Training as a facilitator for Industry 4.0

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Abstract

Purpose – This paper studies the impact of certain characteristics of companies to training programs in the Industry 4.0 (I4.0) context. Partial objective is to rank the main human barriers companies have to overcome so that they can digitalize.

Design/methodology/approach – To accomplish the objectives, a closed-ended questionnaire was sent to Slovak and Italian companies and analyzed using statistical nonparametric tests. The partial objective was achieved using the so-called Henry-Garrett's ranking method.

Findings – Results show the significance impact of companies' characteristics such as foreign participation and company dimension on training practices whereas economic situation (financial health) seems not to influence it.

Research limitations/implications – The study may lack generalizability as only 102 answers were collected. Perhaps, the outcome would be different with another sample from other countries. Moreover, using closed-ended questions, certain features may not have been covered.

Practical implications – Companies should always guarantee training for the resulted benefits. It is fundamental for organizations to find a time gap, resources and professionals who can teach these programs. Even when companies are incurring financial problems they should do so since human capital development can increase their competitiveness. The most critical barriers should be carefully addressed by companies. Training can help to overcome I4.0 barriers related to Human Resources (HR) and contribute to its growth.

Originality/value – This paper gives insights of the impact of certain characteristics of companies to the training programs. Because past research has limited their analysis on the identification of barrier, its novelty lies in the attempt to rank the most significant barriers among those detected by other authors in previous research.

Keywords Training, Human resources, Competences, Industry 4.0, Smart factory, Barriers to change

Paper type Research paper

1. Introduction

All industrial revolutions increased production and shaped industries, thanks to technology advancements. Indeed, technology has been and always will be a human's socioeconomic and cultural ally (Chigbu & Nekhwevha, 2021). Currently, a fourth industrial revolution, started in 2010s, is taking place, also known as Industry 4.0 (I4.0) and digitalization. This is characterized by much higher complexity than the previous ones (Francalanza *et al.*, 2021). Mostly industry-driven (Ruohomaa, Salminen, & Järvenpää, 2019), I4.0 is changing and interconnecting the world. I4.0 is highly dependent on new technologies and concepts focused on machine learning, robotics, radio-frequency identification, artificial intelligence (AI), augmented reality, and the Internet of Things, cloud, horizontal, and vertical system integration, and cyber security (Erboz, 2017; Crnjac, Veža, & Banduka, 2017; Li, 2018;

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Schwab, 2016; Raj *et al.*, 2020). One striking characteristic of I4.0 is the widespread implementation of information and communication technology (ICT), which is blurring the boundaries between the physical and the virtual world (Ruohomaa *et al.*, 2019). As such, a common name for I4.0 is Internet of Things or Industrial Internet, but this only represents a feature of I4.0; therefore, we do not call it by that name (Culot, Nassimbeni Orzes, & Sartor, 2020). Companies are employing technologies that assist and facilitate the daily work of employees, such as virtual reality (VR) and augmented reality (AR). One application of VR is in training, where diverse environments and scenarios can be simulated. For example, employees can be aided in cutting certain materials: virtual guidelines delimit the area to be cut off.

Companies that use VR, AR and other current practices and technologies (AI, additive manufacturing and system integration) with integrated and centralized processes common to I4.0 are called smart. According to Gilchrist (2016), the framework of I4.0 comprises exactly smart factories (Alcácer & Cruz-Machado, 2019). Some smart companies can claim the *status* of "digital champions" (PwC, 2018). Their main singularity is the ability to be aggressively innovative, beyond simple automation and networking. The cluster of activities of customer solutions, operations, technology and people are so advanced that they can make the most of opportunities provided by the digital panorama. Moreover, they have a competitive advantage over "traditional" companies, resulting in increased revenues and profits.

Employees who wish to work in such a setting should know how to use these technologies called 4.0. The skills and qualifications of the workforce are essential for the success of highly advanced companies, from an innovation perspective (Benešová & Tupa, 2017). Different from past industrial revolutions, a training system should be built quickly to develop new major sets of skills and qualifications (World Economic Forum, 2016), since these will be the key to success for a highly innovative factory (Gehrke *et al.*, 2015). For this reason, companies should focus on developing qualified workforce. Hence, training is critical – as never before – in the context of I4.0, for educating the workforce and upgrading its skills and competencies.

However, the introduction of I4.0 in a company is not always simple, even with effective training programs. Several barriers must be overcome by both companies and employees. Marcon *et al.* (2019) identified three main categories: strategical, operational and human resources barriers. Of these, particularly relevant are human resources and financial availability. With an insufficient amount of the latter, it will be hard to digitalize an organization. Human capital is also critical for the success of companies, enhancing their competitiveness.

We carried out this study in Slovakia and Italy, where, apparently, no similar research was done before. The research question was the following: *Is training for I4.0 influenced by companies' characteristics?* The objective was to examine if certain attributes of the companies (size, economic situation) affect training employees for I4.0. There are papers that address I4.0 in a more general way, assessing readiness, challenges and technologies. In Slovakia, Richnák (2019) evaluated the "position and use of industry 4.0" with respect to the employed technologies, arguing that it is not widely used. Regarding Italy, Pozzi, Rossi and Secchi (2021) focused on the critical success factors for implementing an I4.0 technology.

A secondary objective was to analyze the most significant human resource barriers affecting respondents' companies: resistance to change, competencies, human and training barriers. Thus, rather than exploratory and wider regarding barriers and challenges (Stentoft, Wickstrøm, Philipsen, & Haug, 2021; Türkeş *et al.*, 2019; Marcon *et al.*, 2019), our study is narrower. We pay an original attention to this particular group of barriers – despite its central relevance in determining the success of I4.0 implementation. The ranked barriers are those found by Marcon *et al.* (2019), whose study inspired us. Another difference is the

heterogeneity of the sample. Often authors limit their analyses to the manufacturing sector, ours concern companies from different industries.

The rest of the paper is organized as follows: a literature review on the topics of I4.0 and training, the methodology for analyzing the questionnaires and a discussion based on their results.

2. Literature review

The literature on I4.0 is extensive, with papers addressing the new technologies introduced, and many focusing on its specific aspects and challenges. Particularly relevant is the work by Schwab (2016), describing the technologies brought about by I4.0; similarly, Alcácer and Cruz-Machado (2019) discuss key technologies and the settings by which I4.0 is implemented (smart factories). Xu, Xu and Li (2018), by comparing the German government's plan for digitalization (I4.0) and Made-in-China 2025, made an extensive description of the technologies that I4.0 introduces, and the evolution of manufacturing processes from Industry 1.0 to I4.0. Machado, Winroth, and Ribeiro da Silva (2020) review I4.0, emphasizing its link with sustainable manufacturing.

The main objective of I4.0 is the fulfillment of individual customers' needs (customization), which involves areas like order management, research and development, manufacturing commissioning and delivery, until the utilization and recycling of products (Neugebauer *et al.*, 2016, cited by Vaidya, Ambad, & Bhosle, 2018). Since its first definition, I4.0 has dramatically evolved. From the original application, limited to the manufacturing industry, it was introduced in every industry. For defining I4.0, different authors stressed particular features. Several authors highlight the real-time synchronization and customization that I4.0 enables; others describe extensively the technologies used and managerial processes common to I4.0 and initiatives to improve processes, products and services (Moeuf, Pellerin, Lamouri, Tamayo-Giraldo, & Barbaray, 2018). Merging Prause and Atari (2017) definition for the manufacturing industry and CEFRIO's (Danjou, Rivest, & Pellerin, 2016, cited by Moeuf *et al.*, 2018) wider, it is possible to extend it to all industries and describe the improvements it provides to companies. I4.0 is the integration of Internet of Things and its related technology for value creation, enabling companies to control entirely digitalized, connected, smart and decentralized value chains, which altogether lead to improvements in processes, products and services. Such control increases flexibility and strength of firms' competitiveness.

Among the benefits for organizations are the control of costs, rapid adaptation to customers' needs and demands, more accurate decision on what strategy to choose, efficiency and agility. Sustainable practices can be enhanced too.

From a managerial perspective, the Fourth Industrial Revolution – in small and medium enterprises (SMEs) – brings improvements and easier ways to carry out certain activities. Monitoring activities, performance control and optimization of systems and processes were identified in the literature review by Moeuf *et al.* (2018). Further, I4.0 presents considerable opportunities for SMEs, enabling them to innovate and enter global markets to compete.

Employees also benefit from I4.0. They can focus on less exhausting jobs, leaving the dangerous ones for machines to perform. Moreover, autonomous robots can do tasks in restricted places with more precision than humans (Vaidya *et al.*, 2018). Employees can enjoy more flexibility in their jobs and boost productivity (Eberhard *et al.*, 2017; Evangelista, Guerriero, & Meliciani, 2014; Chigbu & Nekhwevha, 2021). It is an opportunity for them to grow intellectually and professionally. Agile workers would exploit their high level of expertise and accept easily to shift jobs in the market (Committee for Economic Development of Australia, 2015). As a consequence, a migration is taking place, from lower to higher positions, especially those requiring "flexibility, judgment, and common sense" (Autor, 2015),

which are unique human traits. Many new jobs will be created, and some renovated. They will mostly consist of managing new technologies (Chigbu & Nekhwevha, 2021). It is predicted that 65% of children starting elementary school will have a job that does not exist yet (Eberhard *et al.*, 2017).

For companies and employees to experience the benefits brought by I4.0, several challenges must be overcome. First, reengineering and reorganization of companies are required, consisting in changed job descriptions, roles and responsibilities, and business models and strategic adjustments (Sony, Antony, Mc Dermott 0., & Garza-Reyes, 2021). Therefore, innovation, learning and training of employees are necessary for a firm to adopt I4.0. Top management has to change Hunam Resources (HR) activities into innovative HR practices (Rana & Sharma, 2019), focused on Smart HR Management practices, where human capital plays a vital role in the organization development (Verma, Bansal, & Verma, 2020).

Many scholars agree that HR function is now essential for "smart" companies. HR is considered a determinant of a company's success and of its enhancement in a hypercompetitive world, the element that distinguishes a great company from a good one (Barykin, Rasskazova Evseeva, Evseeva, & Ostapenko, 2021; Ninan, Roy, & Thomas, 2019). Strategies are responsible for the fit between investments in technology and HR practices (Müller, Kiel, & Kai-Ingo Voigt, 2018). An organization's performance and competitiveness highly depend on how its employees are managed (Hecklau *et al.*, 2016). The gain derives from how well the employees are trained to use technologies 4.0, which would otherwise constitute "scrap metal." "[. . .] The technology is there, but the skills are still following" (Dhanpat, Buthelezi, Joe, Maphela, & Shongwe, 2020). The implementation of I4.0 practices in the area of human capital depends on the company size. Multinational companies are more capable of overcoming I4.0 barriers than SMEs (Horváth & Szabó, 2019). SMEs do not have the significant financial resources required to invest in new technologies and adopt I4.0 in full range (Vaidya *et al.*, 2018; Agostini & Nosella, 2020).

In I4.0, specific and general skills (common core skills of high-tech experts) will be required from employees, in order to work together with machines in the next decades. However, soft-skills are also important. In PricewaterhouseCoopers (PwC)'s final report for the European Commission (2020), the top ten skills identified by the World Economic Forum (2018) are mentioned, and, curiously, they are soft-skills (nontechnical ones), because they are common to all workers. Therefore, reskilling and upskilling are critical for workers. Not only is this essential for filling the gap between required skills and those that workers have, but also to avoid dismissal of workers whose tasks will be soon performed by machines. According to Sony *et al.* (2021), employees must adapt to I4.0, since this determines the successful implementation of I4.0: the greater the adaptation, the more likely the success. An employee can act in two levels to adapt his/her skills to those required by smart companies (Wrzesniewski & Dutton, 2001). The result is an accumulated experience capable of supporting decisions and implementing job crafting and career adjustment (Zhang, Guan, Zhou, & Lu, 2019). Their organizations and, at a lesser extent, universities should prepare and train them, so that the workforce will be able to fully use the tools and concepts at their disposal and to provide a disruptive innovation (Francalanza *et al.*, 2021). According to Benešová and Tupa (2017), instead of hiring new workers, current employees should participate in retraining courses for the new automated machines, which is a good investment, because these workers know the company and its functions. Universities need to prepare students with all skills needed for current jobs, but especially for future jobs (Hang, Thuy, & Tam, 2018).

Along with other factors, training seemed critical for determining the successful implementation of I4.0 technologies, in the companies examined by Pozzi *et al.* in Italy (2021). Many training activities were developed through formal programs, others provided by universities and on-the-job (less formal) training. In some cases, there was a combination of them. Beke (2020) argues that it is increasingly important to recognize an individual's best

abilities and avoid linear forms of education, which favor nonspecific learning processes and prepare students for working in various noncore tasks.

Large companies have an advantage because they can spend a big part of their profits in training and hire experts to teach. Training in I4.0 is very different from the past (Ninan *et al.*, 2019). There is the figure of training professionals – who are excellent in their field and provide a targeted training. Previously, training was general, and professionals were not experts in a particular field.

Understanding, handling and performing new tasks introduced by I4.0 technologies will require appropriate training and skill development for employees and supply chain partners (Waibel, Steenkamp, Moloko, & Oosthuizen, 2017). Training also has a positive effect on the organization, by helping to meet quality standards with a small turnover rate (Ninan *et al.*, 2019). By providing training for all employees, the firm avoids fears and insecurities that may discourage them. As Chigbu and Nekhwevha (2021) found out in the automobile industry of South Africa, where only some working categories received training, the other workers fear their future, which, in turn, makes them unmotivated employees for adopting innovations. In Italy, "competence centers," among others, provide training to spread competencies and show the advantages of I4.0.

Organizational culture would contribute to pave the way for the effective implementation of I4.0 initiatives. Since culture is the set of assumptions known by all actors of the organization (Kurt, 2019), introducing a change is sometimes difficult, and can hinder reorganization. Furthermore, in the perspective of job restructuring, many employees feel uncomfortable, insecure, unprepared and deeply concerned (Chigbu & Nekhwevha, 2021).

Resistance to accept the change is a potential barrier to the transition to I4.0. As such, organizational culture should be carefully analyzed in order to promote a smooth change (Sony *et al.*, 2021). Resistance to change is a generic term representing a broad set of behaviors of employees and managers. It stems from political, psychological or cultural problems that makes a renovation harder (De Wit, 2017). It is particularly relevant in case of technological advances, as resistance usually manifests itself due to "certain blind spots and attitudes that staff specialists have as a result of their concern with the technical aspects of new ideas" (Lawrence, 1969).

Foreign capital is a driver of I4.0. Transition of knowledge from foreign companies plays an important role in I4.0 adoption (Jankowska, Götz, & Tarka, 2021). Indeed, foreign investors provide cutting-edge technologies to upgrade local entities (Scott-Kennel & Saittakari, 2020; García, Jin, & Salomon, 2013). I4.0 is highly connected to the economic situation. Companies with better economic results have a higher probability of adopting I4.0 because of larger financial resources for implementing new technologies (Turkes *et al.*, 2019), and these are integrated to achieve sustainable economic welfare (Bal & Erkan, 2019). We wanted to check if the adoption of I4.0 was influenced by a company's economic situation.

3. Methodology

Our goal was to identify the challenges that companies face and that hamper I4.0 implementation. In addition, we tested if several attributes of companies affect training.

Based on the literature, we developed the following hypotheses:

H1. Competencies are the most critical barrier among human resource barriers.

H2. Large companies give more attention to employees' training than small ones.

H3. Companies with foreign capital give more attention to employees' training.

H4. Companies with a better economic situation give more attention to employees' training.

The goal of training and retraining is to gain competencies, and, for this reason, it is the most difficult challenge to overcome (*H1*). Since not all companies can spend large amounts of their capital in it, they lack specialized personnel, or they do not have time to dedicate to it, our second hypothesis was that large companies have more interest in the development of employees' knowledge (*H2*). We expected to confirm *H3* because of the potential pressure that these companies receive from stockholders, requiring a smooth renovation, and, therefore, qualified people. The last hypothesis, *H4*, tested the impact of the economic situation on training. With the worsening economy, training would be minimized to essential, or simply avoided, since companies might prefer to save money.

We got primary data through a questionnaire with close-ended questions, sent by e-mail to managers and company owners based in Slovakia and Italy. We received 102 answers: 62 from Italy and 40 from Slovakia. The resulting sample was heterogeneous. In 38, foreign investors contributed to the firm capital. The companies carried out their activities in more than 30 different sectors, they had distinct dimensions, respondents worked in different positions, belonged to diverse age cohorts, and had several qualification degrees. Of these companies, 37 enjoyed a better economic situation, it had not changed for 31, and for 34 it had worsened.

Working positions were grouped under four labels: lower managers (28), top managers (28), owners (22) and others (other positions, 24). Qualification degrees varied from high school to postgraduate education. Respondents with a postgraduate title (including PhD) were 65% of the sample.

Considering companies' dimension, the sample comprised: 26 very small (≤10 employees), 22 small (10–49 employees), 26 medium-sized (50–249 employees) and 28 large companies (≥250 employees). Only four companies were public/state owned. Since sectors were numerous, and in some of them very few companies operated, we grouped them in service (37) and tangible product (63) industries (two answers were not classifiable). The goal was to avoid the risk of close to zero variances, which would not enable further analysis.

The questionnaire was divided into three parts (see Appendix):

(1) 12 questions concerning the characteristics of the sample (position, size and location of the company, etc.).

(2) 28 Likert-like scale questions, from 1 (totally disagree) to 7 (totally agree), about *personal*, *marketing and customer*, *strategic* and *technological innovation* necessary to adopt digitalization and I4.0 initiatives and *smart working*.

(3) 4 questions where respondents had to rank a set of given barriers mainly identified by Marcon *et al.* (2019) – in order of importance, concerning strategy.

For the analysis, we chose the following items:

Item 1: Your company provides you with proper training in order to use a specific technology.

Item 2: Your company emphasizes training programs aimed to improve your soft-skills (effective communication, ability to work in group and manage stress).

Item 3: Your company emphasizes training programs aimed to improve your hard skills (technical skills such as being able to communicate in a foreign language, IT skills).

Item 4: Your company provides refresher (retraining) courses periodically.

Cronbach's Alpha coefficient – showing the internal consistency of the Likert scale questions – was 0.843, which, in social science, is acceptable (it is higher than 0.7 and between

0.8 and 0.9) (Gardner, 1995; Streiner & Norman, 2003). Likert scale questions then were tested with selected characteristics of companies. Since Likert scale is ordinal, the assumption of normal distribution was violated. Therefore, we performed nonparametric tests. In case of two groups, such as ownership, we used Mann–Whitney U test. Kruskal–Wallis was employed for more than two groups. For the latter, we used Bonferroni *post-hoc* test to identify the groups that differ from others.

The method chosen for the analysis of the ranking questions (in order of importance) is peculiar if compared to the techniques employed in the analysis of barriers of I4.0, such as Grey-DEMATEL (Raj *et al.*, 2020) and Fuzzy. We used the Garrett ranking method, by Henry Garrett (1926). To find the most significant barriers in order of importance, we used the formula below.

$$100\,x\left(\frac{Rij-0.5}{Nij}\right) \tag{1}$$

Rij = rank for the i^{th} barrier of the j^{th} respondent

Nj = total number of respondents.

The result of this formula was the percentage position, converted into Garrett score by using "Garrett's table." Thus, once counted how many times each barrier was chosen in a certain position, that number was multiplied by the corresponding Garrett value. Subsequently, all scores of each barrier were summed up and the average was computed. The most critical barriers were those with the highest score.

4. Results and discussion

Consistent with *H1*, competencies are considered to be highly relevant for the digitalization process of companies. They are a passport for working in smart companies and enablers for the use of I4.0 technologies; they are complementary to theoretical knowledge. A learning factory, a "learning by doing" mode, is surprisingly suitable for I4.0 (Marmier, Deniaud, Rasovska, & Michalak, 2021). It allows focusing on particular needs of the participant and prepares small workshops to concentrate the required technologies for an education program. There should be an evaluation of the competencies needed for the workforce, in order to fill the gap between competencies and skills.

Resistance to change, the second barrier in the list, should not be underestimated. It should not be only a concern in I4.0 context but also in any organizational change, and it can express itself in several ways. For example, after the adoption of a new machinery, a new strategy or new process, if not well introduced, it may create uncertainty and doubts about the benefits of innovation. Among the solutions offered by scholars, effective and clear communication is a powerful one. Engaging workers in the decision-making process and in managing a task so that they understand the worries, and showing the benefits that the change will bring to their work would reduce resistance to a minimum (Gonçalves & Gonçalves, 2012). The purpose is to create a working environment where anxiety about the uncertain future, represented by the change, is decreased (Ninan *et al.*, 2019). By providing effective guidance, employees will know what to do and how to perform their job. Following a model like Kotter's (2014) may facilitate and decrease employees' resistance to change.

Of minor significance is human barrier, ranked third. It regards new relations with colleagues and the fear that machines will perform current workers' tasks. But respondents' jobs require abilities that machines do not have – critical thinking and creativity. Therefore,

they perceive only a minimum risk of losing their jobs to automation. About new relations and diverse interactions with colleagues, they get used to it sooner or later. In manufacturing companies, full digital integration and automation of entire production processes suggest that, in addition to other changes, workers will have to cooperate *ad hoc* in finding suitable solutions to particular problems (Erol, Schumacher, & Sihn, 2016).

Training ranks fourth. Thus, it appears to be the least critical barrier, among those listed. It can be seen as a facilitator of I4.0. Training is acknowledged to be essential for the personal growth of employees, for the skills they achieve, and for what they learn. Besides, it prevents employees from stagnating in their careers – it is a way of expressing their real potential (Langer & Mehra, 2010, cited by Ninan *et al.*, 2019). In I4.0, employees prepare themselves to work together with robots, avoiding dismissal. In fact, training in the digital context is not the mere acquisition of skills but also to learn how to compete with robots (Ninan *et al.*, 2019).

From the questionnaire, as already argued in Di Sabato (2021), the majority of the surveyed companies provided proper training to achieve the required competencies, except very small companies (Table 1), which may not have enough resources and time to dedicate to training and retraining. In contrast, large companies are able to spend a significant part of their profits in training, ensuring the presence of experts for teaching in these programs. As commonly explained in the literature, decisions on training differ, based on technological and financial opportunities available to firms of different sizes and industries (Boothby, Dufour, & Tang, 2010). The tests were significant for Item2, Item3 and Item4 (p-value lower than 0.05). They were not significant for Item 1: no statistical differences exist for a suitable training in order to use a specific technology. Therefore, *H2* is confirmed in Item 2, Item 3 and Item 4. Moreover, this is consistent with previous studies (Rabemananjara & Parsley, 2006). In a study on SMEs in Mexico (Vásquez-Torres, 2017), the conclusion was similar: as company size increases, more importance is given to training (programs, legal aspects, budget, training culture and instructors for training).

Table 2 shows the average answer for each question related to training and retraining programs regarding foreign capital. As for company size, training is largely influenced by this characteristic: the larger a company, the greater the average value for the questions.

The second factor under analysis was foreign participation in a company's capital structure. *H3* was checked for Item 2, Item 3 and Item 4. Perhaps, this is a consequence of pressure by shareholders and other stakeholders, who seek higher profits and security for their investments. In other words, they demand continuous innovation.

Table 1. Training and company size

	Item 1	Item 2	Item 3	Item 4
Very small companies	4.35	3.38	3.19	3.5
Small companies	5.41	4.68	4.82	4.82
Medium-sized companies	5.58	5.08	4.88	4.54
Large companies	5.36	5.18	5.32	5.32
Total	5.17	4.59	4.56	4.55
Sig. (2-tails)	*0.339*	*0.016*	*0.044*	*0.018*

Source(s): Elaborated by the authors based on questionnaire results

Table 2. Training and foreign capital

Foreign participation	Item 1	Item 2	Item 3	Item 4
Yes	5.39	5.39	5.47	5.18
No	5.03	4.11	4.02	4.17
Total	5.17	4.59	4.56	4.55
Sig. (2-tails)	*0.234*	*0.02*	*0.01*	*0.011*

Source(s): Elaborated by the authors based on questionnaire results

We checked if the economic situation influences training and retraining programs. According to the questionnaires, it would not determine differences among companies regarding these programs (statistically, it was not significant for the groups of companies: *H4* was rejected). This is also in contrast with Turkes *et al.* (2019). Table 3 shows that, in general, all companies provide such programs. Therefore, the role of training for enhancing human capital and the likelihood to raise competitiveness by increasing company's competitive advantage would be recognized. It seems money is not the only factor that management considers: continuing to fund training would be at managers' discretion, which, in turn, would be affected by his/her own personality. Moreover, countries and companies' culture might have a decisive role in influencing that decision. Deep-rooted entrepreneurship and dedication to learning might affect training decisively. Bhat (2013) found how organizational performance is affected by training, "an important antecedent of performance" and "a combination of factors." This is not surprising, as the growth of human capital brings benefits. Therefore, companies can rely on it to improve their economic situation: they can change this challenge into opportunity. In addition, training may stimulate employees to think differently, which may lead to new ways to save money.

5. Conclusion

Thanks to the adoption of I4.0, companies and employees can enjoy benefits and achieve their full potential. Smart companies have advantage and are in a better competitive position than tradition-bound firms. Better control over costs, quick reaction to changes in customers' demand, and more conscious strategic decisions are some of the gains of I4.0, which also helps companies to be more environmentally sustainable and conscious of their operations. From employees' perspective, I4.0 is an opportunity to grow intellectually and professionally. Required competencies combine critical judgment and creativity, less physical and exhausting jobs and more flexibility. Monotonous and repetitive tasks will be performed by automated machines.

Along with the introduction of I4.0 technology, human capital is fundamental for the survival and success of companies; therefore, it should be carefully considered in companies' decisions. It can be boosted with training and periodical retraining programs. Training affects organizations positively: it helps meeting quality standards through a reduced turnover and achieving and preserving competitive edge. In I4.0, training should be targeted to the acquisition of specific competencies and provide employees with soft-skills. Highly specialized personnel need specific competencies in certain fields.

According to the literature, financial availability, competencies, resistance to change and training are the main obstacles for I4.0. Financial availability allows the completion of a digital transformation by purchasing technologies and adopting quality programs for learning to use them. Quite often, organizations do not have the necessary competencies to use new technologies. Resistance to change may hinder organizational transformation, so management needs to deal with it. Finally, training has a key role in I4.0 transformation: specific programs should be designed to train professionals, and other people involved in the process.

	Item 1	Item 2	Item 3	Item 4
Improved	5.38	4.65	5.03	4.97
Unchanged	4.84	4.19	4.19	3.90
Worsened	5.24	4.88	4.38	4.68
Total	5.17	4.59	4.56	4.55
Sig. (2-tails)	*0.353*	*0.369*	*0.147*	*0.055*

Source(s): Elaborated by the authors based on questionnaire results

Table 3. Training and economic situation

Large companies should count on qualified professionals for planning and organizing training programs. This confirms previous studies. Training programs are highly recommended and should be done in any corporation, no matter their size, time availability or personnel. In our sample, companies with less than 10 employees have lower chances to have training practices. When planning, managers should try to find a time interval for conducting periodical training and hire some external experts for teaching benefits are likely to overcome costs (Di Sabato, 2021). Training is influenced by foreign capital, through pressures by foreign shareholders. Economic situation appears not to affect training, due to the benefits it brings for human capital growth.

Regarding the secondary objective, the human barriers were perceived, *in order of importance*, to be competence, resistance to change, human relations and training. Hence, training appears to be the least critical barrier among human resource challenges, possibly for its central role in educating the workforce for their daily routines in smart companies. Acquiring competencies is the purpose of training; thanks to it, I4.0 technologies can be (effectively) used. Employees express resistance to changes, as they are usually synonym of an unknown and uncertain future, which has some important implications on the psychology, status and political power of individuals. Human barriers are not felt so much, maybe because respondents' tasks will hardly be done by machines. Other important finding was that companies with foreign capital tend to be more digitally advanced. Surprisingly, the economic situation seems not to affect training programs: other factors would be decisive (managers' personality, and organizational and national culture).

Finally, we can deduct some managerial implications, based on the fact that training is the main driver for digital transformation. HRs are enhanced by training, and its related barriers can be overcome by it. Thus, it should be emphasized and designed to fit each organization and its specific requirements. The ranked barriers of human resource nature show what to emphasize in dealing with the I4.0 transformation, by formulating and implementing appropriate strategies.

5.1 Study limitations

The study has some limitations. First, respondents were individuals working in Slovakia and Italy: perhaps, a different sample might show different results. Moreover, it is not possible to generalize the results, since the sample is limited. In future research, the sample should involve other countries (even from other continents) to compare the outcomes. An alternative option would be to focus on fewer industries and compare the barriers and challenges between them, with respect to I4.0 transformation.

Potential shortcomings stem from the questionnaire building. Closed-ended questions may not cover certain features. This may be especially relevant in ranking barriers: it is likely that more obstacles than those proposed here might affect the answers. However, it would be harder to reach a satisfactory number of answers by asking open questions.

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Further reading

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Appendix

For the next questions, on a scale of 1 to 7, please indicate to what extent you agree with the statement: 7 means that you totally agree, and 1 that you do not agree at all.

Personal I	*P1*	You thought (at least once) about not being suitable for your company after a new technology/software was adopted
	P2	*Your company provides you proper training in order to use a specific technology*
	P3	If you have an idea, you are not afraid of possible negative feedbacks from your superiors
	P4	The *status quo* was safer than the new state brought about by the change
	P5	*Your company emphasizes training programs to improve your soft-skills (effective communication, ability to work in group and manage stress)*
	P6	*Your company emphasizes training programs to improve your hard skills (technical skills, such as being able to communicate in a foreign language, IT skills)*
	P7	It is important to update periodically
	P8	You think that, in a near future, it is likely that your tasks will be done by machines
Marketing & Customer I	*MC1*	Products are made according to customers' preferences (i.e. individual solutions are used, such as personalization and customization)
	MC2	Multi-channel customer interactions are better for reaching customers (both directly and through third parties)
	MC3	Your company assigns great importance to customer service
	MC4	Customer demand drives product design
	MC5	Good understanding of digital customers and new trends
	MC6	There is collaboration and full transparency across the whole value chain
Strategy I	*S1*	The general strategy of your company is emergent (i.e. not planned ahead: a strategy that is adaptable at any time to find opportunities and threats)
	S2	You participate in all the steps of the strategy, from formulation to implementation
	S3	In your company there is a guideline: the means are not important but the result
	S4	Team members come from different departments and put together for specific projects; when they finish, teams are dissolved
	S5	*Your company provides refresher courses periodically*
	S6	Your company often works together with universities, technical and research institutes
Technology I	*T1*	Your company has a digital vision, clearly stating that strategy and culture need to support digital transformation
	T2	The use of big data analysis has grown in recent years in your company
	T3	AI is extensively used in your company
	T4	Supply chain is end-to-end planned in your company
	T5	AR and VR are used by employees, among other applications, for self-learning and training
	T6	You believe that, in the near future, new technologies will increase your company's profits
Smart Working	*SW1*	Smart working made you and your colleagues deepen technological knowledge
	SW2	In certain ways, smart working accelerated the process toward a "smart" company

Source(s): Own elaboration of the authors

Table A1. Likert scale questions from the questionnaire

Rank, from the most important to the least important, the following Human Resource barriers that may hamper your company's digitalization:

Competencies
Human (fear of being replaced by machines; new working relations)
Resistance to change
Training Barriers

Source(s): Own elaboration of the authors based on Marcon *et al.* (2019)

Table A2.
Human resources barriers

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