The future of job profiles in Logistics 4.0

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Abstract: With the consolidation of the Industry 4.0 paradigm and the constant evolution of technologies in manufacturing, logistics has undergone a profound transformation in recent years. The term Logistics 4.0 is currently used to identify supply chains characterized by higher levels of transparency, integration, dynamism, and reactivity in order to respond to an increasingly fragmented demand, with even higher delivery frequencies and reduced lead times. To cope with this complexity, new technologies have been implemented in the Logistics 4.0 area, borne and developed to support different stakeholders to improve logistics processes management and operations, both in internal and external logistics, also including the potentialities offered by the use of data. The large-scale diffusion of these technologies has, in turn, profoundly changed operational processes in logistics, affecting the specific tasks of operators and managers by changing the company roles. Indeed, the use of increasingly digitalized systems demands professionals, both at management and operational level, with specific knowledge and adequately trained to transform technological advances into new business opportunities. The purpose of this paper is to explore the evolution of the roles of operators and managers in Logistics 4.0. In particular, based on the analysis of academic and industrial literature, along with the collection of data from manufacturing and logistics companies through a survey, this research aims at identifying which job profiles will become soon obsolete and which will gain importance to support the implementation of Logistics 4.0 processes.

Keywords: Logistics 4.0, roles, job profiles, survey.

1. Introduction

The logistics field is one of the most affected by the Industry 4.0 paradigm, which promoted the introduction of new automation and digital technologies supporting the logistics operations. The term Logistics 4.0 is currently used to depict such evolution of traditional logistics processes towards increasingly connected and smart processes, enabling the fulfilment of individualised customer demands without increases in costs (Winkelhaus and Grosse 2019).

However, the scientific literature suggests that Industry 4.0 will not only affect the manufacturing and logistics systems: there will likely be a significant effect on the workforce. Changes in an industrial environment will directly affect the position of workers, leading to significant transformations in job profiles (Kazancoglu and Ozkan-Ozen 2018). In particular, enriched and broader job profiles with extended competence requirements and higher competence levels across a more flexible workforce, are expected (Dworschak and Zaiser 2014). In this context, upgrading the skills and qualifications of the workforce will become the key to the success of any highly innovative manufacturing and logistics system (Benešová and Tupa 2017).
Nevertheless, if the research about the changes in the jobs and skills required by Industry 4.0 is emerging (Pinzone et al. 2017), these topics in the Logistics 4.0 context are under-researched. While some scholars already provided competence models and discussions about the job profiles in the field of manufacturing, the future of logistics roles and job profiles has not been adequately explored. Given the changing tasks that operators in logistics will perform, and the evolving modes of conducting logistics processes, in next years, some jobs could reveal obsolete, while others will gain more and more importance in the Logistics 4.0 field (Winkelhaus and Grosse 2019).

In order to cover this literature gap, the present paper aims at depicting the evolution of roles in the Logistics 4.0 context, highlighting what are the job profiles that have been mostly impacted by the technological innovation, and investigating how logistics roles will change in the future. To develop this research, a survey has been conducted, involving 35 manufacturing and logistics companies in the north of Italy. The results of the survey provided significant insights to outline the rise and the fall of some specific job profiles in Logistics 4.0.

The paper is structured as follows. In Section 2, the literature about Logistics 4.0 and the evolution of roles in Industry 4.0 is discussed. Section 3 focuses on the methodology used to conduct the study. In Section 4, the results of the survey are presented, and then deeply discussed in Section 5. Section 6 concludes the paper with limitations and further improvements.

2. Literature review

2.1 Logistics 4.0 and human factors

The introduction of 4.0 technologies has had a significant impact on logistics operations. As already observed in the more general context of Industry 4.0, also in the case of logistics there has been an evolution of the operator. It is possible to find references the Logistics Operator 4.0, which is defined as "a smart and skilled operator who uses enterprise wearable tech-gadgets and works together with software and hardware social robot companions and

helpers in order to make his/her work easier and safer at internal and external logistics environments" (Cimini et al. 2020). Indeed, 4.0 technologies allow to increasingly assist and collaborate with operators (i.e., collaborative robots, intelligent transportation systems, wearable devices, artificial intelligence applications) in the execution of tasks, and support them in the development and extension of new capabilities (i.e., proactivity, self-management, decision-making) that make them increasingly able to improve production and logistics processes (Barreto et al. 2017).

The view of technology as a way to merely relieve operators from the most physically demanding activities is quite limited. Digital technology, in particular, can help in concentrating the cognitive activities of workers who hold more managerial positions on non-routine activities that give added value to the processes by improving them (Cimini, Lagorio, et al. 2019). Some 4.0 technologies applications (i.e., Internet of Things sensors, Warehouse Management Systems integrations, Big Data Analytics and Cloud Computing) also support the management of information flows by supporting the traceability of goods, stocks, and inventory management (Strandhagen et al. 2017). In this working scenario, it is possible to assist to the interaction between 4.0 technologies that have an essential and direct impact on the logistics operators' and managers' activities, and the involved workers' human factors (e.g., reactivity, perception, decision-making capabilities, memory, proactivity) that play an increasingly decisive role in supporting technological development from a human-centred point of view. In particular, 4.0 technologies affect some human factors that are involved in different logistics operators' and managers' tasks that consequently evolve in new tasks (Grosse et al. 2017). For example, the operators' roles concerning material handling in the warehouses before the introduction of 4.0 technologies required physical efforts and were subjected to lower levels of safety. After the introduction of the 4.0 technologies such as exoskeletons, intelligent transportation systems (e.g., Autonomous Guided Vehicles), drones to reach the highest shelves, collaborative robots, the material handling activities in the warehouses are safer, require less physical efforts, but more flexibility and technical skills.

Consequently, the evolution of the logistics tasks automatically leads to the evolution of the logistics roles, which are composed of these tasks. The evolution of the logistics roles will be discussed more in-depth in the next paragraphs.

2.2 Roles and competences in the Industry 4.0 paradigm

The technological innovations in the industry are expected to bring huge impacts on the labour contents and work organisation (Bonekamp and Sure 2015; Cimini, Boffelli, et al. 2019) and, since many years, this is has been generating a growing debate about the future of traditional job profiles (e.g., Frey and Osborne 2013). The possibility to automate and digitalise some routine and standard activities, traditionally performed by humans, along with an improved data availability supporting cognitive tasks, is pushing both education and industrial stakeholders to question about how the job profiles and workers' competences need to be modified according to the new situation (Prifti et al. 2017). One of the main challenges in the context of Industry 4.0 is to avoid what is known as technological unemployment, redefining current job profiles, and taking measures to adapt the workforce for the new jobs that will be created (Pereira and Romero 2017), minimising the job losses.

In this scenario, each company must necessarily calibrate any intervention according to its company population, but having a picture of the evolutionary trend of the whole industrial sector is becoming crucial to have a point of reference for planning the composition of roles within the company and developing a specific strategy. Moreover, firms are already investing a considerable amount of resources in training and continuous education of workers, in order to upgrade skill sets of workers and develop competences for specialized jobs (Bag et al. 2018).

In literature, some scholars explored the topic of job profiles in Industry 4.0. Dombrowski and Wagner (2014) suggested that the main changes in job profiles will be primarily characterized by decreasing executive production tasks and less subject-specific work tasks, along with increasing importance in troubleshooting and interdisciplinary tasks. Also in the work of Bonekamp and Sure (2015) a significant decrease in lower-skilled highly standardized jobs, being replaced by cyber-physical systems to a large extent, is postulated, while higher-skilled jobs will require more cross-functional management capabilities.

More in detail, a report of Boston Consulting Group discusses how existing job roles, such as machine/assembly operator and service technician, will be modified with the introduction of new technologies and presents some new roles emerging from Industry 4.0, such as industrial data scientist and robot coordinator (Boston Consulting Group 2015). Finally, Janis (2018) summarised the human roles and the related competences required by the Industry 4.0 in the manufacturing and service sectors.

2.3 Roles evolution in Logistics 4.0

So far, the presented researches aimed at providing generic overviews on the workforce needs, but significant gaps remain on how job profiles will evolve and what types of skills will be relevant in Industry 4.0 (Pinzone et al. 2017). This is more evident in the field of Logistics 4.0, which has never been considered by the previously cited researches. Screening the academic and non-academic literature, only a study provided by a consulting group, the OD&M Consulting, jointly with a big logistics group, the Gi Group, directly referring to the evolution of roles in the logistics sector, has been found (Savani et al. 2019). The aim of this work was to develop a model to identify the evolutionary dynamics of roles in the logistics sector for the next 3/5 years. The study is focused on analysing the roles of logistics operators (multisector, specialised, e-commerce) of service and distribution companies, leaving out of the scope of analysis the roles related to intermodal and long-distance transport and freight forwarders.

The model considers three fundamental elements of analysis (Savani et al. 2019):

- analysis of exogenous (economic context) and endogenous (business strategy) context factors;
- analysis of the current contribution of the role to the added value generation for the organization and the future importance recognized to the role according to exogenous and endogenous context factors (thus distinguishing roles in Growth, Stable, Decline);
- analysis of the role covered by people in the organisation, segmented according to the outcome of an individual assessment defined according to the role held. If the person holds a growing role, his or her ability to sustain the growth of the role in the coming years is assessed. If the person holds a stable role, his or her ability to guarantee performance in the coming years is evaluated. Finally, if the person holds a declining role, the person's skills are estimated in order to identify training interventions necessary to reposition the person in other roles within the organisation.

The result of this role analysis is a 6-classes matrix – the Star Matrix – distinguishing ordinary contribution roles in Emerging, Supporting, and Dissolving roles, and extraordinary contribution roles in Strategic, Core, and Declining roles. The results from the investigation in 13 enterprises provides preliminary insights to forecast the evolution of logistics roles in relation to the technological innovation and the changes in market drivers. In particular, in the study conducted by Savani et al. (2019), 108 logistics roles are explored, and finally, the 34% is growing, the 17% in decline, and the remaining 49% stable.

The Star Matrix has been taken as a reference model to conduct the research presented in this paper. In particular, the logistics roles investigated have been derived from the list of Savani et al. (2019) and we followed the same approach to involve logistics companies to collect results, in order to provide a classification of current roles in Growing, Stable and Declining roles, similarly to the Star Matrix model (see Section 4).

3. Methodology

The goal of this research is to analyse the evolution of roles in the Logistics 4.0 context, highlighting which job profile are the most impacted by technological innovations. This topic is a developing phenomenon because companies are still implementing 4.0 technologies and tools; thus, the observations of the impacts and results of this change are still at their early stage. For this reason, the methodology most indicated to study this topic is the survey method, mainly used in exploratory research (Malhotra and Grover 1998). Surveys are an excellent vehicle for measuring a wide variety of unobservable data, such as companies' preferences and behaviours (Bhattacherjee 2012). Moreover, surveys are economical and allow to remotely collect data about a population that is too large to observe directly and also to detect small effects even while analysing multiple variables (Bhattacherjee 2012) such as the case of the impacts of 4.0 logistics technologies implementation on the job profile. Another strength of the survey methodology is that it is easy to replicate it, even after a long time, making more simple to perform longitudinal analysis, suitable to study a developing process (Dale 2006).

For these reasons, we opted for a structured questionnaire survey (ask respondents to select an answer from a given set of choices) self-administered by e-mail. This type of choice allows to be a right choice for the strengths of the survey listed above and also to be inexpensive and unobtrusive, even if response rates tend to be low, around 15% (Lowe and Zemliansky 2010). Of course, survey methodology also has some disadvantages. In particular, surveys are affected by some bias due to the low response rate (non-response bias), the respondent sample (sampling bias), the fact that many respondents tend to avoid negative opinions or embarrassing comments about their companies (social desirability bias), the respondents' motivation, memory and ability to respond (recall bias) (Forza 2002; Malhotra and Grover 1998).

A robust survey research process is needed to prevent and overcome the abovementioned biases. This process regards studied topic identification, sample definition and questionnaire creation. To ensure replicability and consistency in the application of the survey methodology, we have followed the guidelines proposed by Forza (2002) for the implementation of survey research and operations management (Figure 1).

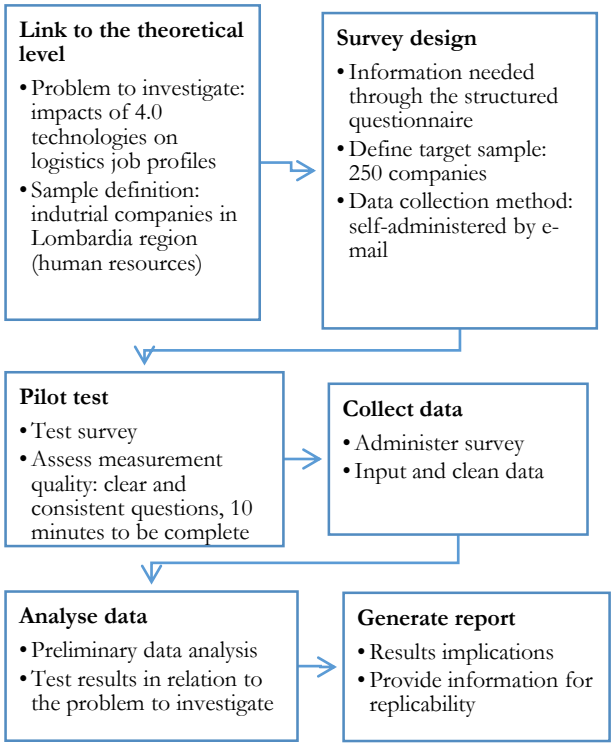

Figure 1: survey research framework (authors adaptation from Forza 2002)

To avoid sampling bias, the sample is restricted to the companies working in the Lombardy region, and the questionnaire was sent to the human resources managers of each selected company. To avoid social desirability bias, in the questionnaire there were no direct questions about company performances, employer satisfaction or more in general about personal opinions. To avoid recall bias, the survey was tested by some authors' colleagues that are

experts in the sector. The goal of this pilot test was to guarantee the readability and the consistency of the questions and the time necessary to complete the whole questionnaire. Finally, to avoid non-response data, the final results of the questionnaire were compared to secondary data such as the already existing reports about competences and roles impacted by the 4.0 technologies (Ratcheva et al., 2020; Bughin et al., 2018) as suggested by Bhattacherjee (2012). Due to the space constraints, the completed version of the questionnaire is available upon request.

4. Results

The questionnaire was administered by e-mail to the human resources managers of 250 companies of different sizes and industry sectors, in the period between 27/01/2020 and 27/02/2020. The selection of the companies analysed in this research has been conducted according to a judgemental sampling approach (Henry 1990) and has been mainly based on available data from a local branch of the General Confederation of Italian Industry. A total of 35 responses were received (14% response rate). The number of respondents is not high, but it is acceptable for statistical analysis to be carried out. Moreover, the companies are homogeneous both as regards the sector of origin (manufacturing/logistics) and the geographical location (Lombardy region), elements that favour the reliability of the results (Lowe and Zemliansky 2010). We reserve the right to extend the sample in both dimensions (sectors considered and geographical extension) in further research.

In the following sub-sections, the general information and the roles evolutions emerged as results of the survey are reported.

4.1 General information

The respondents' sample consist of a 59% small enterprises, 23% medium enterprises and 18% large enterprises, percentages consistent with the actual size of all the companies present throughout the region. Most of the companies that responded to the survey operate in the logistics sector (41%), but responses were also received from companies operating in the manufacturing (33%) and in the tertiary sectors (27%). It is interesting to note that, regardless of the size of the companies, when asked specifically about how many companies feel influenced by the 4.0 industry paradigm, 82% of companies answered that they are implementing significant changes and innovations both at the technological and process level to meet the change; only 3% of companies said that they have already introduced essential innovations. For 15% of the companies surveyed, however, no measures have yet been implemented in this direction. In relation to this, the 66% of the respondent declare to have an intermediate technological asset (with both basic and innovative tools), while the 23% has already an innovative asset with a large use of innovative and integrate tools, and the 11% declare to have a basic technological asset with a low level of innovative technologies implemented.

4.2 Roles evolution

Starting from the 108 roles used in the Star Matrix, 20 roles have been identified as the most relevant for this research, in order to provide a more straightforward questionnaire to respondents. Indeed, the roles reported in the Star Matrix were divided according to different areas (e.g., Engineering, IT, Transportation, Warehouse). For each area, we selected at least two roles, endorsing first the ones labelled as "extraordinary contribution", and then considering the jobs that could encompass profiles working in the same field (e.g., customer consultant, chat operator, customer care and customer service officer are grouped under the label "Customer service officer"). The 20 roles are classified as operational and managerial ones and are listed in Table 1.

Table 1: Investigated roles

OPERATIONAL ROLES	MANAGERIAL ROLES
Administrative clerk	Site manager
Warehouse operator	Buyer
Maintenance operator	Process engineer
Driver (licence B)	Social Media Manager
Forklift driver	Logistic engineer
Loading/Unloading operator	Automation manager
Customer service officer	Transportation manager
Tracking officer	HR manager
Receptionist	Supplier manager
	Warehouse manager
	IT manager

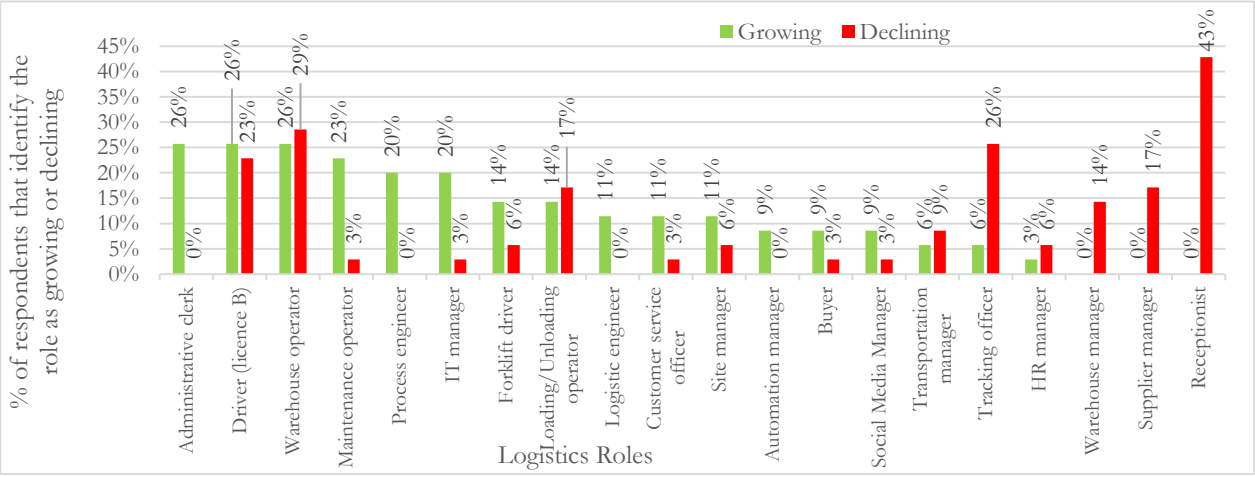

Figure 2: % of companies identifying growing and declining role

According to this list, each respondent has been asked to select the roles which, in his/her opinion, are expected to gain (growing), or loose (declining) importance soon, concerning their expected demand in his/her company. These results have been reported in Figure 2.

A first analysis of the collected data concerns the overall frequency of selection for each role (i.e. how many companies selected that role as growing or declining). On average, each role was selected by the 23% of respondents (both as growing or declining). This suggests that roles with a selection percentage sufficiently lower than the average are considered not subject to relevant changes in demand, i.e. stable. This should be the case of the HR and Automation Manager (9%), the Logistic Engineer (11%), Social Media Manager and Buyer (12%).

Nevertheless, to make a more precise classification of the roles in three categories (growing, stable, declining), we performed a statistical analysis of the collected data.
In particular, given the small sample size, the statistical *t*-test has been conducted in order to determine which are the roles whose evolution can be assumed as statistically significant, comparing the probability of envisioning an evolution (both growing or declining) with the probability that the role will remain stable. Moreover, the *t*-test allowed identifying if the significant evolution of the roles referred to a growing or declining perspective.

The results of this analysis are reported in Table 2. To calculate the means and variances, we assumed a value equal to 1 corresponding to the answers "Growing", a value equal to -1 corresponding to the answers "Declining" and a value equal to 0 for the answers that did not consider that role. Then, we calculated the T statistics and we finally analysed the p-value for each role.

We distinguished three classes of roles, according to the common rules used for statistical significance (Kennedy-Shaffer 2019):

1) In green, we highlighted the roles that have a p-value < 5%, suggesting that evolution can be envisioned clearly;
2) In yellow, we highlighted the roles that have 5%<p-value<10%, suggesting that evolution can be reasonably envisioned;
3) In white, we highlighted the roles that have p-value>10%, suggesting that a clear evolution of the role cannot be identified.

Considering the classes 1 and 2, the positive or negative T statistics offers us the indication of the evolution of the roles towards growth or decline.

5. Discussion and conclusions

In this section, a deeper analysis of the results is provided (section 5.1). Then the main research outcomes, limitations and further research opportunities are summarised in the conclusions paragraph (section 5.2).

5.1 Discussion

The roles that are expected to grow are Administrative clerk, Maintenance Operator, Process Engineer, IT manager and Logistic Engineer. Some of these are operational roles, and SMEs have mainly selected them; while the others (i.e., Process Engineer, IT manager) are more linked to the technological innovation and have been mainly selected by large companies, with innovative technological assets, already well placed in an Industry 4.0 context.

Table 2: Statistical analysis

Role	N° answers Growing	N° answers Decline	N° answers None	Mean ($\bar{X}$)	Variance (s)	T Statistic	P-value	Class
Administrative clerk	9	0	26	0,26	0,19	3,48	0,04	1
Driver (licence B)	9	8	18	0,03	0,48	0,24	0,42	3
Warehouse operator	9	10	16	-0,03	0,54	-0,23	0,34	3
Maintenance operator	8	1	26	0,20	0,22	2,54	0,06	2
Process engineer	7	0	28	0,20	0,16	2,96	0,05	1
IT manager	7	1	27	0,17	0,20	2,27	0,08	2
Forklift driver	5	2	28	0,09	0,19	1,16	0,18	3
Load. /Unload. operator	5	6	24	-0,03	0,31	-0,30	0,33	3
Logistic engineer	4	0	31	0,11	0,10	2,13	0,08	2
Customer service officer	4	1	30	0,09	0,14	1,38	0,15	3
Site manager	4	2	29	0,06	0,17	0,82	0,25	3
Automation manager	3	0	32	0,09	0,08	1,81	0,11	3
Buyer	3	1	31	0,06	0,11	1,01	0,21	3
Social Media Manager	3	1	31	0,06	0,11	1,01	0,21	3
Transportation manager	2	3	30	-0,03	0,14	-0,45	0,31	3
Tracking officer	2	9	24	-0,20	0,27	-2,26	0,05	2
HR manager	1	2	32	-0,03	0,08	-0,58	0,28	3
Warehouse manager	0	5	30	-0,14	0,12	-2,42	0,05	1
Supplier manager	0	6	29	-0,17	0,14	-2,69	0,04	1
Receptionist	0	15	20	-0,43	0,24	-5,12	0,01	1

Conversely, the roles that will decline in the future will be Tracking officer, Warehouse manager, Supplier Manager and Receptionist. Cross-referencing this result with the answers provided by respondents about the reason of this expected decline, we note that the main reason can be attributed to their automation or outsourcing, without a clear distinction regarding company size, sector or technological asset. Indeed, the nature of some of these figures supports such reasoning. For instance, considering the tracking officer: shipments are currently a high activity in the tertiary sector (in line with a policy of cost variability typical of today's business strategies) which therefore allows the elimination of all the figures connected to this business area.

Considering the class 3, a more in-depth analysis of the obtained results is required. In particular, within this class, it is possible to recognise some roles that can be defined as "stable", because they have not been selected by the most of respondents and others that can be defined as "uncertain", because of a similar number in companies selecting them as growing or declining. To make this distinction, we can observe the calculated variance for each role.

The roles that have the lowest variance are Automation Manager, Buyer, Social Media Manager and HR manager. They have been already cited at the beginning of this section, as the less selected roles by the respondents, which can suggest that they are not considered to have a significant evolution in the future, substantially remaining "stable". Also, the Customer service officer and the Transportation manager can be assigned to this group.

The other roles, i.e. Driver (licence B), Warehouse operator, Forklift driver, Load. /Unload. Operator and Site manager are in a more ambiguous situation and can be classified as "uncertain".

Analysing in detail the other information provided by the companies that selected this role, it emerges that, relating to the operational figures (Driver, Forklift Driver, Warehouse operator and loading/unloading officer), the most of those who selected them as growing claim to have an intermediate type of technological asset, probably in the early stages of an innovative process towards Industry 4.0. Why, then, are profiles of a purely operational nature considered to be growing and remain in business realities where technology is evolving and converging more and more towards a 4.0 model? Analysing the data concerning the sector, always with a focus on the companies that have included these figures as growing, the highest percentage belongs to the logistic/commercial segment. We, therefore, assume that in that sector, these roles are still critical and of fundamental importance, today, as well as much more specialized and therefore difficult to replace.

In contrast, for the other two sectors considered (production and services) the same roles are perceived as declining, probably because they are less relevant and therefore more easily automated or outsourced. The lower criticality of the roles united (as emerges from the data) to a large company reality, with more possibilities of investment in innovative instruments, leads to the assumption of an easier substitution of these figures.

Investigating the data related to the managerial figure, i.e. Site Manager, more than on the sector, it is interesting to focus on the business dimension of the companies that have selected them. Most of those who declare the role to be growing have a larger workforce (from 100 employees upwards) than those who declare them to be in decline (less than 10 employees). Since it is a managerial figure, the results suggest that large companies have more needs as well as the possibility of acquiring them in their organization, an opportunity precluded instead to small companies where their usefulness would be limited.

5.2 Conclusion

This paper analysed the evolution of companies' logistics job profiles in relation to the type of technological assets and Industry 4.0 investments.

To investigate this topic, we performed a survey on 250 companies (35 respondents) in the logistics and manufacturing sector in the Lombardy region.

From the results, emerged that the roles that could be more easily automated (i.e., supplier and warehouse manager) or outsourced (i.e., receptionist, tracking officer) are in decline while the roles more related to the 4.0 technologies implementation and management (i.e., maintenance operator, process and logistics engineer, administrative clerk, IT manager) are in growth. In fact, supplier and warehouse managers' roles are increasingly automated thanks to the progressive and effective integration of each company's WMS within the supply chain. There are many cases of companies where warehouse and supplier management operations are fully automated and human operators have only the task of monitoring operations (Cimini et al., 2019). These results are consistent with the already existing scientific literature already investigate in the section 2. The most interesting results emerged from the survey are the stable role and the uncertain roles belonging to the class in which a clear evolution of the roles cannot be identified. The first ones are roles that are considered to not have a significant evolution in the future because of their transversality (i.e., automation manager, buyer, social media manager, HR manager, customer service officer and transportation manager). The uncertain roles are both operational figures (i.e., driver, warehouse operator, forklift driver, Load. /Unload. Operator) and managerial ones (Site manager). For the operational figures the main uncertainties are due to the fact that these roles are high impacted by the new 4.0 technologies (and consequently in constant transformation) but they are still critical and fundamental and hardly replaceable, especially for the logistics companies. As for the role of site manager, the survey shows that this role is identified as declining by small companies with limited investment opportunities and growing by large companies that are already investing heavily in 4.0 technologies.

Certainly this work has some limitations due both to the methodology used (low response rate, methodologies bias) and to the evolving nature of the subject matter. However, for the same reasons, there are many possibilities for future research such as an in-depth examination of roles that have emerged as "uncertain", which could turn out to be key roles to better understand the impact of 4.0 technologies on traditional business roles.

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