

# What should be done to prepare workers for the fourth industrial revolution? A review of the readiness for the digital transformation

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**Abstract.** The fourth industrial revolution (4IR) impacts business models and processes in all sectors worldwide. It is not enough to be efficient only dealing with sales, storage, logistics, and services; it is also essential to use data to reach greater competitiveness. Despite that, advanced manufacturing – combining digital technologies, robotics, IoT, and data analytics – is still in the early stages, and Brazil lags behind those OECD countries in this area. Accordingly, innovation, especially digital transformation, impacts the future of work and, therefore, on the workers. However, according to the OECD, more than 50% of Brazilians have not attained secondary education, and 17% have not completed primary education. Low skills prevent Internet users and workers from using digital technologies effectively and from benefiting from them, thus creating a second-level digital divide. The digital transformation and 4IR literature provide several studies to measure the maturity of organizations in implementing digital technology but lack frameworks for digital readiness, especially employee readiness. Based on a systematic literature review, this study maps the primary constructs related to the theme to propose a framework for preparing workers and to be used for future quantitative approaches and surveys.

**Keywords:** Employee Readiness, Future of work, Industry 4.0.

## 1 Introduction

The industrial revolutions have fundamentally transformed society through the ages, starting with the First Industrial Revolution in the late 18th century, which ushered in the era of mechanization through steam power. The Second Industrial Revolution followed in the late 19th century, introducing mass production and electrification. The Third Industrial Revolution emerged in the 20th century, characterized by the digitalization of manufacturing and the advent of information technology. We are now in the midst of the Fourth Industrial Revolution (4IR), as described by Klaus Schwab in his seminal work [38]. This current era is marked by unprecedented advancements in artificial intelligence, robotics, the Internet of Things, and biotechnology, among other fields. This integration is evident in various fields, from genetic sequencing to

nanotechnology and renewable energies to quantum computing [38], significantly impacting societal and business landscapes worldwide. These technological leaps are revolutionizing how we live and work and presenting complex challenges regarding employment, privacy, and the ethical use of technology. Schwab's analysis underscores the need for a holistic understanding of these innovations' vast opportunities and potential perils, highlighting the imperative for individuals and societies to adapt to new ways of learning, working, and interacting.

In this context, business models are compelled to evolve beyond traditional efficiencies in sales, storage, logistics, and services, necessitating the strategic use of data to foster greater competitiveness [7]. Despite that, advanced manufacturing – combining digital technologies, robotics, IoT, and data analytics – is still in the early stages, and Brazil lags behind those OECD countries in this use [32].

The undeniable impact of innovation, mainly digital transformation, on the future of work and workers presents challenges and opportunities. Although technology adoption typically follows a pattern of initial awareness, excitement, subsequent disillusionment as it hits reality, and eventual explosive growth [15], the trajectory and impact of 4IR innovations, such as Generative AI, are unpredictable. For example, Chat GPT, launched in November 2022, astonishingly reached 100 million daily users in just two months, underscoring the accelerated adoption curve of such technologies [42]. The usage is from editing to coding, showing different kinds of applications.

In light of sustainable development goals aimed at meeting the needs of the current generation without compromising the future, the UN's 2030 agenda [43], with its 17 goals, presents an opportunity for 4IR to contribute significantly to reducing poverty, promoting decent work and economic growth, fostering industry innovation and infrastructure, and reducing inequalities. However, the educational attainment in Brazil, as reported by the OECD, indicates that more than 50% of the Brazilian population has not attained secondary education, and 17% have not completed primary education, significantly exceeding the OECD average of 2%. Enrolment in professional training and technical degrees is low, with only 3.8% of secondary students choosing technical courses. This educational gap and poor performance in international assessments on the OECD's Programme for International Student Assessment (PISA) highlights a profound digital divide and significant disparities in outcomes depending on students' socio-economic background, underscoring the urgency of enhancing digital literacy and skills among the workforce. Low skills prevent Internet users and workers from using digital technologies effectively and from benefiting from them, thus creating a second-level digital divide [31].

Therefore, research focusing on workers' readiness for digital transformation [13], addressing knowledge gaps [28], and stimulating skill development for the new work landscape [30] is increasingly relevant. This study aims to contribute to this body of knowledge through a systematic literature review (SLR), identifying critical constructs related to employee readiness for digital transformation. Our objective is to develop a framework to mitigate the social impacts of digital transformation on employees' digital skills, addressing the preparation gap for the knowledge-based era.

## 2 Methods and Procedures

This study developed an SLR [16;35] to seek the constructs related to workers' readiness for digital transformation and propose a framework for reaching employee readiness. For that, the study considered the most used terms in academia: digital readiness, employee readiness, and digital transformation. Five steps were performed, being them (a) the delimitation of the questions, (b) the database selection, (c) the definition of the search strategy, (d) the choice of the articles, and (e) systematization [21].

The methodology commenced by identifying the guiding question, focusing on the literature-identified gaps. This study aims to delineate the primary constructs of employee readiness and formulate an initial framework to equip workers for the 4IR impacts. The subsequent phase involved an exhaustive literature search using specific keyword combinations. An initial search using the strings ["Digital readiness" and "4IR"] and ["digital readiness" and "employee readiness"] within titles, abstracts, or keywords yielded no results. Expanding the search criteria with alternative keyword combinations facilitated the identification of relevant studies, as depicted in Table 1. This systematic review was confined to studies published in English, with a solitary study in Portuguese being identified and included; however, documents in German, Russian, Bulgarian, and Slovak were excluded. Conducted in November 2023, the search utilized Scopus and Web of Science databases, excluding books, reviews, editorials, and early-access publications, culminating in 198 pertinent studies. These databases serve as conduits to access articles across significant platforms such as Science Direct, Taylor and Francis, Emerald, and Springer, among others, thereby minimizing research biases.

**Table 1.** Strings search criteria and results

Search Strings	Occurrences	
	SCOPUS	WoS
Strings		
"Digital" and "readiness" and "4IR"	18	14
"digital readiness" and "4IR"	0	0
"digital readiness" and "employee"	26	6
"digital readiness" and "employee readiness"	0	0
"employee" and "readiness" and "4IR"	4	3
"Digital transformation" and "employee readiness"	5	2
"Digital transformation" and "digital readiness"	76	44
Total	129	69

**Source:** Prepared by the authors

After the initial screening, 80 articles were identified as duplicates and removed. The fourth phase entailed a meticulous review of the abstracts, during which articles lacking substantial relevance to the theme or failing to address the guiding questions were

excluded. Given the developing nature of the subject matter, the incorporation of grey literature was deemed necessary, leading to the addition of two reports—one from the OECD and another from the ABC. This phase resulted in the exclusion of 11 documents. The final step involved a comprehensive analysis of the remaining articles, focusing specifically on their relation to digital and employee readiness. Through this rigorous process, 95 articles were deemed pertinent and selected to constitute the database. The sequential steps of article selection and exclusion, from initial identification to final inclusion, are illustrated in Figure 1.

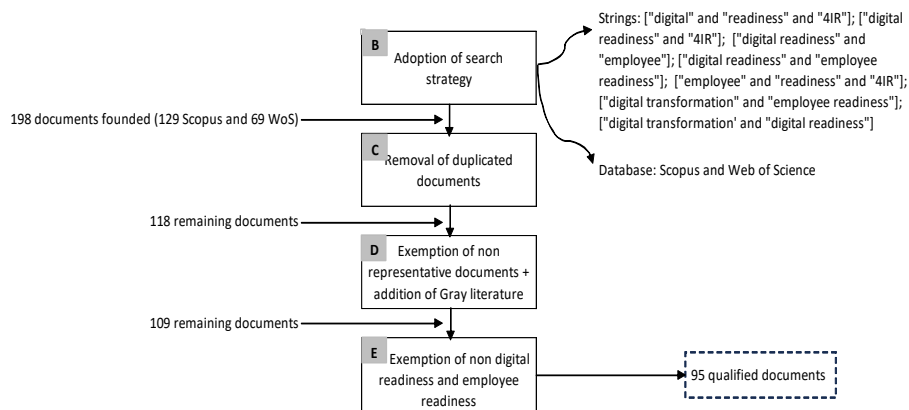


Figure 1: SLR screening process

### 3 Results and discussion

This SLR facilitated a comprehensive examination of the current state of the art concerning employee readiness for digital transformation. It enabled an in-depth understanding of the constructs associated with this theme. Furthermore, this study proposes a structured framework to cultivate digital competencies among workers, aligning with the demands of the 4IR.

#### 3.1 The digital technology impact.

The studies reviewed highlight the critical need for nations and enterprises to embrace digital technology, which is essential for driving productivity growth, ensuring competitiveness in the global arena, and facilitating social development [1;32]. Consequently, it is imperative to devise a fully integrated strategy before adopting digital technologies, as such a transition necessitates substantial investments in infrastructure, knowledge-based capital, conducive business environments, skill allocation, and trust [24;33;37]. On the one hand, adopting digital technology presents an opportunity to mitigate risks for workers by reducing the necessity for manual and repetitive labor, thus improving environmental and social working conditions [1]. On the other hand, it

engenders apprehension among current employees over potential job losses attributed to a lack of requisite skills [28, 34, 37].

### 3.2 Constructs for employee readiness.

The SLR elucidated the primary constructs associated with employee readiness for digital transformation. The investigation revealed a dearth of studies specifically focused on workers' readiness for digital transformation, highlighting a significant research gap [13, 19, 32]. Consequently, the constructs were primarily identified within the broader scope of digital readiness research. Given the pervasive impact of digital transformation on society and the future of work, the relevance and necessity of studies in this area become relevant and necessary.

Table 2 catalogs the primary constructs and their corresponding variables as identified in the literature. Seven specialists scrutinized this compilation, whose critical insights led to the final list of constructs and variables.

**Table 2:** Constructs and variables from employee readiness

<b>Construct</b>	<b>Variable</b>	<b>Reference</b>
New business model and processes	Disruptive changes in the business model	[3;8;23;37]
	Speed of change	[4;17;23;37]
	Digital strategy	[6;13;22;23;24;27;33]
	Organizational capabilities	[9;23;25;26;27;32;37]
	Competitiveness and Survival	[3;9;13;22;23;26;27;37]
Awareness	Technology knowledge	[3;6;9;13;27;28;30;32;33;37]
	Business model knowledge	[3;5;6;12;14;30;34;37]
	Shared values	[3;9;14;20;22;23;26;28;32;33]
	Employability	[13;27;28;32;33;37]
	Engagement	[2;18;23;24;26;27;28;33]
Supportive leadership	Support	[3;9;13;18;20;22;26;27;30;33;36]
	Trust	[9;22;24;30]
	Role model	[8;23;26;27;28;30]
	Openness to innovation	[8; 23; 24; 30; 33]
Equality and inclusion	infrastructure access	[3;4;33]
	Inclusion	[2;18;20;25;34]
	Career Opportunity	[28;33;34]
	Literacy	[18;32;40]
Digital skill	Development	[2;3;5;9;18;22;24;25;28;32;33]
	Self-learning	[20;34]
	Motivation	[2;3;8;20;23;24;28;34;36]
	Demand	[3;13;28;32;33]
	Innovation	[3;30;33]
	Self-Capacity	[2;9;23;28;36]

Source: Prepared by the authors

The concept of digital readiness is defined as an organization's absorptive capacity to seize opportunities while simultaneously exploring new resources and exploiting existing practices in preparation for digital transformation [3, 10, 23]. However, the term digital readiness extends beyond industries to encompass the labor force as well [23;34], being perceived more as a social dimension than a technical issue [23;29;34]. This study focuses on investigating employee readiness.

The constructs related to employee readiness emerged as conditions about workers that precede, are necessary for, or pose challenges to executing digital transformation. These constructs are new business models and processes, awareness, supportive leadership, equity and inclusion, and digital skills.

Enterprises worldwide are developing strategies to implement new digital technologies to foster competitiveness, explore new markets, launch new products, and meet the needs of their clients [1;41]. Other objectives when implementing digital technology in firms are to reach new levels of efficiency and productivity, reduce costs, and improve existing products and services [15]. Studies show that using information and communication technologies (ICT) at enterprises is more critical for countries' development than household usage [32;39]. Therefore, new business models and processes will impact the labor market, demanding new skills from workers [13, 23, 34].

Raising awareness of the benefits of digital technology targeting individuals with low digital uptake and micro enterprises is one of the recommendations for Brazil to increase the adoption and use of digital technologies (OECD, 2020). Many workers will be out of the market because of a lack of digital knowledge [14, 28, 32]. On the other hand, it creates new job opportunities [3;5;12] and raises the work quality [8;13;22]. As managers are more involved in changes that could impact processes, products, and business models, they are more aware of the digital transformation that is to come, even though their attitude toward digital transformation is worse than employees, mainly middle management [23]. Being aware of new technologies and understanding the impacts of their adoption on productivity and cost reduction is vital to engaging in knowing it [9, 23, 28].

The role of managers in digital transformation is cited in many studies [3, 9, 13, 20, 23], but mainly when they act as supportive leaders in the change management process necessary during a digital transformation. Without the support of the management team, employees could not feel engaged in the process [14;22], and for that, these leaders must trust in the digital tools [22], be open-minded, and even become a role model in the adoption of the changes that the implementation will bring for the company [8;22]. Top management is in charge of the business strategy and needs to involve and commit all the stakeholders in implementing the necessary changes to increase competitive advantage [23]. Therefore, they should mobilize middle and lower managers to promote a positive belief in new technologies and processes as they act as a transmission belt for the employees [23;28].

The social divide is concerning, especially in developing countries [32], and the digital transformation could establish the digital divide as a reality. In the context of the labor force, the lack of digital skills could let out of the labor market millions of workers [28;32;34], deepening social exclusion [34] and extinguishing small and medium enterprises [11;22]. On the one hand, workers with digital skills are demanded above the

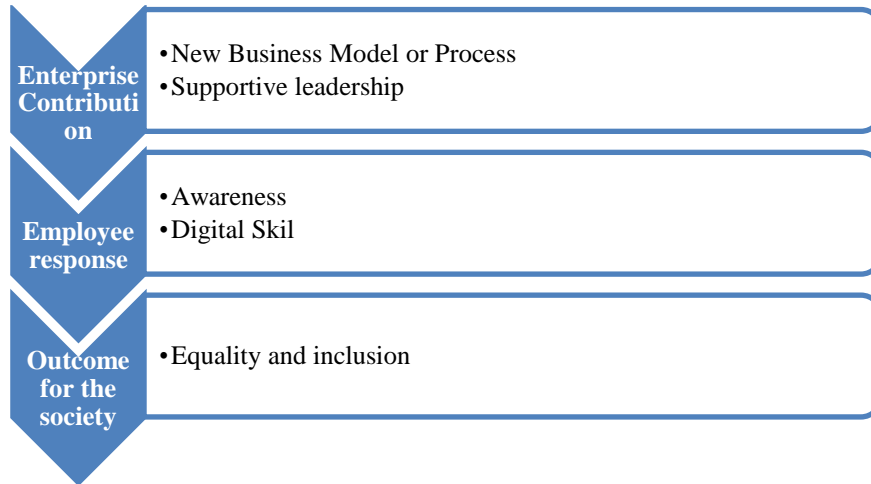
capacity to supply them from the education and training system [32], which increases the opportunities for these employees in their countries and abroad [39;40]. On the other hand, the digital divide could provide evidence of the education gap, the income disparity, the elderly exclusion, and the regional differences in infrastructure [32]. For the 4IR to happen, workers must have the digital skills necessary to implement new processes and foster new economic models [3, 14, 34]. Some studies highlight that digital skills are a predecessor to digital transformation readiness [40] and consider it part of the digital maturity level assessment for companies or countries [5]. South America faces the challenge of not having a critical mass of human resources equipped with the digital competence required for this transition [34]. Brazil lags behind OECD countries regarding education and skills [32], which prevents these workers from properly using digital technology. Studies recommend that companies must offer the proper training that allows their employees to keep up with the digital era [8;22;23] whether they want to thrive in implementing 4IR tools. Not only back-office employees must be trained, but top managers and front-office employees must also be trained [8;20;23;30].

### **3.3 Framework for Employee Readiness**

Regarding the SLR, studies about employee readiness are scarce, and digital transformation could have social impacts since it shocks the labor market; we propose a framework with the constructs that emerged as conditions that are antecedents, necessary for or difficult to implement digital transformation, and hence 4IR on regard of the workers. The framework considers three steps in a logical sequence, beginning with enterprise initiatives that could stimulate an employee response and promote a positive outcome for society. The constructs were matched with each step to build the framework in Figure 2.

The enterprise's initiatives are related to new business models or processes that aim to reach the customer's needs or pursue new levels of efficiency and productivity. In general, enterprises seeking new ways to do their business or launch revolutionary products in the market pursue visionary leaders who stimulate their people to develop new skills. So, companies are responsible for this supportive leadership that will create an environment that fosters people's development.

The encouragement promoted by enterprises raises employee desire to be ready to work for this kind of enterprise, setting the tone for the type of career and skills one could develop to keep their employability. So, the company's contribution raises awareness and promotes the development of digital skills. Consequently, workers are ready for the market job and could generate income, returning in an outcome for the role of society.



**Figure 2:** Framework for employee readiness

#### 4 Conclusion and future research

The present SLR about employee readiness for digital transformation revealed that the literature on the theme is scarce even though the impacts are already observed in society and the labor market. Regarding Brazil and Latin America, studies are more scarce. One study was found to be written in Portuguese, and no one in Spanish. Studies in companies are rare, and only reports and experts' roundtables cite Latin America as the study scenario. The OECD report shows the region's lack of development and the urgency to set a plan involving the government, academia, and enterprises.

The digital transformation publication has increased in the last two decades, and many tools to assess the digital maturity of companies and countries have been developed, considering workers' skills as a performance indicator without defining the steps to reach employee readiness. Even so, it was possible to identify the constructs that emerge in the studies of digital readiness regarding the workers and draft a framework for reducing the social impact of this transformation in the labor force.

This research's contribution is relevant for nations, institutions, enterprises, and individuals since workers' readiness could help increase productivity, raise competitiveness, and reduce the digital divide between developed and developing countries. The managerial implication of this type of research is to offer companies the constructs and observable variables to develop their team as a vital condition for the transformation they seek.

Some limitations regarding this study must be observed. Since the literature is scarce, we could not be profound here, and it was necessary to find the constructs in the closer



terms related to readiness. The search was done in 2 databases, representing a limitation in reaching the total number of studies.

The framework considers the constructs that appear the most in the literature found in the SLR. So, we should not consider it an exhaustive list of constructs.

This study and its framework are a starting point and a first step to formulating a mathematical model and seeking empirical validation. Our next step is to propose hypotheses and test the constructs' relationship with a multivariate statistical technique such as structure equation modeling. It should be noted that the 4IR is impacting industry, requiring enterprises to be agile and innovative. However, studies show that the supply chain business area is less evolved than other areas [20;27]. To reach this goal, professionals must be prepared to use new technologies to meet the labor market's demand.

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