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Core Competence—As a Key Factor for a Sustainable, Innovative and Resilient Development Model Based on Industry 5.0

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Abstract: The main objective of this paper is to highlight the importance of core competences as an important catalyst to enable a sustainable transition of business models to Industry 5.0. According to our research based on a scientific methodology, we illustrated that Industry 4.0 might greatly affect the labor market by introducing ITC, AI, IR and AR that will change many jobs in most areas of activity. One alternative solution to diminish these negative effects is to accommodate and prepare the shift to a more human-centric approach. In order to better implement this alternative solution and to generate mid- to long-run positive effects (from an economic, social and environmental perspective), we consider it is imperative that human resources be prepared to understand and to use new technologies. We have focused our research context on European countries. We found that only a part of the European Union Member Countries benefit from the use of human resources with advanced digital skills. Under these circumstances, we consider that only some countries will be able to face the challenges generated by the transition to Industry 5.0, while others, the emergent countries, such as Romania, will have to intensify the complex process of designing competitive and coherent strategies and implement a more efficient and effective mix of policies. This will help to better capitalize the potential sustainable competitive advantage of industries 4.0 and 5.0.

Keywords: Industry 5.0; Industry 4.0; human capital; core competences and high skills; sustainability; long-term sustainable; innovative and resilient development model

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1. Introduction

As we move further into the 21st century, we find ourselves in a position where we have to face a myriad of complex socioeconomic–ecological challenges. From climate change and environmental degradation to economic instability and political polarization, these issues tend to be interconnected, and they all affect, in a direct or indirect manner, the quality of our life. Addressing these challenges is, therefore, key to understanding how businesses and societies operate today and what may be anticipated for the future.

Given the complexity of the socioeconomic context, we consider business excellence one of the main driving forces within organizations that leads to efficient and effective adaptation in preparation for achieving high performance. This ambitious goal might be accomplished if organizations rely on a long-term sustainable, innovative and resilient development model.

Digitalization is a key part of the aforementioned model and has been the driving force behind the Fourth Industrial Revolution, also known as Industry 4.0. With the

integration of technologies, such as artificial intelligence, automation and the Internet of Things, the industry has experienced unprecedented levels of efficiency and productivity. This industrial revolution describes the way industry uses the technological advance to face the global trends and the increasingly complex challenges expected for the future. Currently, we consider its role successfully fulfilled. However, even if the benefits generated by Industry 4.0 are obvious and extremely important for innovation and adaptation to global evolution, analyzing its implications can really help us assess the most relevant impact on the labor market and implicitly on people's lives. As demonstrated almost a century ago by [1], technological developments can pose a real threat to job security and deepen economic inequalities.

Digitalization and technological progress affect the stability of the labor market, both directly, by dismissing employees who perform certain functions that can now be performed by technological assemblies or software, and indirectly, by increasing labor demand in those economic sectors that are transforming due to the technological progress. In this case, new jobs that involve new types of specializations and the development of new skills are created and have to be further developed.

The COVID-19 pandemic has not only produced devastating effects globally, especially in terms of health, economic activity and social life, but has also highlighted the gaps and the vulnerabilities of Industry 4.0. Thus, it highlighted the need to rethink working methods and, correspondingly, strategies and policies in order to better understand how industries, societies and economies really function. However, as we move towards Industry 5.0, which emphasizes human–machine collaboration, the impact on human resources and organizations is likely to be significant.

The transition to Industry 5.0 is expected to bring new opportunities and challenges for both employers and employees. As machines take on more routine and repetitive tasks, the workforce will need to develop new skills, such as to meet the changing demands of the job market. Soft skills, such as critical thinking, creativity and other skills suggesting to take into account also the emotional intelligence, will become increasingly important as we move towards a more collaborative working environment.

Therefore, the main objective set for this research is to determine the potential impact of the current industrial revolution (Industry 4.0) on human resources and to estimate the degree to which they are prepared for the transition to Industry 5.0.

We consider that the relevance of this research and its contribution to the scientific literature is determined by the fact that it analyzes the current level of skills and mostly core competences preparedness in all European Union (EU) Member Countries as an integral part of the development process of Industry 5.0.

The paper addresses the academic environment and the business environment, but also the policymakers actively involved in developing long-term and inclusive national development policies and strategies.

The first part of the paper is an introduction of the debated topic, while the second section explores the relevant literature in the field. Afterwards, we describe the applied research methodology and analyze the potential impact of the industrial revolution on the labor market.

In the last part of the paper, we test the extent to which human resources are prepared for the transition to Industry 5.0, and we propose various alternative solutions to boost this process, especially in less developed countries.

Conclusions are drawn afterwards on the impact of the transition to Industry 5.0 on human resources.

2. Literature Review

The rise of Industry 4.0 is considered to have brought significant changes in the way organizations operate, having a considerable and relevant impact on both human resources and organizations.

Concerning the impact of Industry 4.0 on the workforce's skills, research [2–4] has shown that adoption of new advanced technologies leads to the displacement of many traditional jobs, as machines become increasingly capable of performing routine tasks, leading to a need to develop technical skills, such as programming, data analysis and systems integration. In addition to requiring new technical skills, the rise of Industry 4.0 will also require employees to develop new soft skills, such as critical thinking, problem solving and adaptability [5–8]. Regarding skills development, [9] points out that in the future, it will become imperative for people to adopt a lifelong learning behavior so as to remain competitive in the labor market.

The adoption of Industry 4.0 technologies is also expected to lead to changes in the organizational structure.

Studies, such as those carried out by [10–12], demonstrate that the integration of the new technologies associated with Industry 4.0 leads over time to a sustainable increase in organizations' degree of competitiveness, regardless of the economic activity or the size of the organization. Among the fields and industries where the opportunities to create added value and to generate a long-run competitive advantage through increased digitalization have been clearly demonstrated, studies include the manufacturing industry [13,14]; agri-food industry [15]; marketing and sales [16]; automotive industry, FMCG, logistics, retail trade and business services [17]; financial sector [18,19]; and business carried out "from home" [20].

Another area of research in this field is related to the challenges generated by the implementation of the solutions offered by Industry 4.0. The professional emergence [21] and the lack of qualified human resources [22–25] are seen as the main challenges and barriers that prevent the sustainable development and the resilience of businesses in certain cases.

Refs. [26,27] showed that the innovation cycle is occurring at a faster pace compared to changes on the labor market and the way people develop their skills, which makes the imbalances on the labor market grow and be reflected in a high and long-term level of structural unemployment.

Regarding the organizational challenges brought up by Industry 4.0, studies [28,29] also show that Industry 4.0 requires significant investment in technology, infrastructure and training. Small and medium-sized enterprises (SMEs) may find it challenging to invest in Industry 4.0 due to limited resources [30–32].

The transition from Industry 4.0, which focuses less on sustainability and more on digitalization and using AI-based technologies to increase production efficiency and flexibility, to Industry 5.0, which, according to Refs. [33,34], emphasizes and highlights the importance of a more people-centered approach, resilience and sustainability, is thought to be tackling the aforementioned challenges [35,36].

Considering the most relevant approach identified within the specialized literature, we tried to provide a definition of Industry 5.0. This could be formulated as a Human Industry, based on the 6Rs (Recognize, Reconsider, Realize, Reduce, Reuse and Recycle) principles of sustainability and focusing on the idea of combining the creativity and know-how of humans with the speed, productivity and consistency of robots [37,38]. In Industry 5.0, humans and robots collaborate and work together, and for this work, humans need to have certain core competences and skills.

The significant implications are in matching human intelligence with machine intelligence and, correspondingly, in training people to adapt to robots while working together.

Industry 5.0 will require new skills in programming, intelligent systems control and emerging technologies [39]. Ref. [40] considers that Industry 5.0 will create more jobs than it will abolish, arguing that many jobs will be created in the field of intelligent systems. Although Industry 5.0 represents an opportunity for companies, there is a skills and core competences gap that needs to be filled [41]. Many employees lack the skills and knowledge to work with new technologies, such as artificial intelligence and robotics. The literature on this topic [35] and Ref. [42] provide examples of jobs, such as AI, programming, training or

inventing new types of robots, that will become the norm, while jobs that entail repetitive activities and that do not stimulate the creativity of employees will have to be abolished. This means that all employees will have to adapt as their occupations evolve alongside increasingly capable machines/robots. Part of this adaptation [43] will require higher levels of education or spending more time in activities that require high social and emotional competencies, creativity, high-level cognitive skills and other relatively hard-to-automate skills and core competences. Digital technology is a key driver of economic growth, and new skills/competencies are needed. McKinsey France divides these skills into four categories: data analysts—profiles with strong statistical and quantitative analysis skills; IT experts—database administrators, cyber security specialists or programmers, and digital ergonomists; managers with digital skills—managers in the digital economy will need to lead teams of digital specialists; technicians specialized in digital infrastructures—for example, welding optical fibers is now a highly sought-after skill in the telecoms sector [44].

The literature also suggests a different category of challenges that come with the transition to 5.0. France, a country that intends to position itself as a leader in artificial intelligence, mentions in the report [45] a particularly important aspect, namely, that the development of Industry 5.0 raises many ethical, moral and legal questions that will have to be answered properly. In the long term, the social and economic impact of AI could be significant, and it is important to prepare all economic actors by implicating society. This requires certain skills, qualities and core competencies. Ref. [46] also draws attention to the fact that co-working between humans and robots can generate certain legal and regulatory challenges, psychological issues, ethical issues, difficulties in the ability and openness to work with robots or unfair competition between humans and robots, while [47] discusses the need for the state to adapt to this transition (Governance 5.0).

However, even so, the problems that may arise on the labor market are inherent, which is why effective and efficient measures have to be taken in order to reduce the potential negative effects and to create a working framework that can accommodate both human resources and the increased digitalization complex process.

Refs. [38,48] analyzed the capabilities of Industry 5.0 in the health sector. Their research showed that through Industry 5.0, therapies and personalized medical products could be developed in order to help sick people and to prove local communities and society care about these people.

Ref. [49] highlighted that, through the collaboration between robots and humans within Industry 5.0, the objectives of sustainable development and the creation of an intelligent and resilient business ecosystem are supported. Another important advantage of Industry 5.0 is highlighted by [50], which shows that a people-centered approach and its involvement in the design of goods and services will create more personalized products and services than ever before.

Industry 5.0 is not only about collaboration between humans and machines, but also about collaboration between companies, universities and government. Ref. [51] highlights the extremely important role of universities in the new industrial revolution 5.0 by shaping the new skills, core competences and abilities required by a "smart" labor market. Ref. [43] estimates that up to 375 million workers globally (14% of the global workforce) will need to transition to new occupations and learn new skills; if their transition to new jobs is slow, unemployment could increase and dampen wage growth.

We can currently affirm the fact that Industry 5.0 has been supported and boosted to a rather high extent by the health crisis.

Thus, even though the COVID-19 pandemic meant, on one hand, a temporary interruption of many innovative activities and stopping the creation of intelligent manufacturing technologies [52], on the other hand, it represented a long-term catalyst for achieving major industrial changes, because, as [53] states, historical evidence has shown that such disasters have decisively influenced technological progress over time.

The transition to Industry 5.0 offers significant opportunities for businesses and industries, but it also poses challenges that require applying a careful management style

and procedures. Policymakers, businesses, universities and civil society must carefully consider the potential opportunities [54].

3. Research Methodology

Within this paper, we used a combined research methodology in accordance with the main goal of the paper in order to better manage to gather relevant and representative (from a statistical point of view) results.

We identified the most relevant work within the international academic literature in order to capture some of the most relevant results obtained previously in this field by other researchers.

In Section 4, we used the descriptive approach involving inductive reasoning, deduction and the interpretation of statistical data to highlight the evolution of the degree of digitalization in certain economic sectors at the European level, as well as the medium- and long-term impact on the labor market.

In Section 5, we used descriptive analysis, induction and deduction to investigate how development and the transition to Industry 5.0 can support the sustainable and inclusive development of human resources and their ability to adapt to the new reality generated by industrial (r)evolution, as well as their resilience to technological advancement and massive digitalization.

In Section 6, we applied the method of econometric analysis in order to identify the degree to which human resources in EU member countries are currently prepared, from a statistical point of view, for advanced digital technologies so that, with the transition to Industry 5.0, positive and sustainable long-term effects will be achieved. In this regard, we used the hierarchical cluster analysis method to see the extent to which each country has human resources with key core competencies in supporting the transition to Industry 5.0.

Method Description

The main purpose of hierarchical cluster analysis is to design and generate a classification tree diagram. For this reason, it is necessary that the similarities between the attributes be achieved, and the method that we used for our analysis is squared Euclidean distance, which can be expressed as:

$$d^2(p,q) = (p_1 - q_1)^2 + (p_2 - q_2)^2 + \cdots + (p_n - q_n)^2 \quad (1)$$

where

$p_1, p_2, \ldots, p_n$ are the coordinates of the first point in n-dimensional space;

$q_1, q_2, \ldots, q_n$ are the coordinates of the second point in n-dimensional space.

The squared Euclidean distances between each point are registered in the proximity matrix.

The method begins with each of the n cases being included within its own cluster. Further, the 2 cases that have the most similarities are joined to form a single group that yields in all $n - 1$ groups. Subsequently, the 2 clusters that have the most similarities are joined in a single cluster, leading to $n - 2$ clusters. The process repeats itself until each case is in the same cluster that appears in step $n - 1$.

The data used in the paper are taken according to the sources mentioned in the References part; these are the most recent official data available at the time of this research.

For computation, we used SPSS and EViews software.

4. The New Industrial Revolution and the Potential Impact on High Skills and Core Competences

In this section, we will test some of the results of previous studies in the field, and next, we identified the latest trends in the implementation of digital solutions generated in the aftermath of the industrial revolution Industry 4.0 in various economic sectors, as well as highlighted their potential impact on the labor market.

Technological progress is advancing at a very fast pace, which is why long-term forecasts are only approximate and should be analyzed with caution.

Ref. [55], in the report entitled "The Future of Jobs Report 2020", provides a strong trend towards the adoption and implementation of technological solutions in most relevant social and economic sectors during the period 2020–2025 (Figure 1).

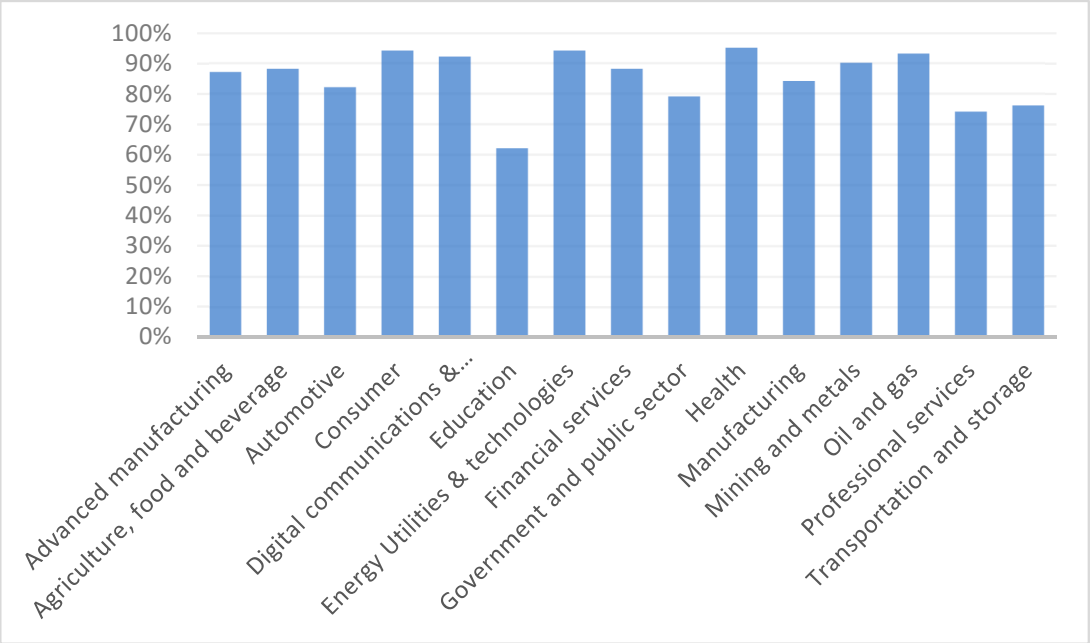

Figure 1. Percentage of IoT solutions projected for 2025, by economic sectors. Source: Designed by authors based on [55], http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf (Accessed on 5 November 2022).

The report is based on data from some of the largest companies internationally.

Figure 1 shows the share of companies that have indicated that by 2025, they will certainly or almost certainly adopt IoT solutions as part of their medium- and long-term development strategies and policies. The highest share is reported in the case of the health-care sector, with 95% of companies predicting that they will implement IoT development solutions by 2025.

Very high shares are also reported in the case of consumers (94%), the energy utilities and technologies sector (94%), oil and gas (93%), digital communications and information technology (92%) and the mining and metals industry (90%).

The lowest share is registered in the education sector, where only 62% of companies estimate that the development of this field will be based on IoT solutions.

Due to the recent evolutions in education focusing on virtual alternatives due to the COVID-19 pandemic, this share seems to also increase.

However, Eurostat data show that at the level of the European Union, in 2022, the share of companies with a high digital intensity index is relatively low (Figure 2), with the exception of companies that are active in the Information and communication sectors (71.6%); Professional, scientific and technical activities (54.2%); and Real estate (43%). These are the sectors where the share of companies with a high digital intensity index is higher compared to that of companies with a low digital intensity index.

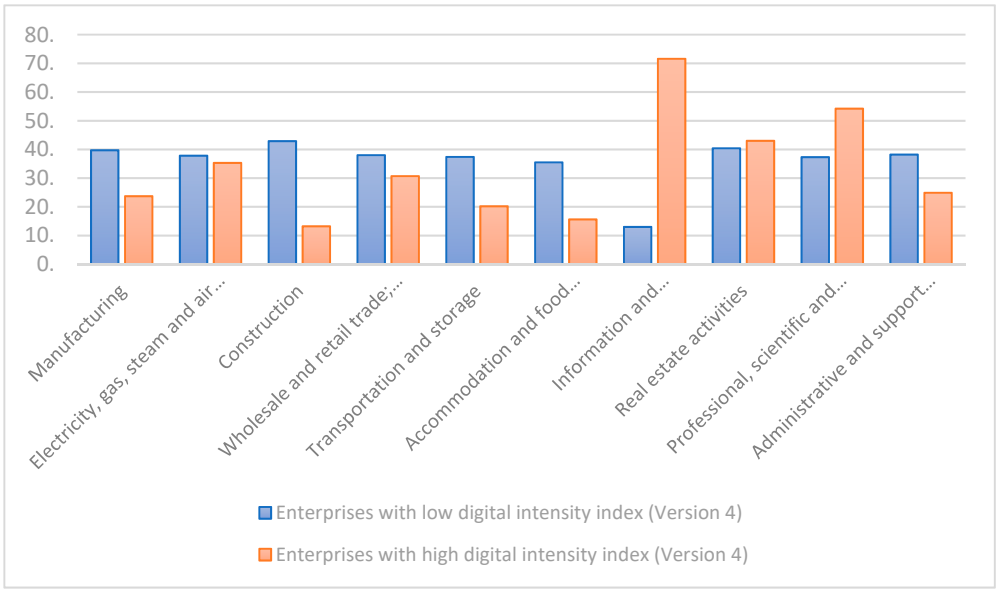

Figure 2. Digital intensity in European Union, 2022. Note: The data for each EU Member State are available on request. Source: Designed by authors based on [56]. Statistics | Eurostat (europa.eu) (accessed on 18 February 2023).

The results presented in Figure 2 demonstrate that in many EU countries, the process of adopting alternative viable digital solutions at the level of corporations is quite low, so that reaching the goals of high digitalization by 2025 will require a rapid process of activity transformation and the allocation of considerable resources. We consider that this accelerated technological and digital development will generate more and more pressure on the labor market, with a high risk of job loss, especially in the case of those involving low-skilled routine workers.

At the level of the European Union Member Countries, the share of this category of workers is high (Figure 3).

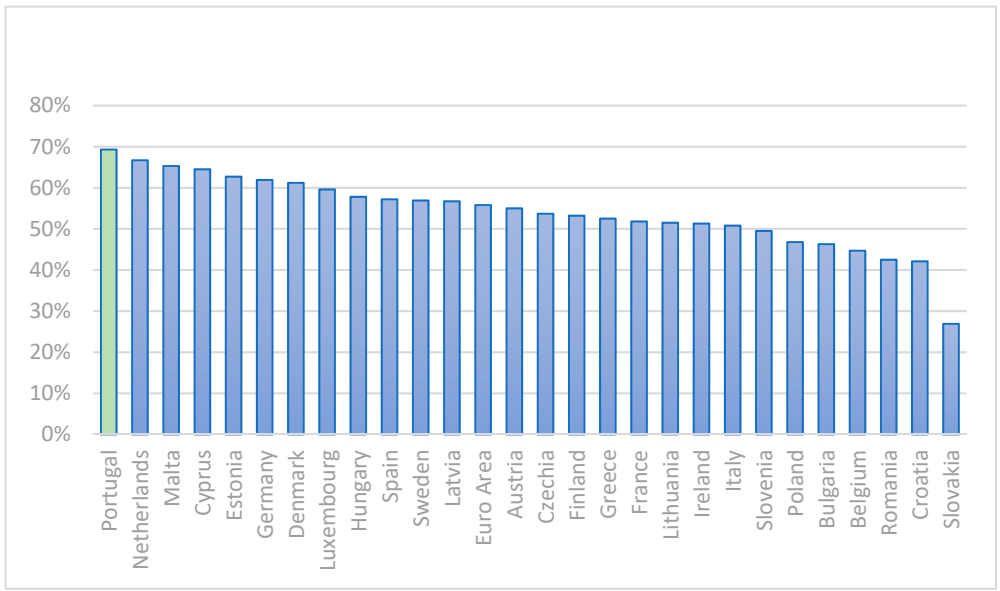

Figure 3. Employment rate of low-skilled persons, 2021. Source: Designed by authors based on [56]. Statistics | Eurostat (europa.eu) (accessed on 18 February 2023).

The highest percentages regarding the employment rate of low-skilled persons (over 60%) are registered in Portugal, the Netherlands and Malta, resulting in the fact that these countries present the highest risk of employee layoffs with the increase in the degree of digitalization of their business models.

Empirical evidence, coupled with medium- and long-term forecasts, indicates that the process of significant digitalization of business models is expected to be accelerated, and the pressure on the labor market will significantly increase, especially in the case of states with a large number of low-skilled persons.

The main question that arises in this case is: what can we do in a relatively limited time horizon so that the impact of digitalization on human resources will be as low as possible?

In the next section, we tried to answer this question, and we debated the new vision of the industrial revolution and its significant role in the economy and society, a vision that places human resources as a basic pillar in its sustainable, inclusive and resilient development, namely, Industry 5.0.

5. Industry 5.0 Model as a Need and Opportunity to Shift to a More Human-Centric Approach

In the recent context, related to the COVID-19 pandemic, the whole world has started to adapt to the new economic and social reality and is trying to create sustainable, resilient and inclusive economic systems in the mid-term and long term, with a greater capacity for adopting in a flexible manner against risks and local and global shocks. This approach entails having the necessary tools to face challenges, if and when they occur, and correspondingly, to see crisis as an opportunity to change in order to assure long-run sustainable, resilient and inclusive development.

Industry 5.0 is a new concept that intends to extend the traditional objective of producing goods and services only for maximizing profits and/or minimizing losing. The main goal of social and economic activities have to be extended by incorporating three essential elements: human-centric approach, sustainability and resilience.

Regarding the human-centric approach component, within the Industry 5.0 model, human needs and interests must be placed at the center of its objectives, and special attention has to be paid to new technologies so as not to affect fundamental human rights and values.

According to this new approach, human resources and mostly core and soft competences are considered as one of the most effective and efficient long-run strategic investments on all the levels (micro, mezzo and macroeconomics). This paper focuses on the micro level, with special reference to the company, which has to function properly as an investor in people, focusing on both professional and personal development, by highlighting the importance of skills development and employee well-being in order to achieve its long-run competitive objectives.

The success of the Industry 5.0 model from a practical implementation point of view highly depends on how employees are actively involved in the development and application of new digital and industrial technologies (such as robotics, AI) so that they are adapted to the needs and diversity of employees and allow the connection between automated assemblies and humans.

These issues are currently being tested. For example, the "*Factory2Fit*" project simulates an industrial factory in a virtual environment in order to analyze how people are integrated and responsible in a connected industrial environment. The results show that a human-centered approach had contributed to the increase of labor and total factors productivity, but also to the improvement of the well-being and quality of life for individuals.

In addition, there is a growing number of projects that focus on the human and social aspects of digitalization, thus supporting the human-centric approach of Industry 5.0.

Projects like "*HuMan Manufacturing*", "*FACTS4WORKERS*", "*CoLLaboratE*" or "*EVRYON*" examine the interaction between humans and robots in terms of production, in order to find ways of valuing all their strengths and capitalize on the capabilities of human capital.

Other types of projects, such as "*BEYOND4.0*", "*PLUS*", "*MindBot*", "*H-WORK*" or "*SemI4.0*", evaluate the implications of digitalization and new technologies on core competences development, human well-being and society. In this sense, human-oriented leaders need to focus more on aspects, such as employee safety, working conditions, physical and mental well-being, or employee satisfaction integrated in a digitalized work environment.

For the transition to Industry 5.0 to be sustainable, resilient and inclusive in order to generate long-term positive effects, we consider it necessary for human resources to have a set of new professional and transversal competencies. Among the most important such competencies, we name:

- Abilities of using, monitoring and controlling technological devices;
- Analytical and innovative thinking;
- Lifelong learning;
- Development of technological and programming solutions;
- Creativity, originality and initiative;
- Emotional intelligence;
- Leadership;
- Ability to solve complex problems.

By developing these types of skills and core competences, individuals will be better prepared to take jobs such as software developer, robotics engineer, IoT specialist, artificial intelligence specialist, researcher, digital marketing specialist, database and networking specialist, materials engineer, analyst of information security, renewable energy engineer or process automation specialist.

Currently, the competencies needed in order to assume such roles are not very widespread among individuals, a significant problem that is addressed in dedicated projects identified by our team ("*ERASMUS+*", "*FIT4FoF*", "*TECHNIQUE*", "*SAIS*").

In this regard, emphasis is placed, on one hand, on the role of universities in the formation and development of such competencies and the adaptation of university programs in accordance with labor market requirements.

On the other hand, it is placed on the need for lifelong learning and training in connection with new technological and innovative development. It is more and more obvious that not all individuals are able to continuously improve their skills and core competences according to technological advancement, but the Industry 5.0 paradigm offers also viable alternative solutions to face these kind of situations as well.

The perspective of the Industry 5.0 model does not generate integrated solutions only for human resources that have the possibility to accumulate such core competencies and skills. Through AI and virtual and augmented reality, tools can be created to help and guide less specialized or less skilled individuals to better perform more complex tasks, which involve advanced and high skills and competences.

Moreover, technologies can be developed to be more intuitive and easier to be used more interactively and effectively.

At the same time, according to a more human-centric industrial revolution approach, innovative alternative viable solutions can be developed for the integration into the labor market of people living in remote regional areas, who cannot make the daily commute to work. Thus, innovative alternative viable solutions can facilitate teleworking as a proper way of working that maintains the level of productivity (or even raises it) of employees, but which also offers opportunities in the labor market mostly for several categories of disadvantaged people.

This type of professional activity has other multiple advantages in terms of reducing costs, time and stress, all of these advantages being experienced during the recent period with the outbreak of the COVID-19 pandemic, when teleworking was the main solution for continuing most social and economic activities.

Therefore, in the current economic and social contexts, corroborated with future anticipated perspectives and trends, we consider it imperative that business models have to be rethought and be more people-centered oriented. Only through the active involvement

of individuals within this process of transition to the Industry 5.0 model can long-term sustainable benefits for all economic agents be obtained.

As we have seen, however, it is absolutely necessary that they in turn have to be better prepared for the transition to the new type of Industry 5.0 model, such as to benefit from a certain set of skills, core competences and abilities in order to better adapt to the new more and more complex, challenging and sometime turbulent context of reality.

Considering these issues, in the next section, we tested the degree to which the human resources from the European Union Member Countries are prepared for better facing the complex process of transition to Industry 5.0 so that we can further suggest a series of measures for their sustainable adaptation to the new conditions specific to this paradigmatic shift to the Industry 5.0 model.

6. Developing Core Competences and High Skills so as to Better Prepare the Road towards a Competitive, Sustainable and Resilient Shift to Industry 5.0

Based on the scientific context discussed in the previous sections, we selected for our analysis the individuals' level of digital skills as main competencies that human resources need to have for the transition to Industry 5.0.

This is why the variables that we have selected for this analysis are the following:

- Percentage of individuals who have above basic information and data literacy skills (S_ID);
- Percentage of individuals who have above basic communication and collaboration skills (S_CC);
- Percentage of individuals who have above basic problem-solving skills (S_PS);
- Percentage of individuals who have above basic digital content creation skills (S_DCC).

These variables are also components of the 'Individuals' level of digital skills' category, designed and published by Eurostat experts.

The data source for these variables is represented by Eurostat statistics and refer to the last available official data for 2021.

Based on these data series, we determined the grouping of the EU Member Countries into four performance clusters, with the 1st cluster characterizing the best performing countries, and the 4th cluster characterizing the least performing countries. The results are detailed in Table 1.

Table 1. Cluster membership of EU Member Countries.

No.	Case	4 Clusters
1	Belgium	3
2	Bulgaria	4
3	Czechia	3
4	Denmark	1
5	Germany	3
6	Estonia	3
7	Ireland	1
8	Greece	3
9	Spain	2
10	France	3
11	Croatia	3
12	Italy	3
13	Cyprus	2
14	Latvia	3
15	Lithuania	3
16	Luxembourg	2
17	Hungary	3
18	Malta	2
19	Netherlands	1

Table 1. *Cont.*

No.	Case	4 Clusters
20	Austria	2
21	Poland	3
22	Portugal	3
23	Romania	4
24	Slovenia	3
25	Slovakia	3
26	Finland	1
27	Sweden	2

Source: designed based on authors' research.

The results presented in Table 1 are represented in a more detailed form in Figure 4, so that we can capture more properly the links established between states, depending on the variables used in the analysis.

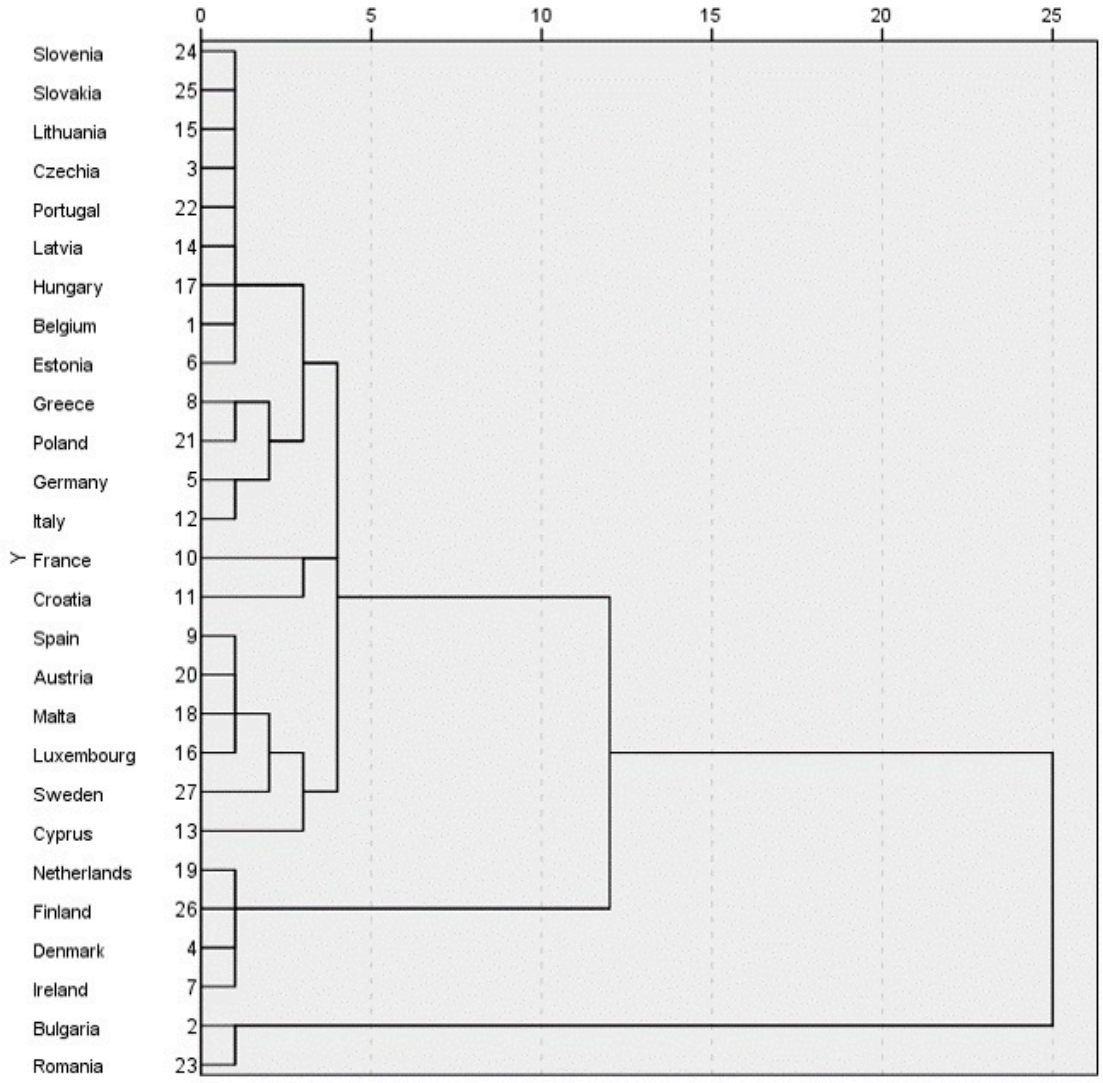

Figure 4. Dendrogram using Centroid Linkage. Source: designed based on authors' research.

The grouping of states in performance clusters shows that, currently, the most developed countries in terms of the digital skills and capabilities of individuals are Finland, Netherlands, Denmark and Ireland, these countries being located in cluster 1. Similar

performance is registered by Sweden, Austria, Luxembourg, Cyprus and Spain, countries that are located in the 2nd performance cluster.

At the opposite pole are Romania and Bulgaria, the only two countries ranking in the least performing cluster.

The situation presented shows that, at this moment, countries like Finland, Ireland, Netherlands or Denmark benefit from human resources better prepared and able to support the sustainable, resilient, competitive and inclusive transition to the Industry 5.0 model. At the same time, it can be noticed that such an objective cannot yet be achieved in countries like Romania or Bulgaria.

Considering this situation, we consider it is of crucial importance to identify possible alternative viable solutions for developing the digital skills and competences of individuals belonging to emergent countries with a lower level of development.

Ref. [47] highlights the very important role played by universities in the new industrial revolution supported by the Industry 5.0 model by shaping the new skills, core competences and abilities required according to the demand of "smart" labor markets.

Further, starting from the results highlighted by this paper, we will try to see what is currently the role of universities in the formation and development of such digital skills and core competences, as well as highlight the role of companies through the specialization training programs they offer to employees.

Partnership and cooperation between universities and the business sector is of key importance for further development, both from an academic context, but mostly from a practical point of view.

For this analysis, we selected three variables that may influence the development of those skills, namely:

- Percentage of individuals who graduated ICT (G_ICT);
- Percentage of individuals who graduated engineering, manufacturing and construction (G_EMC);
- Percentage of enterprises providing training to their personnel to develop their ICT skills (ET).

The source of the data for the above-mentioned variables is Eurostat statistics, and it refers to the available data we identified for the year 2020. In the case of the ET variable, there is no data available for 2020 for some countries (Belgium, Greece and Portugal), so we chose the 2022 data for these countries. We used statistical data from two different years, depending on the last updates of each selected variable available in the Eurostat database. We also assumed that there is a delay of one year between the training process and the effective acquisition of the skills and competences.

Further, we proceeded to determine the correlation matrix between all variables in order to see the relationship established between them, especially the extent to which universities and companies contribute to the development of individuals' digital skills and competences. The results are presented in Table 2.

Table 2. Correlation matrix of the variables included in the model.

Variables	G_ICT	G_EMC	ET	S_ID	S_CC	S_PS	S_DCC
G_ICT	**1**						
G_EMC	−0.149	**1**					
ET	0.258	−0.135	**1**				
S_ID	0.291	−0.232	0.603 *	**1**			
S_CC	0.259	−0.275	0.479 *	0.825 *	**1**		
S_PS	0.340	−0.113	0.501 *	0.777 *	0.798 *	**1**	
S_DCC	0.279	−0.026	0.589 *	0.719 *	0.709	0.867 *	**1**

* Significant correlations between variables. Source: designed based on authors' research

An important result is that both G_ICT and G_EMC have a quite insignificant influence on the other variables, which shows that the universities are not currently prepared and

adapted to the new digital and technology trends, the development of the digital skills of individuals being achieved especially through the companies' training programs.

The results presented in Table 2 also show strong correlations between information and data literacy skills, communication and collaboration skills, and problem-solving skills and digital content creation skills, which demonstrates once again the importance of individuals benefitting on a core competences set of meta-skills.

We have also identified a strong correlation between problem-solving skills, on the one hand, and communication and collaboration skills and digital content creation skills, on the other hand.

This situation proves that the ability to respond proactively to different problems depends especially on individuals' communication and digital skills, with important consequences for policymakers when they design strategies and policies on the companies and organizations (micro) levels, but also on the local (mezzo) and national (macro) levels.

7. Discussion

Our research has shown that the rapid development of advanced digital technologies has significant influence on the core competences and skills of human resources in the sense that, in the absence of a paradigm shift to the Industry 5.0 model, Industry 4.0 will lead to job losses for many categories of employees.

Statistical data show that, by 2025, the percentage of adoption of technological solutions will be very high in most social and economic sectors. Thus, the average share of employees at risk of dismissal will increase proportionally according to this trend.

One possible alternative solution that might be designed in order to combat these negative effects on human resources is to focus on the needs and interests of people and not affect their fundamental rights and values.

In this context, the concept of the Industry 5.0 model appeared as a new paradigm, a new way of thinking, which has a more human-centered approach and, thus, being more capable and viable, contributes to the technological development necessary for the new industrial context so as to define its real strategic role as a provider for local communities and for society as a whole and, of course, for employees.

By developing high skills and core competences according to the anticipated tends of evolution and the progress of innovative technologies based on a more human-centric approach, Industry 5.0 might act as a valuable alternative to support and empower employees, rather than replace them with automated tools, while increasing their long-term sustainability, competitiveness and resilience.

Digital technologies allow and support key innovations regarding jobs, and by rethinking production processes and optimizing human–machine cooperation, we anticipate there will be an increase in employee productivity, and, at the same time, companies will fulfill their social responsibilities, acting in favor of long-run sustainability, competitiveness and resilience.

However, for the transition from Industry 4.0 to Industry 5.0 to take place in a sustainable and even long-term way, we consider it important that people will be better prepared so as to benefit from developing their core competences and skills and to become more and more capable to face the new challenges in a competent way, by transforming challenges into opportunities to support mostly along mid-term and long-term sustainability, competitiveness and resilience.

Our analysis has shown that not all EU Member Countries currently have sufficient human resources prepared to deal with the industrial revolution, and this indicates that low-performing countries cannot take full advantage of technological advancement and are unprepared for a sustainable transition to Industry 5.0. Such countries include Bulgaria and Romania, while the highest performances are recorded by Finland, Netherlands, Denmark and Ireland.

The results refute the conclusions of [47], showing that universities are not fully prepared to contribute to the development of the digital skills and competences of individuals, their development being driven rather by the training programs of companies.

Our contribution to the existing academic literature also resides in the application of the hierarchical cluster analysis method, whereby we find that there are stronger correlations among the problem-solving skills, digital specialization and communication skills of the human capital within the European labor market. We also highlight the readiness discrepancies between more economically advanced and less developed countries in the EU.

In the current global socioeconomic complex, dynamic and sometimes turbulent context, it is paramount for such countries to create the necessary framework to support a sustainable transition to Industry 5.0 as soon as possible, by adopting effective and efficient measures, so that they remain competitive and can ensure a high standard of living for their citizens, both on the local and national levels. In this sense, we propose as a fundamental measure the adoption of a sustainable long-term digitalization strategy, supported by academia and the business sector through cooperation, in order to develop in partnership lifelong learning and training programs for professionals to benefit from the core competences and skills required under the paradigmatic shift to Industry 5.0 models.

An important role belongs at the same time to the governmental sector, which has, on the one hand, to implement a mix of economic strategies and policies as, for instance, the fiscal reforms designed so as to stimulate lifelong learning and training investments in human capital in order to better prepare specialists with specific competencies required by the Industry 5.0 model, and on the other hand, provide employees with sound social protection systems.

Following the best practices review, we consider the development of digital hubs formed by well-qualified and highly skilled, competent people focusing on the core competences and skills well supported by the model of Industry 5.0 pivotal. This, in turn, supports collaboration among the strategic key institutions actively involved, such as universities, government, and public and private administrative actors with important roles in the local communities. Companies will have to be and become a decisive pillar to support long-term sustainability, competitiveness and resilience, as well as to contribute to the development of the business environment under the conditions specific to the Industry 5.0 principles.

8. Conclusions

Based on the results obtained and briefly presented within this paper, we believe that we managed to achieve our main objective mentioned in the introduction.

The technological aspects of the transition, such as the creation of new technologies and procedures, have been the focus of research in other similar research studies dedicated to Industry 5.0, as we identified within the specialized relevant and most recent literature. In addition, our team consider it important to highlight the significance of establishing a culture of supporting lifelong learning as a new way of people's way of thinking and living, encouraging employee empowerment and developing human-oriented competences and skills during the complex process of transition to the Industry 5.0 model. While technical skills are undoubtedly crucial, our paper emphasized also the need for people and organizations to acquire non-technical skills, soft skills and other core competences in order to succeed in a quickly changing, complex and sometimes turbulent social, political and economic environment.

We have shown that the Industry 4.0 economic model causes major disequilibrium in the labor market across geographical boundaries and that the human-centric approach supported by Industry 5.0 can contribute to the development of a sustainable, competituve and resilient social and economic model. We have also shown that the success of the latter depends on the readiness of the labor market to handle rapid technological advancement. We defined the Industry 5.0 readiness of the European labor market as the degree of correlation between the digitally skilled workforce, on one hand, and, correspondingly,

the level of educational specialization in the engineering, manufacturing and construction fields, on the other hand.

We consider that now, the transition to Industry 5.0 cannot be made in a homogeneous way at the level of the European Union, as most large companies, which have a great capacity to innovate and design proper effective strategies and policies for integrating human resources in accordance with the requirements of Industry 5.0, are located especially in the most developed countries. Thus, according to our research, such companies can better attract human resources with advanced core competences and skills, mostly in terms of digital skills from other countries, offering them high salaries and better opportunities by supporting professional and personal development.

At the same time, universities in the most developed countries manage to attract many talented young people from less developed countries through the fact that their prestige helps them to guarantee, to a large extent, great jobs for graduates, mostly in large, well-established and competitive companies.

In this context, large companies located in developed EU countries will advance faster in the future compared to companies in Central and Southeastern Europe. By permanently attracting more financial capital, competent and highly skilled labor, and efficient and effective investments in new technologies, these jurisdictions succeed in rapidly applying the Industry 5.0 model.

The reality at the moment shows a lack of prospects for improving the situation in the case of emergent, less developed countries. We consider that by applying step-by-step measures, such as those suggested within this paper, these countries can become more and more able to register progressive evolutions and will gradually adapt to the requirements of a sustainable, competitive, inclusive and resilient shift to the Industry 5.0 model.

Regarding how our team intend to develop further research and studies in the future, we think we might examine how core competences evolve over time for both people and organizations. Additionally, by contrasting successful and unsuccessful businesses as they make the transition to Industry 5.0, we can pinpoint the corporate cultures and fundamental competencies that set successful businesses apart from unsuccessful ones. This new model of work based on the Industry 5.0 model can help us to identify best practices examples in order to better adapt academic institutions, in cooperation with the business sector, to preparing people and organizations for the transition through better comprehending the effects of this organizational and technological changes on individuals and organizations. Our paper highlights, as well, the effects of Industry 5.0 on the labor market, including the changes in demand for different skills and competencies.

9. Limits of the Research

Our research presents, of course, a series of limitations because it does not analyze the technological development capacity of industries in EU Member Countries, so that we might better identify the extent to which these industries might benefit from human resources specialized in technology and with core competences and high digital skills. We intend to take these issues into account for further research studies.

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