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Industry 4.0 and Internal Knowledge Management
The case of Corporate Academies in Emilia-Romagna region

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Abstract

Industry 4.0 is not only a bundle of linked innovations, but a wide-ranging revolution that also affects the organizational aspects of the company and its value chain. This work focuses on the relationship between the tacit knowledge inherent in human resources and the codified knowledge built within the machinery and the whole production process 4.0. Human resources have returned to the center of the production process. Companies face a trade-off between the need to invest more and more resources towards internal training and the increased need to "retain" their employees. The Corporate Academy can be an interesting tool to achieve these two goals simultaneously. This work analyzes and compares 29 Italian Corporate Academies in the manufacturing sector based on a research and survey Nomisma. The study helped to understand the motivations that led these companies to adopt this tool, in addition to understand the different methods that they undertook in the process and the relative actual and expected benefits.

Keywords: *Industry 4.0; Internal Knowledge; Corporate Academy; Emilia-Romagna; Exit and Voice; training; tacit knowledge; codified knowledge*

Introduction

Industry 4.0 is not only a set of chained innovations, but is a wide-ranging revolution that also involves organizational aspects of the company and its value chain. The way knowledge is created, used and learnt is changing. Knowledge is embedded in R&D and patents; built-in machinery and transferred to the human resources employed in the company.

At the center of industry 4.0 is the Cyber Physical System (CPS), which enables all the physical processes and information flows to be readily accessible when and where they are needed across whole manufacturing supply chains (Zhong et al., 2017). The CPS denotes the conjunction between the physical and digital world, creating global networks that incorporate machinery, storage systems and production facilities (Shafiq et al., 2015). The term also indicates a system of collaborating computational entities in connection with the physical world (Monostori et al., 2016). This arrangement of information and physical components decentralized and autonomous operates under the term of interoperability, the ability of two systems to understand each other using the same functionality and considered one of the major benefits of industry 4.0 (Chen et al., 2008). In this extraordinary transformation, human resources regain a central role in the production process, becoming a fundamental meeting

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point in the creation and circulation of knowledge between information systems, technology, and machines that dialogue with each other. However, human resources unlike machinery are *mobile*. By purchasing a machine, the machine and the knowledge incorporated into it becomes the property of the firm. In addition to all subsequent customization and upgrades occurred to it.

On the contrary, this scenario is not applicable for human resources. Knowledge that is largely tacit and that grows over time is a "personal" asset of which the company has no property rights, as in the case of machinery. This difference poses two order of problems for the company: First, human resources can abandon businesses by being attracted by better economic offers from competing businesses. In this case, this results not only in the loss of tacit knowledge but also the in training investment made on the person that will benefit the competing company. For this reason, it is significant to increase their loyalty. Secondly, human resources retire at a certain point, and therefore, the tacit knowledge connected to them is irredeemably lost. In response to these two orders of problems, an innovative path is offered by the phenomenon of Corporate Academes. The latter allows the transfer and cement of tacit knowledge, which is present in the company and in addition, strongly consolidates the link between human resources and the company, increasing loyalty and slowing down, or inhibiting the phenomenon of the outflow of human resources (and their knowledge) towards competing companies. The creation of a Corporate Academy in a company is a long process that requires major financial and human resources investments. It can be organized on different levels. Some are simple, while others being much more complex and demanding, which varies according to the different objectives and motivations of the companies that implement it.

This study analyzes 29 companies who are leaders in their sector in Italy, in terms of economic performance, dimension and situated in the Emilia-Romagna region. This region is situated in the northeast of the country and considered one of the most advanced in terms of GDP growth and is home to four main universities. The shared mission that brought such diverse companies to have in common is the corporate academy, with the task to ensure continuous employee training, and gradually opening up to stakeholders and the wider education chain to maintain a competitive advantage.

This work focuses on the relationship between the tacit knowledge inherent in human resources and the codified knowledge built within the machinery and the whole production process 4.0. The main objective of this research is analyzing 29 Italian Corporate Academies that belong to leading Italian companies in the manufacturing sector. This work aided to understand the motivations that led these companies to adopt this tool and the different methods that they embarked on in the process.

The rest of the paper follows with main key analysis from literature review of Industry 4.0, human resources, corporate academy, old and new capabilities, and the effects of the corporate academy on membership, loyalty and attractiveness. The research is followed by the methodology, results and ends with a conclusion.

Literature Review

Industry 4.0, big data and enabling technologies

Since its inception, the term Industry 4.0 has been used as a synonym for Cyber Physical System (CPS) in the production sector (Vogel-Heuser and Hess, 2016). Thenceforth, the term expanded to comprise several definitions: Internet of Things (IoT); Big Data; Cloud manufacturing (cloud computing); Smart Manufacturing; Additive Manufacturing Technologies (3D). These various definitions of industry 4.0 have been articulated according to two different perspectives: the technological and organizational perspective. The first explores all the possibilities offered by the enabling technologies connected to Industry 4.0. The second analyzes how the company, or the institution, must modify its organization to make the most out of the potentials of Industry 4.0. In a broad sense, this analysis also extends the relationship between companies and the value chain as a whole. Therefore, Industry 4.0 can be defined as a new level of organization and management of the value chain along the product life cycle (Henning, 2013). The definition of the term also combines technologies with concepts of the value chain, where within the modular structure of the intelligent factory or the so-called Smart Factory, the CPS monitors the physical process by creating a virtual copy of the physical world (Hermann et al., 2016), and cloud manufacturing for Industry 4.0 (Thamesa and Schaeferb 2016).

At the strategic core of Industry 4.0 is the use of available data, where production technologies can be improved and transformed by the Cyber Physical System (CPS) that represents the merging between the physical and the digital world. It enables all the physical processes and information flows to be available when and where they are needed across holistic manufacturing supply chains, multiple industries, small and medium-sized enterprises (SMEs), and large companies (Zhong et al., 2017). The CPS also establishes global networks that incorporate machinery, storage systems and production facilities (Shafiq et al., 2015), but also "systems of collaborating computational entities" in connection with the physical world (Monostori et al., 2016), and human resources. This combination of information (immaterial world), tacit knowledge and physical components (materials), named interoperability (Chen et al., 2008), become the most effective lever to improve industrial performance. The enterprise structural design consists of three sub-systems that network with each other: i) physical sub-system, including human and technical agents; ii) decision sub-system, where planning, decisional and monitoring actions are made; iii) information sub-system, where information flows as well as process, storage and retrieval actions on data (Romero and Vernadat 2016). Each of these subsystems can be viewed as a complex system, so enterprise structural design can be configured as System of System (Ackoff, 1972; DiMario, 2010).

Romeo and Vernadat (2016) observed several evolutions of the Enterprise Information Systems (EIS) in which increases the degree of complexity and information management by the enterprise. In the eighties, the task progressed towards planning production and resources through Manufacturing Resources Planning (MRP). In the nineties, Enterprise Resource Planning (ERP) was born, incorporating different databases to create elaborations on workforces and quality management. Currently, the most progressive version of ERP manages IT systems that support intra-organizational collaboration between logistics, procurements, sales, marketing, human resources and finance (Callaway, 2000; Møller, 2004). At the beginning of the 2000s, the practice of ERP has gone beyond the enterprise with reference to

organizing supply chains, comprising customers and the sales side of the marketplace through Supply Chain Management (SCM). The process follows the product from the initial stage of purchasing raw materials to the further stages of transforming into finished products and up to the logistics and distributing stages (Kusrini et al., 2016; Mishra and Shekhar, 2015; Muzumdar and Balachandran, 2001).

A range of enabling technologies are closely connected to the CPS, and which constitute a closer interacting connection between technology, machinery, human resources and the organization of production. We consider three of these to be particularly significant: IoT, additive manufacturing and augmented reality. By connecting humans with machines, IoT integrates knowledge between organizations (Lu, 2017), which, once advanced, increase efficiency and effectiveness in the management of the company and the value chain. Production decisions will have a growing role in the relationship between producer and seller, given consumer choices managed in real time, dwindling the division between manufacturing and services sector, as industrial products will be linked with advanced services (Viticoli, 2017). Ashton first used the term Internet of Things in 1999 (Ashton, 2009). The term showed the power of connecting radiofrequency identification in the context of supply chain management (Lee et al., 2017). Henceforward, the term has gained increased popularity in industry and academia (Bandyopadhyay and Sen, 2011), retaining IoT between the revolution of the internet and the metamorphosis of objects (Sundmaeker et al., 2010). Hence, the term IoT has become wider and defines technological developments in which internet connectivity grasps different fields that modify its functions. Various definitions of IoT have been introduced today, which can divided into four groups: i) intelligent objects; ii) extension of the Internet; iii) global network infrastructure; iv) interaction of information (Lee et al., 2017). In order for IoT to develop, the latter embraces different areas of knowledge, such as telecommunications, informatics, electronics and social science (Atzori et al., 2010). Consequently, the strategic role of the government becomes central, both in the supply and use of data and in securing highly skilled human resources with suitable training, to fully exploit the colossal potential of IoT. Particularly, the required government action must include regulatory policies in technological, social and legal areas, addressing the challenges of interoperability and cybersecurity (Lee, 2019).

The blend of these enabling technologies produces the need to process an impressive quantity of data. Usually so-called Big Data. The level of volume and detail of data acquired by enterprises that use IoT produce an immense flow of data that can be handled to develop new products and services. The different streams of information offer companies with an exponential growth of vast amount of data every year (Kaisler et al. 2013). The prompting aspects of Big Data is the exponential growth of data production with reference to quantity and variety, and its use of a range of systems for data collection at lower costs and volumes needed to store data. The common four V definitions of Big data include volume, variety, velocity and value (Zikopoulos et al. 2012; Berman, 2013; Gantz and Reinsel, 2011). The fifth V (5Vs model) of "veracity" was recently added (Bello-Orgaz et al., 2016).

Digital data is a precious resource for markets and is used across diverse sectors. Marketing experts use it to direct advertising and promoting channels; production businesses use it for machine learning for predictive maintenance and intelligent warehouse logistics; insurance professionals to enhance their offers; financial executives to interpret and analyze the markets; large distribution organizations to elevate the planning and traceability of their products.

Nevertheless, this may result in the emergence of new computational and statistical challenges (Fan et al., 2014; Lv et al., 2019), in addition to the cost and threat to collect and retain such enormous amounts of data can make it a burden for many organizations (Cumbley and Church, 2013).

Internet of Things facilitates the overlapping of Big Data and industry 4.0 in various areas. For instance, the collection and the processing of diverse types of data from diverse tools such as temperatures, pressure and vibrations enables the anticipation of malfunctions of a machine (Dobos et al. 2018), the so-called predictive maintenance. Similarly, the combination of economies of scale of standardized and mass production with extreme product differentiation, provides products that meets the need of a single customer (Tamas, 2017), the so-called mass customization. Other cases include ERP and SCM systems to manage the supply chain as a single production flow.

Industry 4.0, human resources and training

Big data uses a massive amount of data (Manyika et al., 2011) that often are too complex to be processed with the normal software available to organizations and enterprises (Mayer-Shonberger and Cukier, 2013). It is associated with codified knowledge (Bandyopadhyay and Sen 2011), which is subsequently processed by complex algorithms, which can be pushed up to artificial intelligence (Duan, Edwards and Dwivedi, 2019; Xing et al., 2016). The data can be processed through their own Business Intelligence (BI) or through the use of infrastructure as a Service (IaaS) delivered over the Internet and remote data centers (Armbrust et al. 2010). The picture described so far would seem to crush human resources in a small corner, as non-interfering observers of automatic systems, which, in addition to producing, it replaces human resources in the decision-making processes (Onik, Miraz and Kim, 2018; Forrester Research, 2018). Fortunately, as claimed in this paper, the operational reality is very different. Human resources count, even more than in the past, and the tacit knowledge that they carry with them becomes of a distinctive value, which companies that operate at the top of their market niches cannot give up. However, enabling technologies and CPS impose new languages and new skills to heighten the knowledge generated by the system. Companies are therefore facing an intense investment in internal training. Both of the human resources already present in the company and of those just hired. The latter, despite having new and adequate skills obtained through schooling and university training process, would need to further obtain those "final stage" skills necessary to adapt their knowledge to the specific reality of the company in which they operate.

To improve both the adaptability of human resources to industry 4.0 and the profitability of the firm, four phases are necessary. The first phase is the training process that includes two problems: the need of an increasing number of student graduates, with adequate educational qualifications by companies undertaking industry 4.0 and big data (Poma, L.; Al Shawwa, H., Maini, E., 2020). The second problem is to define especially in developing countries, the professional standards that meet the labor market requirements of the new industry (Chulanova, 2019). The second phase implies the need of an adequate recruitment policy, able also by virtue of the use of the Blockchain, to identify the effective skills of future workers in the company (Onik et. al., 2018). The third phase is the need of an adequate internal training structure within the company to refine and direct the "school" competences and skills towards customized characteristics of each company, and especially if the company is leader

in the market. The fourth and final phase is the need of a policy directed towards the retention of human resources, those who were subject to immense and important investment in training, or are in possess of distinctive tacit competences. The Corporate Academy approach offers a response to the third and fourth stages.

Corporate Academy

Corporate Academies are company-specific structures created inside the company for purposes of technical, managerial and organizational training needs, and aimed at creating a shared corporate sense (Allen, 2002). They can be simple autonomous corporate training departments that provide training and may involve courses that provide recognized university credits. In more advanced cases, it may also entail wide-ranging training and development programs resulting in earning an academic degree at completion (Allen 2007; Prince and Stewart, 2002).

A first element of interest is about the progressive opening of Corporate Academies, born as a tool for training internal staff (Prince and Beaver, 2001), and are gradually opening up to stakeholders: customers, suppliers and subsidiaries, including those operating within industry 4.0, which results in a stream of knowledge that flows between the latter. This progressive opening makes the Corporate Academy a new territorial glue to create innovative environments for knowledge circulation.

One of the main reasons that have led the Emilia-Romagna companies to equip themselves with Corporate Academies is due to the need to preserve and ensure the transmissibility, of the specific company know-how, that is largely tacit. Industry 4.0 will require to always turn tacit knowledge that is present in the enterprise into codified knowledge. In addition, Corporate Academies facilitate the creation and sharing of a unitary culture of the enterprise that results functional for two reasons. First, in a vigorous process of acquisitions and mergers, such as the current one, stabilizing a unitary corporate culture helps to deal with corporate reorganizations. Second, knowledge embedded in human resources becomes central, yet, are *mobile*. It is essential to create loyalty mechanisms between the human resources, on whom knowledge is invested, and the company that supports such investment (Poma, 2003). The research, carried out by Nomisma Research Centre, surveyed the largest 120 regional companies in terms of turnover and tracked down 29 Corporate Academies, of which the factors that defined their creation, benefits and the problems they faced were analyzed.

The old and new capabilities

Capabilities, membership, loyalty and attractiveness are the four key words within which the Cyber Physical System (CPS) in Industry 4.0 is articulated. Industry 4.0 to some extent reverses the direction of the technological process, that since Marx's time saw machines that "replaced" the specific skills of workers, previously largely artisans. In this way, the processing phases became simplified, that even women and children supervised the operating machines. From the first stage of "replacing" specific worker's capabilities, it has passed during the Fordist revolution, to the alignment of workers to the rhythms of the machine to maximize the benefits of reducing idle times (Landes, 1969; Galbraith, 1953 and 1987). The third stage saw an acceleration of capital/labor replacement, through the introduction of increasingly automated and later robotic machinery (Jonas, 1994). Up to this point in the tug of war between machine and man, the former was always successful, becoming more and more

central over the centuries compared to the latter within manufactories. The appearance of Industry 4.0 has partially changed this trajectory. Human resources return to the center of production through the so-called Human-Machine connection (Lo, 2017; Rahman and Asyhari 2019; Zhang, 2017), made possible by the extensive use of IoT in production lines and more extensively throughout the entire production chain (Atzori et al. 2010; Gubbi et al., 2013; Lee, 2019; Witkowski, 2017).

People interact "intelligently" with machines and make decisions according to the situation and make use of their problem solving skills to face new production combinations and new problems connected to them. In addition, big data and it's processing, forcefully enters production processes.

Some large groups have equipped themselves with Data Analytics Units, within which computer, physical and mathematical engineers compete in data processing, also using artificial intelligence algorithms. A significant investment in economic and human resources, which must find its finalization in a close connection between what has been elaborated in such Units and the effects it has on the production, assistance, logistics and distribution departments.

This technological revolution and the re-stated centrality of human resources in the production process poses new challenges for companies. The first is to enhance the old capabilities of employees, channeling tacit knowledge into the new communicative language with IoTs present in machines, and the entire production and distribution cycle. The second is to increase the skills by providing new workers with cognitive and technical tools, necessary to better understand the potential offered by the enabling technologies of Industry 4.0. The third challenge consists in recruiting new potential figures (for example, staff of the Data Analytics Unit), equipped with skills that were until yesterday irrelevant and indispensable today.

Effects of Corporate Academy on membership, loyalty and attractiveness

Companies that undertake these three challenges face two main issues which, if not resolved, can affect the positive effects for the company. The first is that people, unlike machinery, are mobile. A high investment in training makes the people who benefited from it more attractive in the market and highly demanded among competing companies or even companies from other sectors. The second is that of new scarce skills, especially those related to Big Data and artificial intelligence, compared to the exponential growth in demand on such professional figures by companies. In recent years, a very fierce competition has been created to ensure the company holds the best and most competent human resources in these fields of knowledge. The Corporate Academy can be an interesting solution to significantly reduce these problems.

Following the contribution of Hirschman (1970), consumers who are not happy with a product offered by a company can activate the exit and the voice options. The first option is considered much simpler and less "expensive" to be implemented, which is also the most used one. Thus, not allowing companies to be able to remedy the defective product.

The more distinctive these skills, the greater the damage that the company suffers if a worker leaves the existing company in favor of another company that has offered the worker more advantageous general conditions. If the company has incurred a significant individual

investment cost towards one of its employees, on the one hand, it is more convenient to retain the employee, on the other hand, it can hardly compete with the salary offers of competing companies, which having not incurred the training costs, are able to offer higher salaries as they "recover" the training costs incurred by the previous company. Companies are therefore faced with a dilemma.

To exploit the potential of Industry 4.0 enabling technologies to the full, it is necessary to invest many economic resources in staff training. In addition, the more investment on people, the greater the risk that they become more attractive to competing companies that run into minor costs by "buying" already trained human resources, albeit at a higher wage price. In Hirschman's book, a solution to the conflict between exit and voice options is given by the loyalty factor and this remains true even in the transposition we have made (Poma, 1995). If human resources are steeped in high loyalty towards the company in which they work, then they will not resort to the exit option even if the salary offered is higher. Under these conditions, the specific investment in human resources is certainly profitable for the company. The advantage of a Corporate Academy grows the more it becomes articulated, structured and when the company becomes a powerful training resource, but at the same time an authoritative membership instrument that helps to strengthen and weld loyalty towards the company. In this way, the option made by the Corporate Academy is more expensive and the voice option rises. The latter intended in terms of increased dialogue and exchange of different forms of knowledge and different perspectives of solutions to problems that arise with the increasing frequency in profound organizational changes to which companies are subject to grasp the potentials offered by the 4.0 revolution.

The membership created by the Corporate Academy also performs another function, namely, to preserve the tacit knowledge base inherent in every skilled worker. Through the Corporate Academy there is a sharing of knowledge, which through overlapping welds into the group becoming partially codified. By acting in this way when a worker leaves the company (or retires for example), a significant part of his tacit knowledge remains in the company.

Finally, the Corporate Academy also becomes a hub for international talent. For example, the case of an important Italian pharmaceutical group that attracted the best young talents of scientific research in its area of production of medicines. It leverages both, having turned into a benefit corporation, and boasting a Corporate Academy, in collaboration with a prestigious Italian University, which officially certifies participants a second level Master degree at the end of the training course.

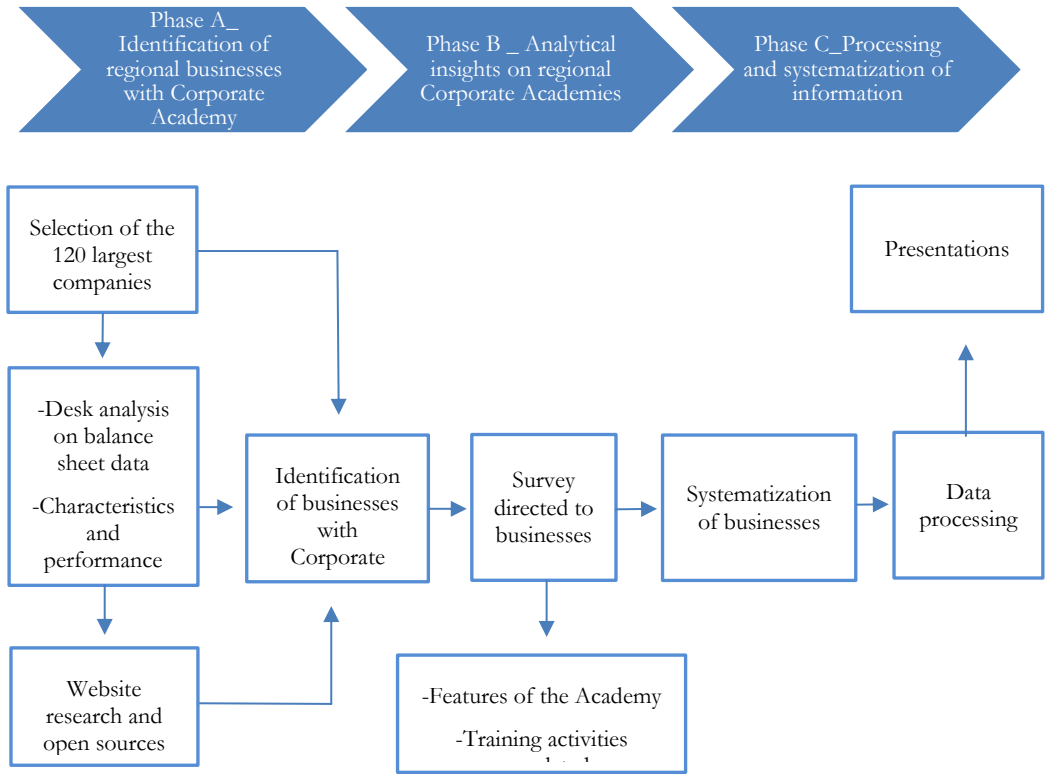
In short, in order to make the best use of the enabling technologies of industry 4.0, a company must codify and share previous knowledge, in line with the new "languages", and provide human resources with new skills and acquire new skills, externally through new hires. This massive amount of training investment must be developed and safeguarded from the exit hypothesis. The Corporate Academy is proposed as a very efficient instrument to achieve both objectives.

Methodology

For the investigative part of this paper, authors used a research carried out by Nomisma by the end of 2016 combined with qualitative in depth interviews during the following years

including 2019[4]. Nomisma is one the most prestigious independent companies that engages in economic research and consulting activities for companies, associations, and public administrations at the national and international level based in Italy. This work included three phases, starting from the selection of the 120 largest companies in the Emilia-Romagna region. The data presented in the paper is based on the survey carried out by Nomisma on almost all the companies in Emilia-Romagna that equipped themselves with a Corporate Academy. The investigation followed three phases as per the scheme in Fig. 1.

Figure 1. Phases of the survey



Source: Nomisma elaborations based on collected suvey data.

As shown in the figure, the first phase identified a sample of regional companies, selected from the AIDA Bureau van Dijk database – the 120 largest regional companies in terms of turnover and that are operating in tertiary and manufacturing sectors. The process of which the sample has been identified posed some methodological questions.

First of all, it was necessary to evaluate the presence of companies belonging to the same group or the same holding company in the sample. In this regard, we proceeded by keeping only one company for each group or holding, considering where the consolidated financial statements of the companies in question are present. This aggregation procedure reduced the

[4] The corresponding author of this work holds role of Chief Economist at Nomisma and Scientific Supervisor of Industry and Innovation at the same company.

reference sample, and consequently further companies were selected, with the aim of obtaining an overall sample that included a total number of 100 companies. This sample was joined by 20 companies operating in financial and insurance services sectors.

After proceeding with the selection of companies in this way, the process was followed by open sources research and telephone contact was established. This served as initial monitoring aimed at identifying those companies that in fact have an actual Corporate Academy. This phase of analysis highlighted the presence of very heterogeneous and different realities. The difficulty in defining and distinguishing the different business realities attributable or not attributable to the Corporate Academy is well known in investigations of this type and is reinforced by the most accredited literature on the subject. The creation of a Corporate Academy implies above all a problem of definition and on this it has been found that each company has the tendency to interpret its Corporate Academy in a different way, defining the functions, the degree of openness to the outside and the purpose of the latter in very different ways. For example, it has been found in many of the companies that were contacted, the presence of similar structures to the Corporate Academy by function and organizational characteristics, but not consolidated into (or not named as) an actual Corporate Academy: there is the example of autonomous departments of training and development for staff within the company, aimed at training human resources on specific tasks. It is clear that all the companies in the sample – large companies, often with an international profile – carry out training courses, but not all have chosen to label their training activities as corporate universities or academies. In order to provide an in-depth specific picture of the phenomenon, it was decided not to include those companies that do not have a proper Corporate Academy in the second phase of the analysis. All the 29 companies included in this study have an internal and formal structure named a corporate academy within their company, and of which provides a significant amount of training investment.

Direct contact with companies with Corporate Academy provided the ability to grasp how they decided to take a step beyond the definition of training policies to structure the management of internal knowledge in defined paths.

The structure of the sample

The companies that have set up a Corporate Academy are large and some are international brands represented by the merchandise mark - Made in Italy in the world: Ferrari, Technogym, Tetrapack, Barilla, Chiesi, Ferretti, Carpigiani and Yoox.

Table 1. Companies with Corporate Academies.

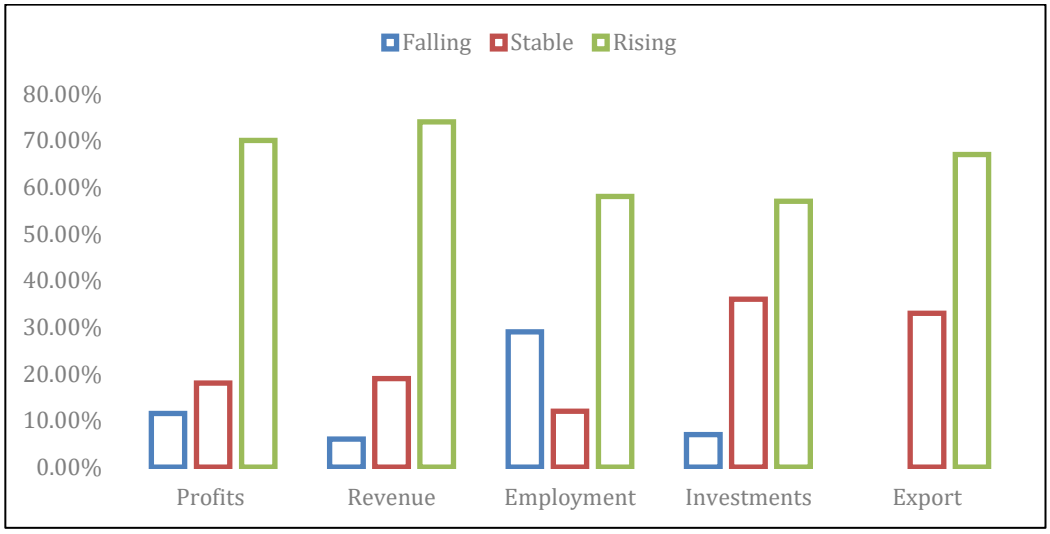
	Company	**Activity description**
1	COOP (Centrale Adriatica Soc. Coop.)	Wholesale
2	Ferrari	Vehicles manufacturing
3	Barilla	Food industries
4	Hera	Multi-utility

5	Coesia (GD)	Industrial machines
6	Sacmi	Industrial machines
7	Chiesi	Pharmaceutical
8	CMC Ravenna	Construction
9	Technogym	Sporting goods manufacturing
10	Landi Renzo	Mechanics
11	Emerson Network Power	Mechanics
12	Toyota Material Handling	Mechanics
13	Florim Ceramiche	Ceramic tiles manufacturing
14	CRIF	Business Information
15	Unipol	Insurance and Banking services
16	BPER	Banking services
17	Cariparma	Banking services
18	Bunge	Food industries
19	Tetrapak	Packaging
20	Amadori	Food industries
21	Grandi Salumifici Italiani	Food industries
22	CIR Food	Restaurant services
23	Yoox	E-commerce
24	Newlat	Food industries
25	Cremonini Chef Express	Restaurant Services
26	Ferretti	Boat building
27	Lombardini	Mechanics
28	Comer	Mechanics
29	Carpigiani	Mechanics

Source: Open source

These are companies that show very positive trends in main economic performance variables, with turnover profits, investments, employment and growing exports, which shows a similar economic profile for most of the companies in the sample.

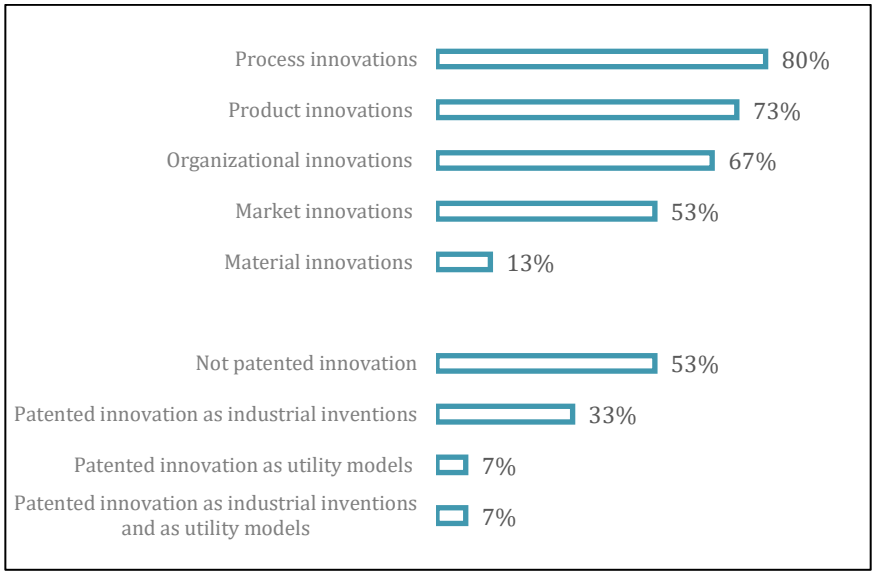
Figure 2. Trend of some business variables in the last two years



Source: Nomisma elaborations based on collected suvey data.

On the innovation front, almost all companies have implemented process and product innovations, as well as organizational innovations related to market and some new materials used for production.

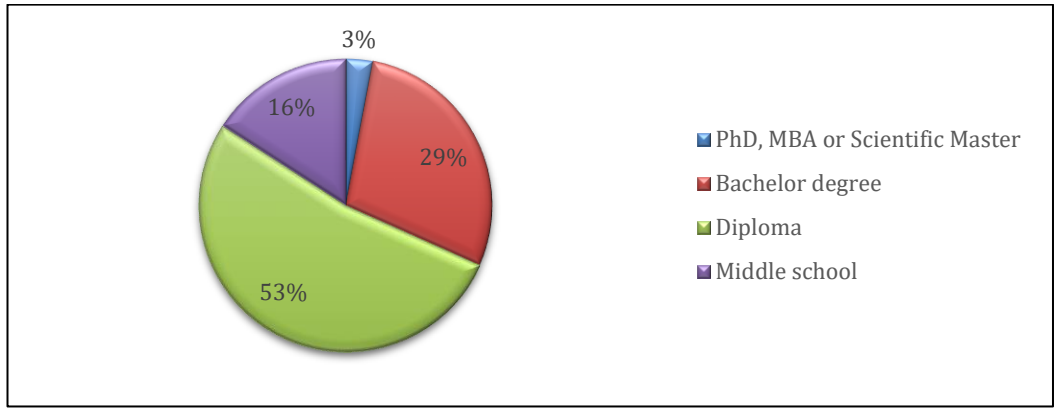
Figure 3. Type of business innovation implemented and patented innovations in the last two years.



Source: Elaborations based on Nomisma collected suvey data.

Thirty one percent of the average staff of the companies interviewed holds an academic bachelor degree together with a post-graduate degree, a very high percentage compared to the standards of Italian companies, even large ones.

Figure 4. Percentage of employees by educational qualification



Source: Elaborations based on Nomisma collected suvey data

Results

As previously discussed, one of the key topics for analyzing the phenomenon of Corporate Academies is the reasons and motives that prompted the companies to adopt the Corporate Academy, which as emerged from the interviews, were varied according to the sector, organizational type and the time in which they were created.

Mainly, a recurring strategic motivation is to maintain the specific corporate know-how and to guarantee its transmissibility. In the case of highly specialized productions, which are located in highly competitive international markets, maintaining knowledge within the company is the first synonym of product quality. This is a competitive advantage that has exponentially increased its potential with the advent of Industry 4.0. Secondly, many of the companies interviewed cited the key role of academies in creating and sharing a unitary corporate culture: in the moments of transition due to acquisitions, mergers or market expansions, the academies provided specific paths for sharing different practices and for creating a sense of belonging, or were necessary, to facilitate the change of approach to work. In addition, reinforcing loyalty and workers functioning as members of the company, impeding the exit option in favor of the voice option.

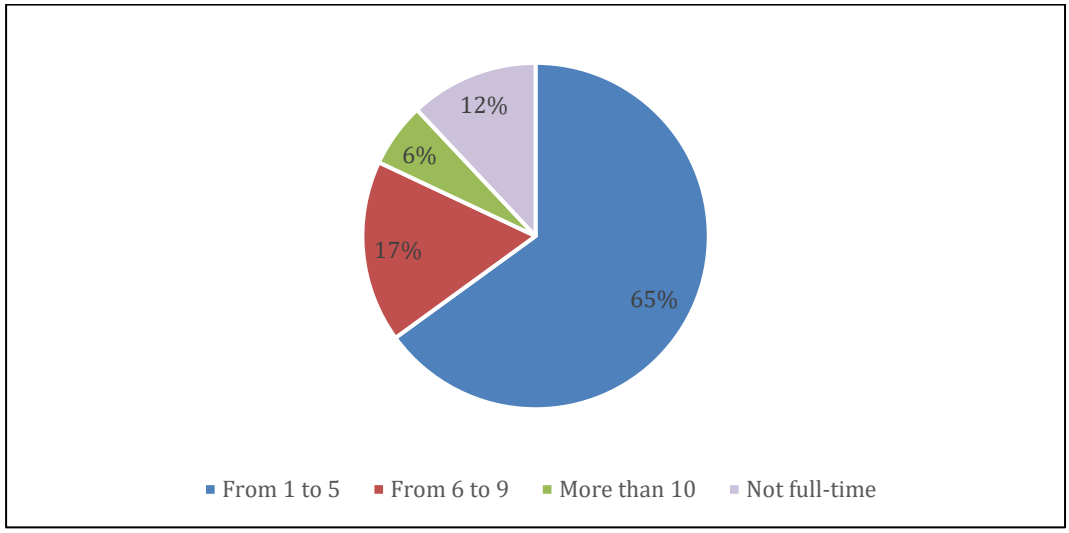
Figure 5. Reasons that led the company to create a Corporate Academy.

Source: Nomisma elaborations based on collected suvey data.

The impact of the Corporate Academy is also recorded at an organizational level. Some Academies were also created to develop talents, with the aim of identifying within organizations occupational figures with high growth potential to be trained to develop competences needed to meet specific challenges and needed to fill roles of high responsibilities. In addition, in many cases, the academies represent a path to stimulate managers to gain leadership skills within the company, to plan and strategically manage growth and changes in the international competitive context. From a different perspective, there is also a link between innovation and the Corporate Academy, For some companies, the Academy represents a sort of an innovation laboratory, where new projects are proposed for development. The Academies operate by organizing meetings, workshops and working groups on highly innovative tasks and not necessarily directly related to the product/service offered, making it a place to provide the elaboration of new ideas and defining new paths. In other rarer cases, the Corporate Academy represents a real business product, in which the specific knowledge of the company takes on market value and is offered as a product with high added value, for example, in the form of consulting or providing specific training.

The main role of the Corporate Academy is connected to training, career, attractiveness and loyalty towards the company. For this reason, the role of reference of training activities for the Corporate Academy in 69% of the cases is carried out by the person in charge of human resources and only in 6% of the cases by the CEO. Despite the strategic potential of this tool, the number of dedicated full-time employees in the Corporate Academy is considered low on average, albeit with some relevant exceptions. Only few companies (6%) are keeping more than 10 employees working full time for the Corporate Academy.

Figure 6. Staff number dedicated to the Corporate Academy.



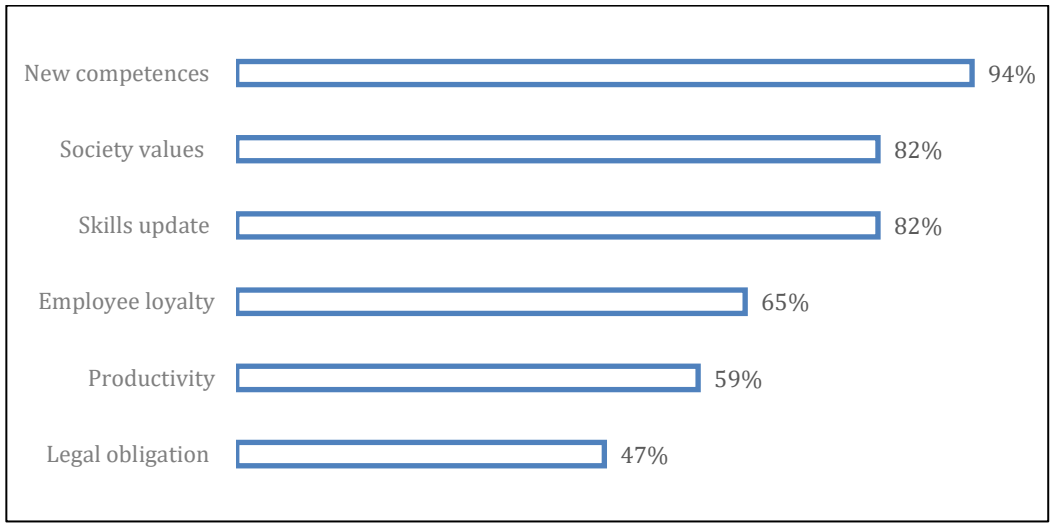
Source: Nomisma elaborations based on collected suvey data.

The data shows difficult to compare given the extreme heterogeneity of the organizational structures: the range of full-time staff ranges from one employee to over sixty in the most complex structures. In general, the activities carried out by the Corporate Academy involve a wider percentage of internal staff (for example full time employees working for the company and collaborate occasionally with the Corporate Academy) than the full-time dedicated staff: as we will see later, lessons are often held by the full-time employees of the companies, who therefore, participare actively in the activities run by the Corporate Academy and not only only participate as users.

The result is not surprising. First of all, it is a new tool with which companies must become familiar with and fully evaluate its positive return effects. In fact, some companies that we recently returned to contact have increased investments in this tool. Furthermore, the data must be contextualized in the Italian entrepreneurial reality characterized by the so-called "family capitalism". Even large corporations are often part of a family group. This entails a greater use of "informal" structures to address the problems of the company and its strategic issues. In fact, companies finance the Corporate Academy's activities in a preponderant way with their own resources (76%), compared to the share of public resources that contribute to the financing of activities which reaches only 24%.

For all these reasons, institutionalizing a training path through the creation of a Corporate Academy involves a significant step forward towards a greater structuring of the company organization. The data collected concerning the content of the training activities carried out by the Corporate Academy highlight the essentially strategic nature of the structres: only in a few cases, the Corporate Academy become the "container" of all the company's training activities (including for example, those required by law on safety and health).

Figure 7. Goals of training activities.



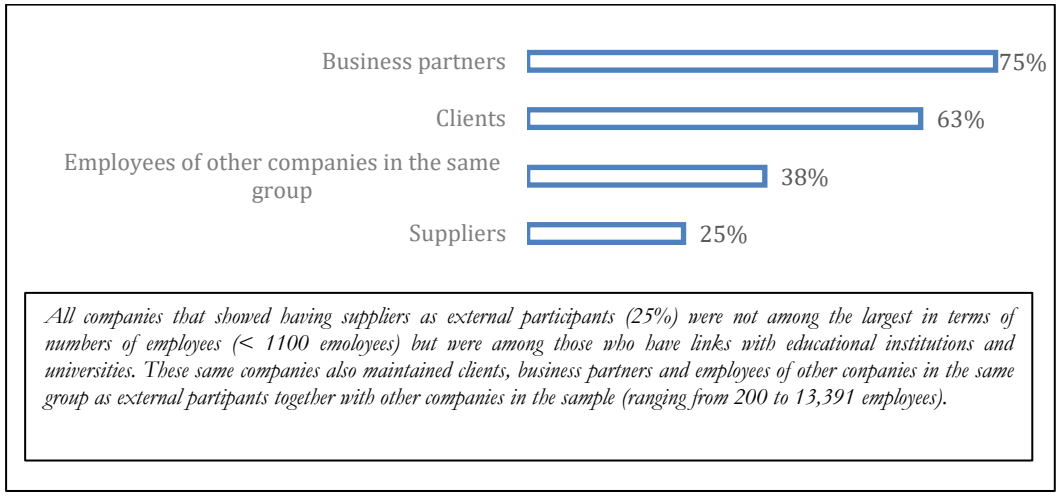
Source: Elaborations based on Nomisma collected suvey data

The figure highlights the validity of the theoritical assumptions made in the first part of our paper. Gaining new competences (100%) and updating of skills (82%) are among the main objectives of training activities. In addition, corporate society value (82%) and employee retention (60%) become sharp weapons to slow down the exit option and stimulating the voice option, also in terms of the investments in human resources made by these companies.

On the other hand, the number of participants in the Corporate Academy activities and the number of training hours provided, ranged from 20/30 participants per year for the most structured and focused academies on "talent development", and up to over 10,000 participants for the most open structures to the market and that are engaged in organizing events not exclusively addressed to internal staff. For the count on the training hours provided for each participant, the data collection methods are so different that they report data ranging from a few hours per year to over 800 hours for more structured paths. Classroom trainings constitute the preferred training method modality (51% on average). For e-learning, academies mostly resort to this method when staff are abroad or used for short introductory modules (23% on average). Seminars are another widespread method: some of the companies interviewed use seminars to create real case studies and work groups of external experts and internal staff, aimed in some cases at publishing the results.

Overall, the Corporate Academy teaching staff is made up of 49% of staff within the company and 51% that are external tutors. The training activities of the academies are aimed primarily at the company's staff, mainly directors, managers and executives (77%). However, there are organizational models in some companies involving a combination of participants in which the presence of the company's employees prevails but there is a certain degree of openness to the outside world, ranging from the involvement of business partners, customers, suppliers, to a wider audience for seminar activities.

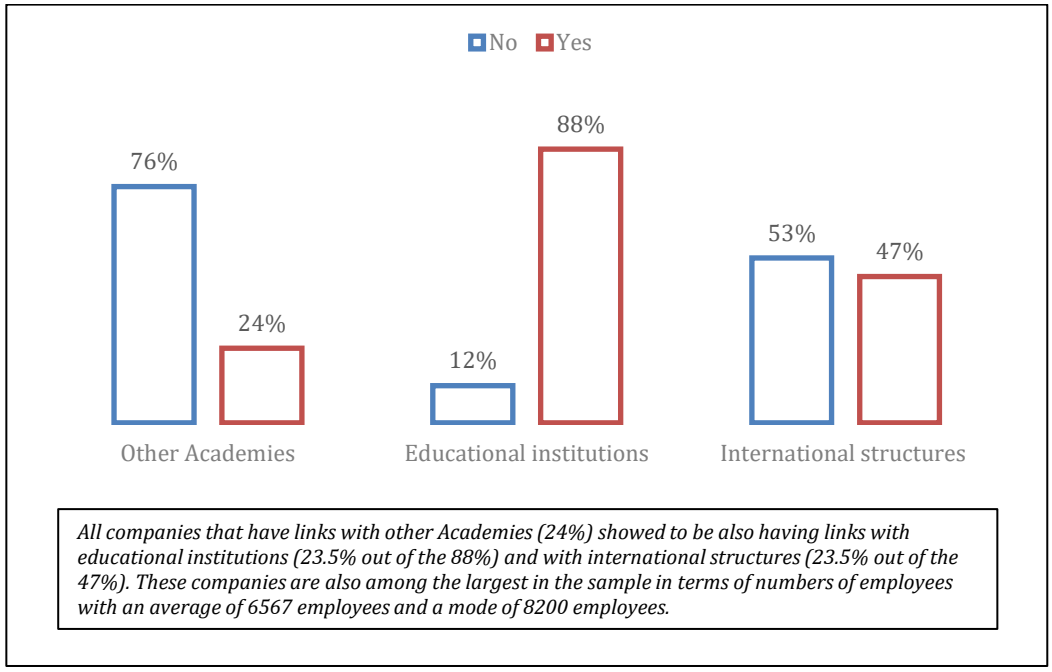
Figure 8. Type of external participants.



Source: Elaborations based on Nomisma collected suvey data

In this case, another important strategic lever of the Corporate Academy is highlighted. A tool to strengthen and share the values of the company, as well as the different levels of knowledge and competences within the supply chain and along the value chain. This fact related to the diffusion of Industry 4.0 will be crucial. Enabling technologies, in particular the IoT and Human-Machine Dialogue, do not fully fulfil their potential within the walls of the enterprise, but the course of knowledge flows along the entire value chain. The machines will have to "dialogue" with machinery from other companies along the supply chain, even with logistics and distribution units. It will be necessary to create a language that is as unified and shared between the different components of the value chain, and the Corporate Academy can represent a powerful glue in this regard. The Corporate Academy itself can become part of a wider education chain.

Figure 9. Links with other institutions and companies in need of support actions from institutions to support the training activities of the Corporate Academy.



Source: Elaborations based on Nomisma collected suvey data

There are few and especially informal links with other Corporate Academies, while almost all the Academies surveyed have links with universities and educational institutions. Some frequent links are also those with international facilities, that may be the academies of companies of the same group located abroad, in the case of multinationals, universities or international consultancies.

Conclusion

Industry 4.0 place human resources at the heart of the production process of companies. Enabling technologies, and in particular the use of IoT, allowing machines to dialogue with each other and interact differently and more articulately with the company's staff (human-machine process), transforming industrial production (and services) into a dense flow in which knowledge flows.

For this reason, companies face four problems: (i) Safeguarding and passing on the tacit knowledge among the company's human resources; (ii) passing on new skills related to enabling technologies; (iii) broadening the codified knowledge along the supply chain; iv) creating strong loyalty in order to make it more advantageous to opt for the voice option rather than the exit option. The Corporate Academy can be a tool that can help businesses address and solve these issues. The following is shown by the survey. First, the internal socializing process, generated by the Corporate Academy and the working groups helped to safeguard and pass on the tacit knowledge. Secondly, one of the main goals of the Corporate Academy is to pass new skills and knowledge, often advanced ones, to selected employees. Third, in cases where the academies are also open to the staff of other partner companies,

subcontractors or contractors of the enterprise, the creation of a shared "common language" is facilitated. Fourth, the Corporate Academy also produces a loyalty process, partly linked to a greater sense of belonging to the company, partly related to the greater opportunities for career development and the person participation in the Corporate Academy's training courses. This reduces the pressure of the exit option and favoring the voice option.

References

Allen, M. (2002). The corporate university handbook: Designing, managing, and growing a successful program. Amacom Books.

Allen, M. (Ed.). (2007). The next generation of corporate universities: Innovative approaches for developing people and expanding organizational capabilities. John Wiley & Sons.

Ackoff R.L. (1972), 'Towards a system of systems concepts', *Management Science*. 17 (11) (1972) 661–671.

Armbrust, M., Fox, A., Griffith R., Joseph, A.D., Katz, R., Konwinski A., Lee G., Patterson, D., Rabkin, A., Stoica, I., Zaharia, M. (2010) 'A view of cloud computing', Communications of the ACM 53 (2010) 50–58.

Ashton, K. (2009). 'That "Internet of Things" thing'. *RFiD Journal*, 22(7), 97–114.

Atzori L., Iera A, Morabito G. (2010), 'The Internet of Things: A survey', *Computer Networks* 54 (2010) 2787–2805.

Bandyopadhyay D. and Sen J. (2011), 'Internet of Things: Applications and Challenges in Technology and Standardization', *Wireless Personal Communications* (2011) 58:49–69.

Bello-Orgaz, G., Jung, J.J., Camacho, D., (2016). 'Social big data: recent achievements and new challenges'. *Information Fusion,* 28, (2016) 45–59.

Berman, J.J. (2013) 'Introduction, in: Principles of Big Data', *Morgan Kaufmann, Boston*.

Callaway E. (2000), 'ERP—The Next Generation: ERP is Web enabled for e-Business', *Computer Technology Research Corporation, South Carolina*.

Chen D., G. Doumeingts, F. Vernadat (2008), 'Architectures for enterprise integration and interoperability: past, present and future', *Computers in Industry*. 59 (7) (2008) 647–659

Cumbley R. and Church P. (2013), 'Is "Big Data" creepy?', *Computer Law & Security Review* 29 (2013) 601-609.

DiMario M.J. (2010), 'System of Systems Collaborative Formation', *World Scientific Publishing Co. Pte. Ltd.*

Dobos P., Tamás P., Illés B. and Balogh R. (2018), 'Application possibilities of the Big Data concept in Industry 4.0', *XXIII International Conference on Manufacturing (Manufacturing 2018),* IOP Conf. Series: Materials Science and Engineering 448 (2018).

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International Journal of Information Management*, *48*, 63-71.

Forrester Research, (2018), Emerging Technology Projection: The Total Economic Impact™ Of IBM Blockchain, Forrester Research July 2018.

Galbraith, J. K. (1952). American Capitalism: The Concept of Countervailing. Power. London: Penguin.

Galbraith, J. K. (1987). Economics in Perspective: A Critical History Houghton MifBn.

Gantz J. and Reinsel D. (2011), 'Extracting value from chaos', *IDCi View* 1–12.

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. Future generation computer systems, 29(7), 1645-1660.

Hermann M., T. Pentek , B. Otto, (2016), 'Design principles for Industrie 4.0 scenarios', *49th Hawaii International Conference on System Sciences (HICSS),* IEEE, 2016, pp. 3928–3937.

Hirschman A.O. (1970), Exit, Voice, and Loyalty. Responses to Decline in Firms, Organisations and States, Harvard University Press, Cambridge, Mass 1970.

Jonas H. (1994), Das Prinzip Leben. Ansatze zu einer philosophischen Biologie, Verlag, Frankfurt am Main 1994; trad. it. Organismo e libertà, Einaudi, Torino 1999.

Kaisler S., Armour F. Espinosa, J.A., Money W. (2013) 'Big Data: Issues and Challenges Moving Forward, System Sciences', *in: Proceedings of the 46th Hawaii International Conference on System Sciences,* IEEE, 2013, pp. 995–1004.

Kusrini E., Subagyo, Masruroh N., (2016), 'A new approach to design supply chain key performance indicator for actors and regulator: a case stufy in innovative product in Indonesia', *International Journal of Business Performance Management*, Vol. 17, No. 1, 2016, pp.1-29.

Landes, D. S. (1969). The Unbound Prometheus: Technological Change and Development in Western Europe from 1750 to the Present. Cambridge University Press.

Lee G. (2019) 'What roles should the government play in fostering the advancement of the internet of things?', *Telecommunications Policy* 43 (2019) 434–444.

Lee, S.-E, Choi, M, Kim, S. (2017), 'How and what to study about IoT: Research trends and future directions from the perspective of social science', *Telecommunications Policy* 41 (2017) 1056–1067.

Lu Y. (2017), 'Industry 4.0: A survey on technologies, applications and open research issues', *Journal of industrial Information Integration* 6 (2017) 1–10.

Manyika J. et al. (2011), *Big Data: '*The next frontier for innovation, competition and productivity', *MacKinsey Global Institute*

Marx K. (1867,1885,1894), Das Kapital, Hamburg Meissner; trad. it. *Il* Capitale, a cura di D. Cantimori, R. Panzieri, M.L. Boggeri, Editori Riuniti, Roma 1994.

Mayer-Schonberger, V., and Cukier, K. (2013). 'Big Data: A Revolution That Will Transform How We Live, Work, and Think'. *Boston, New York: Houghton Mifflin Harcourt.*

Mishra P.K. and Shekhar B.R. (2015), 'Analyzing the product and service aspect of a manufacturing supply chain: a dairy industry perspective*', International Journal of Business Performance Management*, Vol. 16, Nos. 2/3, 2015.

Møller C. (2004), 'ERP II-Next-generation Extended Enterprise Resource Planning', *Aalborg Universitetsforlag*

Monostori L. et al. (2016), 'Cyber-physical systems in manufacturing', *CIRP Annals - Manufacturing Technology* 65 (2016) 621-641.

Muzumdar M. and Balachandran N. (2001), The supply chain evolution, AspenTech 11 (1) (2001) 1–4.

Onik, M. H., Miraz, M. H., & Kim, C. S. (2018). A recruitment and human resource management technique using Blockchain technology for Industry 4.0. in Proceeding of Smart Cities Symposium (SCS-2018), Manama, Bahrain, pp. 11-16. IET.

Poma L. (1995), Economia e valori in A. O. Hirschman, *L'Industria – Rivista di Economia e Politica Industriale*, Anno XVI, n.1 gennaio-marzo.

Poma L. (2003), Oltre il distretto. Imprese e istituzioni nella nuova competizione territoriale, Franco Angeli Editore, Milano.

Poma, L., Al Shawwa, H and Maini, E. (2020) 'Industry 4.0 and big data: role of government in the advancement of enterprises in Italy and UAE', *Int. J. Business Performance Management*, Vol. 21, No. 3, pp. 261-289.

Prince, C., & Beaver, G. (2001). Facilitating organizational change: the role and development of the corporate university. Strategic Change, 10(4), 189.

Prince, C., & Stewart, J. (2002). Corporate universities–an analytical framework. Journal of Management Development, 10, pp. 298-811.

Rahman, M. A., & Asyhari, A. T. (2019). The Emergence of Internet of Things (IoT): Connecting Anything, Anywhere. 40.

Romero D. and Vernadat F. (2016) 'Enterprise information systems state of the art: Past, present and future trends', *Computers in Industry* 79 (2016) 3–13.

Shafiq S.I., C. Sanin, C. Toro, E. Szczerbicki (2015), 'Virtual engineering object (VEO): toward experience-based design and manufacturing for Industry 4.0', *Cybern. Syst.* 46 (1-2) (2015) 35–50.
Sundmaeker, H., Guillemin, P., Friess, P., Woelffl_e, S. (2010). 'Vision and challenges for realising the Internet of Things'. *The Cluster of European Research Projects on the Internet of Things, European Commission*.
Thamesa L. and Schaeferb D. (2016), 'Software-Defined Cloud Manufacturing for Industry 4.0', *Procedia CIRP* 52 (2016) 12 – 17.
Vogel B-Heuser, D. Hess (2016) '*Guest editorial Industry 4.0–prerequisites and visions'*, *IEEE Trans. Autom. Sci.* Eng. 13 (2) (2016) 411–413.
Witkowski, K. (2017). Internet of things, big data, industry 4.0–innovative solutions in logistics and supply chains management. Procedia engineering, 182, 763-769.
Xing, E. P., Ho, Q., Xie, P., & Wei, D. (2016). Strategies and principles of distributed machine learning on big data. *Engineering*, *2*(2), 179-195.
Zhang, Y., Ren, S., Liu, Y., & Si, S. (2017). A big data analytics architecture for cleaner manufacturing and maintenance processes of complex products. Journal of Cleaner Production, 142, 626-641.
Zhong Ray Y., Xun Xu Eberhard Klotz, Stephen T. Newman (2017) '*Intelligent Manufacturing in the Context of Industry 4.0: A Review'*. Engineering 3 (2017) pp. 616-630; *Elsevier*.
Zikopoulos, P., Parasuraman, K., Deutsch, T., Giles, J., Corrigan, D. (2012), 'Harness the Power of Big Data. The IBM Big Data Platform', *McGraw Hill Professional*.

Appendix 1. Company questionnaire scheme

Section A – General company information

- Company name
- Name and role of the interviewee
- Number of employees and qualifications until 2015

Section B – Characteristics of the Academy

- Year of creation
- Legal structure
- Management and financial organization
- Organizational structure
- Characteristics and composition of dedicated staff
- Reasons that pushed the company to create an Academy
- Objectives and type of training offered

Section C – Training activities carried out by the Academy

- Content of training activities
- Recipients of the training activities
- Type of participants in training activities (internal, external, customers, suppliers, etc.)
- Number and type of participants
- Hours of training per participant
- Composition and type of the teaching staff (internal or/and external)
- Method of training

Section D – Evaluation of the training activities carried out by the Academy

- Evaluation of training results

- Type of evaluation method

Section E – Other information about the Academy

- Activities carried out above and beyond training activities
- Average annual budget for the activities
- Impact on company performance
- Method of financing activities (own resources, public funding, etc.)
- Links with other Academies, with local educational institutions or/and with international bodies
- Initiatives by institutions to support actions to strengthen role of Academies

Section F – Company positioning, innovation and social responsibility activities

- Financial performance of the company – financial, employment and investment variables
- Business innovation activity in the previous three years and if any patents
- Relevance of sources of information for the development of the company's innovative activities (typology)
  Innovative investment plans in the next two years
- Institutions needs to strengthen the company innovation activities
- Presence of activities in the area of social responsibility and internal representatives delegated to the topic
- Obstacles to the diffusion of social responsibility practices