldag and Kuzuhara, 2015). This requires a change in management style, as traditional direct management methods are impossible in remote environments (Lockwood, 2015; Morley, Cormican and Folan, 2015). For these reasons, elements of e-leadership are increasingly being used (Jawadi, 2013; Darics, 2020). Another significant challenge is building trust in remote teams because team members often have no interaction behind them and must quickly form a cohesive unit (Berry, 2011; Crisp and Jarvenpaa, 2013; Jawadi, 2013).

Further complicating the situation is the fact that team members may never meet in person, making them vulnerable to the actions of relative strangers (Jarvenpaa and Leidner, 1999). Also, knowledge sharing must not be overlooked. Knowledge sharing is a critical aspect of team performance that can be hindered in remote environments (Pangil and Moi Chan, 2014; Eisenberg and Mattarelli, 2017). Recent studies have shown that despite adapting tools for virtual work, challenges remain in areas such as knowledge gathering and sharing (Barry and Kane, 2023). Last,

cultural differences must also be considered from a managerial perspective. Cultural differences can also affect team performance, as team members often have different norms and attitudes based on their diverse backgrounds (Powell, Piccoli and Ives, 2004; Aldag and Kuzuhara, 2015). This can lead to misunderstandings and conflicts that can hinder team performance. All these disadvantages and risks of remote working bring many challenges for the whole organisation, such as different team leadership for managers, setting up new HR procedures (e.g. e-recruitment or e-HR), introducing security measures in employment and ICT law and much more. For these reasons, research into remote working is essential and brings several areas and questions that need to be answered.

2.3.2 Employees and team perspective

For employees (individuals), remote working presents opportunities and challenges that can significantly affect their work-life balance and overall well-being. Based on Eurostat (2023a) data, in 2022, 11.4% of employees used complete remote working (within the Euro area). When comparing genders, men worked from home slightly less than women (10.8% men, 12.1% women). Employees often value remote work for its flexibility, allowing them to manage work and personal responsibilities better (Hopkins and Bardoel, 2020; Samek Lodovici, 2021; Du et al., 2022). This flexibility can increase job satisfaction because employees can adjust their work schedules to fit their personal needs and family obligations (Bhandari, 2022). Other benefits include non-commuting, financial savings, increased productivity, and more time for family and hobbies (Hopkins and Bardoel, 2020; Fitria and Tan, 2021; Samek Lodovici, 2021). The autonomy that comes with remote working is also a significant advantage for many employees (Harborth, 2022; Zychová, Šímová and Fejfarová, 2023). Samek Lodovici (2021) also claims that remote work may improve opportunities for people with disabilities, females and older workers, and people living far from the main cities of industry.

However, remote work has its challenges. While some employees thrive in a remote work environment, others may struggle to blur the lines between work and personal life (Glazer, Kożusznik and Shargo, 2012; Hopkins and Bardoel, 2020; Du et al., 2022). This can lead to isolation, stress and burnout, negatively affecting their well-being, motivation (Orsini and Rodrigues, 2020) and job satisfaction (Bellmann and Hübler, 2020; Kelly et al., 2020). Some employees also struggle with inadequate technical or space facilities and poor internet connectivity (Richards, 2015; Hopkins and Bardoel, 2020). Waizenegger et al. (2020) also add that remote

working has several challenges for the whole household, from the arrangement of services, communication, and negotiation of home space to the well-being of all involved. Before COVID-19, women were the majority gender group in remote work (Powell and Craig, 2015). Nevertheless, the COVID-19 pandemic has burdened all remote workers regardless of gender. Yet, research suggests that women during COVID-19 were more burdened with domestic work and childcare (Del Boca *et al.*, 2020). These challenges that employees must face create many questions and areas for research and organisation. Whether it is the employee experience concerning their job performance, team, leadership, or personal level, it is necessary to determine which factors influence this experience.

2.3.3 Policymakers' perspective

Policymakers have an essential role in setting policies and laws that affect the functioning of entire countries, including organisations and individuals. Therefore, it is also necessary to mention the perspective of policymakers as essential stakeholders in transforming the work environment and moving towards remote working. Looking at the distribution of working from home in European countries (Figure 3), Ireland topped the ranking of EU Member States for working from home, with 25.3% of employed people usually working from home. Ireland was followed by Finland (23.1%) and Siden (18.1%). In contrast, the lowest shares of people working from home are recorded in Romania (1.4%), Bulgaria (1.6%) and Greece (2.5%).

Figure 3: Selected countries and employed persons working from home as a percentage of the total employment, by sex, age and professional status (%) from 2017 to 2022
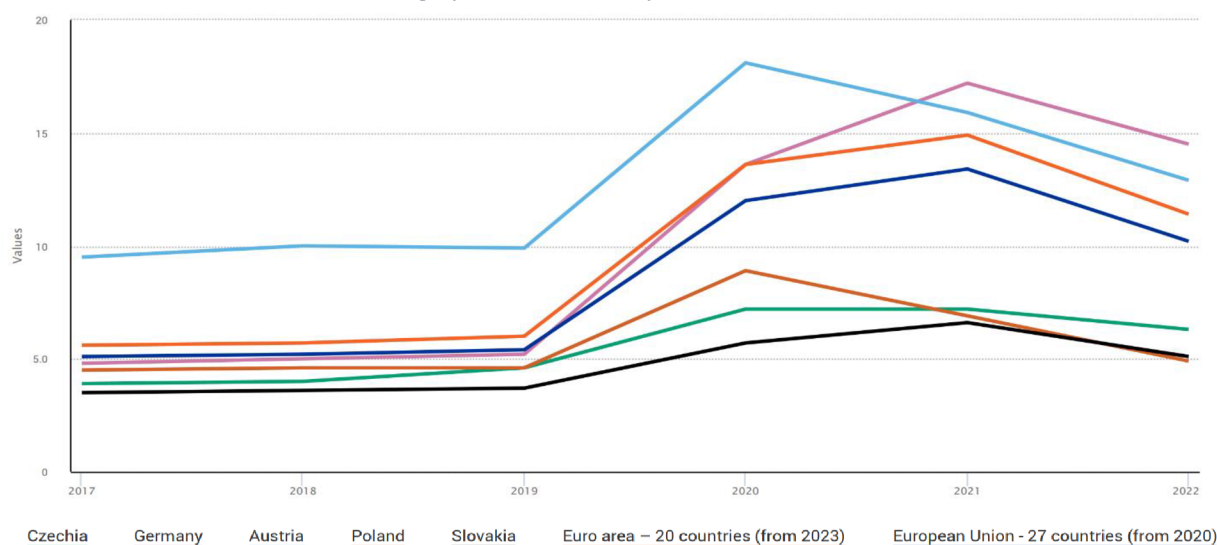
Source: Eurostat (2023)

Note: Graph has been created automatically by ESTAT/EC software with following specification: Time / Geopolitical entity (reporting) Time frequency: Annual; Unit of measure: Percentage; Sex: Total; Frequency: Usually; Age class: From 15 to 64 years; Activity and employment status: Employed persons

Figure 3 also shows the trend of working from home since 2017, clearly showing the impact of the COVID-19 pandemic and the downward trend in 2022, when some companies decided to return to the office. As the map in Figure 4 suggests and as Lund et al. (2020) stated, remote work has higher potential in advanced economies.

Figure 4: Employed persons working from home as a percentage of the total employment by sex, age and professional status (%) in Europe
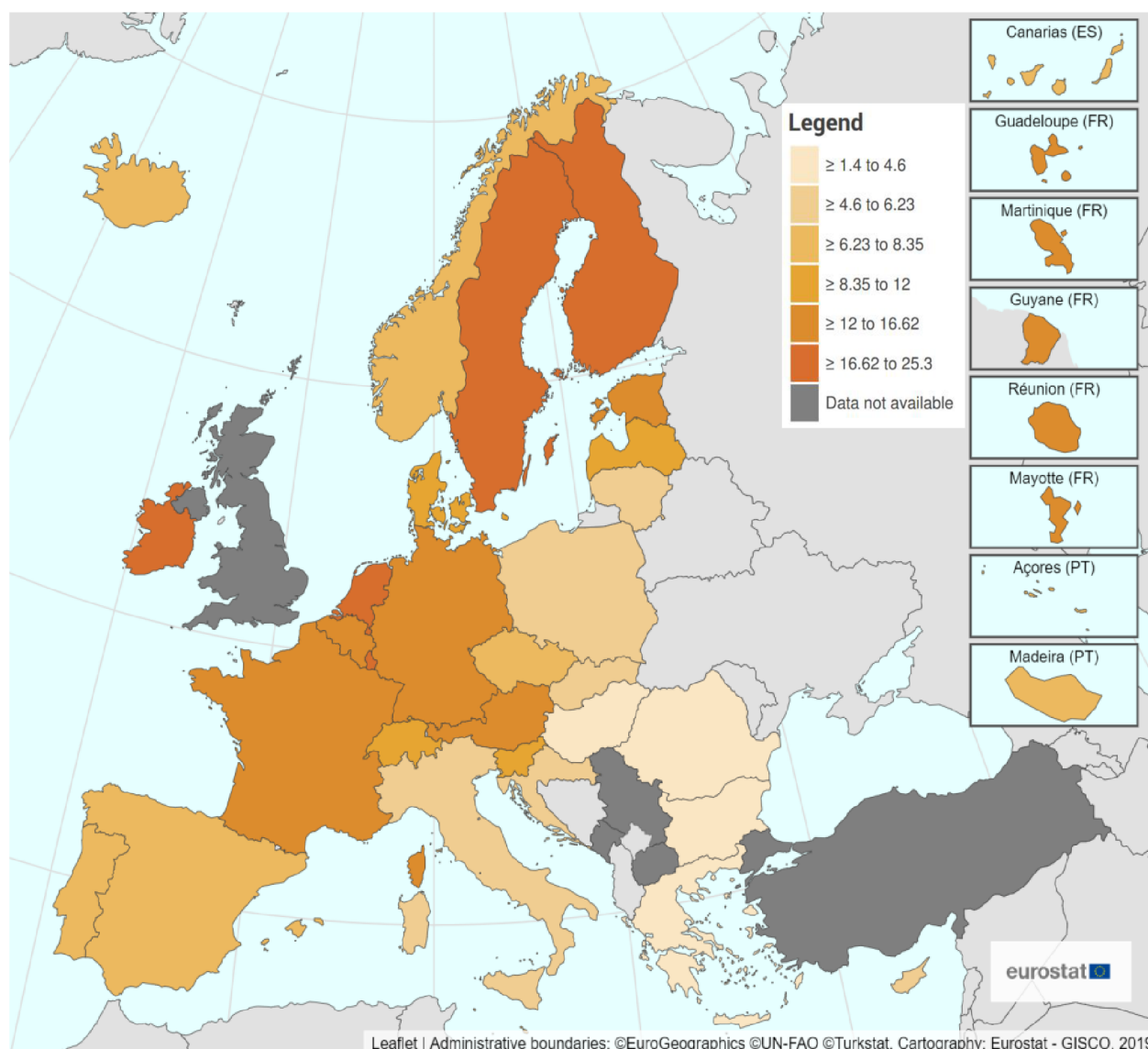

Source: Eurostat (2023)

Note: Graph has been created automatically by ESTAT/EC software with following specification: Time / Geopolitical entity (reporting); Time frequency: Annual; Unit of measure: Percentage; Sex: Total; Frequency: Usually; Age class: From 15 to 64 years; Activity and employment status: Employed persons

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Policies on remote work

Some policymakers have already responded to the increased demand for remote working by introducing policies and regulations that ensure workers are protected in these new ways of working and promote digital literacy and skills development. These policymakers strive to create sustainable and inclusive economies that promote green jobs and encourage environmentally conscious practices. Samek Lodovici (2021) reported that 21 out of 27 members of the EU in 2021 had some policies and laws addressing remote work. The US (United States Office of Personnel Management, 2021), Poland (Ministry of Family and Social Policy, 2022), and the UK (Störmer *et al.*, 2014) are examples of early policies that address work changes in the context of the transition to virtual environments. Other countries have gone further and, in recent years, offered, e.g., visas for digital nomads (see Table 1 by Sánchez-Vergara, Orel and Capdevila (2023)). Nevertheless, on the European level, there is no specific legislative act on remote work and these new working agreements (Samek Lodovici, 2021).

As Bentley et al. (2021) state, the future of work is not only of interest to individual national policymakers but also to bodies that operate at the international level (e.g. the World Health Organization (WHO) or the International Labour Organization (ILO)). Even though there are already several perspectives, strategies, laws, guidelines, and regulations, they are still not established, and the policy frameworks that apply have not been studied extensively. However, it is clear that most labour policies are human-centred (International Labour Organization, 2019), promoting growth, equity and sustainability through increased investment in people's skills, labour institutions and decent and sustainable labour (Bentley *et al.*, 2021).

Policymakers must also contribute by creating policies for more sustainable working practices in this digital era and providing sustainable digital infrastructure. This includes incorporating sustainable practices into remote working, such as optimising energy efficiency in homes, responsible e-waste management and striving for urban and suburban planning that respects ecological boundaries. In this way, we can move from perceiving our environment to protecting it, thereby shaping a more sustainable future.

Table 1: Countries with Relevant Policies Supporting Digital Nomads

Country	Policy naming	Formalisation	Stay period	Visa fee
Anguilla	Lose The Crowd Find Yourself. Work. Life. Bliss.	August, 2020	3–12 months	$2,000
Antigua & Barbuda	Nomad Digital Residence (NDR)	September, 2020	24 months	$1,500
Argentina	Digital Nomad Visa	June, 2022	6 months	$200
Bahamas	Bahamas Extended Access Travel Stay	October, 2020	12–36 months	$1,025
Barbados	Barbados Welcome Stamp	July, 2020	12 months	$2,000
Bermuda	Work from Bermuda Certificate	August, 2020	12 months	$263
Brazil	Digital Nomad Visa	January, 2022	12 months	$100
Cayman Islands	Global Citizen Concierge Programme (GCCP)	October, 2020	24 months	$100
Costa Rica	Rentista visa / Digital Nomad Visa	August, 2021	24 months	$250
Croatia	Digital Nomad Visa	January, 2021	12 months	$60
Curacao	@Home in Curacao programme	February, 2021	6–12 months	$300
Cyprus	Cyprus Digital Nomad Visa	January, 2022	36 months	$152
Czech Republic	Zvino (Czech Freelance Visa)	January, 2020	12 months	$270
Dominica	Work in Nature (WIN)	March, 2021	36 months	$800
Estonia	Digital Nomad Visa, e-residency	December, 2014	12 months	$80
Georgia	Remotely from Georgia	August, 2020	12 months	$2,000
Hungary	White Card (Hungary Digital Nomad Visa)	January, 2022	24 months	$125
Iceland	Long-term visa for remote work	October, 2020	6 months	$94
Italy	Digital Nomad Visa	March, 2022	12 months	$116
Latvia	Digital Nomad Visa	February, 2022	24 months	$60
Malta	Nomad Residence Permit	June, 2021	12 months	$350
Mauritius	Mauritius Premium Visa	October, 2020	12 months	Free
Seychelles	Seychelles Workation Programme	January, 2021	12 months	$45
UAE	Dubai's virtual working programme	March, 2021	12 months	$287

Source: (Sánchez-Vergara, Orel and Capdevila, 2023, p. 242)

2.3.4 Societal and environmental perspective

Technological advancement is creating many job opportunities, but in the same way, it is closing some outdated jobs. For example, the World Economic Forum (2020, p. 29) report stated that "by 2025, 85 million jobs may be displaced by a shift in the division of labour between humans and machines, while 97 million new roles may emerge that are more adapted to the new division of labour between humans". The skills necessary to work in specific positions may not be enough in the future; the ability to constantly learn is essential. The labour market and social security system can also be affected by the expansion of youth populations in some places and the ageing population in others (International Labour Organization, 2019). Moradi and Levy (2020) claim that technology in the workplace can change new social dynamics and thus change society as a whole. Woolgar (2002, p. 5) stated, "all aspects of social, cultural, economic, and political life thus stand to be affected by the continued massive growth in electronic technologies. Given their potential to transform many fundamental and wide-ranging aspects of society radically, these new technologies require us to rethink the basis to which I relate to one another. If there are radical transformations in the structures of information and data flow, what will be the nature of the "social glue" that holds societies together in the future?".

Indeed, remote working is changing the lifestyle of many who use the opportunity that technologies offer. Consider the example of digital nomads - they combine leisure with work and change the traditional 9 to 5 work pattern. It is such changes that are creating a modern work paradigm that is based on greater flexibility and work balance. But it's not just about changing work habits. Remote work can, for example, decentralise economic prosperity, change real estate and infrastructure, decongest urban areas, or influence the environment. But these changes take time to happen. It is a long and relatively slow process with many challenges. Martin Heidegger (1977) already introduced the term "standing reserve", which reflects his concern about how modern technology encourages us to see nature only as a resource for human consumption. Heidegger's concerns also resonate when we discuss the future of work and the environmental and societal effects resulting from the rise of remote work. When remote working, we largely depend on technology - computers, internet, or/and software - which become part of Heidegger's (1977) "standing reserve". Our homes are turning into workspaces, and we rely more on the convenience of digital resources. The flip side of this convenience and efficiency is a significant environmental impact. The environmental pressures present a major challenge that needs to be addressed.

On the one hand, remote working reduces the carbon footprint by reducing commuting, business travel, associated greenhouse gas emissions, and the need for ample, energy-intensive office space (Hook *et al.*, 2020). Samek Lodovici (2021), besides lower carbon emission, also positively impacts more balanced spatial development. The Washington Post article "Working from Home Can Save Gasoline" (Schiff, 1979) introduced remote work as a way of saving fuel. Therefore, we can argue that aligning work practices with environmental sustainability goals is an ethical imperative. At the same time, an organisation may use environmental sustainability goals as organisational benefits to strengthen an organisation's brand and appeal to environmentally conscious employees and customers (Kolk, 2016). On the other hand, remote working increases household resource consumption, increases e-waste and can lead to urban sprawl due to the freedom to live further away from urban centres. Indeed, Shreedhar, Laffan, and Giurge (2022) stated that remote working is not so favourable if we take multiple environmental net impacts. All of these aspects can be seen as manifestations of Heidegger's concept (1977) of the "standing reserve", where technology and nature are used to satisfy the convenience of people to work remotely.

Going even further, these problems reflect the broader environmental issues of the Anthropocene epoch - a term describing the current geological age when human activity has become a significant influence on the environment (Coeckelbergh, 2022; Lemmens and Van Den Eede, 2022). The shift to remote working and the resulting environmental consequences reflects the broader story of human-induced environmental change in the Anthropocene. Looking at possible future scenarios, if current trends continue, we may see an acceleration of these environmental impacts. Increased remote working could lead to even greater reliance on technology, exacerbating problems such as e-waste, increased energy consumption and urban sprawl. On the other hand, this scenario could also stimulate more sustainable practices. Managing these environmental pressures could drive innovation in energy efficiency, sustainable urban planning and e-waste management. Therefore, organisations must create a supportive remote work policy considering environmental factors (Shreedhar, Laffan and Giurge, 2022). But the action of organisations is only enough, with the support of governments. Policymakers must contribute by creating policies for more sustainable work practices in this digital era and provide sustainable digital infrastructure.

2.4 Research opportunity

With the advancement of digital technologies, there has been a significant shift towards remote working, leading to significant changes in workplace structures, employee wellbeing, social norms and environmental impacts (as described in section 2.3). This shift has been compounded by the advent of COVID-19, when almost the entire world shifted to a virtual environment. The COVID-19 is fading, but the changes it has caused in workplaces remain. Research differs on how many companies will continue with the changes they have implemented during the pandemic. Yet many employees, organisations, and policymakers see remote work as a regular aspect of work. For these reasons, this dissertation contributes to a growing body of research on remote working. However, research on remote work is contradictory, insufficient, or even biased in many ways.

From the perspective of organisations, there is a need to clarify how organisations should adapt remote work to the workplace and create effective and sustainable remote work management. It is necessary to determine how to ensure all HR processes are in place along with tax and legal regulations and how to adapt policies for remote working. From the perspective of employees and teams, it is necessary to examine how remote work affects employee productivity, motivation, job satisfaction, and overall well-being. Determining how digital technology can support employees and teams in remote work is essential to enhance their performance. From the perspective of policymakers there is a strong need to develop policies and infrastructure that reflect the multifaceted challenges and opportunities of remote working. Therefore, policymakers need to be supported by evidence-based research on remote work. As the above-described, remote work impacts society and the environment. Remote work radically changes many fundamental aspects of culture, whether discussing changing the working environment, the need for new knowledge and skills or the use of digital technologies for work. There are still many uncertainties about these aspects. There are also uncertainties in the research on the impact of remote working on the environment and creating a sustainable/green way of working remotely. Therefore, this dissertation aims to investigate the future of work — focusing on the dynamics of remote work, the influence of emerging technologies such as the metaverse in the workplace, and the concept of digital nomadism.

3. Objectives, outcomes, and significance of the dissertation

Based on the above-mentioned research opportunity, the main aim of the dissertation is to explore the future of work - focusing on the dynamics of remote working, the impact of new technologies such as metaverse in the workplace and the concept of digital nomadism. In addition, this dissertation aims to demonstrate the effectiveness of bibliometrics for mapping research, predicting trends, and informing evidence-based management in organisations and governments. The objectives of this dissertation are based on a two-level approach. While the first level aims to explore the future of work with a focus on remote work, metaverse and digital nomadism, the second level seeks to highlight the importance and versatility of bibliometrics as a tool for mapping research, predicting trends and informing evidence-based management and decision-making.

Level 1 - Future of work in the digital age:

- Analyse the evolution and dynamics of remote work:
  - *Objective:* to identify and explore the core themes that have driven remote work research over the past decade.
  - *Outcome:* identification of the core themes and the design of a framework that enables organisations to adapt their management practices in line with historical and current research trends in remote working.
- Assess the new technologies in the remote workplace:
  - *Objective*: to investigate how emerging technologies, specifically metaverse, can enhance productivity, collaboration, creativity, and well-being in virtual and remote work environments.
  - *Outcome*: definition of metaverse in the workplace, complemented by a proposed framework for organisations to employ metaverse in the workplace.
- Create a framework for research on digital nomadism:
  - *Objective:* to explore digital nomadism, identifying its scientific foundations, societal benefits, environmental impact and policy considerations.
  - *Outcome*: comprehensive research framework that will serve as a basis for academic research and offer valuable insights for organisational managers, policymakers, and societal stakeholders.

Level 2 - The power of bibliometrics as a tool for science mapping, trend prediction and evidence-based management, decision-making in organisations and policymaking

- Demonstrate the effectiveness of bibliometrics in science mapping*:*
  - *Objective:* to illustrate the value of bibliometrics in systematic identification, mapping, and analysis of core research trends in remote work, metaverse and digital nomadism.
  - *Outcome:* showcase the usefulness of bibliometrics as an essential tool for analysing emerging and dominant research themes that can serve as a tool for managers and policymakers to follow evolving trends in a rapidly changing environment.

- Demonstrate the role of bibliometrics in evidence-based management, decision-making and policymaking:
  - *Objective***:** to demonstrate and critically evaluate the results of bibliometric analysis, exploring its applicability and value in evidence-based management and decision-making processes in organisations and at the policymaker level.
  - *Outcome:* demonstration of applying bibliometrics to the evidence-based creation of practical frameworks for management or policymaking.

3.1 Significance of the dissertation

The work environment is evolving rapidly in the digital transformation era, bringing new opportunities and challenges in different dimensions. Phenomena such as remote working, metaverse in the workplace, and digital nomadism are just a small representation of these transformations. My dissertation explores these emerging trends while demonstrating the versatility of bibliometric methodologies for scientific research, evidence-based management, and policymaking. The significance of this research extends far beyond academic discourse; it carries implications for science, management practices, social norms, health and well-being, environmental considerations, urban planning, and policymaking. Table 2 illustrates how this dissertation addresses these various challenges:

Table 2: Challenges and solutions offered by the presented dissertation

Challenge	How the proposed dissertation addresses the challenge
Scientifical	Presented dissertation pioneers' new areas, such as the use of metaverse in the workplace and digital nomadism and offered a novel approach to using bibliometrics in evidence-based management. The findings thus provide a basic conceptualisation of these new trends and can serve as a cornerstone for future research. The results can also serve as a basis for developing new curricula and training programs, e.g., in HR. The dissertation findings also enhance the understanding of bibliometric methods in evidence-based management and policymaking.
Managerial	The dissertation offers valuable insights for managers and organisations to adapt strategies and technology solutions to maximise employee productivity, collaboration, and well-being in an increasingly remote work environment. At the same time, bibliometrics can provide managers with a dynamic, evidence-based tool to extract information, analyse large volumes of data and identify trends, research gaps and emerging themes. This can advance knowledge discovery, strategic planning, and decision-making and contribute to their growth, innovation, and competitive advantage.
Societal	The dissertation sheds light on the societal implications of changing work patterns and prepares society for changes in the way of working that also lead to lifestyle changes. Part of the research focuses on better understanding the implications of emerging work patterns for mental and physical health, leading to new strategies or interventions to promote health and well-being. The dissertation also encourages a deeper understanding and respect for cultural and gender differences in global working practices.
Environmental	This research contributes to identifying environmental problems and solutions by stimulating the innovation of greener digital infrastructures and workplaces, thereby reducing commuting, business travel, and the carbon footprint. The dissertation also has implications for urban planning and the real estate market, as remote work and digital nomadism are changing places and ways of working. This could change the shape of city centres and influence residential real estate trends.
Political	Policymakers can use the insights from the presented dissertation to create or update labour and employment laws to accommodate new work models, extending to areas such as digital privacy, cybersecurity, digital infrastructure, and taxation. Dissertation results can also inform policymaking in the tourism and hospitality sectors. Finally, bibliometrics can analyse large volumes of data and identify trends, research gaps and emerging themes, providing policymakers with a robust and comprehensive evidence base to inform their decision-making and take proactive action. Thus, my research not only tells policy changes in response to the current digital transformations in the world of work but also presents an application of bibliometrics to data-driven decision-making for evidence-based policy development in various fields.

Source: author

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4. Methodology

The dissertation's methodology comprises several methods and techniques to achieve the objectives. Different approaches were used to ensure the methodological triangulation of the research. The mixed nature of this research stems from the use of both types of methods: quantitative methods help to structure and identify patterns in a large number of publications (e.g. Multiple Correspondence Analysis, K-means Clustering, Co-occurrences Network), while qualitative findings (e.g. from in-depth literature review) allow for interpretation and understanding of the context of these patterns. This combination strengthens the triangulation of your research and provides a more comprehensive understanding of remote work research and thematic relationships. Most of the methods used in this dissertation are based on bibliometrics, scientometrics, and information science. The techniques are, in general, briefly introduced below, together with research design, data management and the basic principles of transparent and ethical practice in this dissertation.

It is important to mention that the procedures described below are written on a general line of procedures that have been used to maintain certain standards (good research practices, conventions in the field, openness, etc.). Specific methodological procedures are then always listed in the Methodology sections of individual articles.

4.1 From scientific change theory to modern research trend detection

The scientific change underlies the pursuit of knowledge is the subject of extensive discussion across philosophy and the history of science. Scientific change results from constant evolution, revolutionary shifts, and competing intellectual endeavours. Understanding these dynamics is critical to understanding the trajectory of scientific progress and the ongoing production of knowledge within scientific disciplines. Various theories offer insights into how scientific change occurs. Kuhn (1996) spoke about the theory of scientific revolution drawing on "paradigm shifts". Popper (2010) introduced falsificationism, according to which theories must be falsifiable to be scientific. Lakatos (1970) wrote about "research programs" as a way of understanding scientific progress. At the same time, Fuchs' theory (1993) suggested that scientific progress is driven by sociological reasons such as recognition and reputation. Despite the differences in these theories, they all emphasise one common challenge - understanding how knowledge is created, validated, and integrated in scientific domains. A common feature of these

theories is the recognition of the complex, dynamic and multidimensional nature of scientific change. These theories acknowledge the challenges posed by the scale and pace of scientific discovery and data production, which are continuously increasing in the current digital age. The rapid advancement of knowledge, coupled with the increasing interdisciplinarity of research, adds many layers of complexity to understanding the current state of science. This rapid increase in knowledge can lead to fragmentation and over-specialization of scientific disciplines, making it challenging to maintain a holistic view of the field. A more comprehensive understanding of knowledge, identification of research trends and forecasting future directions is crucial for various stakeholders, including researchers, organisations, policymakers, and individuals. As Debacker and Glänzel (2004) claimed, identifying trends enables stakeholders to stay at the forefront of their fields, identify new research areas and contribute to cutting-edge knowledge.

There are many methods to identify research trends and predict future research directions. Examples include text mining (Rodríguez Bolívar and Alcaide Muñoz, 2022) and big data (Mureddu, Schmeling and Kanellou, 2020). However, strategic decisions in organisations and policymaking must be evidence-based (Malterud, Bjelland and Elvbakken, 2018; Phillips, Castle and Smyth, 2020). For these reasons, methodologies such as bibliometrics, scientometrics or meta-analysis can significantly help in this context (Malterud, Bjelland and Elvbakken, 2018; Donthu *et al.*, 2021). Quantifying research outputs through academic literature analysis helps navigate the complex scientific environment. It offers a way to track the growth of the scientific literature, understand research trends, identify critical contributions, uncover patterns of scientific collaboration, and understand side effects. These capabilities make these methods an indispensable tool for understanding the direction of scientific change, anticipating new trends, and improving evidence-based decision-making and policymaking in an increasingly complex, data-driven environment.

4.2 Introduction to bibliometrics

Pritchard (1969) originally defined bibliometrics as "the application of mathematical and statistical techniques to books and other communication media". Bibliometrics is a tool that allows the prediction of scientific trends by examining patterns and relationships presented in the scientific literature (Aria and Cuccurullo, 2017; Derviş, 2020). By assessing the prevalence of specific keywords or thematic categories in scholarly publications, bibliometrics allows the identification of emerging topics that could potentially become future areas of focused research (Callon, Courtial and Laville, 1991; Khasseh et al., 2017; Aria, Misuraca and Spano, 2020). In other words, bibliometrics is used to map science that reflects the aggregate intellectual contributions of scientific community members or specific domains relevant to the underlying research agenda (Van Eck et al., 2010; Chen, 2017). In addition, bibliometric analysis can shed light on critical authors and institutions in the field. By studying citation networks and patterns of co-authorship, bibliometrics can identify influential researchers whose work has had a significant impact and is highly cited (Glänzel, 2001).

Moreover, bibliometrics allows us to track the distribution and influence of scientific research. Analysing publication trends and citation patterns will enable researchers to evaluate the visibility and effect of research contributions (Levitt and Thelwall, 2011; Stern, 2014; Agarwal et al., 2016). This analysis can facilitate predicting the adoption and impact of new research and identifying the potential significance of emerging trends. Bibliometrics provides a mechanism for transparent and reproducible assessment of scientific outputs and, thus, identification of research trends (Aria and Cuccurullo, 2017). This can subsequently help various stakeholders, including researchers, funding agencies, organisations and policymakers, to allocate resources efficiently and keep abreast of evolving trends (Debackere and Glänzel, 2004). In this dissertation, I will use science mapping techniques and methods, sometimes called bibliometric mapping.

4.3 A novel workflow for an open and transparent science mapping

Previous study and practice in bibliometrics presented the recommended workflow for using science mapping (Cobo *et al.*, 2011; Zupic and Čater, 2015; Aria and Cuccurullo, 2017). In the presented dissertation, I adapt and extend these recommendations to emphasise the requirements for openness and transparency in research. A novel approach, recommended workflow for science mapping following open science principles, is presented in Figure 5. In the upper part of Figure 5 are phases of the science mapping workflow (study design, data pre-processing, data analysis, data visualisation and interpretation). The phases are complemented by open science and recommendations to foster transparency and openness through the science mapping process.

Figure 5: Science mapping workflow considering the open science practices
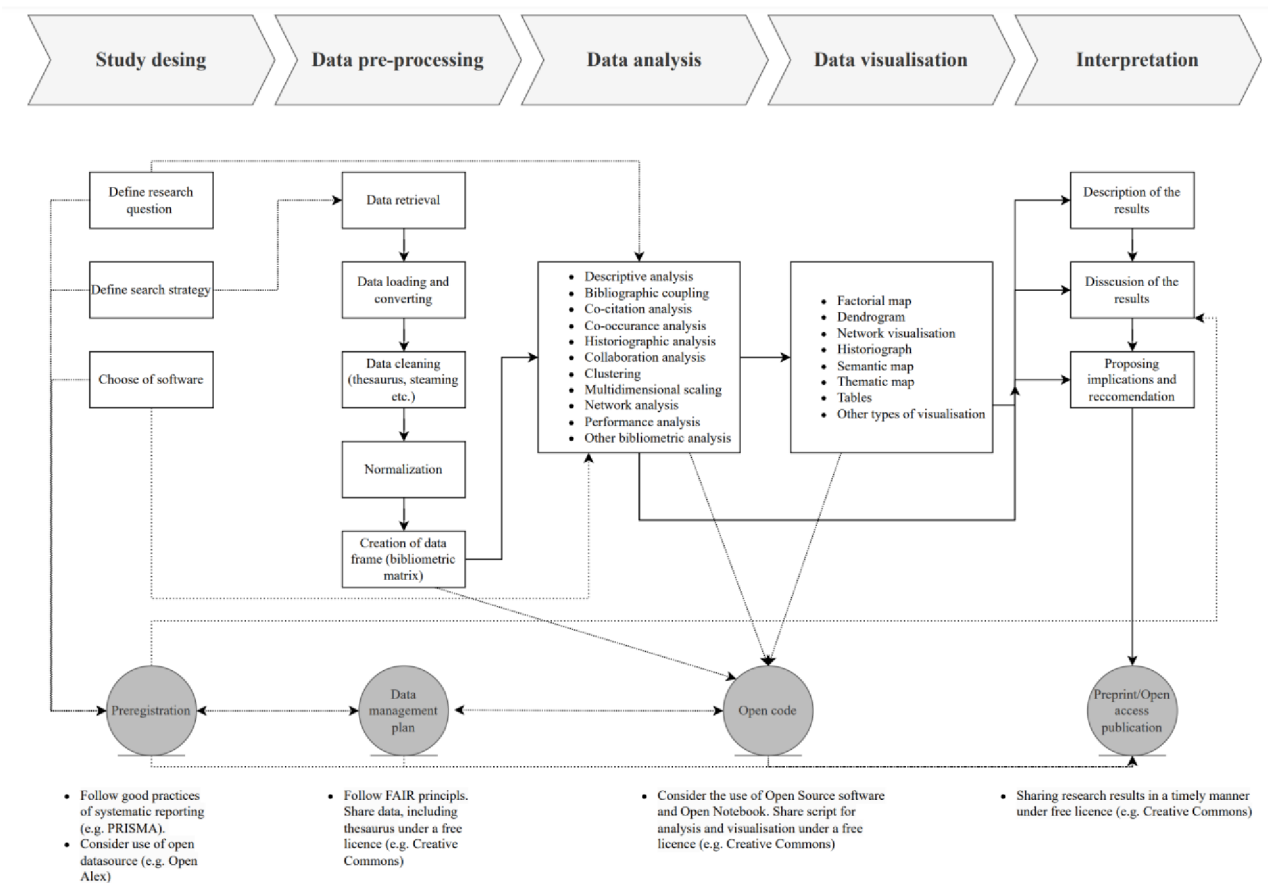
Source: own collaboration based on Aria and Cuccurullo (2017), Zupic and Čater (2015), Cobo, Lopez-Herrera, Herrera-Viedma, and Herrera (2011).

4.3.1 Study design

The research design phase plays a crucial role in bibliometrics. In this first phase, it is necessary to think about formulating research questions, defining a search strategy and selecting software for data analysis. Research questions determine the direction of the study and serve as a compass for all subsequent research steps (Zupic and Čater, 2015). In the case of this dissertation, defining a search strategy and selecting software for data analysis is always described in the Methodology chapter for individual articles.

Next, it is necessary to design the search strategy – i.e., the choice of the scientific database that will serve as the data source, correctly identified search query, and a systematic and comprehensive record of each step, following established reporting standards, such as the PRISMA guidelines (Page *et al.*, 2021). Furthermore, researchers are advised to consider open data sources, thus aligning themselves with the principles of available science. This is followed by software selection. There are a variety of bibliometrics software. The most relevant tools are VOSvieIr (Van Eck *et al.*, 2010), CitNetExplorer (van Eck and Waltman, 2014), SciMAT (Cobo *et al.*, 2012), Bibliometrix (Aria and Cuccurullo, 2017), BibExcel (Persson, Danell and Schneider, 2009), and CiteSpace (Chen, 2006). When selecting software, it is advisable to choose based on its functionality, compatibility with the preferred bibliometric methods and research question, and the principles of open research. It is for these reasons that RStudio was used in this dissertation. In particular, the open-source package Bibliometrix by Aria and Cuccurullo (2017) was supplemented in some cases with an application of Biblioshiny (Aria and Cuccurullo, 2017). A significant advantage of RStudio (and thus Bibliometrix) is that the scripts can be easily shared and reproduced, and it is free software (Quintana, 2015). And as Moral-Muños et al. (2020) suggest, Bibliometrix provides the most extensive set of techniques from available bibliometric software. Finally, the last recommended study design task is the research plan's pre-registration. Pre-registration involves documenting and publicly sharing the research design before data collection and analysis (Nosek *et al.*, 2018; Grahe, 2021). This step creates commitment to specific analytical steps and ensures transparency of research procedures. Pre-registration serves as a study plan that outlines the research design, primary outcomes, and statistical analysis plan (Munafò *et al.*, 2017). There are different types of pre-registration, including unrevised pre-registration and revised pre-registration, such as registered reports.

4.3.2 Data pre-processing

This phase involves data retrieval for bibliometric analysis. In this dissertation, I worked with different scientific publications, including articles, reviews, conference proceedings and books from the Web of Science (WOS). The search query was tailored based on the research topics, ensuring that the most relevant records are obtained. WOS was chosen because it is considered the most selective database (Singh *et al.*, 2021), and therefore, I assumed that the records in WOS are the highest quality research papers. Due to the download limit of WOS, all the collected data are combined into one file, resulting in a data file in txt format. This data was then converted into a data frame for further analysis. In guiding the selection of references included in the bibliometric analysis, I followed the PRISMA methodology proposed by Page et al. (2021), so each decision was systematically and transparently captured. It is possible to use other systematic reporting tools. Once the data collection process was complete, data cleaning has begun. To ensure unbiased data processing, I have used a thesaurus file as recommended by Van Eck and Waltman (2019). The thesaurus file is invaluable for harmonising different variants of terms or synonyms (e.g., "e-learning" and "e-learning environment"; "virtual world", "virtual worlds", and "3D virtual worlds"; "avatar" and "avatars"). It effectively harmonises different spellings or terms used to convey the same meaning. As a result, thesaurus file ensures that other terms are correctly identified as referring to the same idea. The thesaurus file also helps remove terms that clutter the concept map and do not contribute meaningful conceptual information (e.g. "article"). Accurate identification of these synonyms is crucial because they affect the relationships between concepts and their overall occurrence in the dataset. After cleaning, the dataset and the thesaurus file were ready for the next stage of bibliometric analysis. As recommended by van Eck and Waltman (2009), it is advisable to normalise the data for bibliometric purposes. Bibliometrix includes normalisation as one of the basic functions that calculates the following measures: proximity, inclusion index, Jaccard's coefficient, and Salton's cosine (Aria and Cuccurullo, 2017).

As a part of the open science practices in the data pre-processing phase, I suggested creating the Data Management Plan (DMP). The DMP describes how data will be collected, processed, analysed, stored and shared during and after the research project. It provides a plan for handling research data in a way that ensures quality, integrity, privacy, and ethical compliance. It is also advisable to follow the FAIR data management principles (Wilkinson *et al.*, 2016). In bibliometric studies, DMP can bring advantages. A DMP provides a structured outline for dealing with large

volumes of bibliometric data, thereby increasing the efficiency and reliability of the research process. Carefully documenting each step of the data lifecycle promotes transparency and reproducibility, critical aspects of scientific integrity. In addition, it anticipates and outlines solutions to potential data-related problems, ensuring the continuity and integrity of research. Consequently, the DMP acts as a roadmap for navigating the complex data environment in bibliometric studies and enhances the overall quality of research. For complete openness, bibliometric data can also be opened. However, it is always necessary to check the terms and conditions of the data owners on data sharing. The last version of DMP for this dissertation project is available on the [Open Science Framework](#) (OSF - Dissertation Project Šímová, 2023).

4.3.3 Data analysis

In this phase, different bibliometrics methods were used, each serving a unique purpose of revealing various aspects of the scientific environment. These methods aimed to show the conceptual (significant themes and trends), intellectual (how work influences a given scholarly domain), or social (how authors, institutions, and countries interact) development of a research field by revealing patterns, trends, seasonality, and outliers (Calcada De Sousa, 2021). The goal of this phase was to provide comprehensive insights into the data that will guide the subsequent steps of interpretation and visualisation. It was essential to keep in mind that the choice of analysis technique was determined by the nature of the research question and the characteristics of the data. The individual bibliometric methods used in this dissertation are always listed in the methodological section of individual articles.

Even at this stage, implementing open science practices can be beneficial. Figure 5 shows that one approach can be open code, encouraging researchers to share their analysis scripts or code. This can make the analysis reproducible, allow other researchers to learn from the code, and even inspire further refinement or improvement of the original method. It also promotes reproducibility and robustness of results. Similarly, an open notebook provides near real-time public access to the research process. This allows a transparent view of the process and can help other researchers understand how results were achieved. By adopting these practices, bibliometric studies can support the principles of transparency, reproducibility, and collaboration that underpin the open science movement. As part of this dissertation, the code used for the bibliometric study will be published where possible (all accompanying documents are available on the dissertation project repository on the [Open Science Framework](#) (OSF - Dissertation Project Šímová, 2023).

4.3.4 Data visualisation

Visualisations in bibliometric studies serve aesthetic purposes and as tools to reveal the structure and dynamics of scientific research, temporal trends, and geospatial implications. The choice of visualisation technique depends on the type of analysis, the study goals, and the specific output. Network theory is an example of a visualisation technique in bibliometric (Newman, 2018), which provides information about relationships between different entities such as authors, institutions, or countries and displays co-citation, co-occurrence, or collaboration networks. Tool for visualisation of cluster analysis can also be heatmaps (Wilkinson and Friendly, 2009) (for example, in the VOS Viewer (Van Eck *et al.*, 2010)), multidimensional scaling plots or dendrograms (as can provide Bibliometrix (Aria and Cuccurullo, 2017)). A popular visualisation method of collaboration analysis is geographical maps (Goodchild, 2010). For basic yet compelling visualisations, usually histograms and bar charts are used.

This outline of possible techniques is just an example of how bibliometric results can be visualised. The different visualisation techniques this dissertation uses are listed in the individual articles. Even in visualisation, the principles of open science must be remembered. Therefore, working with open code and/or open-source tools for data analysis and visualisation is recommended, as is working with data analysis.

4.3.5 Interpretation

Interpretation of bibliometric results begins with a clear and concise description of the findings. These results concerning previous research should be discussed with direct reference to the research questions. To ensure transparency and reproducibility, it was essential to reflect the findings to the original hypotheses or objectives stated in the pre-registration (Nosek *et al.*, 2018). As Zupic and Čater (2015) said, analysis and discussion should include comparing the results with those of previous bibliometric studies, identifying similarities and differences, and postulating their reasons. The discussion should also critically evaluate the methodologies used and the extent of their influence on the results (indicate limitations).

In addition, the interpretation of bibliometric results should include an examination of the implications of the findings. This means considering the broader context in which the study was set and the potential impact of the results on that context. Recommendations should be provided based on the results of the bibliometric analysis. These recommendations could relate to research practices, organisation and policy implications, and future research directions.

4.4 Bibliometrics and its use in evidence-based management

In the data-driven era, the management of organisations is increasingly turning to empirical evidence. Many organisations rely on evidence-based management in their operations, relying on the best available evidence to improve management practices. The origins of evidence-based management can be traced back to evidence-based medicine. The principles of evidence-based practice were later adapted to the management field, with increasing recognition of the value of methodologically rigorous research for informing organisational management and policymaking (Rousseau, 2006; Reay, Berta and Kohn, 2009). As Reay, Berta and Kohn (2009) wrote, evidence-based management is an opportunity to create synergy between managers and researchers. One of the approaches to evidence-based management is bibliometric because it is a powerful tool for systematically evaluating research outputs and impact. By using bibliometric analysis, organisations can gain insight into trends and current research topics, understand the competitive landscape, and drive strategic planning aligned with evidence-based findings. As Kajikawa (2022) mentions, bibliometrics is no longer limited to academic research but is now much more commonly used by industry, corporations, policymakers and think tanks. Table 3 presents the possible uses of bibliometrics in the broader context of organisational management.

Table 3: Possible application of bibliometrics in the organisations

Application area	Description	Benefits for organisation
Organisational research	Using bibliometric data to evaluate different departments' research outputs and inform resource allocation and strategic planning in the organisation.	Facilitates data-driven strategic decisions and resource allocation.
Trend mapping	Analysing research trends to identify new areas that may influence the organisation's future activities or strategic direction.	The organisation identifies new areas of research that may offer competitive advantages or opportunities for growth and innovation. Trend mapping helps to anticipate and exploit future trends.
Evidence-based decision making	Using bibliometrics to support managerial decisions with empirical data improves the decision-making process in various organisational functions.	The organisation's management bases its operational and strategic decisions on bibliometric knowledge. Bibliometrics thus supports robust, data-driven organisational strategies.
Strategic developments	Using bibliometrics to guide an organisation's long-term growth and innovation strategy. By evaluating research outputs, citation patterns and collaborative networks, organisations can make informed decisions about entering new markets, investing in new technologies and building partnerships that can lead to sustainable competitive advantage.	It allows you to anticipate and exploit new sources of competitive advantage. Supports the identification of key players and potential partners. Facilitates informed decision-making on research and development investment and ensures alignment with strategic objectives.
Intellectual property management	Mapping and assessment of patent portfolios to guide intellectual property strategy, focusing on innovation and technological development.	Organisations use these insights to identify critical technologies, identify risk of patent violation, research potential acquisitions and understand the competitive landscape. This improves strategic decision-making related to intellectual property protection and legal action, guides the organisation's research and innovation, and supports the commercialisation of intellectual property.

Source: author based on Kajikawa (2022)

5. Results in the form of chapters

This dissertation is based on the results presented in scientific articles prepared by the author and published in a scientific journal with an Impact Factor as well as Scientific Journal Ranking. This dissertation form is approved by the Study and Examination Rules for Study in Doctoral Study Programmes of the Czech University of Life Sciences Prague (dated 11 July 2018) and the Deans´ decision No. 3/2020. The following articles have been used:

Chapter I: Šímová, T. and Zychová, K. (2023) 'Who and What is Driving Remote Working Research? A Bibliometric Study', *Vision: The Journal of Business Perspective*. Available at: https://doi.org/10.1177/09722629221139064.

Chapter II: Šímová, T. (2022) 'A research framework for digital nomadism: a bibliometric study', *World Leisure Journal*, Available at: https://doi.org/10.1080/16078055.2022.2134200.

Chapter III: Šímová, T., Zychová, K. and Fejfarová, M. (2023) 'Metaverse in the Virtual Workplace', *Vision: The Journal of Business Perspective.* Available at: https://doi.org/10.1177/09722629231168690.

Chapter I introduced the issue of remote working and, in this dissertation, served as an umbrella study to the two following studies on digital nomadism (*Chapter II)* and metaverse in the workplace (*Chapter III)*. In each chapter, certain core concepts were identified - e.g., in Chapter II's case on digital nomads; these included the gig economy, lifestyle migration, spatial planning, location independence, mobility, coworking, etc. The selected core concepts are presented in Figure 6 as links between the chapters emphasise the progression from theory to concrete cases and future possibilities. The interconnected core concepts across chapters suggest that understanding of each chapter is reinforced by insights gained from the previous chapters, creating a layered understanding of the impact of remote work across different dimensions (personal, organisational, policymakers and societal). This structure is designed to provide a research conceptual framework for the dissertation, offering a comprehensive view that informs readers about current practices and prepares them for new trends and technologies in remote work.

Figure 6: Research conceptual framework of the dissertation
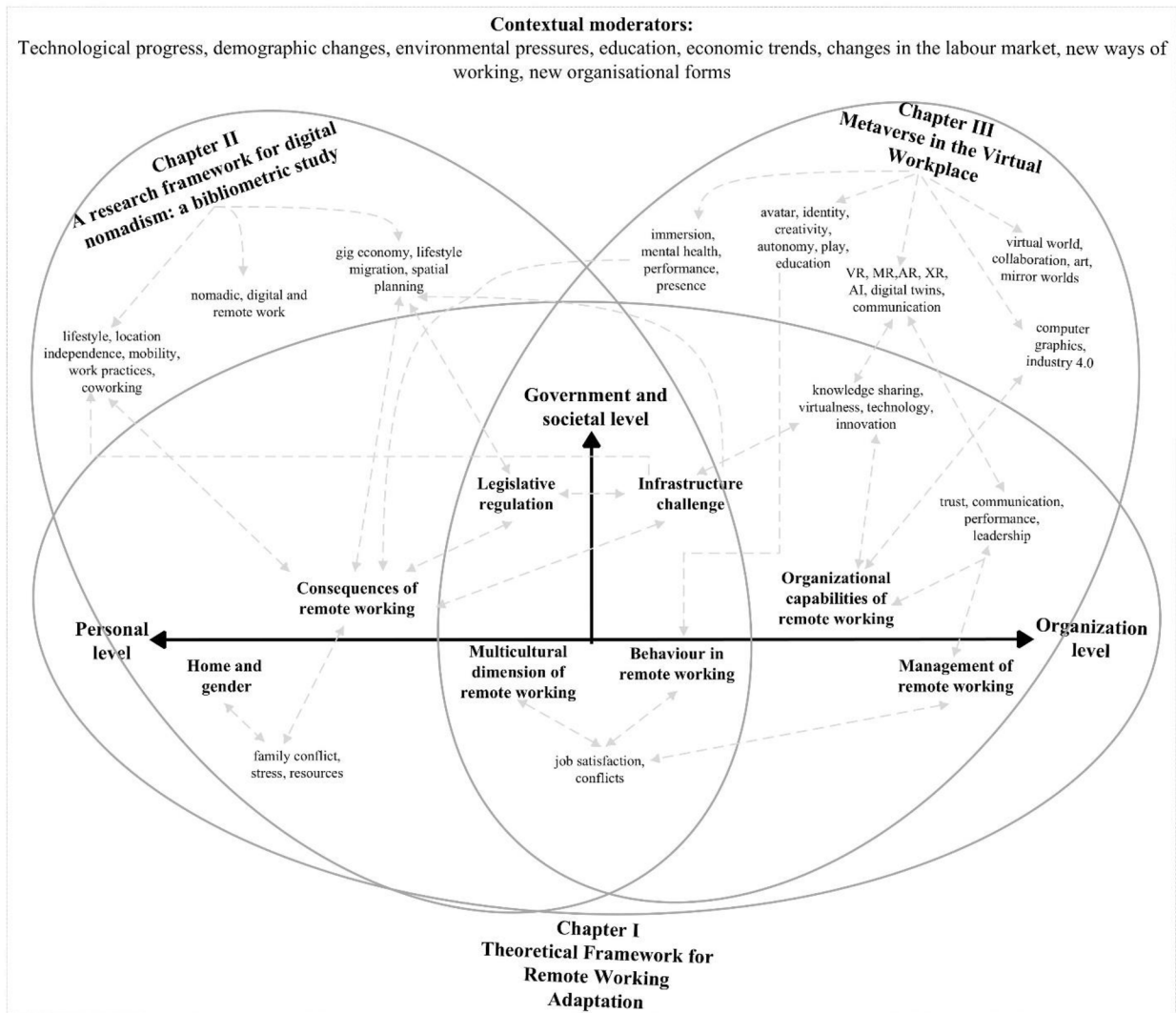
Source: author

Any digital transformation is influenced by several moderators that should be considered when adopting digital transformation (Trenerry *et al.*, 2021). Therefore, the research conceptual framework of this dissertation also includes contextual moderators that are related to the context in which the remote work phenomena was studied.

Chapter I presented an extensive bibliometric analysis of nearly two thousand publications dealing with remote working research. The analysis highlighted the crucial factors for successfully implementing remote workplaces in organisations. *Chapter I* presented already well-known factors and those that have not yet been adequately addressed by research. Based on this analysis, an evidence-based theoretical framework was proposed considering remote working adaptation at three stakeholder levels - personal, governmental, and organisational. The theoretical framework

for remote working adaptation from *Chapter I* recognized that remote working poses challenges for legislative regulation and infrastructural change. This can be very well illustrated on the case of digital nomadism. The changing ways of working and living posing major challenges to infrastructural changes and legislation. Thus, building on the foundational concepts from *Chapter I, Chapter II* delves into the specifics of digital nomadism. Based on the analysis, a new definition of digital nomads was created - digital nomads are individuals with a mobile lifestyle that combines work and leisure, requiring a particular set of skills and equipment. Digital nomads are creating new ways of working, empowered by technological advances that have taken place in recent years. Digital nomadism is a relatively new phenomenon that changes many people's lifestyles, work organisation, management styles, and places different demands on countries' infrastructure (e.g. requiring changes in legal frameworks, changes in urban planning, cultural acclimatisation, etc.). *Chapter II* provided an overview of three clusters of core concepts in digital nomad research - the everyday life of the digital nomad, the nomadic lifestyle, and the difference in digital, nomadic, and remote work. These results, together with the theoretical framework, provided a foundation for future research and policymaking in digital nomadism. For policymakers, this research not only identified which core concepts that should be addressed in policy frameworks but also identifies experts and core studies from the field that can be used in developing these policies. *Chapter II* also clearly showed which locations researchers have already targeted because they are popular with digital nomads. These locations require legislative action that addresses the issue of digital nomadism first. At the same time, this information showed that research has not yet sufficiently addressed several locations that are popular with digital nomads - e.g. Spain, Indonesia, South Africa etc.

Chapter III extended the discussion of technological advances and future possibilities of remote work by exploring the metaverse. *Chapter III* built on the basic theoretical aspects of remote work such as organisational capabilities and infrastructural challenges (from *Chapter I)* and discussed how futuristic technologies may reshape the very notion of the workplace. The metaverse can potentially change how we collaborate, not only in the virtual teams. *Chapter III* offered the first definition of the metaverse in the workplace. We defined the metaverse in the workplace as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity. *Chapter III* also presented an innovative and novel conceptual framework that introduces three levels of factors that are important for practical applications of a metaverse in the workplace - individual factors, team

factors and organisational factors. The framework is complemented by contextual moderators that need to be considered when implementing a metaverse in the workplace. *Chapter III* thereby showed how the results of bibliometrics can be translated into practical frameworks that can be used to develop evidence-based frameworks for innovation and digital transformation in organisations.

The following subchapters presents the individual articles.

Chapter I: Who and what is driving remote working research? A bibliometric study

Authors contributions*:* **Šímová, T:** conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualisation, funding acquisition. **Zychová, K:** conceptualisation, writing – original draft, writing – review & editing, funding acquisition.

Abstract

In the light of the recent pandemic, remote working has become an inseparable part of our lives and a critical factor for many organisations. The paper aims to review the last ten years (2010-2020) of remote working research publications (in Business & Management Studies). We used a bibliometric analysis of 1996 publications from the Web of Science. We created a conceptual structure map to describe core concepts of remote working research. We used the historical direct citation network to show the most important research. Based on our results, the USA, United Kingdom, and China are the leading countries. Results identified two historical areas of research-first cluster connected by the topic of the multicultural dimension, and the second cluster addressing issues of trust and communication, knowledge sharing, virtualness, and leadership. The identified core concepts are organisation and remote working capabilities, behaviour in remote working, consequences of remote working, management issues, home, and gender. We conclude by summarizing the results of the bibliometric study into a theoretical framework for adaptation to remote working that will provide direction for future research, and practical insights for policy and organisations.

Keywords: remote working; bibliometrix; virtual team; work from home, remote work

Note: the citation style of the following chapter followed the required style from journal, and it might differ from the citation style used in this dissertation.

Introduction

Teams have been a joint and inseparable part of our lives for hundreds of years. Team is not just a group in which people are together. Team members are working to reach shared goals. Their energy, motivation, experience, and expertise are used for a shared purpose, so the team achieves more (Partridge, 2007). From this point of view, effective collaboration is essential. Since the last century, workplace flexibility has been discussed (Kathleen et al., 2021). Continuous improvements in communication technologies have enabled individuals to collaborate over distance with greater effectiveness. This caused the emergence of new remote work models (Kathleen et al., 2021). Especially in the light of the COVID-19 Pandemic, companies are trying to find and adopt new ways of remote working (Druta et al., 2021). During the Pandemic, workplace and organisational collaboration have been a significant concern for many organisations (Davison, 2020; Richter, 2020). Many companies have decided to minimize the risks by forcing employees to work remotely to avoid face-to-face contact. and spread the virus (Abarca et al., 2020). All of this played a crucial role in the transition from face-to-face to remote work environment (Meluso et al., 2020). Accordingly, employees and companies had to adjust to new ways of remote working (Bailey & Breslin, 2020). As a result, the use of remote working has increased (Frost & Duan, 2020; Newman & Ford, 2020).

Throughout time, co-located collaboration has evolved to more flexible remote working. COVID-19 has brought together various team members worldwide with a wide range of skills, expertise, and diversified backgrounds (Marques et al., 2021). Remote collaborators form a united effort to seamlessly coordinate and integrate team members' activities (Marques et al., 2021) using information and communication technologies (Partridge, 2007). Without the use of technology, remote working could not work, and team members would be unable to work and effectively coordinate their activities (Ahuja & Galvin, 2003; Ebrahim et al., 2012; Gibson & Cohen, 2003; Ortiz de Guinea et al., 2012; Partridge, 2007). Remote working enables fast problem identification, resolution and intervention, accessibility, and cost-effectiveness (Druta et al., 2021).

Remote working brings a wide range of advantages for companies and team members. Specifically, remote working reduces cost and expenses associated with travel (Bjørn & Ngwenyama, 2009), work across distances, time, and organisational boundaries (Berry, 2011), unlimited worldwide access to needed talent, reduced need for face-to-face meetings, and potential use of 24-hour

workday by traversing time zones (Aldag & Kuzuhara, 2015). As LaBrosse (2008) claim, virtuality help overcome potential barriers of time, space, coordination, and even national culture. Moreover, Snow et al. (1996) point out several benefits for team members, for instance, better flexibility and responsiveness, they can perform the required tasks with considerable freedom and under their schedule (DeRosa, 2009). Remote working and its dispersed nature also bring particular challenges that need to be overcome. Communication is a crucial element (Chang et al., 2011; Gilson et al., 2015; Martins & Schilpzand, 2011; Montoya-Weiss et al., 2001) and ensuring its effectiveness is vital (Partridge, 2007). Aldag and Kuzuhara (2015) claim that the problem in a remote working is synchronizing communication when team members are in different time zones. Furthermore, minimizing or eliminating personal communication contributes to social loafing (Aldag & Kuzuhara, 2015; Kirkman et al., 2002). Kirkman et al. (2002) claim that managers must change how they supervise remote team members, what require different individual skills and characteristics of leaders (Lockwood, 2015; Morley et al., 2015). The usual direct control of team members is impossible in a remote environment. Related to this is the problem of building trust within the team (Berry, 2011; Chang et al., 2011; Crisp & Jarvenpaa, 2013; Golden & Raghuram, 2010; Jawadi, 2013). It is a challenge, as Jarvenpaa and Leidner (1999) mentioned: members are vulnerable to the actions of relative strangers (people they may never have seen in person). Members of remote teams do not have a history of interaction and usually must form quickly. Another issue may be a cultural differences, which can affect team operations (Powell et al., 2004), members often have different reference norms based on varying backgrounds, interests, expertise, and perspectives (Aldag & Kuzuhara, 2015). Another issue of remote working can be knowledge sharing (Eisenberg & Mattarelli, 2017; Pangil & Moi Chan, 2014; Velmurugan et al., 2010; Zhang, 2011).

In this paper, we assume that remote working takes many forms. Thus, we understand remote working as cooperation in virtual and online teams and telework, remote work, and work from home. The presented paper aims to review the last ten years (2010-2020) of remote working research publications (in management and business studies). Our goal is to uncover the leading countries, authors, papers, and the core concepts of virtual team research. Due to COVID-19 and the transformation of the working environment into a virtual world, remote working is issue addressed by organisations worldwide. Providing a complete overview of remote working research can help to better understand the new way of working that the COVID-19 brings.

The research questions follow:

- What are the core concepts of remote working research?
- What countries are leading in remote working research?
- Who influenced the remote working research?
- What are the core papers of the remote working research, and what is their influence on the field of remote working?

Methodology

We used a bibliometric analysis to overview of the remote working domain. The advantage of using bibliometric analysis is that it systematically, transparently, and reproducibly measure science, scientists, and scientific activity (Aria et al., 2020; Broadus, 1987; Pritchard, 1969).

To collect bibliographic information, we obtained articles published on the remote working theme in the last ten years, indexed in Web of Science (WoS) in the category "Management" & "Business". These two WoS categories were selected to understand the domain of remote working in terms of the current needs of the business (primarily due to COVID-19 and the transformation of the working environment into a virtual world). We decided to use the WoS database to fill gaps stated by Abarca, Palos-Sancher, and Rus-Arias (2020). As we stated above, we assume that remote working takes many forms. Thus, we understand remote working as cooperation in virtual and online teams, as well as telework, remote work and work from home. We retrieved the data on January 5th, 2021. For searching, we used search query:

TS= ((virtual team* or online team* or remote work* or telework* or work from home))

AND PY= (2010-2020)

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=1945-2022

The initial search returned 62,471 references. We adapted the PRISMA flow diagram (Moher et al., 2015) to capture our decision on which articles to include in the analysis (Figure 1). In the bibliometric analysis, we included 1996 references.

Figure 1: Prisma Flow Diagram
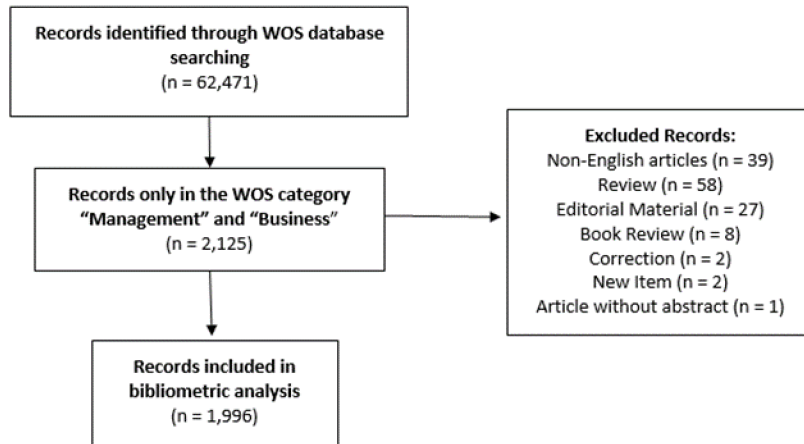
For bibliometric analyses, we used RStudio, package Bibliometrix by Aria and Cuccurullo (2017). First we summarized the main results (annual scientific production, production, impact of countries and authors, cooperation of countries). Second, we applied multiple correspondence analysis and K-means clustering to Keywords Plus to capture core concepts and data frame structures. This analysis created clusters of core concepts (conceptual structure map). We have also created a historical direct citation network of the papers. Identifying the ground-breaking publications thus improves understanding of the field and uncovering linkages among authors (Garfield, 2004). A historical direct citation network defines and measures the impact of publications. It is thus easy to identify the significant authors and papers, the main subjects, their chronology, and their relative influence (Cuccurullo et al., 2016).

All supporting materials (script, data) are available at https://osf.io/cq4sp/, to support the article's transparency, reproducibility, and robustness.

Results

This section describes the core concepts of remote working research and then discusses who has most influenced remote working research (from the perspective of individual authors, publications, and countries).

Core concepts of remote working research

The result of multiple correspondence analysis and clustering generated five clusters. Every cluster shows a core concept, as shown in Figure 2. The number of words in each cluster illustrates how much attention has been dedicated to the themes. Most themes can be seen in cluster number 1 and 2. Red cluster (number 1) depicts remote working organisation and capabilities. This theme addresses trust, communication, organisation, knowledge, diversity, leadership, etc. Blue cluster (number 2) shows themes connected with behaviour in remote working. Attention in this cluster was given to conflict, antecedents, consequences, job satisfaction, impact, performance etc. The orange cluster (number 3) contains themes such as stress, family conflicts, and resources. The orange cluster we called consequences of remote working. In the green cluster (number 4), researchers paid attention to work, technology, management, innovation, and time – we called the green cluster management issues of remote working. Home and gender themes received the least attention associated with remote working (shown by cluster number 5 - purple).

Figure 2: Conceptual structure map

Source: own collaboration

42
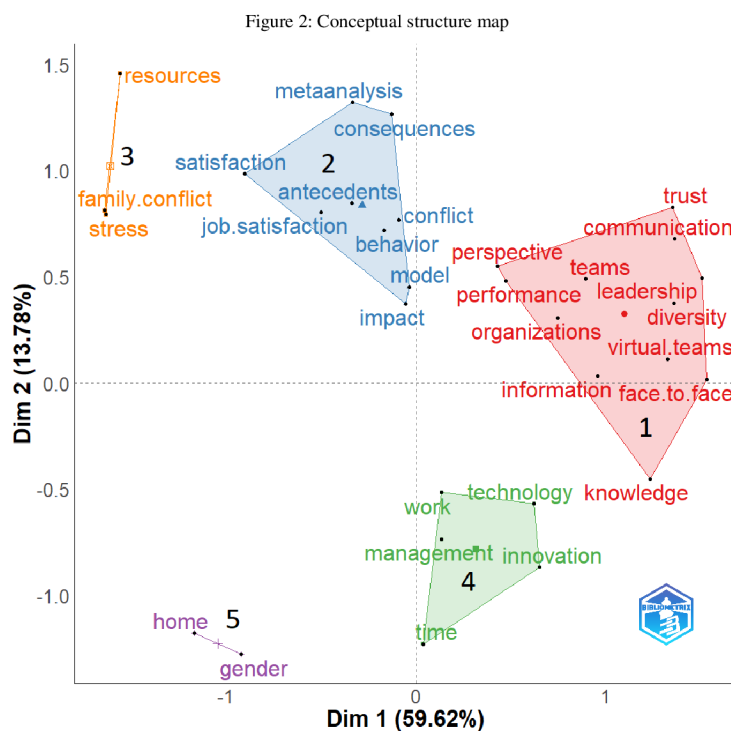
Most Productive Countries of remote working research

Scientists are part of a community that offers countless opportunities for collaboration, inspiration and new ideas and knowledge. Therefore, it is logical that most publications are produced in collaboration between several authors, often from different institutions, countries and disciplines. As Aria et al. (2020) stated, publications that emerge as international co-authored publications are often used to measure international collaboration. Table 1 shows Total Publication (TP), followed by Single Country Publication (SCP), Multiple Country Publication (MCP) and Country Collaboration Rate (CCR).

Table 1: Top ten most productive countries in terms of number of publications

| Country	TP	SCP	MCP	CCR
USA	486	405	81	16.67
United Kingdom	184	122	62	33.70
China	175	129	46	26.29
Australia	104	71	33	31.73
Netherlands	75	44	31	41.33
Germany	72	51	21	29.17
Canada	67	45	22	32.84
India	58	51	7	12.07
France	47	21	26	55.32
Romania	42	38	4	9.52

Source: own collaboration

According to Aria et al. (2020), the CCR shows the country's collaboration and it is calculated as the ratio between MCP and TP. The USA, the United Kingdom, and China have published the most publications (TP) in the field of remote working topics. As CCR show, the most collaborative country is France (55.32 per cent CCR), followed by the Netherlands (41.33 per cent).

Authors' production and influence in the field of remote working

Identification of the most published authors and their impact is helpful in better understanding the past evolution in the field (Cuccurullo et al., 2016). The authors' production and influence are measured by the number of articles they have written and the number of citations they have received (Aria et al., 2020; Cuccurullo et al., 2016). 4719 authors have written the 1996 publications. Among these publications, 349 (17.5 per cent) were single-authored, the rest 1647 (82.5 per cent) authored in the collective. The average paper in the virtual team

research has been written by 2.36 authors. The top-authors' production over the last ten years (2010-2020) is shown in Figure 3.

Figure 3 also shows the number of papers published in remote working and the number of citations. The most productive author from our data set is Arnold Bakker, who wrote 12 articles corresponding to our search query and received 571 citations from these articles. The imaginary second place is shared by Chieh-Peng Lin with eight articles and 229 citations together with Alan R. Deniss, who is the author of the same number of articles, for which he received 119 citations.

Figure 3: Top authors' production over the time

Source: own collaboration
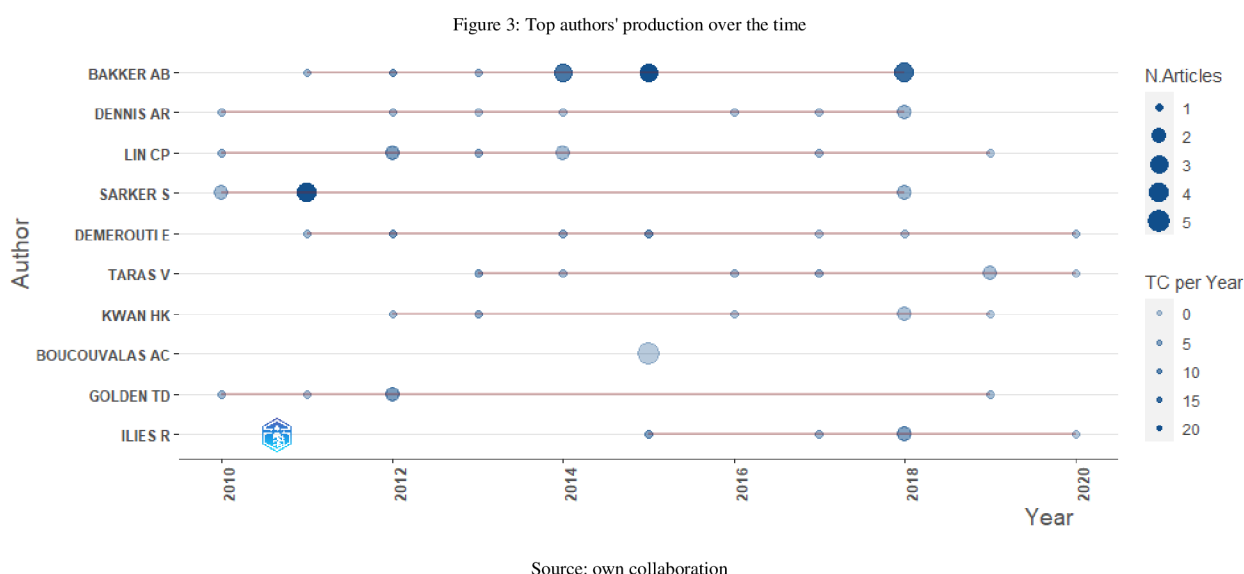
Ground-breaking publications of remote working research

In every discipline, some publications may have a fundamental role in developing the field. The historical direct citation network shows two clusters of publications (see Figure 4). For the blue cluster (cluster A), the critical publication was a meta-analysis by Stahl et al. (2010) dealing with cultural differences within the team. In their article about leading global, cross-cultural teams, Stahl et al. (2010) was subsequently cited by Zander, Mockaitis and Butler (2012). Stahl's results were also followed by Klitmoller and Lauring (2013), who studied the effect of knowledge sharing in virtual teams, considering media type, cultural and linguistic differences. Thus, the results show that the red cluster is connected by articles related to the multicultural dimension of remote working.

Figure 4: Historical direct citation network
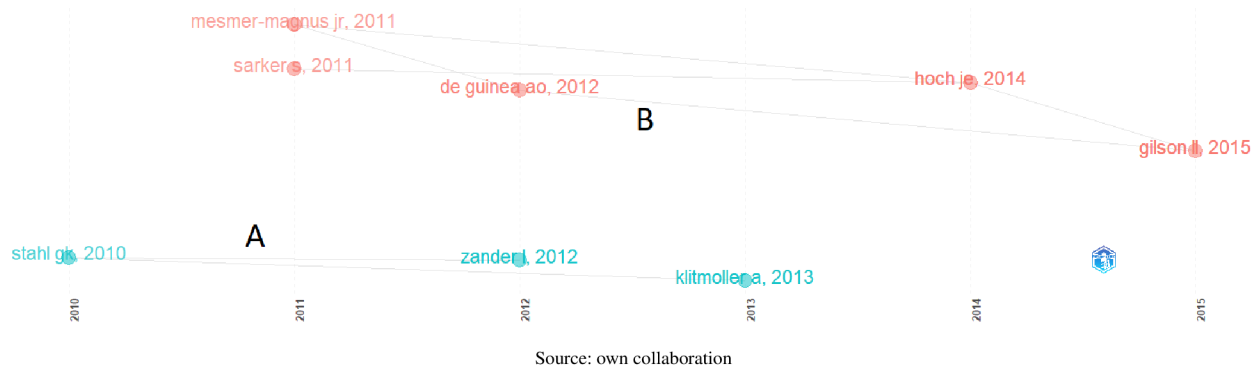
The red cluster (cluster B) consists of five publications. The two oldest ones date back to 2011. The first publication is a meta-analysis dealing with virtuality and knowledge sharing in teams by Mesmer-Magnus et al. (2011). The second publication from 2011 is Sarker et al. (2011). In this article, the authors discuss the issue of the importance of trust and communication in the context of global virtual teams (Sarker et al., 2011). These two articles from 2011 were followed up by Hoch and Kozlowski (2014) with their research on the leadership process in a virtual team. The article by Mesmer-Magnus et al. (2011) was also followed up by Ortiz de Guinea, Webster, and Staples (2012) with a meta-analysis of the implications of virtualness on the functionality of teams. The most recent article from the historical direct citation network is Gilson et al. (2015) entitled "Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities". As the title suggests, is it a detailed literature review covering the essential topics from the past and the future of remote working. Publications within the blue cluster address various associated factors with remote working.

Implications

Comparison of core concepts

The results of this study show the core concepts of remote working research (see Figure 2). The core concepts are organisation and capabilities of remote working, behaviour in remote working, consequences of remote working, management of remote working, home, and gender. These results confirm the findings by Gilson et al. (2015). Gilson et al. (2015), just as we defined the core concept of team virtuality, trust, and leadership (cluster remote working organisation and capabilities). The concept of virtuality and leadership as a core concept was also reported by Abarca et al. (2020) and Powell et al. (2004). We also agreed with Gilson et al. (2015) and Abarca, Palos-Sancher, and Rus-Arias (2020) on core concepts of technology (cluster management of remote working), performance, conflict, and job satisfaction (cluster behaviour). The theme of cultural diversity (cluster virtual team organisation and capabilities) confirmed the ideas of Clark et al. (2019), who suggested cultural diversity as the most significant failure factor in the virtual team.

In contrast to earlier findings, no evidence of core concepts described by cluster consequences of remote working was detected. However, in the last year, scientists have been studying more about the consequences of remote working, especially in connection with the COVID-19 Pandemic. An example can be research by Fiatria and Tan (2021), who studied the impact of working remotely on employee performance. In connection with the COVID-19 Pandemic, papers studying various forms of remote working have increased. Therefore, there is room for research on how the COVID-19 Pandemic has affected the remote working research domain (Abarca et al., 2020).

Furthermore, the theme of home and gender has not been defined as the core concept. The topic of gender in remote working has already been addressed by multiple authors – for example by Lind (1999), by Bryant, Albring and Murthy (2009), and by Kim, Billinghurst, and Lee (2018). The concept of home appears as a core concept for two reasons: the first is that the synonymous term for remote working is working from home; the second reason is the effects of remote working on the employees' home. Similarly, to the topic of working remotely, the topic of "home" is increasingly being raised in the context of the COVID-19 Pandemic. As Waizenegger et al. (2020) note, working remotely in the COVID-19 era raises several challenges for the entire household, from the arrangement of services, communication, negotiation of home space, to the

well-being of all involved. Women were the majority gender group in remote work before the COVID-19 pandemic outbreak (Powell & Craig, 2015). For example in Australia this was particularly the case mostly in managerial positions, professional, clerical and administrative positions in medium and large companies (Hopkins & Bardoel, 2020).In the home, the Covid-19 pandemic has placed a burden on everyone, regardless of gender. Yet research suggests that women at the time of Covid-19 had higher burdens in housework and childcare (Del Boca et al., 2020). Despite the fact that research already exists on the issue of gender in remote working, it is still not clear how organisations and their managers should approach the issue. There is also a gap in research on how remote working affects the well-being of families, the running of the household and what are the best practices for this area. From a scientometric perspective, it is also advisable to focus on gender aspects of authors publishing in the field of remote working.

There is also lack of clarity in the understanding differences in terms such as virtual team, online team, remote working, remote cooperation, telework, remote work and work from home. The issue of term inconsistency in remote working is also highlighted by Williamson et al. (2021). Thus future studies on this topic are recommended.

International co-authorship as an indicator of research advancement

Comparison of the most productive countries show that the USA, the United Kingdom, and China have published the most publications in remote working topics. These findings are similar to those made by Abarca, Palos-Sancher and Rus-Arias (2020) in the bibliometric study about virtual teams from publication indexed in Scopus and WoS. Abarca, Palos-Sancher and Rus-Arias (2020) stated the USA, UK, and Germany as the most productive countries. The USA's lead in the number of publications is not surprising - many bibliometric studies confirm that the USA is one of the countries that dominating in the number of publications in many fields (Abarca et al., 2020; Zhu & Liu, 2020). Zhu and Liu offer the explanation that developed economies have sufficient budgets to subscribe to the WoS database and subsequently publish in WoS-indexed journals. In contrast, the budgets of many developing economies may be limited. However, it remains unknown how the author's origin and country of residence, or even the organisational culture of research institutions, may influence the core research topics.

The results also show that France's the most cooperative country (55.32 % CCR), followed by the Netherlands (41.33 % CCR). The high number of co-authored publications indicates a closer relationship between authors within the same field and a greater possibility of future collaboration (Wang et al., 2014).. Our results also show the most productive authors in remote working (Arnolad Bakker, Chieh-Peng Lin and Alan R. Deniss). As we stated earlier, identifying the most published author and their impact is helpful in better understanding the field's past evolution (Cuccurullo et al., 2016).

Ground-breaking publications and their impact on the development of remote working research

As we stated above, some publications may have a fundamental role in developing the field. Articles identified by the historical direct citation network are ground-breaking works that enhance knowledge and reveal connections between authors (Cuccurullo et al., 2016; Garfield, 2004). The historical direct citation network shows two clusters of publications. The blue cluster (cluster A) is connected by articles related to the multicultural dimension of remote working. Cultural differences play a critical role in remote working. Martins and Schilpzand (2011) state that a great management challenges in virtual teams are budgeting, scheduling, and communication (specifically the cultural and language barriers).

Similarly, Zakaria and Talib (2011) stated that the management of an organisation must adapt to global virtual team's cultural differences. The importance of cultural difference in managing remote workers was further supported by Chang, Chuang and Chao (2011), Zhang (2011) and Erez et al. (2013) as well as articles identified by our historical direct citation network (Klitmøller & Lauring, 2013; Stahl et al., 2010; Zander et al., 2012). What scientists still cannot agree on is the effect of culture on communication in remote working. Berg (2012) argues that texts risk the possibility of misinterpretation of texts and the loss of nuance from personal communication, which is refuted by Han and Beyerlein (2016), who argue that virtual teams remove the cultural block because communication is primarily done in writing. Militaru et al. (2014) argue that culture negatively affects communication in remote working due to different cultural backgrounds, conflict, confusion, the ambiguity of communication, or less accuracy. According to Han and Beyerlein (2016), most of the research found that due to cultural/linguistic differences and different communication styles, weaker communication affects team processes and performance. This lack of clarity in the effects of culture in remote working requires future research.

Publication within the red cluster (cluster B) addresses various factors associated with remote working –the issue of trust and communication, knowledge sharing, virtualness, and leadership. The issue of trust, communication, and leadership also have been identified as core concepts by multiple correspondence analyses and K-means clustering (see Figure 2).

Knowledge sharing is a critical concern for all organisations whether its employees work virtual or in the workplace. Velmurugan, Kogilah and Devinaga (2010) and Pangil and Moi Chan (2014) suggest knowledge sharing is essential for company success. Taskin and Bridoux (2010) compared knowledge sharing between non-teleworkers and teleworkers. Their results indicate that teleworking may negatively impact identifying with the values, shared mental schemes, or good relationships. Researchers also explore the effect of trust and knowledge sharing. Golden and Raghuram (2010) support these findings and claim that trust is essential for knowledge sharing. Further insights into knowledge sharing were provided by Zhang (2011) and Eisenberg and Mattarelli (2017) who found how cultural differences affect knowledge sharing. Knowledge sharing in virtual teams is also influenced by trust (Germain & McGuire, 2014; Pangil & Moi Chan, 2014) and positively influenced by enjoyment, age, nationality and computer experience (Killingsworth et al., 2016).

Trust has been an issue that will torment scientists engaged in teamwork. Trust has a crucial role in the team's effectiveness, whether it is virtual or face-to-face (Berry, 2011). Trust has been studied primarily as a factor influencing team efficiency (Berry, 2011; Chang et al., 2011) and influencing knowledge sharing (see above). Attention has also been paid to ad hoc global virtual teams, and to building swift trust in these unique, temporary teams (Crisp & Jarvenpaa, 2013), to leadership and trust (Jawadi, 2013) as well as to cultural adaptation and trust (Chang et al., 2011). Although much has already been explored in trust in remote teams, there are still a couple of unanswered questions. Future research could address, e.g., the effect of team building activities on increasing trust in remote teams, the effect of gender, age, or education on trust, etc.

Martins and Schilpzand (2011) stated that communication is crucial in remote working. Our results support this claim – multiple correspondence analyses and the historical direct citation network identified communication as one of the core concepts. Similarly, Chang, Chuang and Chao (2011) confirmed that communication quality positively affects the performance of employees who work remotely. It is important to note that frequency of communication does not automatically mean

high quality of communication (Chang et al., 2011). Also, Gilson et al. (2015) listed communication as one of the mediators that affect the efficiency and effectiveness of the virtual team. Communication in remote working is mainly done through information and communication technologies (ICT) which have both positive and negative effects on the quality of communication. The positive side of using these technologies is overcoming geographical and organisational differences (Aldag & Kuzuhara, 2015; Chen, 2014), cost reduction and performance improvement (Kasemsap, 2016), as well as limiting travel expanses (Chen, 2014). Communication also influences trust (Gilson et al., 2015). Negative impacts in the use of ICT are e.g. increase of anxiety in remote working (Fuller et al., 2016), synchronization of communication when team members are in different time zones (Aldag & Kuzuhara, 2015) and introduced fewer novel ideas (Fuller et al., 2016). Communication can also negatively affect remote working if the quality of technological equipment is different across the team (West, 2012).

Our conclusion about the importance of leadership in remote working is consistent with the result by Gilson et al. (2015), Abarca et al. (2020) and Powell et al. (2004). Leadership in remote working has been studied from many perspectives. Jawadi (2013) explore the effect of trust in the leadership process. Other authors focused on forms of leadership and management in different cultures (Lockwood, 2015; Scott & Wildman, 2015), or on individual characteristics and skills of leaders and their training (Lockwood, 2015; Morley et al., 2015).

A theoretical framework for remote working adaptation – direction for future research, policies and organisations

We identified core themes of remote working research in management and business using bibliometric analysis. These core themes can be divided into personal and organisational levels (see horizontal line in Figure 5 - the colours reflect the colours of the individual clusters from Figure 2: Conceptual structure map). However, based on the literature review and the results of the bibliometric analysis, we found that researchers have not sufficiently addressed remote working from a legislative and governmental perspective. For this reason, we include a vertical line in the theoretical framework of adaptation, which should draw attention to issues related to the governmental setting of remote work.

Figure 5: A theoretical framework for remote working adaptation
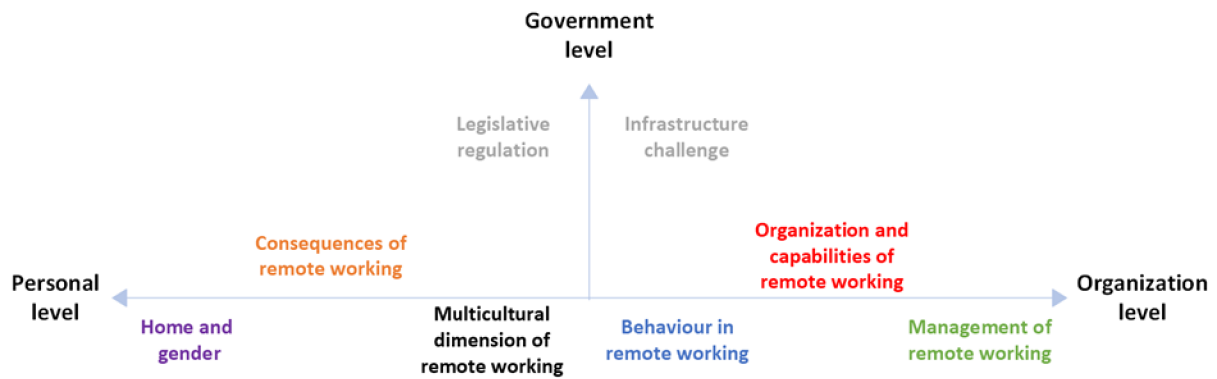
Source: own collaboration

From the results of our study, we conclude that at the individual level, future research should focus primarily on the study of home and gender in the context of remote working. Therefore, future research should focus on the well-being of entire families of individuals who work remotely, as well as on the best practices for running the household. Also, exploring how managers should approach teleworkers with families would be helpful. From a scientometric perspective, it is also advisable to focus on gender aspects of authors publishing in the field of remote working. Furthermore, research should focus on the consequences of remote working at the level of entire demographic and ethnic groups. The multicultural dimension of remote working and the shift to an online environment is changing the perception of cultural differences and overall team collaboration. Body language is eliminated, and the mimic or haptic communication elements are minimal. Therefore, it is essential to address the issue of the multicultural dimension on a theoretical level (future research) as well as on a practical level in organisations. At the same time, in this area, it is also necessary to provide a legislative framework that addresses the issue of working abroad, digital nomadism, online workplaces, etc.

From a governmental point of view, policymakers must focus on developing infrastructure that will support remote working and thus reduce digital disparity issues. Urban, sociological, and economic studies will be necessary in this area. Changing legislative regulations to reflect new ways of working will also be necessary. Ensuring digital safety, sufficient information and education at a global level is another integral part of the transformation of the working environment. Therefore, these areas should also be addressed by future research and governments.

At an organisational level, organisations should focus on supporting the transformation to a digital environment. Organisations should ensure sufficient digital equipment and sufficient know-how on how to work in a digital environment for employees at all levels. As mentioned above, there are many factors to consider in the digital work environment, and this is where researchers can help organisations by studying factors such as culture, knowledge sharing, trust, communication, leadership and virtualness and their effect on remote working.

Conclusion

The paper aimed to review the last ten years (2010-2020) of remote working research publications (in Management & Business studies). To provide an overview of the remote working domain, we used a bibliometric analysis of a 1996 publication from the WoS. The finding of this research provides insights for the ten years of remote working research, uncovering the leading countries, authors, and papers and the core concepts of the virtual team research. Due to COVID-19 and the transformation of the working environment into a virtual world, remote working is an issue, that organisations worldwide are addressing. Providing a complete overview of remote working research can better understand remote working issues.

We created a conceptual structure by multiple correspondence analysis and K-means clustering to describe core concepts. The core concepts are organisation and capabilities of remote working, behaviour in remote working, consequences of remote working, management of remote working, home, and gender. 4719 authors have written the 1996 publications. Among these publications, 349 (17.5 per cent) were single-authored, the rest 1647 (82.5 per cent) in the authored collective. The average paper in the virtual team research has been written by 2.36 authors. The most productive countries in remote working research are the USA, the United Kingdom, and China. The most collaborative countries are France, followed by the Netherlands. The most productive author from our data set is Arnold Bakker, Chieh-Peng Lin, and Alan R. Deniss.

The historical direct citation network shows two clusters of publications. The first cluster is connected by articles related to the multicultural dimension of remote working. The second cluster addresses various factors associated with remote working – the issue of trust and communication, knowledge sharing, virtualness, and leadership. Our analysis shows as the most critical concepts in the remote working research trust, communication, and leadership (these concepts have been identified by historical direct citation network and multiple correspondences analysis).

We have developed a theoretical framework for remote work adaptation. The framework contains core themes divided into three levels - personal, organisational and governmental. Within each of these levels, we emphasize different themes that should be addressed by researchers, organisations and governments.

The bibliometric approach itself limits the study. We used only publication indexed in the WoS category "Management" & "Business" for our analysis. To capture the core concepts and create the conceptual structure map, we use only Keywords Plus. Notwithstanding these limitations, uncovering core concepts interesting connections between concepts, publications, and authors lays the groundwork for future remote working research.

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Chapter II: A research framework for digital nomadism: a bibliometric study

Authors contributions: **Šímová, T**: conceptualisation, methodology, validation, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualisation, funding acquisition.

Abstract

Digital nomads live a new way of life that creates an ideal balance of work and leisure. Research on the phenomenon of digital nomads is still in its early stages and is not fully framed as a proper research category. Therefore, the present research aims to explore research on digital nomadism by study leading countries, authors and themes that can become a foundation for future research. This study is exploratory and interpretive - using bibliometrics, we systematically searched all articles indexed in the Web of Science database. The study presents the evolution of scholarly production and identifies key authors and countries that have the potential to become pioneers in digital nomad research. We identified 17 core concepts of digital nomad research as well as concepts that have not yet received much attention from scientists. Additionally, our study provides a framework for research on digital nomadism and presents topics for future research: we determine how the 17 core concepts identified in this study affect the lives of digital nomads, research into legislation that directly affects digital nomads, study how COVID-19 has changed working styles, and offer a bibliometric analysis of data on digital nomads from other databases.

Keywords: digital nomad; remote work; bibliometrix; scientometrics, work and travel

Note: the citation style of the following chapter followed the required style from journal, and it might differ from the citation style used in this dissertation.

Introduction

The development of Information and Communication Technologies (ICT) and globalization has opened the possibility of new flexible working arrangements. In today's world, it is common to work remotely using digital technologies (Kathleen et al., 2021; Thompson, 2019). Especially now, in light of the COVID-19 pandemic, flexible work arrangements have been adopted as a standard practice in many industries (Davison, 2020; Druta et al., 2021; Frost & Duan, 2020; Meluso et al., 2020; Newman & Ford, 2020). COVID-19 has brought together diverse groups of team members worldwide with a wide range of skills, expertise, and backgrounds (Marques et al., 2021). However, remote working is nothing new; it was certainly possible before the COVID-19 pandemic. People have been working remotely for many years. Today, people are looking for opportunities to combine work and travel either to gain skills or simply to have exciting and fun experiences. Many companies today offer remote working to increase the job satisfaction of their employees. Remote working may improve performance as well as increase the likelihood of attracting excellent employees (Demaj et al., 2021), reduce overhead costs and travel costs for businesses (Bjørn & Ngwenyama, 2009; Thompson, 2018), and access talented people worldwide (Aldag & Kuzuhara, 2015; Marques et al., 2021).

Remote forms of work also have disadvantages. The legal regulation of flexible employment relationships remains difficult for some companies due to inflexible labour codes. Some countries do not allow employees to work outside their designated workplace. Tax rules based on residence can also be problematic (Tyutyuryukov & Guseva, 2021). Moreover, communication issues are a frequently discussed factor in the success of remote collaboration (Aldag & Kuzuhara, 2015; Gilson et al., 2013). Other challenges include establishing trust (Jawadi, 2013), cultural differences (Aldag & Kuzuhara, 2015; Powell et al., 2004) and knowledge sharing (Eisenberg & Mattarelli, 2017; Jarrahi et al., 2019). Often people take advantage of remote working opportunities, and they work from exotic destinations (Dal Fiore et al., 2014) or destinations that align with their specific work needs and lifestyle (Mladenovic, 2016). Thus, when managed properly, remote work and travel can offer ideal combinations of work-life balance and work-leisure lifestyle (Orel, 2019). Makimoto and Manners (1997) coined the term 'digital nomads' for this type of workers.

Towards a definition of digital nomads

To understand digital nomadism as a new form of rapidly expanding mobility and a recent social phenomenon, it is necessary to further conceptualize the topic (Hannonen, 2020). Digital nomads are primarily young (Millennials or Generation Z) individuals who are motivated to explore and combine travel with virtual work (Reichenberger, 2018). According to Hensellek and Puchala (2021), all definitions of digital nomads have common factors: digital work, flexibility, mobility, identity, and community. Similarly, Demaj et al. (2021) claim that nomadism is linked to digitalization because digital nomads are people who can work while moving from one place to another simply by having one mobile device and connection to the internet. Another definition describes digital nomads as "internet-enabled remote workers, who focus on connectivity and productivity even in leisure" (Bozzi, 2020). The importance of digital technologies and infrastructures for digital nomads is also confirmed by Nash et al. (2018) and (Lee et al., 2019). But as Hannonen (2020) argues "the use of technology on the road does not make one a digital nomad. It requires the accomplishment of the work-related and professional activities while traveling." Thus in addition to use of digital technologies, Nash et al. (2018), offers a definition of digital nomads that highlights three other key elements - gig work, nomadic work, and global travel adventure. De Almeida et al. (2021) created a conceptual framework for digital nomads that includes use of tech as well as personal life and social dimensions. Orel (2019) suggests that digital nomads are people who have an optimal work/leisure ratio, who value freedom of movement quite highly, and who like to work in community-oriented workspaces.

Müller (2016) understands the digital nomad as a social figure who combines work with a new vision of personal life, usually an entrepreneur or a location-independent freelancer, and he offers two research streams on digital nomads. The first stream of research examines digital nomads as individual travelers, e.g., "flashpackers" - people who travel with all the necessary digital equipment for their work, wherever their heart takes them. The second stream of research that Müller (2016) described is a view of digital nomads as labour mobility. In this case, people become nomads due to moving for work. Based on a comparison of many definitions, Hannonen (2020) provides the following description of digital nomads: "The term refers to a rapidly emerging class of highly mobile professionals, whose work is location independent. Thus, they work while traveling on (semi)permanent basis and vice versa, forming a new mobile lifestyle." Digital nomads are highly motivated and free-spirited people (Macgilchrist et al., 2020) who are changing

the perception of what is considered a good livelihood (Demaj et al., 2021). Finally, Richards (2015) delineates three types of digital nomads: the backpacker, the flashpacker and the global nomad.

Commonly, telecommuters, freelancers, location-independent workers, remote workers and online entrepreneurs are also referred to as digital nomads, and these various terms are mistakenly used as synonyms for digital nomads. This creates terminological confusion (Hannonen, 2020). The distinction between remote working, telecommuting and digital nomadism is important when conceptualizing the concept of the digital nomad (Hannonen, 2020). Nash et al. (2021) points out other inaccuracies in defining digital nomads by highlighting that labelling digital nomads merely as location-independent workers is misleading. They argue that it is critical for digital nomads to be able to find or create a suitable workspace that matches individual preferences and technological requirements.

Given the presented definitions and their limitations, in this paper, we understand digital nomads as individuals with a mobile lifestyle that combines work and leisure, requiring a particular set of skills and equipment.

How does research respond to digital nomadism?

A large body of literature focuses on specific local areas that are attractive to digital nomads. For example, Cruz et al. (2021) study the co-working spaces in Proto City. Another study by Foley et al. (2022) deals with sustainability and digital nomadism in the so-called Small Island Developing States, which are also a frequent target of digital nomads. Green (2020), de Loryn (2022), and Mancinelli (2020) describe digital nomads' situation in Chiang Mai, Thailand. Korjus et al. (2017) illustrate the perspectives from Estonia. MacRae (2016) and Woldoff & Litchfield (2021), adding the community perspective in Ubud. Hannonen (2020) points out that places like Chiang Mai and Bali are the places that meet the needs of digital nomads.

Researchers also study co-working spaces, which are the favourite options of digital nomads (Chevtaeva & Denizci-Guillet, 2021; Cruz et al., 2021; Lee et al., 2019; Orel, 2019, 2021). Other research has explored the lifestyles of digital nomads. As Demaj et al. (2021) mentioned, digital nomads do not wake up every day stuck in traffic to get to work; they are changing the presumption of what we consider as a good living. Digital Nomads are highly self-determined

and free people (Macgilchrist et al., 2020). They often share their way of living on social media (Bozzi, 2020; Macgilchrist et al., 2020). Digital nomads are studied from the aspect of employment (Thompson, 2018), well-being (Korpela, 2020; von Zumbusch & Lalicic, 2020), motivation (Cook, 2020; Hall et al., 2019) and knowledge management (Jarrahi et al., 2019).

As Reichenberger (2018) stated, the phenomenon of digital nomads is not yet well established. Similarly, Nash et al. (2018) pointed out that the body of empirical and academic research into digital nomadism is very small. Also, Hannonen (2020) stated that even though the study of digital nomads is growing, the term is used in many different, often contradictory ways (de Almeida et al., 2021). Knowledge of digital nomads is also often limited or even biased (Reichenberger, 2018) because the sources of information are commonly not academic, peer reviewed papers, but merely online blogs, newspapers, interviews, etc. (Nash et al., 2018). As Hannonen (2020) mentioned, digital nomadism is not yet framed as a proper research category. For these reasons, we explore the research on digital nomadism by studying leading countries, authors and themes that can serve as a foundation for future research. The presented paper uncovers the underlying concepts of digital nomadism, as well as identifies leading countries and authors, and their evolution over time so as to reveal possibilities for future research. This study is exploratory and interpretive - using bibliometrics, we systematically searched all articles indexed in the Web of Science database (WOS).

Materials and Methods

We used the PRISMA (Preferred Reporting Items for Systematic Reviews) diagram created by Page et al. (2021) to describe our search process (see Figure 1). First, we obtained records from the WOS databases. WOS was chosen because it is considered the most selective database (Singh et al., 2021) and therefore we assume that the records in WOS are the highest quality research papers. We retrieved the data on March 4th, 2022, with the following search query:

TS = ((digital nomad*) or (nomadic work*) or (neo-nomad*))

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=1945-2022

Our search returned 1,173 bibliographic references. In total, we removed 214 non-English articles. In the first round of the analysis, we screened the titles and abstracts of the articles. The selection criteria were based on the research questions (we removed all reports that did not match the research objective, book reviews, editorial materials, corrections, meeting abstract, and review articles). Among the records excluded for not matching themes were records that dealt with e.g. the historical view of nomads (pastoral nomads, trader nomads), records dealing with nomadic livestock-production or even research on nomadic football players, etc.

Figure 1. PRISMA Diagram
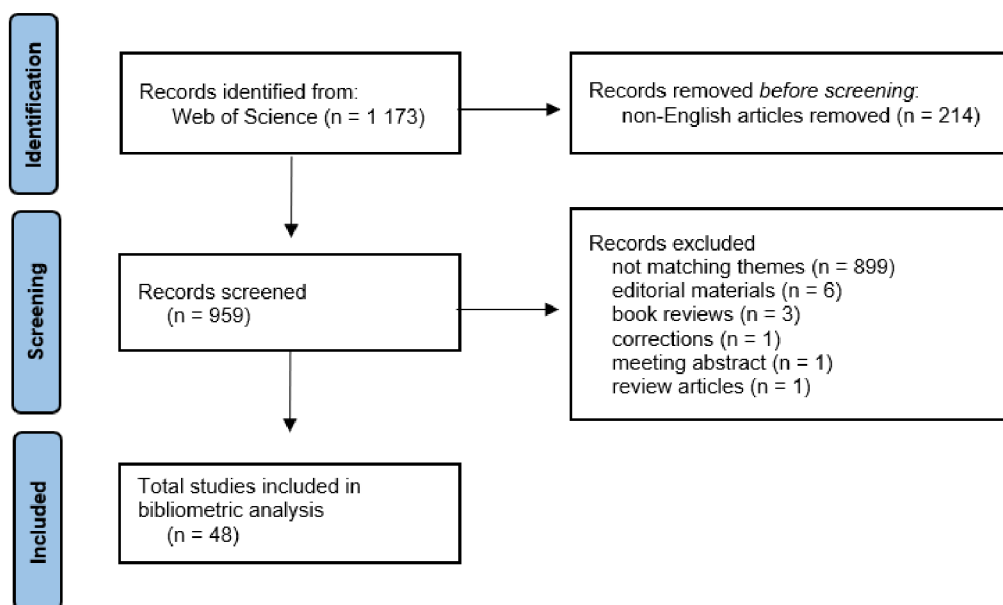
Source: own collaboration based on Page et al. (2021)

The second step was a bibliometric analysis of the 48 studies that match our research questions. For our bibliometric analysis we used RStudio, package Bibliometrix, and Biblioshiny app (Aria & Cuccurullo, 2017). First, we described the basic information about the annual scientific production and the authors. We analysed the most productive and influential authors based on the number

of articles they have written and the number of citations they have received (Aria et al., 2020; Cuccurullo et al., 2016). Second, we analysed the most productive countries, including the scientific collaboration between countries. Third, we evaluated international cooperation based on publications that emerge as international co-authored publications (Aria et al., 2020). We calculated the country collaboration rate (CCR). According to Aria et al. (2020), the CCR is calculated as the ratio between the multiple country publication (MCP) and total publication (TP). We provided information about publications that had been created within one country (single country publication - SCP). We have also captured the evolution of trends topics (based on the authors' keywords). Last, we performed multiple correspondence analyses and K-means clustering to divide publications into clusters (based on the authors' keywords). To avoid bias, we merge synonyms (digital nomad = digital nomads, digital nomadism; mobility = lifestyle mobility, mobilities).

Results

The first publication on digital nomads indexed in WOS is from 2006. The article titled Abductive reasoning and ICT enhanced learning: Towards the epistemology of digital nomads by Erkki Patokorpi (2006). In this article, Patokorpi (2006) reflects on elements of constructivist pedagogy using ICT to educate digital nomads. As shown in Figure 2, the number of publications on digital nomads in WOS then stagnated until 2015. As Richards (2015) pointed out, the blurring of the line between work and leisure, combined with the rise of digital technology, has given this community the ability to work anywhere they can connect to the internet. Richards (2015) also defined the importance of research on digital nomads, which points to distinctions between different types of nomads (and specifically in young individuals). This argument was followed by studies by Reichenberger (2018) and Nash et al. (2018), which provided some of the first conceptualizations of digital nomadism and outlined digital nomadism as a research category. In 2018, digital nomadism was also included as a stand-alone category in the State of Independence in America annual research report (Hannonen, 2020). These highlights are behind the increase in digital nomad publications we see after 2018. The annual growth rate is 24,36 %.

Figure 2. Annual Scientific Production
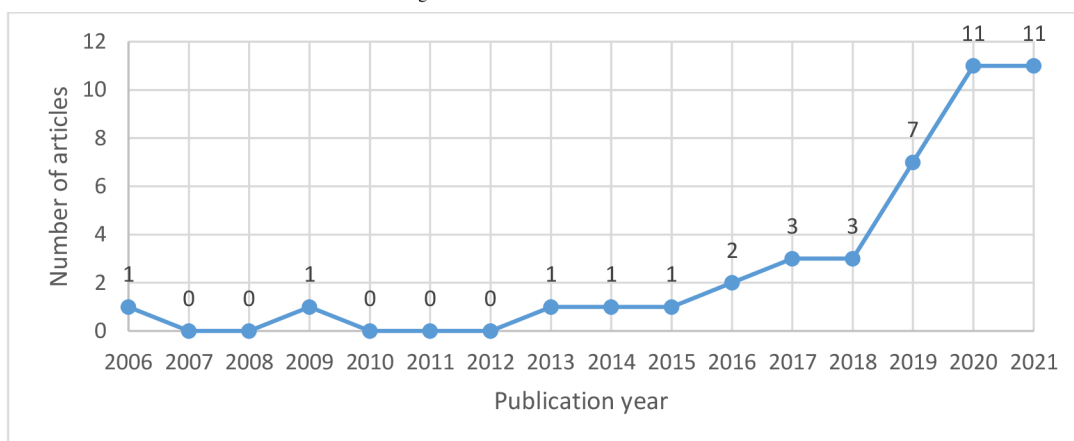
Source: own collaboration

Most publishing authors and their impact can be used to understand better the field's past development (Cuccurullo et al., 2016). Our dataset included 48 publications written by 107 authors (average of 2.46 co-authors per publication). Of the total, 18 publications were single-authored. The average article in the field of digital nomads was cited 6,792 times in WOS. Over time, the most influential authors (see Figure 3) are Mohammad Hossein Jarrahi (4 publications from 2018 to 2021), followed by Will Sutherland (3 publications from 2018 to 2021). In Figure 3, the bubble size represents the number of publications written by each author in a given year (in this case the

values are one or two - the authors wrote a maximum of two articles per year), the intensity of colour indicates the total number of citations per year – TC per year (Aria & Cuccurullo, 2017).

Figure 3. Top-Authors´ Production over Time
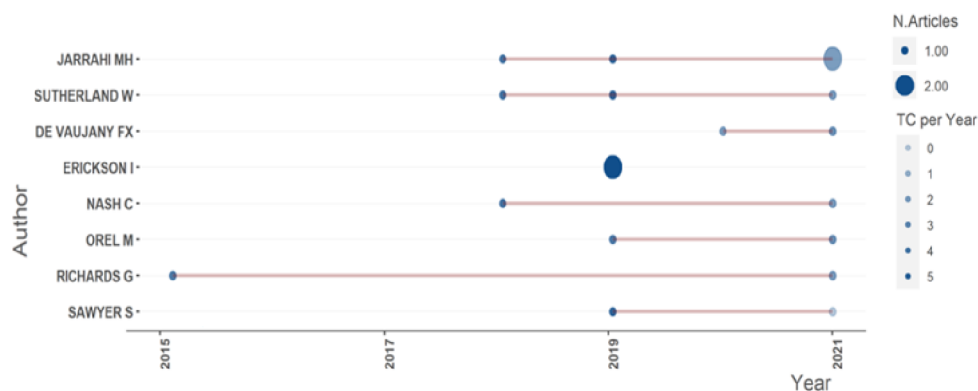
Source: own collaboration

Sharing knowledge and gaining inspiration and new ideas from colleagues is common in academic life. Therefore, it is not surprising that two or more authors have collaborated to write most publications. It can happen that authors are from different institutions or even countries. Therefore, international co-authored articles are published, and thus they can be used to evaluate international collaboration (Aria et al., 2020; Leydesdorff et al., 2013). In this, the most productive country is the USA, followed by Russia and the UK (see Table 1). The countries with the most international cooperation (highest CCR) are Germany, the UK and the USA.

Table 1. Production of publication by country (only countries with three and more publications per country are listed)

Country	Publication	TP	SCP	MCP	CCR
USA	(Dal Fiore *et al.*, 2014; Naz *et al.*, 2017; Nash *et al.*, 2018; Jarrahi *et al.*, 2019, 2019; Lee *et al.*, 2019; McElroy, 2020; Nash, Jarrahi and Sutherland, 2021)	8	6	2	0.25
Russia	(Seliverstova, Iakovleva and Grigoryeva, 2017; Klyagin *et al.*, 2018; Alekseevna, Efimovna and Valerievna, 2019; Nikolaeva and Kotliar, 2019; Tyutyuryukov and Guseva, 2021)	5	5	0	0
United Kingdom	(Aroles, Granter and de Vaujany, 2020; Bozzi, 2020; Cook, 2020; Willment, 2020; Foley *et al.*, 2022)	5	3	2	0.4
Australia	(Hall *et al.*, 2019; Green, 2020; de Loryn, 2022)	3	3	0	0
Czech Republic	(Mladenovic, 2016; Orel, 2019, 2021)	3	3	0	0
Germany	(Macgilchrist, Allert and Bruch, 2020; Cnossen, de Vaujany and Haefliger, 2021; Nurhas *et al.*, 2021)	3	1	2	0.667

Source: own collaboration

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The results also show that researchers focus on different destinations that are popular among digital nomads. Thus, these studies provide unique insights into local issues faced by nomads. Of the 48 studies, 23 did not specify the countries studied (mostly literature reviews or studies analysing social networks), and 10 studies indicated that research was conducted in multiple countries. The most studied nation is Thailand with 5 study (Cook, 2020; de Loryn, 2022; Green, 2020; Mancinelli, 2020; Orel, 2021), followed by Russia with 2 study (Alekseevna et al., 2019; Tyutyuryukov & Guseva, 2021). Nations that were a focus of a single study include Brazil (Jung & Buhr, 2021), Estonia (Korjus et al., 2017), India (Korpela, 2020), Indonesia (MacRae, 2016), Israel (Al-Zobaidi, 2009), Oman (Al-Hadi & Al-Aufi, 2019), Portugal (Cruz et al., 2021), Romania (McElroy, 2020) and United Kingdom (Andrejuk, 2022).

Based on the authors' keywords, the analysis divided core themes into three clusters (Figure 4). The size of the cluster (coloured area and number of dots) determines how many publications addressed issues within the cluster. The interpretation of the conceptual structure map (Figure 4) results is determined by the relative position of the points and their distribution along the dimensions. Aria & Cuccurullo (2017) state that the more similar the authors' keywords are in distribution, the closer they appear on the map. At the same time, the closer the points are to the 0:0 coordinates, the more research has addressed the theme. The largest cluster (red colour) merges themes that are connected with digital nomad everyday life (themes from tourism and mobility, youth travel, and lifestyle migration to work practices, co-working, gig economy, or even COVID-19). The blue cluster describes research themes that deal with distinguishing the differences between digital, nomadic and remote work. The last green cluster is one of themes that describe the life of the digital nomad – location independence, work and lifestyle.

Figure 4. Conceptual Structure Map
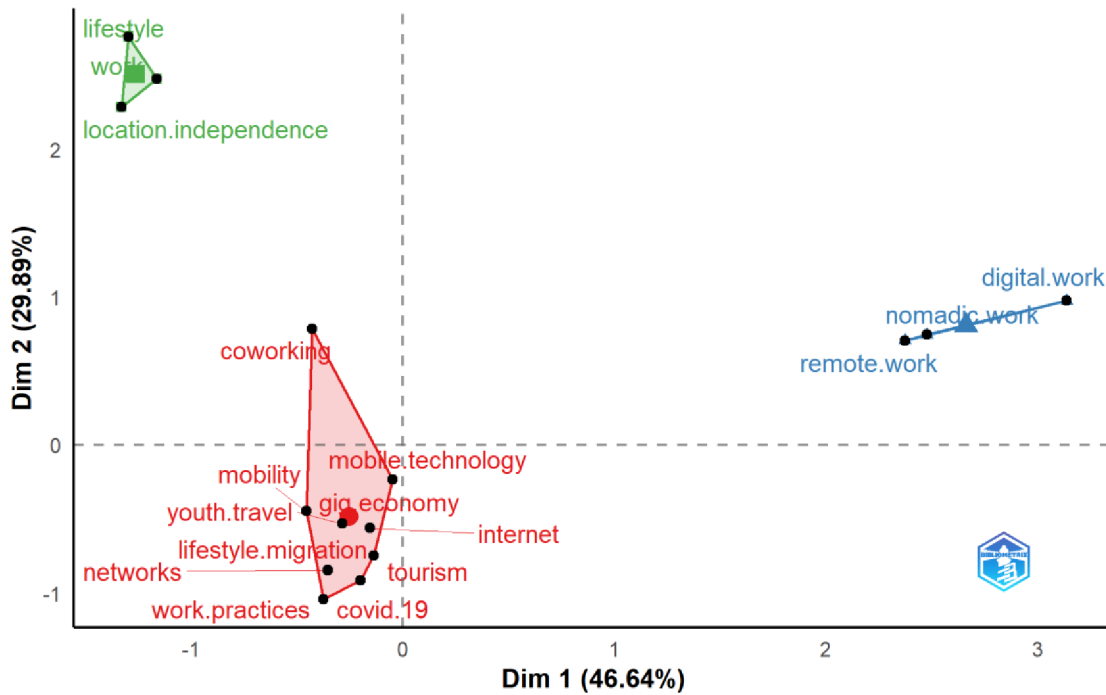
Source: own collaboration

To capture the evolution of the themes of the digital nomad, we continue analysing author keywords. As shown in Figure 5, until 2017 the themes that were addressed were primarily related to the technical infrastructure of digital nomad (mobile technology, networks, internet). One very influential article from this period was by Dal Fiore (2014), which looked at how mobile technology fosters travel. This study predicted that "in the age of 'digital nomadism,' mobile technology is likely to play an important role for the new mobility and work-life arrangements put into practice by a multitude of creative knowledge professionals." Another important research was a global survey of young travellers conducted by Richards (2015), which indicated three primary youth travel styles - the backpacker, the flashpacker and the global nomad. Between 2018 and 2020, digital nomadism was discussed as a lifestyle that combines work with migration and lifestyle (Hall et al., 2019; Orel, 2019; Reichenberger, 2018). Some articles also dealt with conceptualizing the phenomenon of digital nomads (Hannonen, 2020; Korpela, 2020; Mancinelli, 2020; Nash et al., 2018; Reichenberger, 2018). Other research studied the work of digital nomads and its specifics, such as working with information (Al-Hadi & Al-Aufi, 2019) or knowledge (Jarrahi et al., 2019) as well as working in co-working places (Orel, 2019; Yang et al., 2019). In 2020, the amount of research and so also the number of core themes grew. The most important core themes were gig economy, lifestyle and tourism (Bozzi, 2020; Cook, 2020; Willment, 2020),

work practices (Aroles et al., 2020; Green, 2020; Nikolaeva & Kotliar, 2019). The COVID-19 pandemic left its mark even in research into digital nomads. For example, Richards & Morrill (2021) studied changes in youth travel in the beginning of the pandemic and confirmed that youth tourism businesses were severely affected. De Almeida et al. (2021) studied posts on Reddit and found that the COVID-19 pandemic was also seen as an opportunity to experience the lifestyle of digital nomads. Beyond the pandemic, the topic of co-working was also raised in 2021. At this time, co-working was perceived as a business opportunity, and was included in the tourism agenda (Chevtaeva & Denizci-Guillet, 2021). Digital nomads and co-working and its impact on society have also been examined from the perspective of organisational studies (Cnossen et al., 2021) and migration (Jung & Buhr, 2021), but also from the perspective of responsible, ecological and sustainable society (Cruz et al., 2021).

Figure 5. Trend Topics
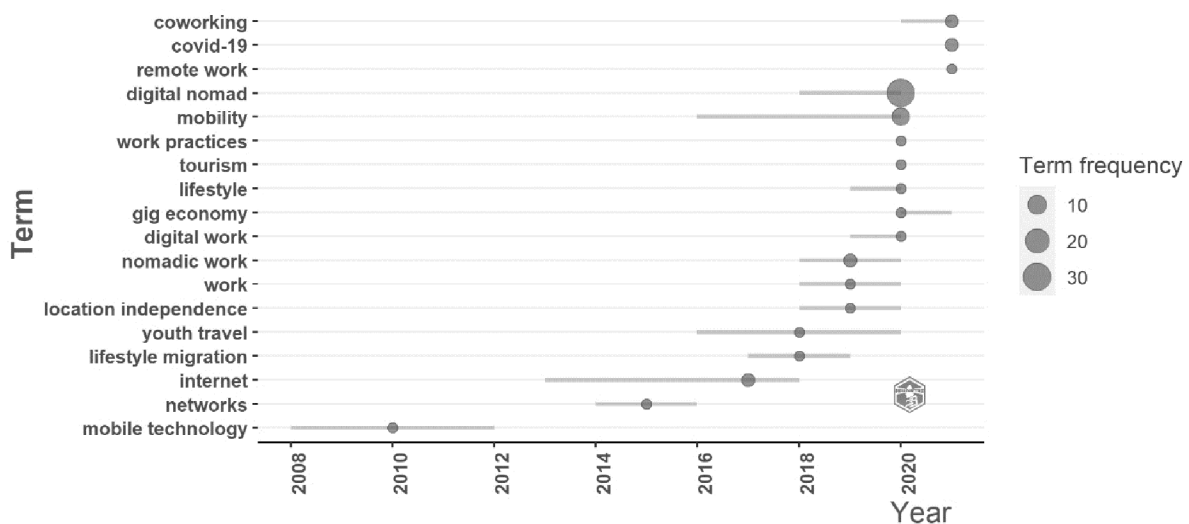
Source: own collaboration

The themes illustrated in Figures 4 and 5 are core themes of research into digital nomads. The researchers addressed 17 themes that define the concept of digital nomads (COVID-19, co-working, digital work, gig economy, internet, lifestyle, lifestyle migration, location independence, mobile technology, mobility, networks, nomadic work, remote work, tourism, work, work practices and youth travel). As shown in the Conceptual Structure Map, these core themes can be further divided into three areas of interest. These areas (clusters) form a framework for research into digital nomads. The first area of research on digital nomads includes publications focusing on the definition and distinction between remote, nomadic and digital work. The second includes publications on changing life and work styles in relation to location independence. And the third includes publications addressing the factors that define and affect the lives of digital nomads.

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Based on these results, it is possible to identify themes that have not yet but need to become a focus of future research. One such area is that of policymaking; identifying specific changes to legislation that would make life more settled for digital nomads is an as of yet unexplored potential core theme of research. Likewise, few scholars have discussed the economic and taxation factors of nomadic life. Last but not least, we see too little research in the intersection of digital nomadism and social media - digital nomads often use social media to share their nomadic lifestyle.

Discussion

Although the term digital nomad first appeared in 1997, used by Makimoto and Manners in the WOS database, the first research article into the phenomenon only appears in 2006. Reichenberger (2018) and Thompson (2018) have already observed the low degree of scientific attention given this area. But as stated by Hannonen (2020) and as our results show, the number of publications is steadily growing.

As our research is the first bibliometric analysis of the domain of digital nomadism, it is not possible to compare the results obtained from WOS with others. However, it is possible to draw general conclusions for discussion. In accordance with the present results, previous studies have demonstrated that the USA is the most productive country terms of the number of publications on digital nomads (Shehatta & Al-Rubaish, 2019). According to our results and in contrast to earlier findings (Shehatta & Al-Rubaish, 2019), Russia is the second most productive in terms of the number of publications on digital nomads. Shehatta and Al-Rubaish (2019) agree on third place for the United Kingdom. To compare the productivity of different countries in this field, we can also look to fields that are similar to the domain of digital nomadism. Abarca et al. (2020) carried out a bibliometric study on working in virtual teams. His results show that the USA is the most productive country, followed by the UK and Germany (Abarca et al., 2020). Overall, the USA is the most productive country in publishing – as is confirmed by our research and the research of others (Abarca et al., 2020; Shehatta & Al-Rubaish, 2019). Co-authored papers are commonly used to indict international collaboration (Aria et al., 2020; Leydesdorff et al., 2013). Therefore, it can be assumed that the countries with the highest CCR in our research (Germany, the UK and the USA) will become international leaders in the field of digital nomad research. Digital nomads are not yet grounded as a research area (Hannonen, 2020). Therefore, the results of our research about the most productive authors suggest that their publications will serve as and establish the foundations of the research field of digital nomads.

Three areas of research on digital nomads

Our results divided the core research concepts into three clusters - everyday life of the digital nomad, the nomadic lifestyle, and the difference in digital, nomadic and remote work. Red cluster (everyday nomadic life) refers to the issues of the remote work of digital nomads and its impact on the outside world. The publications in this cluster address themes such as nomadic working practices and the fundamentals of digital nomadism – mobility (Dal Fiore et al., 2014; Hall et al.,

2019; Jung & Buhr, 2021) and tourism (Bozzi, 2020; Nash et al., 2018; Orel, 2021; Willment, 2020). Other studies focus on youth travel (Alekseevna et al., 2019; Richards, 2015; Richards & Morrill, 2021). Studies in the red cluster also focus on the working environment of digital nomads – co-working spaces (Cruz et al., 2021; Lee et al., 2019; Orel, 2019) and social networks (Bozzi, 2020; Cnossen et al., 2021; Philippou, 2013). The publications within the red cluster focus not only on the work and environment of digital nomads but also on the factors that enable digital work - such as the internet and mobile technologies (Dal Fiore et al., 2014; de Loryn, 2022; Jung & Buhr, 2021; Patokorpi, 2006), and the gig economy. Publications in the red cluster also studied digital nomads from the perspective of the recent pandemic. For example, de Almeida et al. (2021) see COVID-19 as an opportunity to test digital nomadism, while Richards and Morrill (2021) see COVID-19 as a challenge for young travellers and the travel business.

Publications from the green cluster deal with nomadic lifestyles based on work and location independence. This small cluster includes, for example, the Reichenberger (2018) study, which examined the motivations and lifestyles of digital nomads, and the Mancinelli (2020) study which, based on ethnographic and non-ethnographic research, describes the cases of digital nomads from Chiang Mai.

The blue cluster, which refers to the differences between digital, nomadic and remote work, consists of studies by Nash et al. (2021) and Hannonen (2020). Hannonen (2020) argues that it is important to distinguish digital nomadism from telecommuting and remote working. In so doing, she builds on the work of Thompson (2018), who clearly distinguishes between remote workers, who have a stable home, and digital nomads, who do not. Nash et al. (2021) goes even further, arguing that it is misleading to label digital nomads merely as location-independent workers because the ability to find or create a suitable workspace that matches individual preferences and technical requirements is critical for digital nomads.

Evolution of core concepts in digital nomad research

We analysed the authors' keywords to capture the evolution of core concepts in digital nomad research. Mobile technologies have become one of the most critical factors for developing digital nomads. Patokorpi (2006) studied how mobile technologies and ICT can be embedded in the education of future digital nomads. Between 2013 and 2018, researchers addressed topics related to the Internet. As Demaj et al. (2021) wrote, a mobile device and an internet connection

are most important for digital nomads. Bozzi (2020) even calls digital nomads "Internet-enabled remote workers." Similarly, Lee et al. (2019) interviewed digital nomads and found that high-speed internet is a priority when choosing a workspace. Our research results thus support these claims and highlight the Internet's importance in the lives of digital nomads.

The perception of digital nomads as a mobile people, that is, individuals with a migration lifestyle, is supported by many studies (Hannonen, 2020; Müller, 2016; Nash et al., 2018; Reichenberger, 2018). As mentioned above, moving from place to place is one of the basic ideas of nomadism. As our results reveal, the migratory lifestyle, referred to as mobility or location independence, is a core concept that permeates research on digital nomads through years of study – the themes emerged in 2018, 2019, and 2020. The combination of work and tourism is another fundamental principle of digital nomadism. A lifestyle that combines work and travel is what makes digital nomads their true selves. The ideal work/leisure ratio is exactly what nomads are looking for (Orel, 2019). Nash et al. (2018) point out that global travel adventure is one of the critical elements of digital nomads. Our results build on these claims and confirm that work and tourism are core concepts of digital nomadism.

In 2018, the core concept was youth travel. Reichenberger (2018) states that digital nomads are mainly young people (Millennials or Generation Z). Also, Seliverstova et al. (2017) mentions that these generations have been crowded by modern technologies from birth and therefore find it much more natural to work with them. In accordance with current knowledge, our results confirm that the gig economy is another core concept of digital nomadism. Some scholars describe digital nomadism as a form of flexible working in the gig economy (Jarrahi et al., 2019; Nash et al., 2018; Thompson, 2018). Cook (2020) points out that a large portion of autonomy and self-determination is needed in the gig economy to allow people to maintain the discipline of digital nomads.

The definition and conceptualization of digital nomads is a topic that has been a subject of several studies - as the blue cluster from the analysis confirms. As we stated in the literature review, there are many definitions of terms such as nomadic work, remote work or digital work e.g. (Bozzi, 2020; Hannonen, 2020; Hensellek & Puchala, 2021; Müller, 2016; Nash et al., 2018; Reichenberger, 2018). However, the phenomenon of digital nomadism is as of yet not firmly established (Reichenberger, 2018), nor is it a well-established area of research (Hannonen, 2020).

COVID-19 changed the world as we knew it. Almost the entire world had to move into a virtual workspace in a matter of weeks. Most companies chose to work remotely due to concern about the spreading virus (Abarca et al., 2020). Employees had to get used to new ways of working and use ICT technology to communicate and work daily (Frost & Duan, 2020; Newman & Ford, 2020). As our research shows, researchers have explored the impact of COVID-19 on digital nomads. COVID-19 raised interest in experiencing digital nomadism (de Almeida et al., 2021). COVID-19 has also changed the way people meet. As Milosevic et al. (2021) pointed out, in the post-COVID-19 era business conferences and similar meetings have been moved online, which may save money for the companies and time for the employees (Thompson, 2018). But as Richards and Morrill (2021) point out, COVID-19 also affected the tourism sector, resulting in, among other things, reduced travel possibilities for digital nomads.

In addition to COVID-19, co-working is also an important topic. Co-working centres are, to some extent, a substitute for open office space. Co-working centres are popular workplaces for digital nomads, as they offer the necessary infrastructure that nomads need. The motivation for choosing co-working centres may be the need for a pleasant and well-equipped workspace, a separation of work and personal life (or environment), and the need for socialization and professional collaboration (Lee et al., 2019). According to Orel (2019), co-working centres can be viewed from three perspectives: a community centre, an optimizing work-flow environment, and a supportive space that encourages individuals to pursue job opportunities. Consistent with the literature (Chevtaeva & Denizci-Guillet, 2021; Cruz et al., 2021; Lee et al., 2019; Orel, 2019, 2021), this research finds that co-working is a core theme for digital nomadism.

Conclusion

The present research aims to explore research on digital nomadism. This paper uncovers the underlying concepts, and explores leading countries and authors, as well as their evolution over time to reveal opportunities for future research. This study is exploratory and interpretive – in it we used bibliometrics, we systematically searched all articles indexed in the WOS database. This research also provides directions for a future conceptualization of digital nomadism.

In this research, we understand digital nomads as individuals with a mobile lifestyle that combines work and leisure and requires a particular set of skills and equipment. This study followed the evolution of scholarly production in the WOS database, identifying key authors and countries that have the potential to become pioneers in the field of digital nomads. It also identified 17 core concepts of digital nomad research (COVID-19, co-working, digital work, gig economy, internet, lifestyle, lifestyle migration, location independence, mobile technology, mobility, networks, nomadic work, remote work, tourism, work, work practices, youth travel). Furthermore, our findings suggest that there are three areas of research into digital nomadism in general. The first of these are publications focusing on the definition and distinction between remote, nomadic, and digital work. The second are publications on nomadic lifestyles and location independence. And the third are publications that address the factors that define and affect the lives of digital nomads. Taken together, these 17 core concepts and 3 areas of research form a framework for research on digital nomadism. Based on our results, it is possible to identify themes that have not yet been addressed in formal research and need to be addressed in the future. The area of policymaking and legislative changes that would make life more settled for digital nomads has not been identified as a core theme. Furthermore, economic and taxation factors of nomadic life have not received significant scholarly discussion. Last but not least, we perceive a lack of development in social media research - digital nomads often use social media to share their nomadic lifestyle. Further work needs to be done to determine how the 17 core concepts identified in this study affect the lives of digital nomads (e.g., empirical research or meta-analysis of the factors we have identified in this paper). Moreover, a study of the changes in working style wrought by COVID-19 pandemic is yet to be defined. Furthermore, a bibliometric study that would analyse data from other scientific databases (such as Scopus, Google Scholar, Pubmed, etc.) is needed to complete the picture of scientific publishing in digital nomadism.

One limitation of the study is the scarcity of elements of bibliometric analysis. For example, we only used articles indexed in one database WOS, thus limiting the number of publications, authors and themes we identified in this study. Therefore, further bibliometric analysis of publications in other databases is needed to extend the results of our investigation. Another limitation comes from the use of author keywords to analyse core themes. Further limitation is the deletion of publications that were not written in English (see the screening process in the Materials and Methods section). Deleting non-English written articles may have biased the results of our analysis of national contributions to the study of digital nomadism. Despite its limitations, the study certainly adds to our understanding of research into the phenomenon of digital nomads. The findings reported here shed new light on research into digital nomadism. The study contributes to our understanding of core concepts of digital nomads. It is beneficial not only for researchers who want to understand the topic of digital nomadism but also for policymakers who are preparing changes in labour or tax law, employers who are managing digital nomads and co-working space companies, etc.

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Chapter III: Metaverse in the virtual workplace

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Abstract

The emergence of digital technologies has significantly transformed the workplace by enhancing productivity and improving employee well-being. One of the latest technological advancements in the workplace is the metaverse, which has tremendous potential to facilitate collaboration in virtual teams. In this study, we conducted a comprehensive bibliometric analysis to identify core research themes on applying metaverse in the workplace. Our findings reveal core themes, including an avatar, computer graphics, immersion, virtual world, and virtual reality. We also developed a theoretical and conceptual framework to define a metaverse in the workplace, which includes individual, team, and organisational factors as well as contextual moderators that influence its implementation. Finally, we propose a definition of a metaverse in the workplace as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity. Our study contributes to the growing body of research on the practical applications of a metaverse in the workplace. It highlights the importance of considering various factors for its successful implementation.

Keywords: Post-work, bibliometrics, remote work, digital technology, virtual team, bibliometrix

Note: the citation style of the following chapter followed the required style from journal, and it might differ from the citation style used in this dissertation.

Introduction

The COVID-19 pandemic has intensified the need to incorporate digital technologies (DT) into the workplace, leading to a significant acceleration in the transition to DT adoption in various business areas (Davison, 2020; Newman & Ford, 2020; Selimović et al., 2021). During COVID-19, organisations were forced to immediately digitise the workplace and switch to the virtual environment (Meluso et al., 2020). As a result, organisations and employees alike became accustomed to new working environments and remote collaboration forms (Bailey & Breslin, 2020; Frost & Duan, 2020). All this led to the expansion of new virtual forms of cooperation in the workplace across space or time. It is important to note that DT adoption in the workplace does not necessarily equate to a virtual environment. While DT refers to using digital tools and technologies, a virtual environment is a digital representation of a physical space or world, often created through computer simulation, that allows users to interact through a virtual interface. For the successful adoption of DT in the workplace, Trenerry et al. (2021), developed a multi-level framework that emphasizes three levels of factors that organisations must consider during DT - individual, group, and organisational factors.

A classic example of the use of DT in the workplace is telework. Nilles (1994) and Olson & Primps (1984) defined telework as using computer-based technology or telecommuting outside the typical office setting to communicate with it. In teleworking, employees are asked to perform some of their duties at an official workplace (e.g., an office). In cases where the employee works permanently from home, we talk about remote working. Remote working brings several benefits to organisations and employees. Specifically, it reduces the costs (Bjørn & Ngwenyama, 2009; Thompson, 2018) and expenses associated with travel access (Bjørn & Ngwenyama, 2009). Remote working also improves the performance of the organisations by the possibility to access talented people worldwide (Aldag & Kuzuhara, 2015; Marques et al., 2021). Remote working has its advantages, such as a high degree of flexibility in the day's scheduling (DeRosa, 2009) and a certain autonomy in the execution of individual tasks (Ryan & Deci, 2017)., but also disadvantages – necessary information and communication technologies (ICTs) and ergonomic equipment for work (Gilson et al., 2015; Kačerová et al., 2022; Mcgill et al., 2020), impact of remote working on well-being of the employee, or for example unclear legal basis for remote work in some countries, including tax rules (Tyutyuryukov & Guseva, 2021). Remote workers are

often joined into virtual teams, who collaborate through ICTs and rarely meet face-to-face (Aldag & Kuzuhara, 2015).

DT also brings new elements into the work environment, such as extended reality (XR), augmented reality (AR), mixed reality (MR), and virtual reality (VR), which takes remote work further. Many authors understand XR as an umbrella term that includes AR, MR and VR (Kaplan et al., 2021; Milgram & Kishino, 1994; Morimoto et al., 2022; Mystakidis, 2022; Zhang et al., 2022). Based on these authors, AR integrates digital elements into the real environment. MR freely builds on and extends AR, thus allowing digital components to interact in the real world. VR is a cutting-edge human-computer interface replicating real-world settings and provide a feel of telepresence in virtual reality. But the understanding of these terms is inconsistent. For example, Rauschnabel et al. (2022) argue that XR should not be an acronym for extended reality because X should represent all endless new formats of xReality. Wedel et al. (2020) perceive MR as integrating VR and AR. Furthermore, Hoyer et al. (2020) described MR as augmented AR, except that MR requires a unique headset (e.g. Oculus). Rauschnabel et al. (2022) understand the distinction between AR and VR based on the principle of the individual's surroundings - in the case of AR, the user's surroundings are part of the experience, at least visually. In contrast, users of VR are immersed in a simulated world to the point where they feel as though they are really "there" (Bowman & McMahan, 2007). Regardless of the clarity of the definitions of XR, AR, MR and VR, it is clear that these technologies are changing the current world. In numerous industries, including aerospace, manufacturing, employee training, process simulation or visualization, and marketing, VR is gradually becoming a stable technology (Kumar et al., 2022; Kumar, 2022; Mortazavian et al., 2019; Stone et al., 2011). In line with three-dimensional representation, VR is essential in the workplace. For example, virtual office, which is designed to support casual interaction in an organisation (Sharma et al., 2011), allows users to virtually enter the office (own or others), opening doors for informal encounters and getting acquainted with an unfamiliar environment. One of the newest types of innovation in workplaces is becoming a metaverse.

Metaverse as the future of the virtual workplace

As Lee et al. (2021) stated, the word "metaverse" consists of the prefix "meta", which denotes transcendence, and the word "universe", which describes an imaginary synthetic environment connected to the physical world. Wei & Zhang (2022) projected that the revolutionary nature of the metaverse will lead to several new technological advancements in a long line of IT technologies. This concept uses many associated technologies, such as game worlds, social networks, artificial intelligence (AI), VR, AR, MR, XR, brain-computer interface (BCI) or internet of things (IoT) (Park & Kim, 2022; Wei & Zhang, 2022; Zhu, 2022). Dwivedi (2022) divides the application of metaverse into two categories - metaverse as a tool (e.g. for office, social life, education and healthcare) and metaverse as a target (can be used in games, business, role play or real estate). Metaverses are being incorporated into numerous aspects of our lives, more businesses are implementing metaverse offices for telework and remote work (Choi, 2022). Worldwide, teleworkers use immersive, interactive, and collaborative metaverse systems. Specific examples are platforms created by Gather, Teamflow or Meta Inc. (Park & Kim, 2022). The metaverse office provides a user experience, an immersive service that replaces the actual physical space (Dwivedi et al., 2022). The reason for implementing metaverse into the workplace is apparent - more effective employee communication. When setting up meetings or requesting documents from coworkers, teleworkers do not need to send messages or emails, they can only do it by moving their avatars (Choi, 2022). Purdy (2022) also stated that the metaverse workplace can offer a direct line between work and leisure, by creating the impression of walking in and out of the virtual space. Thus, it can improve the well-being of employees. Another reason for implementing metaverse in the workplace that Purdy (2022) argue is the possibility of creating original virtual office space. There is also discussion of the involvement of the metaverse in recruitment and talent acquisition (Durana et al., 2022; Lyons, 2022), training and skill development (Hawkins, 2022) or for example, virtual human resources (Zvarikova et al., 2022).

Research into using metaverse in the workplace is in its early stages. Still, it is already of interest to big players in remote collaboration transformation, such as Meta Inc., Microsoft or Nvidia. In 2021, all of these organisations introduced their metaverse projects: Nvidia introduced Omniverse (Petrosyan & Aristova, 2022), Microsoft presented a new mixed reality platform for enterprise use - Microsoft Mesh and Facebook transformed into Meta Inc. (Bian et al., 2022). Another exciting venture is NextMeet, creating an immersive platform that deals with interactive

collaboration using virtual avatars (Purdy, 2022). Despite the growing interest in metaverse in recent years (Kaplan et al., 2021; Morimoto et al., 2022), there is still a limited body of research on the topic. At the same time, it is not clear how to define the metaverse as a form of virtual workplace. Researchers have offered definitions of metaverse per se (Al-Ghaili et al., 2022). For example, Bourlakis et al. (2009) understand the metaverse as online virtual worlds. Hudson-Smith (2022, p. 343) understand the metaverse "at first sight, a mirror to the current world, a digital twin, but it is more than this: It is an inhabited mirror world where the physical dimensions and rules of time and space do not necessarily apply". Based on Bolger (2021) and Lee et al. (2011) four elements can characterize the metaverse – augmented reality, lifelogging, mirror worlds and virtual reality. However, Park and Kim (2022, p. 4209) have a different suggestion and claim that the current metaverse has "three components (i.e., hardware, software, and contents) and three approaches (i.e., user interaction, implementation, and application)". Bolger (2021) suggests that the metaverse is a pervasive expression of technological culture and will have a global impact. Bolger (2021) further argues that AI will integrate all the elements through knowledge, social and geospatial technologies by various digital means, thereby creating a three-dimensional information and experiential layer across the globe called the metaverse. Other scholars defined the metaverse as a 3D virtual environment where users can interact with each other and objects in real-time using avatars (Duan et al., 2021; J. Kim, 2021; Ng et al., 2021). Despite numerous definitions of metaverse (Al-Ghaili et al., 2022), none have yet addressed metaverse in the workplace. Metaverse has the potential to revolutionize the way we work, collaborate and communicate in virtual environments. This indicates a need to define the metaverse in the context of the virtual workplace to fully understand its potential impact, leverage its benefits, improve the employee experience, and address the potential risks and challenges associated with its adoption.

It is also unclear what factors influence successful collaboration in the midst of a metaverse. Based on research, it is known what factors help to enhance the productivity of virtual teams - for example, knowledge (Bennet, 2022; H.-Y. Choi, 2022; Davis et al., 2009; Gilson et al., 2015; Schouten et al., 2016; Tunk & Kumar, 2021), autonomy (Moe et al., 2010), creativity (Anderson et al., 2014; Torres-Coronas & Gascó-Hernández, 2009), trust (Jimenez et al., 2017), communication (Jarvenpaa & Leidner, 1999; Purvanova et al., 2020) or mental health (Glazer et al., 2012; Ho et al., 2022). However, whether these factors also can be applied in a metaverse environment remains unclear.

Another problem is that the source of information is often internet blogs, newspapers, and interviews rather than academic and peer-reviewed literature (Adhyaru & Kemp, 2022; Kačerová et al., 2022; Kalischko & Riedl, 2021). Moreover, Metaverse in the workplace is emerging but is not well established as a proper research category yet. Dahan et al. (2022) stated that the metaverse framework is still unclear because the components are not specified yet. Davis et al. (2009) point out that studying metaverse in the workplace can contribute to a deeper understanding of virtual collaboration and teamwork in traditional contexts, showing how metaverses differ from other types of work environments and how their uniqueness can improve the functioning of virtual teams, including the design of technologies for team collaboration in the metaverse.

This study presents a comprehensive study of the application of metaverse in the workplace to enhance collaboration in virtual teams. Firstly, our study aims to identify core research themes on metaverse in the workplace using a bibliometric analysis of current research. Second, the study aims to describe the identified core themes (clusters) and interpret their role in transforming the virtual workplace into a metaverse. And thirdly, this study aims to propose a conceptual framework towards the definition of a metaverse in the workplace. Identifying fundamental themes and creating a conceptual framework can become the groundwork for further research, practical implementation within the organisations and policymaking affecting the issue of virtual environments in the workplace.

Methodology

To highlight the main research themes and their development, we used bibliometric analysis, a systematic, transparent and reproducible measurement of science (Aria et al., 2020; Broadus, 1987; Pritchard, 1969). In the first step, we searched the Web of Science (WoS) database on 27 July 2022 with the following search query:

TS=(metaverse) AND TS=(team* or *work* or cooperation*)*

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=1945-2022

According to Singh et al. (2021), WoS contains top-level research work and is considered the most accurate. For this reason, we choose this database. During the searching process, we have adapted the PRISMA flow diagram by Page et al. (2021) to capture our decision on which references to include in the bibliometric analysis. Search query returned 144 records – 130 in the English language. We excluded the editorial materials and letters (as shown in Figure 1). Overall, we used 123 records for bibliometric analysis.

Figure 1: PRISMA diagram
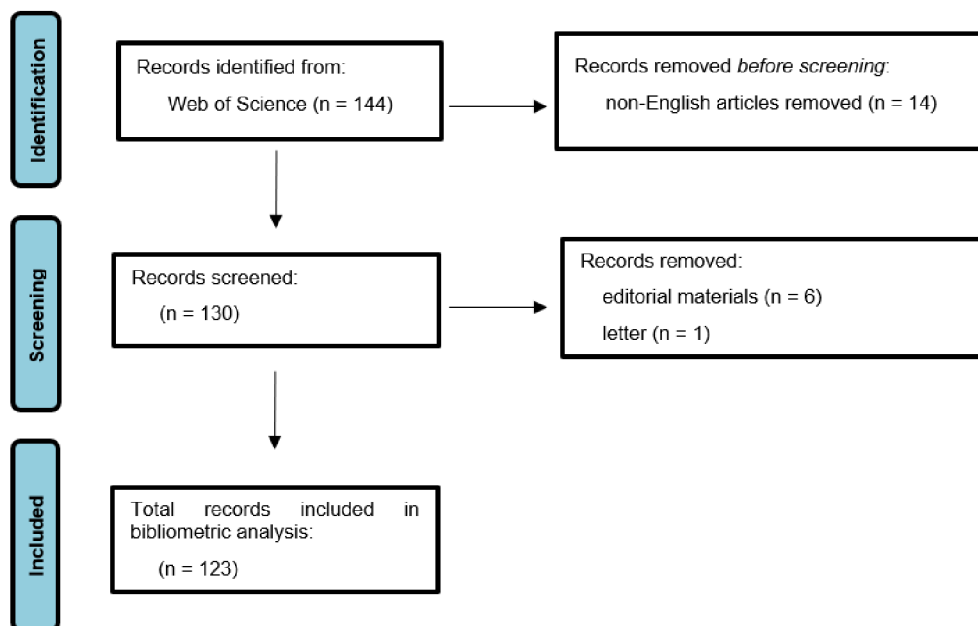
Source: own collaboration based on Page et al. (2021)

For bibliometric analysis, we used RStudio, Biblioshiny app by Aria and Cuccurullo (2017). We used a technique from social network analysis to create co-occurrences networks. By applying a clustering algorithm and the Callon centrality method (Callon et al., 1991) on the author's keyword co-occurrences networks, we highlighted the different themes and created a thematic map and network. To avoid bias, we merge synonyms and plurals of certain keywords (e-learning and e-

learning environment; virtual world, virtual worlds, and 3D virtual worlds; avatar and avatars). To avoid biased results, we did not include the keyword metaverse in the analysis. In the thematic map, the centrality shows the importance of the theme in the research field, density shows the theme's expansion (Cobo et al., 2011). We can read the thematic map according to the quadrant in which the theme is placed: upper-right quadrant = motor themes; lower-right quadrant = basic themes; upper-left quadrant = highly developed and isolated themes (very specialised or niche themes); lower-left quadrant = emerging or declining themes (Aria & Cuccurullo, 2017; Pourkhani et al., 2019). In which quadrant a given cluster appears depends on its centrality and density – for example, clusters with high centrality and density (containing strong internal lines) are found in the motor theme quadrant. In contrast, clusters that have weak ties with other clusters, but strong internal ties appear in the upper left quadrant (Firdaniza et al., 2022). Each bubble in the thematic map represents a network cluster. The bubble size is proportional to the cluster word occurrences and the bubble name is the word with the highest occurrence value (Aria & Cuccurullo, 2017).

Results and discussion

The search query identified 123 records in the WoS database. These records are articles, proceedings papers, and reviews – in this study we call all these formats papers. A total of 327 authors contributed to these papers. The dataset contains 34 single-authored papers, with an average of 2.93 authors per paper. The average paper receives 1.7 citations per year (overall, the average paper has 13.8 citations). Looking into the history and development, we find that the oldest paper in our dataset is a paper by Shi et al. (2004), which describes the development of technology for low-cost network immersive environments. However, the metaverse is an older concept. For the first time, this word was used in Neal Stephenson's fiction novel Snow Crash (Stephenson, 1992). As Ning et al. (2021) mentioned, this concept has constantly been evolving since then. Thirty years later, the metaverse is ready to emerge as a new digital platform for business relationships (Wei & Zhang, 2022), or even as a tool to promote social good or healthcare (Duan et al., 2021; Wiederhold, 2022).

As shown in Figure 2, the number of papers in our dataset was constant except for 2010, 2011 and then the big boom in 2022. Till 2020, the Annual Growth Rate was 7.6 %. But now, with the rapid increase in publications in 2021 and 2022, the annual growth rate for the analysed dataset is 25.73 %. Focusing on the first increase of papers in our dataset (in 2010), we found that most papers were dedicated to the online multimedia platform Second life (Ayiter, 2010; Getchell et al., 2010; Morie, 2010; Sharma et al., 2010). Another important milestone for the metaverse was the production of the prototype Oculus Rift by Palmer Lucccore in 2010. We can see the second increase in publications in 2021 (13 publications) and 2022 (49 publications so far - calculated as data download date 27 June 2022). There are several reasons for the increase in the last two years. The first reason is the support of the metaverse by major organisations like Meta Inc. (formerly named Facebook, Inc.), Microsoft or Nvidia. In March 2021, Nvidia released the key features of Omniverse - a platform for connecting 3D worlds into a shared virtual universe (Petrosyan & Aristova, 2022). In April 2021, Microsoft Mesh was introduced as a new mixed reality platform primarily for enterprise use (Bian et al., 2022). In October 2021, Mark Zuckerberg launched Meta Inc. Zuckerberg also refer to the metaverse as the integrated environment that links all of Facebook product and services (Bian et al., 2022). A second reason for the rapid increase in publications is COVID-19. During the COVID-19, organisations were forced to immediately digitise the workplace and switch to the virtual environment (Meluso et al. 2020). As a result,

organisations and employees alike became accustomed to new working environments and remote collaboration forms (Bailey a Breslin 2020; Frost a Duan 2020). Overall, all types of flexible forms of collaboration, such as remote working, working from home or digital nomadism, are taking on new dimensions (Meluso et al. 2020). For organisations, moving to a virtual environment can be a challenge. Organizations are therefore demanding solutions to transform the workplace into a virtual world. Researchers are responding to this unusually high demand by publishing the latest knowledge on remote collaboration, virtual teams, teleworking and working from home, as well as digital nomads and the metaverse.

Figure 2: Number of publications in time
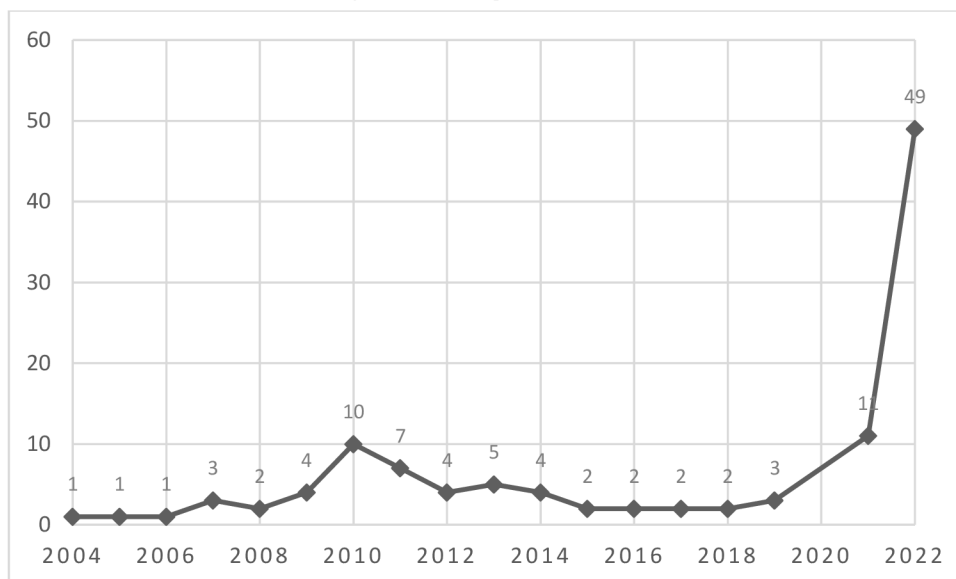
Source: own collaboration

Zhang et al. (2022) conducted a bibliometric study on VR, AR and MR in surgical research, results showed a steady increase in publications. Further research also confirms the growing interest in VR, AR and MR (Kaplan et al., 2021; Morimoto et al., 2022). Those results are consistent with our results and confirm the growing interest in topics connected to the metaverse. Also, given that we downloaded the data mid-year, we can expect a further significant increase in publications dealing with the metaverse in the workplace. Future research should therefore explore the issue of the rapid increase in research on this topic in more depth.

Identification of core themes

The core themes of the metaverse research in the workplace are shown in Figure 3. As can be seen, the research of metaverse in the workplace is divided into six thematic clusters – avatar, computer graphics, immersion, industry 4.0., virtual reality, and virtual word. The position of each cluster (bubble) indicates its potential for future research (see methodology).

Figure 3: Core themes and its potential – Thematic map
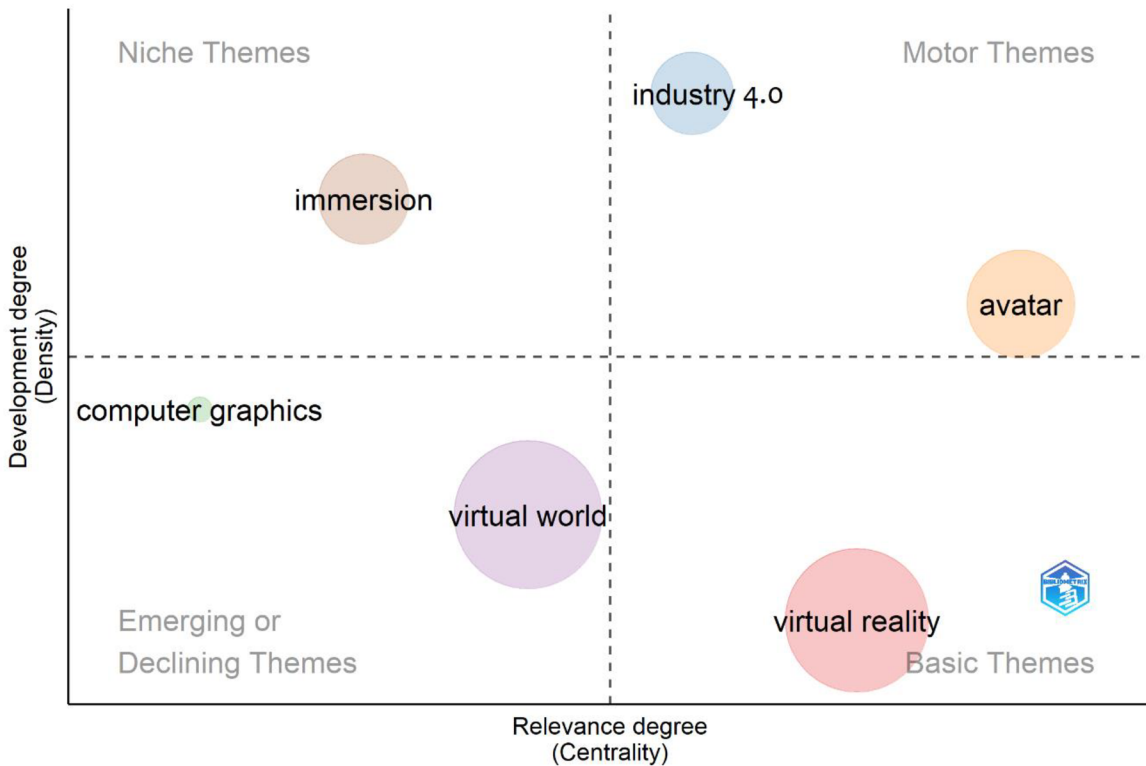
As seen in Figure 3, research connected with the keyword immersion is highly developed and isolated theme – so called niche theme, that have a great potential to become motor theme. The cluster of research related to "computer graphics" is on the rise and heading towards becoming a niche theme. One of the most significant clusters is research on "virtual worlds". Based on the location of the purple cluster in the Figure 3, we can assume that many studies on virtual worlds have already been done and therefore this cluster is moving to declining themes. Therefore, researchers should focus on innovative ideas that they can bring to the factors addressed in this cluster. The clusters in the motor themes quadrant are research related to industry 4.0 or avatars. These are medium-sized clusters, which nevertheless generate the driving force for the entire metaverse research. Another major cluster is research related to "virtual reality". The so-called basic themes form this red cluster, are the fundamental pillars of the metaverse research. Table 1 provides a statistical description of the individual clusters.

Table 1: Cluster information

Cluster	Callon Centrality	Callon Density	Rank Centrality	Rank Density	Cluster color
Avatar	1.29	102.03	6	4	Yellow
Computer graphics	0	75	1	3	Green
Industry 4.0	1.05	147.22	4	6	Blue
Virtual reality	1.16	41.95	5	1	Pink
Virtual world	0.95	64.91	3	2	Purple

Source: own collaboration

The results of our bibliometric analysis can be compared with papers published in the journal Psychosocial Issues in Human Resource Management (Volume 10 (1), 2022). The authors of these papers mainly analysed records from WoS, Scopus and ProQuest databases. The results of these analyses showed, for example, that virtual meetings, teamwork, and workspaces can be improved by cognitive technologies such as motion and behavioural tracking, voice biometrics, and so on (Popescu Ljungholm, 2022). Bennett (2022) argued that workplace technology and immersive work environments can enhance the virtual reality training experience. Zvarikova et al. (2022) analysed how immersive work environments support the productivity and performance of virtual teams. Hawkins (2022), in turn, analysed virtual reality-based recruitment tools.

Avatar

The orange cluster connects the factors that shape the avatar. The orange cluster is between the motor and basic themes (as shown in Figure 3). The avatar is the central agent for the metaverse. As Davis et al. (2009) argue, avatars allow members of virtual teams to communicate face-to-face using 3D technologies to represent each member's thoughts, values, objects or feelings. Park and Kim (2022) argue that the avatar in today's metaverse represents the alter ego, the social role of the individual based on the individual's perceptions in real life. Purdy (2022) takes the idea even further and says that in the future, in the metaverse, there will not be just lifelike employee avatars, but there will also be AI-created avatars who will make work easier for real employees. Al-Ghaili et al. (2022) state that avatars can play an important function, allowing co-workers to quickly and intuitively understand what a client or colleague needs to communicate, just like in real life.

The orange cluster also contains factors that influence virtual team members in the metaverse (and thus their avatars) - identity, play, autonomy, and creativity. Team members may build trust and a sense of shared identity by working together over time, which improves their capacity to communicate and learn from each other (Kimble, 2011). For example, in virtual teams, identity plays a crucial part in communication; knowing someone's identity is essential to building a shared understanding, which then contributes to establishing shared meanings by offering a common viewpoint (Kimble, 2011). Identity in the metaverse consists primarily of avatars through which team members communicate their opinions, thoughts, etc. (Davis et al., 2009; Park & Kim, 2022). Autonomy in virtual teams fosters higher trust and collaboration, encouraging team effectiveness and performance (Choi & Cho, 2019) and promoting individual satisfaction (Robert & You, 2018). Another factor withing the orange cluster is creativity. Various factors can influence team creativity not just on a personal level but also on team-related components like emerging states and processes (Reiter-Palmon et al., 2021). Chávez-Aguayo (2009) argues that creating original content in the metaverse encourages creativity because it allows people to express themselves in original ways that enrich the content of virtual life. Torres-Coronas & Gascó-Hernández (2009) mention that creativity may help virtual teams work better; however, due to the lack of research in this area, there is still a challenge in reaching high levels of creative performance.

Part of the research in the orange cluster is also devoted to education and e-learning. As mentioned above (in the description of the red virtual reality cluster), the metaverse is used in educational contexts (Abeles, 2007; Crespo et al., 2013; Cruz-Lara et al., 2011; Dahan et al., 2022; Kanematsu et al., 2014; Siyaev & Jo, 2021). Nevertheless, is still unclear is how the metaverse can be used to train employees in various areas of education.

Computer graphics

As argued by Zhao et al. (2022), computer graphics and hence the visualization of the metaverse is a very important factor that influences the visual construction of the metaverse and user-centric exploration. In addition to creating a virtual 3D world, the metaverse also includes the creation of holographs (Purdy, 2022); therefore, visualization and computer graphics are a crucial part of the metaverse. As seen in the Figure 4, there is a small body of research on computer graphics and human-centered computing. The position of this cluster (Figure 3) suggests that computer graphics is an emerging theme in the metaverse.

Figure 4: Network analysis of core topics
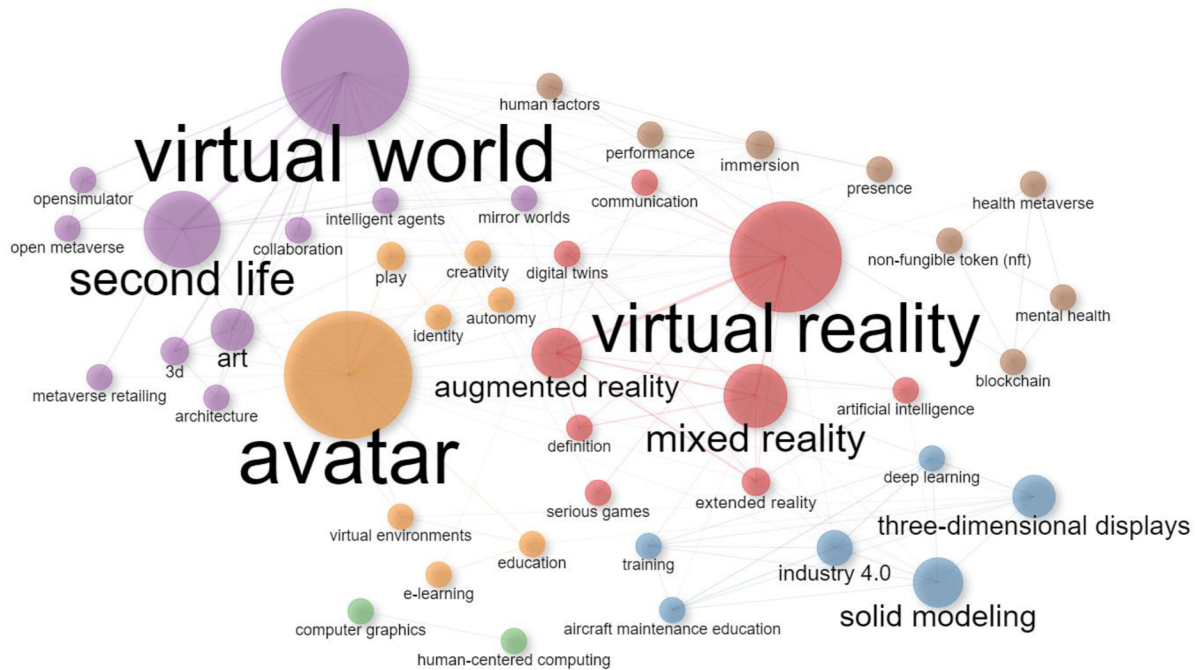
Source: own collaboration

Industry 4.0

The blue cluster comprises research that deals with industry 4.0. As can be seen from Figure 4, factors such as training, deep learning, three-dimensional display and solid modelling are associated with this theme. As we argued in the literature section, DT is a crucial driver in transforming the work environment. In today's world, we need high levels of digital inclusion, and robust and resilient infrastructures to deliver optimized, automated and protective networks (Jacquenet, 2021), we need smart factories where automated processes will take place (Alpala et al., 2022; M. Kim et al., 2018) and we also need to incorporate elements of deep learning and AI to make employees' jobs easier (Purdy, 2022). Industry 4.0 smart technologies are already standard in factories, and these technologies place significant demands on the knowledge of the workforce. At the same time, it is not yet clear how the elements of industry 4.0. should be integrated into the metaverse in the workplace. Another example of using a metaverse in the industry is the design and development of a serious game for a real industry partner that aims to simplify and provide complex information (Khan et al., 2022; Siyaev & Jo, 2021). As the position of the cluster in Figure 3 suggests, this is a motor theme, which has been the focus of several researchers. But as Park and Kim (2022) noticed, there is still a small

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body of literature focused on technology for the metaverse, thus there is still room for further research.

Immersion

Research from the brown cluster is concerned with the presence and immersion of participants in the metaverse - examines the impact of this immersion on the health and performance of metaverse participants. As mentioned in the literature review, the performance of virtual teams depends on many factors, such as autonomy (Choi & Cho, 2019), satisfaction, trust (Robert & You, 2018) and communication (Espevik et al., 2006; Kozlowski & Ilgen, 2006), team members' perceptions of fairness and unity (Boroş et al., 2010), the social interactions between the team members (Horwitz et al., 2006), or positive atmosphere (Coppola et al., 2004). Our research suggests that there is a connection between immersion, presence, and performance in the metaverse. However, the question remains how the immersive environment of the metaverse can be supported to enhance the performance of virtual teams. Health is addressed in the metaverse both in terms of physical health - e.g. ergonomics of the working environment (Kačerová et al., 2022; Mcgill et al., 2020) and mental health (Ho et al., 2022). Mystakidis (2022) claim that the metaverse is facing several challenges such as the physical well-being of users, psychology (such as information overload). Regrettably, there is a great lack of research in the metaverse's mental and physical health areas (as also suggested by the location of the cluster in the niche themes quadrant – see Figure 3). Therefore, future research should focus on emotional, psychological, and social well-being as well as physical health in the metaverse workplace.

Virtual reality

As you can see in Figure 3, the virtual reality cluster is located in the basic themes area. We can conclude that the factors from this cluster are already explored to some extent and thus form the basis for further research. As can be seen in Figure 4, within that cluster, publications address the definitions and differences of extended, virtual, mixed, and augmented reality. The differences between these concepts is clear. As we stated in the literature review, XR can be seen as an umbrella term that includes AR,MR and VR (Kaplan et al., 2021; Milgram & Kishino, 1994; Morimoto et al., 2022; Mystakidis, 2022; Zhang et al., 2022). VR creates a fully immersive digital environment where the real world is completely blocked out (Kaplan et al., 2021). There are many examples of the use of VR - whether in the field of medicine (Moro et al., 2017), serious games

(Bozanta et al., 2016), entertainment (Hartmann & Fox, 2021), or in the workplace (Bozanta et al., 2016; Hasler et al., 2009; Schouten et al., 2016; Tunk & Kumar, 2021). AR integrates digital elements into the real environment. Many researchers in various fields have studied the possibility of overlaying digital objects onto the real world - for example, in games (P. A. Rauschnabel et al., 2017), education (Lee, 2012), healthcare (Moro et al., 2017). MR freely builds on and extends augmented reality - MR allows digital elements to interact in the real world. Examples of the use of MR can be found in many fields - e.g. to enhance museum experiences (Antlej et al., 2018), in education (Birt et al., 2018; Schaf et al., 2012; Weng et al., 2019), avatar immersion (Etienne et al., 2016) and medicine (Birt et al., 2018). Park and Kim (2022) argue there are three differences between metaverse, AR and VR. Firstly, they highlight the social and sustainable overlap of the metaverse, secondly, the metaverse does not necessarily need to use AR and VR technologies, and thirdly, the metaverse can accommodate a large number of people and thus enhance social relevance (Park & Kim, 2022). However, as can be seen in Figure 4, metaverse, AR, VR, XR are often associated and addressed with metaverse.

VR is also used in education - e.g., using the serious game, which is in line with our results. As Mystakidis (2022) points out, the metaverse allows students to apply theoretical knowledge in a virtual environment, to experiment or learn from their mistakes, all in a safe virtual environment. The use of virtual reality in the serious game is often seen in medicine. An example is the Virtual Emergency TeleMedicine game, which creates a safe and controlled environment with virtual patients for medical students (Nicolaidou et al., 2015). Creating a safe and controlled environment is the main advantage of connecting metaverses with serious game. These are benefits that offer teamwork improvement (Bozanta et al., 2016), enhancing collaborative learning (Vahdat et al., 2013) or even crisis management training (Loreto et al., 2013).

Another example is developing a serious game for a real industry partner that aims to simplify and provide complex information (Khan et al., 2022). Purdy (2022) stated that the metaverse can revolutionize workplace training and skill acquisition through gamification in the metaverse. Despite the fact that there are already pioneers in the application of serious games to virtual reality and to metaverse in the workplace and in-team cooperation, this area is still very under-researched, and there is much room for future research - either in the integration of serious games or elements of gamification into the metaverse.

Within the red cluster, we can also see AI. Mozumder et al. (2022) argue that AI is one of the fundamental technologies of the metaverse. AI has been used in the metaverse, for example, to improve the teaching of football (Li et al., 2022), to improve medicine (Tan et al., 2022), or to study deep fake news (Neethirajan, 2021). Purdy (2022) talks about AI agents, digital colleagues, supervisors or assistants that could make the work of human workers easier in the future. However, research on the application of AI in the workplace metaverse is currently lacking. Therefore, this area opens great potential for both theoretical contributions and practical applications of AI to the working metaverse environment.

Virtual world

The research connected in the purple cluster deals with the theme of the virtual world. As can be seen in Figure 4, Second Life plays an important role in this cluster. Davis et al. (2009) claim that Second Life was the most visible platform of the metaverse. Several papers in our dataset deal with Second Life. Whether in terms of the demands that users have on it (Kumar et al., 2008), the study of communicative behaviour (Sharma et al., 2010), creativity and cultural production (Chavez-Aguayo, 2009), but also more technically based challenges such as the 3D representation of objects in the metaverse (Arroyo et al., 2009; Steurer, 2011). Salmasi and Gillam (2009) also point to the ethical dimension of Second Life and offer a framework for responsible gambling. Park and Kim (2022) argue that the metaverse and its focus on Second Life is not an appropriate platform for the current Generation Z, and therefore new platforms and ideas for the metaverse are necessary. In Second Life, researchers also investigated how individuals and organisations functioned in marketing products and services - metaverse retailing (see Figure 4). For example, Bourlakis (2009) studied what challenges and opportunities the metaverse offers in retailing. Hassouneh and Brengman (2015) consider metaverse retailing as an evolution of conventional e-commerce, that offers customers benefits and a better shopping experience. Gadalla, Keeling a Abosag (2013) offer a framework for retail in metaverse. However, there is a lack of recent studies to investigate how major organisations such as Meta Inc, Nvidia or perhaps Microsoft behave in the retail metaverse.

Another factor that the purple cluster contains is collaboration in virtual worlds, hence in the metaverse. Metaverse enables employees to communicate more effectively, primarily because the experience is more authentic, cohesive and interactive in the metaverse than in a traditional virtual environment (Purdy, 2022). As we stated in the literature, collaboration is crucial in the virtual workplace (Purvanova, 2014). Metaverse also allows to take collaboration to a higher level by encouraging networking, informal and spontaneous conversation, and overall supports the social aspect of teamwork (Purdy, 2022). However, it remains unclear how collaboration in the metaverse can be improved to achieve even higher performance of virtual teams.

Metaverse allows the creation of new worlds. This is inextricably linked to creativity, aesthetics and overall, it is a form of art. This is also why the word "art" can be seen in the purple cluster. Morie (2010), for example, deals with aesthetic expression in Second Life and presents the possibilities of new forms of art in virtual worlds. Tasa and Gorgulu (2010), in turn, describe the historical development of the metaverse and the dynamic and transformative relationship between art and information and communication technologies (ICTs). They introduce a new concept of "meta-art" that transforms the viewer into a participant, user, and even creator of artworks and content on the web. Chavez-Aguayo (2009) even suggests that the metaverse contributes to the democratization of culture, art and education by bringing creation closer to consumers and thus breaking down social, economic and political barriers. According to Morie (2010), the metaverse certainly brings a new dimension to art as well. However, from the perspective of this study´s focus, it is unclear how art in the metaverse affects the work environment and, consequently, employee satisfaction in the metaverse work environment. This lack of knowledge requires further research.

Towards the definition of metaverse as the future of the virtual workplace

As we mentioned in the Introduction, there are several definitions of metaverse per se, but there is no definition for the use in the workplace. Based on the bibliometric analysis, we have identified six core themes that serve as the basis for the conceptual framework (avatar, computer graphics, industry 4.0, immersion, virtual reality and virtual world). We applied the findings from the bibliometric analysis to the framework for Workplace Digital Transformation by Trenerry et al. (2021) and developed a theoretical conceptual framework towards the definition of a metaverse in the workplace (Figure 5). Similar to Trenerry et al. (2021), we suggest three levels of factors, that are important for practical applications of metaverse in the workplace.

Figure 5: Theoretical conceptual framework – Metaverse in the workplace
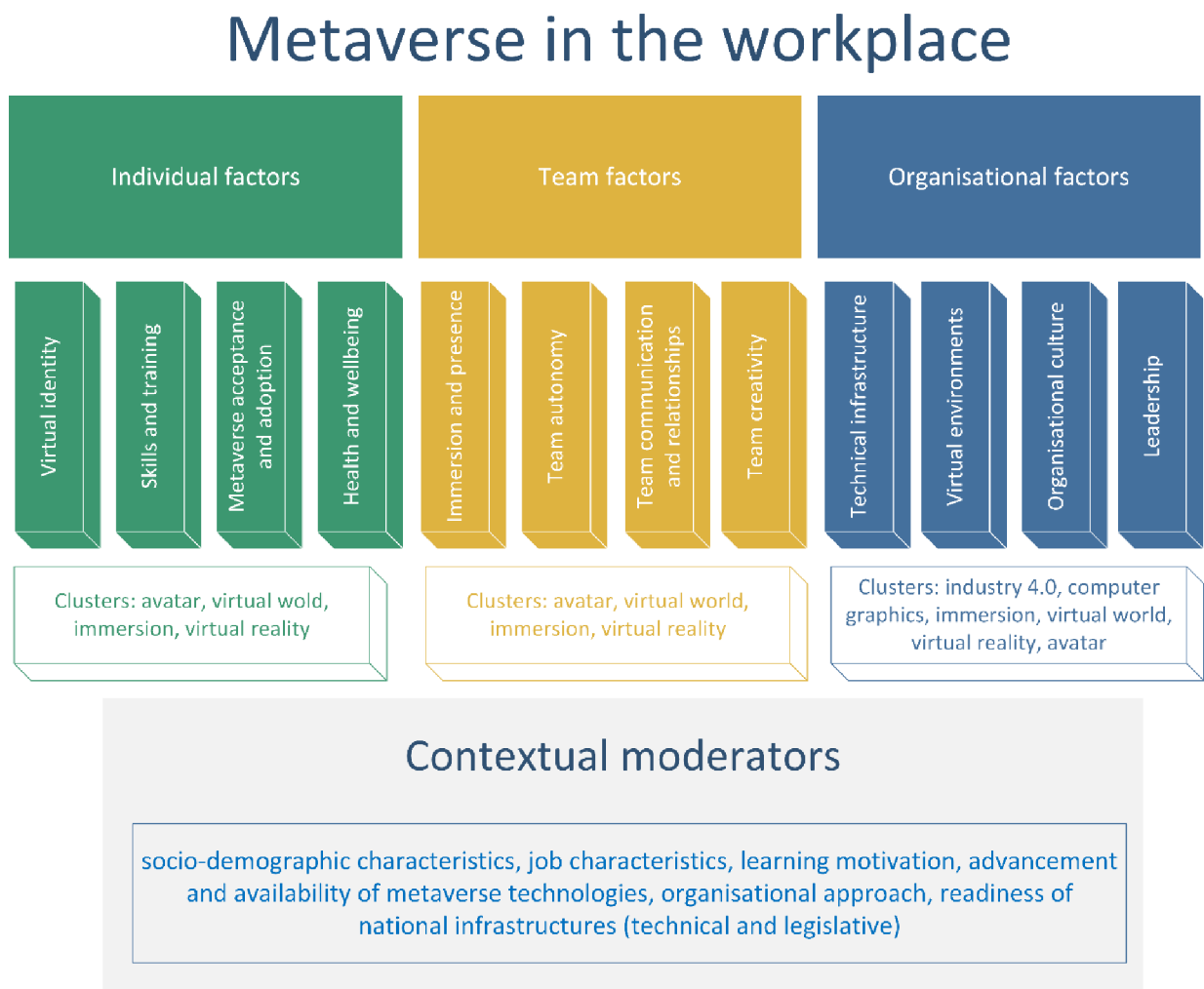
Source: own collaboration

At the level of individual factors, we emphasize the importance of virtual identity in the metaverse. Furthermore, specific skills and training are necessary to empower employees to work in the metaverse. Equally important is the acceptance and adaptation to the metaverse environment. Finally, it is essential to consider employees' health and well-being. At the level of team factors, we theorized that critical factors are immersion and presence in the metaverse, team autonomy, communication, creativity, and relationships. At the organisational level, we suggest creating a robust technical infrastructure, a virtual environment, and supporting an open corporate culture. Last but not least, a proper approach of the organisation's leadership in a metaverse environment is also essential.

As stated by Trenerry et al. (2021) it is important to note that the outcomes of any digital transformation are influenced by several personal, contextual and cultural moderators that should be considered when adopting digital transformation. Therefore, in our theoretical conceptual framework, we add contextual moderators that influence metaverse implementation in the workplace.

Based on the definitions of metaverse (see Introduction), on the results of the bibliometric analysis and the theoretical conceptual framework mentioned above, we proposed a definition of a metaverse in the workplace. The workplace metaverse can be understood as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity.

Looking ahead: limitation and future research directions

Our study has some limitations and areas for future research that could extend the findings and contribute to a deeper understanding of metaverse application in the workplace. First of all, the study focuses on a very small area of the metaverse, which is related only to the workplace (see the search query in the Methodology section). Another limitation is based on the bibliometric method used. For example, we used only papers indexed in WoS. We based the analysis of core themes on the authors' keywords. Our study offers a conceptual theoretical framework and a definition of metaverse in the workplace. But it does not offer a practical perspective of the impact of the metaverse on employee behaviour, attitudes, and outcomes, which could be addressed in future research.

Researchers should focus on innovative ideas that they can bring to the factors identified in our study. While our study identified some factors that influence creativity in the metaverse, more research is needed to explore how these factors can be leveraged to enhance creativity and innovation in the metaverse workplace. Also, it is not clear how the metaverse can be used in staff training in different areas of education (including serious game and gamification). Such research could investigate the effectiveness of these approaches in enhancing employee learning, engagement, and performance. Furthermore, a relatively small body of literature deals with technologies in the metaverse workplace (3D work environments, use of AI and retail). Further research could explore the potential of these technologies in improving collaboration and productivity in metaverse workplace. Another area for future research are immersive environments, which according to our study has a connection to performance and collaboration in the metaverse. Research in this area could examine how immersive environments can be designed and implemented to facilitate collaboration and promote positive outcomes in the metaverse workplace. The question also remains how the workplace metaverse affects emotional, psychological and physical health as well as well-being and what organisations can do to improve these factors. An equally interesting area for future research is how art in the metaverse affects the work environment and, consequently, employee satisfaction in the metaverse work environment.

Despite the aforementioned limitations, our study has several practical and theoretical implications for applying metaverse in the workplace. From a practical perspective, our findings suggest that organisations can use metaverse to enhance collaboration and creativity. This could lead to increased productivity and employee satisfaction in the workplace. Our study also identified areas where organisations can focus their efforts, such as employee training use of immersive environments and avatars. On a theoretical level, our study contributes by providing a comprehensive analysis of research on metaverse in the workplace. The core themes we identify can serve as a foundation for future research in this area. Moreover, our proposed conceptual framework towards defining metaverse in the workplace can guide researchers and practitioners in their efforts to understand and implement this technology. Overall, our study highlights the potential of a metaverse in the workplace and provides valuable insights for researchers and practitioners.

Conclusion

Since the early 1990s, we have seen a continuing transformation of the work environment. One of the newest workplace innovation types is becoming a metaverse. This study aims to study how metaverse can enhance collaboration in virtual teams by identifying core research themes, describing their role in transforming the virtual workplace, and proposing a conceptual framework for defining metaverse in the workplace. The results showed a dramatic increase in researchers' interest in metaverse issues in the workplace in the last two years (2021 and 2022). Based on the results from the bibliometric study, we identify core research themes on metaverse in the workplace – avatar, computer graphics, immersion, virtual world, and virtual reality. Further, we developed a theoretical, conceptual framework towards the definition of a metaverse in the workplace. We suggest three levels of factors that are important for practical applications of a metaverse in the workplace – individual factors, team factors and organisational factors. Further, we suggest contextual moderators that influence the implementation of a metaverse in the workplace. Finally, we proposed a definition of a metaverse in the workplace as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity. Overall, this study provides valuable insights into the practical and theoretical implications of using a metaverse in the workplace. By identifying core themes and developing a theoretical and conceptual framework, this study offers a foundation for future research and practical applications of this technology.

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6. Conclusion

By applying the conceptual framework of research presented in this dissertation (referred to in Figure 6), we can effectively integrate the individual articles into a unified structure. This approach delivered comprehensive, overarching results that directly addressed the research areas defined by the dissertation objectives. These results are detailed in Table 4 for the second level of objectives – the power of bibliometrics as a tool for science mapping, trend prediction and evidence-based management, decision-making in organisations and policymaking and in Table 5 for the first level of objectives – the future of work in the digital age.

Table 4: Results on Level 2 of objectives – The power of bibliometrics as a tool for science mapping, trend prediction and evidence-based management, decision-making in organisations and policymaking

Objective	Results
To illustrate the value of bibliometrics in systematic identification, mapping, and analysis of core research trends in remote work, metaverse and digital nomadism.	Using the practical example of three research papers, it has been systematically illustrated how bibliometric analysis has enabled a detailed understanding of the core research trends and their trajectories within the research. This allowed a detailed understanding of how certain concepts gained or lost importance, which is essential for predicting future trends and making informed decisions. Results have shown how insights gained from bibliometrics can be used to develop frameworks that support organisations and policies in adapting to technological advances (in this dissertation using specific examples in remote working and in integrating new work approaches such as digital nomadism and metaverse).
To demonstrate and critically evaluate the results of bibliometric analysis, exploring its applicability and value in evidence-based management and decision-making processes in organisations and at the policymakers level.	Results shown how bibliometrics provides managers with a dynamic, evidence-based tool for gathering information, analysing large volumes of data and identifying trends, research gaps and emerging themes. This capability supports knowledge discovery, strategic planning and decision-making and contributes to organisational growth, innovation, intellectual property management solutions and competitive advantage. An example of this is a practical framework that synthesizes the research and offers clear points for the management of organisations implementing metaverse in the workplace.

Source: author

Table 5: Results on the Level 1 of objectives – Future of work in the digital age

Objective	Results
To identify and explore the core themes that have driven remote work research over the past decade.	The core themes of remote work research are the organisation and possibilities of remote working, remote working behaviour, the consequences of remote working, managing remote working, home and gender. The historical network shows two clusters of publications. The first cluster links articles related to the multicultural dimension of remote work. The second cluster deals with various factors associated with remote working - issues of trust and communication, knowledge sharing, virtualness and leadership. Based on these findings, a theoretical framework for remote working adaptation was proposed based on personal, organisation and governance levels to capture the broad nature of this challenge. This framework became the theoretical foundation for the overall dissertation - see Figure 6.
To investigate how emerging technologies, specifically metaverse, can enhance productivity, collaboration, creativity, and well-being in virtual and remote work environments.	The workplace metaverse can be understood as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity. The results indicated the potential use of metaverse in the workplace, with avatar, computer graphics, industry 4.0, immersion, virtual reality and virtual world identified as core themes. A three-factor conceptual framework for metaverse in the workplace was proposed - based on individual, team, and organisational factors, complemented by contextual moderators. At the level of individual factors, we emphasize the importance of virtual identity, specific skills, and training to empower employees to work in the metaverse. Equally important is the acceptance and adaptation of the employees' health and well-being. Critical factors at the level of team factors are immersion and presence in the metaverse, team autonomy, communication, creativity, and relationships. At the organisational level, we suggest creating a robust technical infrastructure, a virtual environment, supporting an open corporate culture and a proper approach of the organisation's leadership.
To explore digital nomadism, identifying its scientific foundations, societal benefits, environmental impact, and policy considerations.	The results showed that there are three areas of research on digital nomadism that form a comprehensive research framework. The first are publications focusing on the definition and distinction between remote, nomadic, and digital work. The second are publications on nomadic lifestyles and location independence. The third are publications that address the factors that define and affect the lives of digital nomads (e.g. COVID-19, co-working, digital work, gig economy, internet, lifestyle, lifestyle migration, and location independence). The results also highlighted which countries are the most studied for digital nomadism, with Thailand being the most studied with 5 studies, followed by Russia with 2 studies. The results also point to large gaps in policymaking and legislative changes, in the areas of labour, tax, as well as visa policy, green deal and spatial planning.

Source: author

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6.1 Dissertation contributions, recommendations, and discussion

The contribution and significance of this dissertation extend far beyond academic discourse; it has implications for science, management practices, social norms, health and well-being, environmental aspects, urban planning, and policymaking. Even though this dissertation looked at different perspectives on remote working, it is clear from the results that there are certain concepts that are underlying all these perspectives. It is, therefore, possible to provide practical recommendations for different stakeholders. Following the structure of stakeholders from the theoretical part, the following lines show practical recommendations for the organisation and management perspective (combined with the employees and team perspective), the Policymakers perspective (policymakers), the societal and environmental perspective and of course contributions for the theory. The recommendations below are based on the results of this dissertation, supplemented by the findings of current research in the areas of remote working, metaverse and digital nomadism (as there have been new developments in some areas since the articles were published).

6.1.1 Recommendation from the organisation, management, and team perspective

- **Open communication:** implement specific communication protocols and digital tools designed to increase transparency and trust within remote teams. Schedule regular virtual check-ins and feedback sessions using collaborative platforms with an emphasis on trust, communication, and knowledge sharing.

- **Work-life balance:** offer workshops and resources to help employees effectively manage work-life integration. This could include training on digital tools to help plan and prioritize tasks or for example time etiquettes for messaging and meeting scheduling.

- **Cultural and gender sensitivity training:** implement ongoing cultural competency and gender sensitivity training programs that are tailored to the unique challenges of remote and cross-cultural teams, not just for team leaders, but for all team members.

- **Corporate social responsibility and remote working**: profile your organisation as flexible, innovative, and green through remote work.

- **Implement comprehensive cybersecurity protocols:** implement comprehensive cybersecurity protocols tailored for remote working, including, for example, the use of secure virtual private networks, mandatory multi-factor authentication, and

regular security audits. Establish data access and control policies to ensure that employees have access only to necessary data, supported by regular security software updates and cybersecurity training.

- **Metaverse integration**: start with a small pilot project, such as a specific team or department using metaverse for collaboration and creative work. Use the immersive metaverse platform for team exercises that go beyond traditional virtual meetings and include activities that can only be done in virtual reality. Evaluate the results and shared the lessons learned within the organisation or behind.

- **Digital nomad for month(s)**: Create tailored packages for your employees to experience the life of a digital nomad that include flexible working hours, location-independent resources, and access to global coworking spaces. Establish clear policies on how nomads should report work and interact with managers and colleagues.

- **Evidence-based management and strategic development**: use bibliometrics as a tool for evidence-based management. Use bibliometrics to identify emerging trends and potential areas for innovation that are aligned with the organisation's strategic goals. This can guide decisions on entering new markets, developing new products, or initiating research and development projects.

- **Using organisational research and collaboration with the academic sector**: introduce bibliometric analysis to assess the productivity and impact of different departments within the organisation. Use bibliometrics to understand the dynamics within teams, especially those working on innovation and research projects. Analyse collaboration patterns and publication outputs to optimize team composition and project assignments (including collaboration with the academic sector).

- **Manage intellectual property and seek founding calls**: use bibliometrics to manage intellectual property (e.g., patents or certified methodologies) and take advantage of founding organisations incentives to leverage resources for organisational development.

- **Professional development**: use bibliometrics to identify skills gaps or areas for staff professional development based on trends and emerging areas in research.

Organisations are advised to implement protocols and digital tools that promote transparency, trust and communication within the remote teams. This is essential for maintaining effective teamwork and cohesion (Martins and Schilpzand, 2011; Gilson *et al.*, 2015). Scheduling regular virtual check-ins and feedback sessions is essential to ensure open communication, especially in geographically dispersed teams (Aldag and Kuzuhara, 2015; Barry and Kane, 2023). In addition, is necessary to address work-life balance issues (Glazer, Kożusznik and Shargo, 2012; Hopkins and Bardoel, 2020). Cultural and gender sensitivity training is essential to mitigate cross-cultural misunderstandings and conflicts in remote teams (Powell, Piccoli and Ives, 2004). This is consistent with the findings of Aldag and Kuzuhara (2015) who highlighted the impact of diverse backgrounds on team dynamics. Remote working can help in the development of corporate social responsibility strategies, whereby organisations can be profiled as flexible, innovative and environmentally conscious, which should be attractive to environmentally conscious employees and customers (Kolk, 2016). To protect sensitive data in remote environments, organisations should implement comprehensive cybersecurity protocols, including secure virtual private networks, multi-factor authentication and regular security audits (KMPG, 2022; Eurostat, 2023b). These measures are in line with the recommendations of Samko Lodovici (2021), who highlighted the importance of ICT security guidelines for remote meetings and access to corporate resources.

The emergence of the metaverse as a 3D virtual space brings new opportunities for immersive collaboration and creative work (Duan *et al.*, 2021; Kim, 2021). By starting with small pilot projects, organisations can explore the potential of metaverse platforms such as Omniverse or Microsoft Mesh (Bian, Leng and Zhao, 2022; Park and Kim, 2022). Such pilot projects should include team-building exercises that leverage the unique capabilities of virtual reality (Purdy, 2022). The metaverse also presents privacy and ethical challenges (Mystakidis, 2022), further highlighting the need for comprehensive cybersecurity protocols tailored to these new virtual work environments.

Another way to begin to support remote forms of working is by creating tailored packages for employees to experience digital nomadism, including flexible working hours and access to global coworking spaces. However, digital nomadism poses specific regulatory challenges, such as untailored labour and tax regulations (Sánchez-Vergara, Orel and Capdevila, 2023). Therefore, clear guidelines on how digital nomads should report work and how they should interact with their leaders and colleagues are essential.

In the context of evidence-based management, bibliometric analysis empowers organisations with the tools to make informed decisions by providing a robust, data-driven basis for strategic planning (Rousseau, 2006; Reay, Berta and Kohn, 2009). For example, organisational research through bibliometrics can evaluate departmental outputs to better allocate resources and refine strategic directions (Kajikawa, 2022). This approach not only facilitates data-driven decision making but also increases the agility of the organisation in responding to changing market and research trends. In addition, bibliometrics supports trend mapping by identifying new areas of research that may influence future activities or the strategic direction of the organisation. This capability enables organisations to anticipate and exploit upcoming trends to gain a competitive advantage, which promotes innovation and growth (Debackere and Glänzel, 2004). In the area of strategic development, bibliometric analysis helps in entering new markets and investing in new technologies by identifying key players and potential partners, thereby guiding long-term growth and innovation strategies. Moreover, bibliometrics plays a crucial role in intellectual property management by mapping and evaluating patent portfolios, which serves as a basis for strategic decisions regarding innovation and technological development. This application supports organisations in navigating the competitive landscape, identifying potential acquisitions, and managing legal risks associated with intellectual property (Kajikawa, 2022).

Overall, the integration of bibliometric analysis into the management practices of organisations not only supports evidence-based decision making, but also improves strategic planning, resource allocation, and intellectual property management. By aligning organisational strategies with empirically based knowledge, organisations can effectively navigate the complex environment of modern business and maintain a competitive advantage in rapidly evolving industries.

6.1.2 Recommendation to the policymakers

- **Legislation on remote working**: propose specific amendments to existing labour laws to address remote working scenarios, with a focus on digital rights, data protection and fair working practices for remote workers.

- **Comprehensive policy development**: work with experts in economics, environment, spatial planning, and labour law to formulate policies that address the broader implications of expanded remote work and digital nomadism.

- **Special visas for remote workers** (e.g. digital nomads): introduce or revise visa categories specifically for digital nomads and detail a legal framework that supports temporary and flexible work arrangements in different countries (including visas for third-country nationals).

- **Develop specific legislation for remote work security:** legislate specific standards for remote work cybersecurity, focusing on data protection and defining the obligations of employers and employees.

- **Incentivise organisations:** support organisations that want to boost greener remote working.

- **Launch national awareness and education campaigns:** raise awareness about remote working, digital nomadism, the importance of cybersecurity in remote working environments, and trends for the future of work. In schools, training should be introduced to acquire skills needed for working in remote environments.

- **Use bibliometrics to identify critical issues:** bibliometrics can serve as a tool to identify emerging trends and potential areas for innovation as well as areas that might pose an issue in the future.

- **Evidence-based policymaking**: incorporate bibliometric analysis into the policymaking process to capture comprehensive evidence from research.

- **Use bibliometrics to identify experts and monitor investments**: encourage policymakers' agencies to use bibliometrics to monitor and evaluate the impact of their research investments, thereby informing future decisions on funding and policy formulation. Bibliometrics can also provide a list of experts in their respective fields.

The development of remote working has necessitated significant legislative changes, particularly in the context of labour law. Given the increasing prevalence of remote working, as highlighted by Agrawal et al. (2013), and its escalation during the COVID-19 pandemic (Meluso, Johnson and Bagrow, 2020), there is an urgent need for specific changes to existing labour laws to address digital rights, data protection and fair working practices for remote workers (KMPG, 2022). For example, Romania (1.4%), Bulgaria (1.6%) and Greece (2.5%) currently have the lowest rates of remote working (Eurostat, 2023a), partly due to legislative gaps that fail to adequately safeguard workers' rights. Policymakers should ensure that amendments cover working hours, health and safety and telework monitoring, as well as employers' obligations to provide facilities and promote work-life balance (Agrawal *et al.*, 2013; Samek Lodovici, 2021).

In addition, it is essential to develop a comprehensive policy that addresses the broader implications of remote working, including digital nomadism. This involves working with experts in economics, environmental sciences, urban planning, and labour law to develop comprehensive policies. These policies should consider spatial planning to accommodate changes in where and how people work that are influenced by remote working trends. Environmental impacts, such as the potential for reduced urban congestion in contrast to greater suburban expansion, should also be carefully managed (Samek Lodovici, 2021). The need for such comprehensive planning is underscored by digital nomadism, a phenomenon that is growing in popularity. Several countries have already introduced visas for digital nomads, to meet the growing demand for flexible working arrangements. Estonia offers a visa for digital nomads, Barbados has its own welcome stamp, and Portugal has introduced a temporary residence visa (Cruz, Franqueira and Pombo, 2021; Sánchez-Vergara, Orel and Capdevila, 2023). These frameworks encourage talent mobility and attract foreign workers. However, challenges arise in managing local infrastructure, ensuring fair taxation, and preventing social inequality due to increased demand for housing and services. Policymakers should create legal frameworks that ensure transparency, data protection and fair taxation, while offering clear guidance on the obligations of both workers and employers.

To promote greener remote working, policymakers should incentivise organisations to adopt sustainable practices. This includes subsidies for green digital infrastructure, tax incentives to reduce business travel and grants to develop cybersecurity protocols (KMPG, 2022). In addition, launching national awareness and education campaigns can help society to understand the benefits and challenges of remote working. Such campaigns can also promote public awareness of digital

nomadism and the importance of cybersecurity in remote working environments. Comprehensive training, starting at the school level, should focus on the acquisition of skills needed for remote environments, including digital literacy, cybersecurity, and teamwork (Pangil and Moi Chan, 2014).

Bibliometrics can contribute significantly to evidence-based policymaking by identifying emerging trends and potential areas for innovation (Kajikawa, 2022). By employing bibliometric analysis, policymakers can systematically identify emerging trends, critical issues, and potential areas for innovation, which are crucial for adaptive and responsive policymaking (Kajikawa, 2022). Moreover, bibliometrics can help identify experts and monitor the impacts of research investments, guiding strategic decisions in policy development and funding allocations. This approach not only ensures that policies are grounded in empirical data but also enhances the effectiveness and efficiency of policymakers' interventions in the remote work landscape (International Labour Organization, 2019).

6.1.3 Recommendations from a social and environmental perspective

- **Investing in digital infrastructure**: let the policymakers and the private sector allocate funds to develop digital infrastructure that supports remote working while minimizing environmental impact.
- **Spatial planning initiatives:** work with spatial planners to redesign cities to meet the needs of a more mobile workforce, including expanding green spaces, health and administrative facilities, and co-working centres. At the same time, ensure rights for local residents so that they are not displaced by remote workers.
- **Awareness campaigns**: launch educational campaigns to raise awareness of the benefits and challenges of remote working and digital nomadism.
- **Sustainability planning with bibliometric:** Use bibliometric analysis to identify research trends on the environmental impacts of remote working and digital infrastructures. This can inform urban planning and environmental policies to better adapt to changes in working patterns.

In response to the growing demand for remote working, it is crucial that policymakers and the private sector work together to invest in a robust digital infrastructure. This includes not only high-

speed internet, but also advanced technologies that facilitate effective teleworking. As detailed in recent studies, the explosion of remote working due to technological advances has led to significant changes in the labour market and workplace dynamics (Agrawal *et al.*, 2013; Vallas and Schor, 2020). As the shift to remote working becomes more permanent, expanding access to high-speed internet in all regions, including rural and underserved areas is essential. This not only supports remote working but also promotes inclusiveness and ensures that advances in digital nomadism and the technology metaverse are universally accessible. Moreover, this infrastructure must be built with sustainability in mind and incorporate green technologies that reduce the ecological footprint of digital activities (Agrawal *et al.*, 2013; Vallas and Schor, 2020).

Spatial planning must evolve to meet the needs of an increasingly mobile workforce. Evolving work patterns require a rethinking of urban planning to accommodate the needs of a mobile workforce. This includes the expansion of green spaces and co-working centres that facilitate remote working. However, this development must be balanced with the rights of local residents to avoid displacement caused by the influx of teleworkers. Concrete examples of such problems have been noted in cities favoured by digital nomads, where rapid gentrification has sometimes led to dissatisfaction among local residents and increased living costs (MacRae, 2016; McElroy, 2020). Urban redesign efforts must therefore include comprehensive community engagement processes to ensure that the needs of new telecommuters and long-term residents are addressed equitably.

To facilitate a smoother transition to remote working paradigms, policymakers should launch large-scale education campaigns. These campaigns would not only highlight the benefits and challenges of remote working and digital nomadism, but also help to normalise this modern working arrangement. This is like the historical adoption curves of major technologies, where initial resistance and inequalities in access were gradually overcome by targeted educational initiatives (Meluso, Johnson, & Bagrow, 2020).

6.1.4 Contributions to theory

From a *scientific perspective*, this dissertation pioneered new remote working areas, such as using metaverse in the workplace and digital nomadism (see Table 4 and 5). The dissertation offered a range of theoretical foundations for research on remote working, digital nomads and metaverse in the workplace, including identifying the core areas of past, contemporary, and future research. Identifying past, present, and future trends is a cornerstone for advancing scientific knowledge in remote work.

From a *methodological point* of view, the dissertation showed an innovative approach to using bibliometrics for evidence-based management and decision-making in organisations and policy. The use of bibliometrics proved invaluable in this endeavour. Using an innovative and open way of conducting bibliometrics has brought a new and transparent approach to understanding work trends. The dissertation demonstrated the role of bibliometrics in evidence-based management, decision-making and policymaking through three different examples of research on the future of work. As noted above, and as this dissertation demonstrated, bibliometrics can serve as one tool for organisational research, trend mapping, evidence-based decision-making, strategic developments, and intellectual property management. It has also been demonstrated how bibliometrics can serve as a tool for evidence-based policymaking.

Theories and frameworks presented in this dissertation can be reflected in *education and training curricula* (the dissertation author has already piloted a framework for remote working adaptation in a Business Skills course).

6.2 Concluding remarks, limitations, and further directions

The dissertation explored the future of work, focusing on the dynamics of remote working, the concept of digital nomadism, and the impact of new technologies such as the metaverse in the workplace. On another level, the dissertation showcased bibliometrics as a tool for science mapping, predicting trends, and facilitating evidence-based management and decision-making for organisations and policymakers. The dissertation was grounded in a unique and novel methodological approach - a workflow for open and transparent science mapping. Thus, the dissertation research workflow included a transparent methodology, data management, timely and open sharing of results, etc. The dissertation is composed of three articles that practically show how bibliometrics can be used for evidence-based management and decision-making for organisations and policy makers.

Chapter I presented an extensive bibliometric analysis of nearly two thousand publications dealing with remote working research. The analysis highlighted the crucial factors for successfully implementing remote workplaces in organisations. Chapter I presented already well-known factors and those that have not yet been adequately addressed by research. Based on this analysis, an evidence-based theoretical framework was proposed considering remote working adaptation at three stakeholder levels - personal, governmental, and organisational. Chapter I also illustrated how bibliometrics can be used for trend mapping, innovation strategy and potentially c decisions about investing in new technologies or research partnerships - see e.g. core concepts of remote working research and Authors' production and influence in remote working. Chapter I introduced several directions for future research - e.g. how remote working affects the well-being of families, the running of the household and what are the best practices for this area. Future research should also address how organisations and their managers should address the issue of gender equality in remote working. Lack of clarity is on the effect of culture on communication in remote working and the effect of team building activities on increasing trust in remote teams. The research also showed the insufficiency of legislative frameworks in the area of remote work, what could be improve in comprehensive policy study. From bibliometric perspective would be interesting to study how the author's origin and country of residence, or even the organisational culture of research institutions, may influence the core research topics.

Chapter II explored research on digital nomadism by studying leading countries, authors and themes that can become a foundation for future research. Based on the analysis, a new definition of digital nomads was created. Digital nomads are individuals with a mobile lifestyle that combines work and leisure, requiring a particular set of skills and equipment. Digital nomads are creating new ways of working, empowered by technological advances that have taken place in recent years. Therefore, it is a relatively new phenomenon that changes many people's lifestyles, work organisation and management styles, and places different demands on countries' infrastructure (e.g. requiring changes in legal frameworks, changes in urban planning, cultural acclimatisation, etc.). *Chapter II* provided an overview of three clusters of core concepts in digital nomad research - the everyday life of the digital nomad, the nomadic lifestyle, and the difference in digital, nomadic, and remote work. These results, together with the theoretical framework, provided a foundation for future research and policymaking in digital nomadism. For policymakers, this research not only identified which core concepts should be addressed in policy frameworks but also identifies experts and core studies from the field that can be used in developing these policies. *Chapter II* also clearly showed which locations researchers have already targeted because they are popular with digital nomads. These locations require legislative action that addresses the issue of digital nomadism first. Based on the results from *Chapter II*, it is possible to identify topics that have not yet been the subject of formal research on digital nomadism and that need to be addressed in the future. There is a lack of research in the economic, tax and legislative areas, which are key to successful adaption of digital nomadism policies. Room for future research is also on digital nomads in social media research - digital nomads often use social media to share their nomadic lifestyle. Sustainable/green remote working is also a growing challenge - further research is also needed in this area. It is also recommended to develop empirical research or meta-analysis on the factors identified in *Chapter II*. In addition, a study on the changes in work style caused by the COVID-19 pandemic has yet to be defined. Furthermore, a bibliometric study that analyses data from other scholarly databases (such as Scopus, Google Scholar, Pubmed, etc.) is needed to provide a complete picture of scholarly publishing in digital nomadism.

Chapter III presented a novel approach to enhance productivity and improve employee well-being in the workplace using the metaverse. The metaverse can potentially change how we collaborate, not only in the virtual teams. *Chapter III* offered the first definition of the metaverse that has been developed in the workplace. We defined the metaverse in the workplace as a 3D virtual immersive environment where employees interact with each other using their avatar identities, perform work tasks, and have autonomy and opportunities for creativity. *Chapter III* also presented an innovative and novel conceptual framework that introduces three levels of factors that are important for practical applications of a metaverse in the workplace - individual factors, team factors and organisational factors. The framework is complemented by contextual moderators that need to be considered when implementing a metaverse in the workplace. *Chapter III* thereby showed how the results of bibliometrics can be translated into practical frameworks that can be used to develop evidence-based frameworks for innovation and digital transformation in organisations. As Chapter III discussed a new way of using metaverse in the workplace, there are many directions for future research. More empirical research is needed to validate the identified factors from the Theoretical Conceptual Framework. It is also unclear how metaverse can be used to train staff in different areas of education (including serious games and gamification). There is also room for research on metaverse technologies in the workplace (3D work environments, use of artificial intelligence and retail), including immersive environments, which according to the results of *Chapter III* are related to metaverse performance and collaboration. At the same time, there is a need to explore how metaverse in the workplace affects emotional, mental, and physical health, well-being and satisfaction, and what organisations can do to improve these factors.

Despite the diverse perspectives on remote working, it is clear from the results that certain concepts are core to all of them. These findings led to practical recommendations for different stakeholders. The recommendations follow the structure of stakeholders from the theoretical section, addressing the organisation and management perspective (combined with the employees and team perspective), Policymakers perspective, societal and environmental perspective, and theoretical contributions.

Although the dissertation offered extensive findings, it acknowledges certain limitations. Bibliometric analysis itself has several limitations - for example, bibliometric analysis primarily focuses on published documents such as journal articles, conference proceedings and patents. In the case of this dissertation, data was used exclusively from the Web of Science database because it is considered the most prestigious and therefore expected to contain the highest quality information. This reliance means that it may overlook relevant grey literature (informally published papers), internal reports, books and data that are not available in the databases analysed, potentially missing important insights. This is in the case of digital nomads and metaverse in the workplace, where the number of publications is very limited. Therefore, the research was supplemented with an in-depth literature review to fill in any missing information. Also limiting from a bibliometric perspective is its time bias - bibliometric analysis may be biased towards older publications simply because they have had more time to accumulate citations. Bibliometrics is also vulnerable to publication bias - research that produces positive results is more likely to be published than studies with negative or inconclusive results. This bias in favour of positive findings can skew bibliometric analyses, making certain ideas or results appear more significant or confirmed than they are in the larger scheme of all the research conducted.

Nevertheless, this dissertation highlights the profound impact of digital transformation on the workplace. The findings of this dissertation have demonstrated the need for adaptive and informed management and policy strategies to ensure that organisations and policymakers keep up to speed with these rapid changes. The research presented here contributes to academic discourse and has far-reaching implications for future work practices, social norms, environmental considerations, and policy development.

7. References

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Annex

All accompanying materials for this dissertation are available in digital format, at the links provided in the table below, including a link and QR code for the reader's convenience.

Annex	Link	QR code
Data Management Plan	https://osf.io/7qtdm	
Data, scripts for Chapters	https://osf.io/7dz2p	
Recorded conversation with ChatGPT	https://chat.openai.com/share/e9e7cc50-b30e-4db0-9b80-8bb32249323e (also available as txt at https://osf.io/srgm5)	