Digital Ecosystem Model for Workplace Transition in Post-COVID Era

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Abstract—Industry 4.0 is a period of rapid technological advancement and development that has had a profound impact on society, the environment, and business. Unquestionably, COVID-19 has accelerated the adoption of digital technologies and fundamentally altered the workplace and style of working. Employees and businesses have accepted new working practices that include using digital tools but also accepting more agile and flexible procedures and norms. The workplace has transitioned to being digital or at least hybrid. The broad adoption of Industry 4.0 technology and the critical role that innovation plays in scaling-up processes will have a major, even disruptive, impact on the workforce, workplace ecosystems, and labor market. The purpose of this paper is to look into the underlying mechanisms and dynamics that support the digital environment and ecosystems and propose a digital ecosystem model for transition and improvement of workplace in the post-COVID period.

Keywords—Digital Ecosystem, Workplace, HRM, Transition, Industry 4.0, Post-COVID

I. INTRODUCTION

The COVID-19 pandemic has dramatically impacted the market by significantly increasing the number of employees working from home. We can say that remote work in the organizational sense is the biggest change that the pandemic has brought us. As evidence of the speed of this change, we bring information that, before the pandemic, companies needed (on average) more than a year to implement a feasible solution for working from home. On the other hand, in the pandemic, they needed only 11 days to implement a satisfactory model of homework [1]. A study by the McKinsey Global Institute shows that the hybrid model (which is a combination of working from home and working in the office) could become a permanent characteristic of the labor market in the future. In the future, 20 to 25% of employees in developed economies and 10% of employees in developing economies could work from home three or more days a week without affecting work productivity. This represents a four to five times higher level of working from home than before the pandemic [2]. Also, the Gensler Research Institute survey shows that 52% of employees in the post-pandemic future would prefer a hybrid work model. This represents a significantly different opinion of employees compared to the time of the pandemic when they predominantly preferred working from home. At the same time, younger employees prefer the hybrid model more than older employees [3]. The hybrid work model is preferred by 75% of respondents in the 2022 McKinsey & Company survey. Even 85% of the employees currently working on a hybrid model chose to make that model even in the future. A distinct tendency for a hybrid labor model appears in all sectors of industry, geographic areas and demographic groups involved in research. It is an interesting fact that the hybrid model is very acceptable to different marginalized groups and can be a good basis for their easier integration into the company [4]. The post-pandemic period is characterized by attempts by companies to return employees to their offices. Other companies make changes, and they try to find the best hybrid solution, going so far as to talk about personalization of the model for each employee. Management of hybrid teams, successful inclusion, and training, ensuring employee visibility and the possibility of advancement in the company's hierarchy, creating an inclusive organizational culture of the company, and recruiting new employees, will be some of the biggest challenges for management and employees in the future.

The development of digital technologies has created the conditions to talk about work-from-home models. According to this, digital technologies and digital interface are key for productive work based on homework models.

The purpose of this paper is to look into the underlying mechanisms and dynamics that support the digital environment and propose a digital ecosystem model for companies whose employees work partially or fully from home, which can help in dealing with the aforementioned challenges.

II. DIGITAL ECOSYSTEMS

As a fresh perspective on the evolving, complex, and interrelated systems, the idea of digital ecosystems is put out in new millennia [5]. The *Digital Ecosystem* is a new, multidisciplinary term that is challenging to explain. As a result, many definitions of the concept have been proposed from various perspectives such as economics, technology, and ecology, thus making it challenging to comprehend.

The Digital Ecosystem is described [6] as a practical metaphor for comprehending the dynamics of business networks at the sectoral and regional levels, as well as their interaction with and through information and communication technologies (ICT), from an economic point of view. The OPAALS project community [7] defines the term Digital Ecosystem as emerging fresh paradigm for the catalysis of sustainable regional development driven by SMEs, distributed and peer-to-peer functioning in a shared, public worldwide environment enables this technology. A digital version of biological ecosystems, which are thought to be strong, self-organizing, and scalable architectures that can automatically handle complex, dynamic issues, are seen as the Digital Ecosystem from a technology standpoint [8].

Term *Digital Ecosystem* from an ecological viewpoint is defining digital component as any useful idea that is expressed by a language (formal or natural), digitalized, and transported within the ecosystem, and that can be processed by humans or computers [9]. Digital Ecosystems should be viewed holistically and from a multidisciplinary standpoint [10] as a self-organizing digital infrastructure designed to facilitate collaboration, knowledge exchange, the creation of open and adaptable technologies, and the evolution of business models in a digital environment for networked organizations. Therefore, a digital ecosystem is a self-organizing, scalable, and sustainable system made up of disparate digital entities and how they relate to one another. It emphasizes interactions between entities to increase system utility, gain benefits, and encourage information sharing, internal and external cooperation, and system innovation.

A megatrend that fundamentally alters economies, communities, and the environment is technological change. In addition to technology advancements, the COVID-19 has significantly influenced the rate, scope, and priority of digital transformation. Thanks ICT and the tools made available by the Industry 4.0, we now possess amazing power. The Industry 4.0 consists of the interaction of technologies across the physical, digital, and biological domains [11]. Additionally, various advancements, fields, and specialties are combined and harmonized in an intelligent manner to produce new types of intelligence [12]. In addition to employees, who make up the internal and traditional workforce, the term *workforce ecosystem* is now frequently used, and it refers to two other significant participant groups as well: the external workforce such as freelancers (gig workers), service providers, developers, accessory providers, etc., and intelligent technology for workforce augmentation and human-computer interaction [13].

In the era of Industry 4.0, artificial intelligence (AI), augmented reality (AR), virtual reality (VR) and robotics will play a significant role in the workforce ecosystem in addition to internal and external human resources. The digital age's unique ICT developments have led to significant changes in the economy, the labor market, and employment dynamics, including the expansion of the mixed workforce and gig work [13].

Emerging technologies like AI, automation, and sophisticated robotics/intelligent systems, which can replace, help, or work in conjunction with human resources by boosting their skills and capabilities, are a crucial component of talent management. It is clear that the three types of hybrid workforce, internal (employees), external (gig workers and other external workforce), and advanced/intelligent technologies, are interdependent [14].

Another crucial component of the work ecosystem is the workplace. The majority of the internal workforce worked full or part-time in an actual office prior to the COVID-19 epidemic. A disruptive change was influenced by the pandemic and organizations were compelled to have their staff work remotely as a result of the measures that social distance imposed. Since the pre-pandemic era, remote work or teleworking has been a strategy worth thinking about in the context of digital transformation and considering businesses' interest in implementing new policies that encourage human resources. However, only businesses that often worked on projects and had international teams with geographically distributed employees made the transition from the traditional setting to a hybrid model, which combines office time with remote work. However, even in these situations, most of the remote workers also worked from their offices, which could have been in a different city, region, or even another country [14].

The infrastructure and corporate culture were not ready to accept working from home until COVID-19 pandemic became the *black swan* that was required to hasten this process of transition, digitization, and spread of the hybrid workplace. As a result of the pandemic's social isolation, employees are beginning to profit more from flexibility and other advantages of working from home. The workforce is now increasingly favoring a mix of working from anywhere, including from home or the office.

Pre-COVID and post-COVID data used in a study to determine the preferred work models of workers around the world [15] highlight the desire for hybrid work now in so called home and office blended. As a result of the pandemic, preferences have radically altered, with 81 percent

supporting the hybrid model, compared to only 29 percent who favored hybrid work choice during the pre-COVID time.

Additionally, even though remote work has been used for a long time before COVID-19 [16], the pandemic has accelerated this change, which may have longer-lasting consequences on management methods [17] and work organization in general [18]. It is evident that, because of COVID-19, most academic studies have been on remote work [19, 20]. To enhance convenience, functionality, and wellbeing, the proposed ecosystem strives to offer adaptable and on-demand spaces. The workplace can be chosen by each person individually based on their present requirements, preferences, workload, job character, etc. According to a previous prediction [15], fifty percent of the workforce will probably split their time between an office, their home, and a third location (such a café or library), creating a *Total Workplace Ecosystem*.

Significant advantages of digital workplace transformation include increased employee engagement, enhanced teamwork, lower operating costs, and it fosters innovation and raises customer satisfaction [21, 22, 23]. Although the literature also highlights some of the difficulties associated with this phenomenon, such as those related to infrastructure, adopting new technology, and personnel management, the benefits of the digital workplace transformation exceed these issues [22, 24].

III. MODEL

The proposed digital ecosystem model (Fig. 1) for working places transition in post-COVID era contains the following key parts: users, infrastructure, technologies, content, and management. The parts of the model are designed to enable the building and maintenance of a strong organizational culture for on-site, hybrid and remote employees.

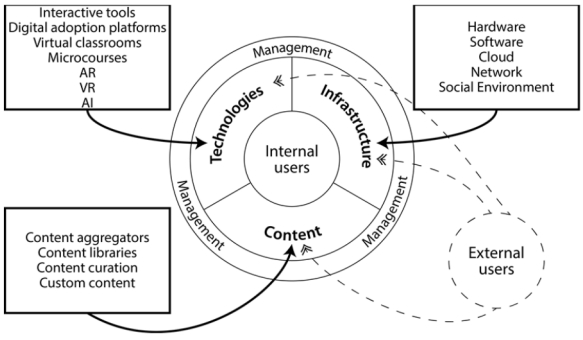

Fig. 1. Proposed Digital Ecosystem Model for Workplace Transition in Post-COVID Era

A. Users

Users present the first part of the digital ecosystem model. Users usually represent anyone who has access to digital technologies because of the ubiquity of computers, smart devices, and their increased use [25]. In the proposed model, the users are considered as internal and external. Internal users are employers, employees, administrators, managers, while external users are represented by those who occasionally interact with certain parts of the model, e.g., external educators, external content creators, technical support and so on. Managers are especially important when looking at hybrid and remote workers because they are the main link between company, employee, and organizational culture. As such, they must have appropriate skills set to meet the demands of today's business environment. Users can access various content that will help not only in gaining new knowledge and skills, but also in communication and cooperation to build a strong organizational culture for different types of employees.

B. Infrastructure

Infrastructure includes all basic services needed for a digital learning ecosystem to work properly. It refers to hardware, software, cloud, network, and social environment (users, designers, and system developers) [26]. Infrastructure is often the crucial foundation for digital transformation in organizations [26].

C. Technologies

Technologies in the proposed model should enable productive work from home (remote work), development, improvement and preservation of organizational culture, and professional development. Professional development in the model refers to the use of different technologies to acquire new knowledge and skills in the post-pandemic business environment.

A strong company culture means that the benefits of the company are expressed in many ways, such as: increased profits, more engaged employees, stronger relationships, and higher productivity rates [27]. Along with the digital transformation, the transformation of the organizational culture is also happening. The following tools are very useful in the transformation of organizational culture [27]: learning management systems (LMS) for cultivation and growth, mentorship platforms for support and growth, online time tracking system for flexibility, engagement platforms for communication and feedback, employee recognition program for reward and recognition and productivity monitoring software for employee autonomy. In addition to the learning purpose, LMS is also important in the organizational culture because it can be adapted to the specific needs of the company. Mentoring platforms are essential for support, growth, and professional development, especially for hybrid and remote employees. There are various types of mentoring online platforms and some of them are: GrowthMentor, MentorPass, Oneday, Sparrow, Mentessa, Pearl, etc. [28]. Since the beginning of the pandemic, time tracking software has become widely used as it provides flexibility in terms of where and when

employees work. Some of the examples of time tracking software are Timecamp, TrackingTime, ClickUp etc. Employee engagement platforms can help in achieving a positive emotional connection between employees and the company and they usually include features like employee feedback, survey sentiment analysis, and recognition of top achievements [29]. Some of the platforms for employee engagement are Slack, Jotform, Blink, Kudos, Workvivo, ect. Employee recognition proved to be a significant motivator that has a direct positive impact on the performance and satisfaction of employees, which also has a positive impact on organizational performance [30]. The most popular tools for employee recognition are Nectar, Fond, AwardCo, WorkTango, Blueboard, Bucketlist and Motivosity. Employee monitoring software is used to monitor employee productivity and evaluate their efficiency. The best employee monitoring software overall for 2023 is Teramind according to Forbes advisor [31].

There are many tools that can help build and maintain an organizational culture in the post-COVID era. Such tools can serve a variety of purposes, including [32]:

- Tools for *getting employee feedback,* e.g., 15Five, Bonsly, CultureIQ, BlogIn, Kanjoya.
- Tools for *defining company goals and managing directions*, e.g., Charlie, Emplo, Pinipa, Trello.
- Tools that *improve team communication*, e.g., Atlassian, BlogIn, Workplace by Facebook, Jive Software, SalesForce Chatter, Slack.
- Tools for *improving innovation and team creativity,* e.g., BrightIdea, OI Engine, Speakup, Spigit, Wazoku.
- Tools that help in *taking care of employees*, e.g., Perks at Work, SmartHub, Looop, Headspace, Sleepio, Briq.

"*Learning ecosystem platforms enable easy discovery, collaboration, management, and measurement of learning that is geared to a blend of digital, synchronous, internal, and external content.*" [33] Management and content are separate parts of the model, so they will be discussed later. In the context of learning technologies employers and employees can use a range of technologies and tools including interactive tools, digital adoption platforms, virtual classrooms, microcourses, AR, VR, AI etc. What specific technologies and tools will be used depends on the industry, the nature of the work and the required knowledge and/or skill that needs to be acquired.

Interactive tools that can be used in digital learning ecosystems include [34]:

- *Polls and quizzes* - allow learners to actively participate in different learning activities.
- *Games/gamification* - benefits of gamification include promotion of critical thinking and active participation, as well as creativity of learners.
- *Interactive infographics* - combine diagrams, charts, text, images and more. Interactive infographics are used to enhance understanding of abstract information and to attract learners' attention.
- *Interactive videos and live streaming* - they have certain advantages over asynchronous educational videos. Interactive videos and live streaming promote interaction, active and participatory learning.
- *Jamboard* - this Google tool can be used as an interactive whiteboard or as the tool which promotes collaborative skills, creativity, and critical thinking.

Besides interactive tools, tools as learning record stores, digital adoption platforms and modality-specific tools can be used in learning ecosystems [33]. Learning record stores (LRS) are becoming increasingly important in digital learning systems, and they are used to store learning experiences [35]. LRS is not the replacement for LMS. It is a service in the cloud that deals with learning information storage, as well as its retrieval [36]. Some of the benefits of using a LRS are recording learning experiences, informal learning scenarios, support for different content types, team-based learning, learning monitoring, etc. [36].

"*A digital adoption platform overlays applications (e.g., CRM, HCM, ERP, legacy and external) with in-application guided learning, simulations, analytics and nudging to drive adoption, proficiency and engagement.*" [37] Digital adoption platforms are very beneficial during digital transformation. These platforms help employees to learn new technologies, offer detailed walkthrough of different processes and tasks, increase internal efficiency, decrease the number of technology-related queries and request for technical assistance and they usually result in more digital savvy employees [38]. Some of the products in the digital adoption platforms market include Whatfix, WalkMe, ADOPT, Userlane etc. [37].

Modality-specific tools align with learning styles preferences. The assumption is that individuals will achieve better learning outcomes if their preferred modalities (visual, auditory, or kinesthetic are considered [39].

In addition to the above-mentioned approaches, for the workplace transition in post-COVID era microcourses, augmented and virtual reality, and artificial intelligence can also be used. Micro-courses are limited both in terms of content and duration. Micro-courses are used to structure and design courses in less independent courses and each of them should be defined with specific learning objectives [40]. Some of the advantages of using micro-courses in the workplace are improved learning retention, better satisfaction, faster learning, raised engagement, reduced development time and costs and learning culture support [41].

"*We define Augmented Reality (AR) as a real-time direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it*". [42] Benefits of AR training of employees include employee engagement, safety awareness, alleviation of training cost, lowering learning curves [43].

Virtual reality is an advanced human computer interface that simulates a real environment. You can simply move in the virtual world as a participant, see from different angles, and reach for something [44]. Virtual reality

can provide us with education as well as entertainment because it is both informative, useful, and entertaining.

"A*rtificial intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable*." [45] AI tools automate away some of the manager tasks so they can be "free to do more of the creative and strategic work that has a bigger impact on the success of their companies". Some of these tasks that can be done through AI are smarter people analytics, removing biases, identifying employees on the way out, litigation strategy etc. [46].

During the COVID-19 pandemic, tools for online collaboration and communication enabled functioning of all business processes when it comes to management and organizational culture. For there to be no major backlog in the mentioned processes it was necessary to find tools that will completely replace the current way of conducting business. It was necessary to find tools that would enable and facilitate 1:1 meeting, group meetings, event planning, introducing new employees to their tasks and their responsibilities, etc. Some of the most important tools that support communication culture and collaboration are Google Drive, ProofHub, Process Street, Slack, LucidcHart, Zoom, LastPass, Zapier, Shift. These tools can help enhance the remote workforce and boost collaboration. [47]

D. Content

Content can be obtained from content aggregators, content libraries or through curation. [33] Since there is available a large amount of data, the way in which the content is collected and presented is very important. Content aggregators are tools or entities that gather web content from various web sources for reuse. Learning content aggregators are suitable for todays' business environment since their usage can overcome limitations such as team size, learning styles and preferences, budget, etc. Benefits of content aggregation include easier content curation, increased learner engagement, improved learner retention, greater flexibility, and increased ROI [48]. Content libraries usually refer to off-the-shelf learning materials. These types of content mostly include industry knowledge, soft skills development or compliance information and it is beneficial for training of teams/ departments of content that is not company specific [49]. Content curation refers to existing content that will be republished. Benefits of content curation for learning and development programs include focuses on relevant information, saves time and resources, encourages continuous learning, enhances productivity and performance gain [50]. In addition to the mentioned options for content generation, there is also an option for custom content creation. Custom content gives an organization control over the content, and it is suitable for individualized training needs. [49]

E. Management

Management in the digital ecosystem implies specifying the way in which some of the most important managerial tasks will be defined and maintained. Management in the model refers to management of all other components of the model. It can include training of existing and new employees, planning of group and 1:1 meetings, managing digital teams, opportunities for visibility and progress of employees, recruitment of new employees and evaluating them, monitoring, measurement of progress, etc. Some of the digital tools that can help with all of the above are: Asana, Slack, Microsoft Teams, Trello, MeisterTask and Miro [51] The tools should help managers and employees to effectively and efficiently fulfill their tasks. Each tool has certain advantages and disadvantages, and it can be oriented towards communication and collaboration, organization of daily work routine, transparency, management of digital teams, etc. [51]. The tool will be chosen according to the needs of the company and the manager.

A significant part of the digital ecosystem model for working places transition are measurement and metrics for assessment of the effectiveness of the business processes. In addition to financial metrics, in the post-COVID era it is important to monitor non-financial metrics. "*The most common learning and growth metrics that are used to assess non-financial organizational performance are human resources (HR), information capital (IC), and organizational culture and alignment (OCA).*" [52] Monitoring is also part of management and some of the areas that need to be monitored are strategy, development, freedom of thought, superior support, and well-being of employees. Besides the above-mentioned, the proposal is to measure loyalty and satisfaction of employees.

IV. CONCLUSION

The interaction between technology and people will become incredibly complex in the upcoming years and we must be ready for such changes in advance. It is our responsibility to have the skills necessary to control Industry 4.0 tools and technology. A substantial number of issues, hazards, and concerns linked to traditional unemployment, technical unemployment will arise if AI and intelligent automation systems only replace human resources. However, if this combination of people and technology works in harmony, it may result in cost savings and extra benefits for businesses, clients, and other stakeholders.

Industry 4.0 specific new technologies and innovation as a fundamental component of scaling-up processes will soon result in significant and occasionally even disruptive changes to the labor market, as well as changes to the workforce and workplace ecosystems.

The COVID-19 showed numerous flaws and problems that have been in business for a very long time, especially regarding how to conduct daily tasks from the standpoint of physical to virtual contacts. The conflict between re-

turning to work and rethinking work as they accept a new reality is likely to be the largest difficulty companies face during the recovery.

The development of digital technologies created new conditions to implement work-from-home models. Since digital technologies and digital interface are key for productive work based on homework models this paper is proposing a digital ecosystem model for companies whose employees work partially or fully from home, to help them in dealing with the challenges of post-COVID workplace.

To accomplish people's well-being, it is crucial to support a productive and healthy workplace that supports hybrid work from the office, home, and/or other locations. Understanding and meeting the requirements of the workforce is a crucial step in raising satisfaction, motivation, and engagement, which will ultimately improve worker performance. Performance in the workplace today and in the future should take these changes into account. Emerging technologies will be crucial in redefining society, as well as in enhancing corporate performance and rearranging work, workplace, and worker ecosystems.

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