Digital Transformation challenge for Italian Universities' education:isomorphism or hybridization?

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Introduction. In the current socio-economic scenario, the acceleration driven by the digitalization processes characterized by the exchange and sharing of fluid and participatory knowledge among different social actors, both individual and collective, is contributing to the definition of an innovative paradigm that involves the introduction of new communication structures with significant implications in terms of model organization, as well as skills and new professional roles. In particular, among other aspects, the digitalization process requires organizations to redefine their structure and update their human resources to survive the competition. In this scenario, Higher Education Institutions (HEI) play a strategic role in the educational and learning process; this condition is reinforced by the European regulatory framework (Digital Education Action Plan, 2021-2027) which aims to support the adaptation of education and training systems to the digital era.

Purpose of the paper. The contribution aims to propose an analysis of the educational offerings developed by Italian Universities, focusing on the theme of digitalization for the competitiveness enhancement of socio-economic organizations. The intention is to examine *how Italian universities participate in the formalization and dissemination of educational and training programs aimed at preparing professional profiles consistent with the Digital Transformation process*.

Main findings. An increasing attention is expected to be observed towards the training of professional profiles capable of guiding entrepreneurial organizations, and more, towards their future in the context of Industry 4.0. This is due to the definition of new educational scenarios resulting from the hybridization of canonical paths in the perspective of trans-disciplinarity.

Type of paper. *Empirical*. For this purpose, the authors will focus on the educational programs activated by Italian Universities from the academic year 2019-2020 to date (database: universitaly.it) within the Master's Degree Programmes in "Techniques and Methods for the Information Society" (Italian classes LM-91 and LM Data). The analysis will be conducted based on Annual Unique Course Sheet for the period 2019-2023. This focus will "unveil" the intention/direction that Italian Universities are taking in terms of advanced education oriented towards digitalization and its nature, attributable to processes of social legitimation and institutional isomorphism or inspired by elements of intrinsic technical rationality.

1. Introduction

The theme of the relationship between innovation and change is well known to scholars of managerial disciplines[1]. Widespread connectivity, digitalization and new technologies pervade social systems, generating a disruptive impact on economic and productive organizations, as well as on political and cultural ones: the former with particular regard to entrepreneurial ones; the latter identified in those that deal with education, training and research at different levels[2]. In fact, in addition to contributing to the redefinition of the related *business models* in a competitive key, digitalization and the applications of Artificial Intelligence (AI) advances give rise to spaces of analysis and discussion within the areas of *knowledge education* and *knowledge management*[3].

It is particularly evident that the current dynamism of the social and economic scenario, associated with the acceleration caused by the digitalization process, is characterized by a continuous exchange and sharing of knowledge and by a *fluid participation* among the various social actors, connected in an increasingly dense network of relationships, a premise for economic growth and knowledge development itself[4].

This implies that the discontinuity determined by *Digital Transformation* contributes to the definition of a new production paradigm, introduces new communicative registers with considerable repercussions both in terms of organizational models and in terms of skills and new professionalism. In short, it is a discontinuity with purely *generative traits,* oriented to the adoption of tools and methods of *training* and *knowledge management*. This is even more evident if we consider that the process of digitalization in the organizational field impacts especially on the socio-cultural sphere of the actors involved, requiring organizations to redefine their structure as well as to update the resources employed.[5]

In this scenario, it is indisputable that the University Organizations (*Higher Education Institutions* – HEI), whose mission is to promote and support the dissemination of knowledge and the

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[1] Cfr. SCHUMPETER J. A., *Theory of Economic Development*, Harvard University Press, Cambridge, MA, 1934; FREEMAN C., PEREZ C., *Structural crises of adjustment: business cycles*, Printer, London, 1988; BETZ, F. *Managing technological innovation: competitive advantage from change*, John Wiley & Sons, 2003; DOSI G., *Sources, Procedures, and Microeconomic Effects of Innovation*, Journal of Economic Literature, vol. 26, no. 3, 1988, pp. 1120–71; VON HIPPEL E., *The sources of innovation*, Gabler, 2007; MARCH J. G., *Exploration and exploitation in organizational learning*, Organization science 2.1 (1991): 71-87.

[2] Cfr. DRUCKER P., *The Age of Discontinuity: Guidelines to Our Changing Society*, Routledge, 1992; NONAKA I, TAKEUCHI H, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, 1995.

[3] Cfr. BRYNJOLFSSON E., MCAFEE A*., The second machine age: Work, progress, and prosperity in a time of brilliant technologies*, W W Norton & Co, 2014; ARNTZ M., TERRY G., AND ULRICH Z., *The risk of automation for jobs in OECD countries: A comparative analysis*, 2016; WESTERMAN G., BONNET D., MCAFEE A., *Leading Digital: Turning Technology into Business Transformation*, Harvard Business Review Press, 2014; KAHNEMAN D., *Thinking, fast and slow*, macmillan, 2011; CHUI M., MANYIKA J., MIREMADI, M., *Where machines could replace humans-and where they can't (yet)*, 2016; DAVENPORT T. H., *Thinking for a living: how to get better performances and results from knowledge workers*, Harvard Business Press, 2005; NONAKA I., TOYAMA R, *The knowledge-creating theory revisited: knowledge creation as a synthesizing process*, Knowledge management research & practice, 1(1), 2-10, 2003.

[4] Cfr. BROWN J. S., DUGUID P., *The social life of information: Updated, with a new preface*, Harvard Business Review Press, 2017; MILL J. S., *The wealth of networks: How social production transforms markets and freedom*, New Haven and London: Yale University Press, 2006; CASTELLS M., Communication, power and counter-power in the network society. International journal of communication, 1(1), 29, 2007; BARLOW J., *Smart Mobs: The Next Social Revolution*, Interface: The Journal of Education, Community and Values, 3(1), 2003; SHIRKY C., *Here comes everybody: The power of organizing without organizations*, Penguin, 2008; OSTROM E., *Governing the commons: The evolution of institutions for collective action*, Cambridge university press, 1990.

[5] Cfr. SCHMARZO B., "The Economics of Data, Analytics, and Digital Transformation. The theorems, laws, and empowerments to guide your organization's digital transformation", in *Packt Publishing*, 2020; SOLIS B., *The Six Stages of Digital Transformation*, Altimeter Group, 2016; STEIBER A., ALÄNGE S., GHOSH S., & GONCALVES D., "Digital transformation of industrial firms: an innovation diffusion perspective", in *European Journal of Innovation Management*, 2020; NORMANN R., "Organizational innovativeness: product variation and reorientation", in *Administrative Science Quarterly*, n. 16, 1971, pp. 203-215; VENIER F., *Trasformazione digitale e capacità organizzativa. Le aziende italiane e la sfida del cambiamento*, EUT Edizioni Università di Trieste, 2017, p.15.

development of new skills in the changing society, play a strategic role in the higher education process, consistent with the impact produced by Digital Transformation in the professional field.

This condition is strengthened by the recent *Digital Education Action Plan* (2021-2027), a renewed European Union (EU) policy initiative aimed at supporting the sustainable and effective adaptation of EU Member States' education and training systems to the digital age, both in terms of training methods and the contents selected to train and educate.[6]

Starting from this premise, the contribution intends to propose an analysis of the educational offer, with particular reference to the Master's Degree classes in *Techniques and Methods for the Information Society* (*Tecniche e metodi per la Società dell'Informazione* LM-91 ex Decreto Ministeriale 270/2004_MIUR) and to the Master's Degree class in *Data Science* (LM-Data ex Decreto Ministeriale n.146 del 9-02-2021 – MUR), developed by public and private Universities on the national territory, both centred on the theme of digitalization for the strengthening of the competitiveness of socio-economic organizations. To reach this goal, the authors have conducted a preliminary analysis of the traits that characterize the current *Digitalization in the superior educational and training processes*, taking into consideration the upcoming applications and imminent advances of AI, that require the implementation of new communication registers, as well as the activation of mechanisms capable of reducing the *knowledge gaps*.

A growing attention to the training of professional figures able to drive socio-economic organizations towards their 4.0 future is expected, as well as the opportunity to imagine new training scenarios, as a result of a process of canonical paths' hybridization in the perspective of *trans-disciplinarity*: this condition could motivate the establishment of the new LM-Data class.

To this end, sections 2 and 3 will propose a quick reconstruction of both the current socio-economic and educational scenario, underlining the institutional role that Italian Universities play in the training process oriented to Digital Transformation.

Section 4 will propose the results of the analysis conducted on the educational offer, concerning the Course of Study (CoS) activated with reference to the Master's degree classes in *Techniques and Methods for the Information Society* (LM-91) and to the Master's Degree in Data Science (LM-Data). Finally, section 5 will consist in the closing of the work and contain the final reflections and the discussion.

2. A first identikit of the new professions induced by digital change

There is no area of life of every individual that has not experienced a profound change induced by *Digital Transformation* (DT) and the spread of digital technologies in recent years. The digitalization process, in particular, is responsible for giving a profound acceleration to the innovation of human activities, especially to economic-productive, political and cultural organizations forced to redefine activities and processes in a competitive perspective.

In this respect, Digital Transformation has taken on the role of *accelerator* of organizational change in a competitive key – by activating in socio-economic organizations that *"process of alignment of digital technology, skills, organizational processes and business models, aimed at creating new value for stakeholders and maintaining the sustainability of the organization in a constantly changing digital ecosystem"*.[7] This profound change, guided or induced by *disruptive* technologies, cannot fail to recognize the centrality of man, as a bearer of interests, expectations and needs and in search of constantly evolving knowledge and skills. This centrality strongly emerges in the process of Digital Transformation at a social and, therefore, organizational-entrepreneurial level, where it seems strategic to have resources, knowledge and new skills with a view to creating value and competitiveness.

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[6] "The education and training system is increasingly part of the digital transformation and can exploit its benefits and opportunities. [...] The new Action Plan presents a vision to improve digital literacy, skills and abilities at all levels of education and training and for all levels of digital skills (from basic to advanced)." See COM (2020) 624, *Digital Education Action Plan 2021-2027. Rethinking education and training for the digital age,* Brussels, 30/09/2020.

[7] Cfr. VENIER F., *Trasformazione digitale e capacità organizzativa. Le aziende italiane e la sfida del cambiamento*, EUT Edizioni Università di Trieste, 2017, p.15.

This idea is confirmed by the emergence of new professions induced by digitalization which, as detected by various studies conducted by research institutes, require higher education institutions to direct new training paths towards the definition of professional profiles, consistent with the needs of a constantly changing market.

Among the others, the article published by *Sole24Ore* in 2018 traced the *identikit* of the *Five digital professions with 5 million jobs*. The contribution, starting from the examination of about two million job offers and the top trends of digital evolution, traced a forecast of over five million new jobs worldwide in the following nine years for the IT sector, probably destined to grow more. In addition, IDC (International Data Corporation) for *Cisco* recently proposed a synthesis of the most requested professional figures currently on the market, or those able to drive socio-economic organizations towards their 4.0 future: profiles specialized in *Change Management* and *Transformation Consulting* related to the rapidly expanding world of the Internet of Things (IoT).

Only two years later*, ManpowerGroup-Luiss* qualified the Italian labour market as unable to meet the demand for the required innovative profiles, with particular reference to the energy sector. "Scientists and data analysts are the two emerging professions in the energy sector, and profiles with expertise in social media management, artificial intelligence, circular economics or cybersecurity are no different. However, companies are struggling to find these increasingly digital professions on the market, so much so that some are focusing on training and retraining of available personnel, if not also on the *in-sourcing* of external personnel".[8]

At the same time, in 2021*,* the *World Economic Forum* reinforced the idea of an indisputable acceleration induced by technology, digital and automation to the global labour market of such magnitude as to determine, in the next 3 years, the creation of 133 million new employment opportunities, compared to 75 million jobs destined to disappear.[9]

Unioncamere estimates that only in Italy in the next five years there will be a need for 2.5 million more employees; the 2021 *Unioncamere-ANPAL* dossier estimates that 75% of Italian companies will put in place *reskilling actions* for the staff already present in the company to cope with the crisis.

The first reflection emerging from the current scenario is that the need for new profiles is associated with a substantial lack of professionalizing training courses on the Italian territory, with a few exceptions, mostly confined within engineering or computer science courses.[10] We are in front of the so-called *skill mismatch*, that is, the distance that separates the skills required by the market with those proposed by school and university programs. The *skill mismatch* has a negative impact on: workers, because of the impossibility of placement or in terms wages; companies that witness a sharp slowdown in internal growth and, consequently, in the entire country-system, because of the absence of necessary skills from an organizational or productive point of view.[11]

The evidence of this condition is confirmed by the *Unioncamere-ANPAL* analysis (Figure 1) on the intersection between professional needs for companies and the relative difficulty of finding on the market.

[8] Cf. F. BRUNETTA, V. DERIU, MANGIACOTTI E., Evolutionary trajectories and skills for energy companies, Sector dynamics, Strategic choices and professional needs*, Manpower & LUISS, 2020.*

[9] Cfr. World Economic Forum, *The Future of Jobs Report 2020*, October 2020; World Economic Forum, *The Global Risks Report 2021*, https://www.weforum.org/agenda/2021/01/global-risks-report-2021.

[10] Cf. E. MARRO, Five digital professions with 5 million jobs *(and where to study them in Italy),* www.ilsole24ore.com, 16 June 2018; Rusconi G., *The most requested professions in 2022: how the world of work changes*, www.ilsole24ore.com, 28 December 2020.

[11] Cf. I. COUNCILLOR, op.cit*., 2020.*

Fig 1 - Requirements over the next five years and difficulties in finding jobs*
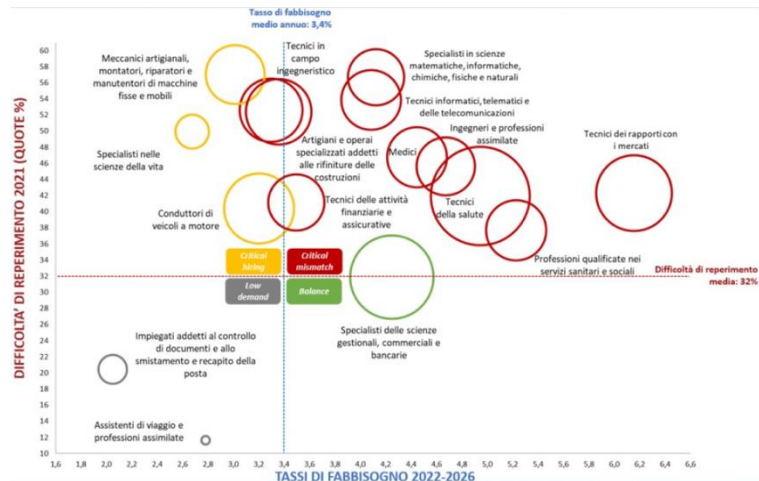
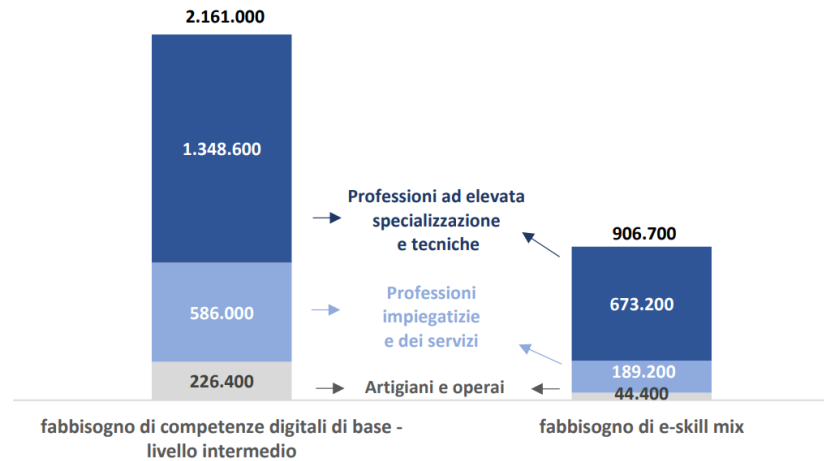*Source:* Unioncamere-ANPAL, Sistema Informativo Excelsior

*The dimension of the bubble represents the requirement in absolute value previewed for the profession in the quinquennium 2022- 2026 according to the intermediate scenario

In particular, the *Critical Mismatch* quadrant shows the professions already characterized by a high degree of difficulty in finding (equal to 32%), for which an intense demand is expected in the following five years (with particular reference to professions in the health and social sectors).[12] What is even more relevant for the purposes of this study concerns the professions that are crucial for advances in the processes of technological innovation and digital transition, bearers of key competences in the evolution of the socio-economic system. It is indisputable that the digital transition requires the most sought-after digital skills – basic for most workers – such as the use of internet technologies, visual communication tools and multimedia. At the same time, a substantial increase in the demand for figures with *e-skill* mixes is expected, i.e., in possession of a high degree of qualification for at least two of the *e-skills* – basic digital skills, ability to use mathematical and computer languages and methods – and needs that are substantiated in over 900 thousand professionals, about 23% of the total (see Figure 2).[13]

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[12] In this regard, it should be considered that the achievement of the objectives related to the digital transition, as indicated by the NRP, digital skills will continue to be increasingly sought after over the next five years. See A. PEDESTRIAN, Training systems and the digital transition. From emergency response to the Digital Education and Training Action Plan, 2021, https://oa.inapp.org/xmlui/handle/20.500.12916/3292; BELLANDI, M., GIANNINI, V., & D. IACOBUCCI, "La Missione 1 del PNRR: quali opportunità da seize e barriere da overcome?", in *L'industria*, 43(2), 2022, pp. 227-244.

[13] For more information see the reports of Unioncamere, Excelsior Information System. Digital skills. Analysis of the demand for digital skills in companies; Excelsior Information System, Forecasts of employment and professional needs in Italy in the medium term (2022-2026). Please refer to the documentation cited at the following link: https://excelsior.unioncamere.net.

Fig 2 - Occupations needs of professions with digital skills in the period 2022-2026

Source: Unioncamere-ANPAL, Sistema Informativo Excelsior

An even more interesting aspect refers to the role of the figures supporting the transformation of organizational and business models, as well as to the direction taken by organizations, both entrepreneurial and of a different nature. These organizations are able to support the growth of investments for the development of new business models and, at the same time, the greater use of digital channels in all areas of management. These changes determine, in turn, the increasing investments in innovative technologies (*cloud, mobile, big data analytics, cyber security, IoT)* and in software for the acquisition and management of data to support decisions, design and engineering of products and services.

In the light of the proposed reflections, it clearly emerges that the pervasiveness of the use of machines, digital technology and artificial intelligence (AI) requires more and more specific knowledge in the technological field, not only for highly qualified professions, but also for apparently less qualified ones that actually have to integrate themselves with extremely sophisticated and complex robots and machines. This means that digital skills have unquestionably become a prerequisite for the work of organizations in every socio-economic sector, public or private.

At this point, it becomes necessary (if not essential, at least from 2018 to date) for higher education institutions (HEI) to evaluate the impact of this challenges and changes on the design of new training courses. This does not mean that the paths will have to 'hoard' skills in 4.0 areas, but rather they will have to be inspired by alternative principles – *trans-disciplinarity*, among all – for the integrated structuring of soft and priority technical skills.[14] All this in order to create "*an intellectual space where the connections between different isolated topics can be explored and revealed*" and, at the same time, to guarantee professionals flexibility, which has become central for business organizations increasingly attentive to the construction of agile *teams* and dynamic contexts, in order to guarantee resilience in the face of internal and external changes. In short, *the professions of the future are obviously to be invented!*[15]

In summary, the Digitalization process[16]:

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[14] Cf. A. Frolla, Energy, digital specialists are missing: companies struggling in the hunt for talent, *www.repubblica.it/economia/*, 30 January 2020.

[15] Cf. I. Counselor, *The professions of the future? 60% of new jobs are to be invented: here's how to prepare for the revolution*, www.corriere.it/economia/lavoro/, September 29, 2020.

[16] Cfr. Dubravac S., Shapiro G., *Digital Destiny: How the New Age of Data Will Transform the Way We Work, Live, and Communicate*, Regnery Publishing, Washington, DC, 2015; Iaia L., *Management 4.0*, Vol. 7, Giappichelli, Torino, 2019. Per ulteriori approfondimenti in merito all'impatto dell'innovazione tecnologica nel processo di creazione di valore si rinvia, tra gli altri, a: Barile S., Polese F., & Saviano M., *Immaginare l'innovazione*, Giappichelli Editore, Torino, 2012; Barile S., Grimaldi M., Loia F., & Sirianni C.A., "Technology, value Co-Creation and innovation in service eCoSystems: Toward sustainable Co-Innovation", in *Sustainability*, Vol.12, n.7, 2020, 2759; Barile, S., Bassano, C., Piciocchi, P., Saviano, M., & Spohrer, J. C., "Empowering value co-creation in the digital age", in *Journal of Business & Industrial Marketing*, 2020, https://doi.org/10.1108/JBIM-12-2019-0553; Gong C., Ribiere V., "Developing a unified definition of digital transformation", in

- is the main factor of change that is contributing to the transformation of the labour market and that will take on an even greater weight in the coming years, with the impetus of European investments aimed at a digital transition;
- has undergone a strong acceleration, leading to the digital change of many production activities (*Smart Working*, online *commerce,* digitalization of procedures in many services to businesses and people);
- has imposed an 'obligatory' growth on the digital skills of many workers and in general of a large segment of the population.

And, again, *Digital Transformation*[17]:
- has, and will continue to have a decisive weight in characterizing the employment needs of the various economic sectors, with particular reference to the profiles equipped with the '*e-skills*';
- will create discontinuity with respect to the past, introducing a new production paradigm and new organizational models, with repercussions in terms of personnel, as well as on the demand for skills and new professionalism and training.

The emerging scenario, with respect to the need of the actors in the social system to equip themselves with new professionalism in line with the process of Digital Transformation, is characterized by the following dynamics:

1. the action promoted by Italian Universities, aimed at supporting the dissemination of knowledge and the development of new skills that can guide DT;
2. the change brought about by the recent European regulatory framework – a particular reference to the recent *Digital Education Action Plan* (2021-2027) – aimed at promoting the sustainable and effective adaptation of EU Member States' education and training systems to the digital age.

With regard to the last aspect, the new directives in the field of education and training aim to promote a new digital education and training system through the planning of training paths for the development of digital competences and skills necessary for Digital Transformation. In particular, since the Academic Year 2017-2018, Universities have launched a series of training courses focused on the acquisition of knowledge and skills in line with market demand in terms of DT, with the LM-91 Master's degree class "*Techniques and methods for the information society*". The cultural objectives of this Master's degree class are following ones[18]:
- know how to combine the methods and techniques of business management and public and private administration with the technologies and methodologies of information technology (IT), possessing skills in each of the areas;
- be able to effectively interpret technological and organizational change and innovation in companies and administrations;
- know how to operate in interdisciplinary groups made up of experts with skills in the fields of IT and economic-managerial technologies, as well as with specific skills for certain application sectors, having general knowledge in each of the areas and more in-depth in at least one of them;
- know how to deal with regulatory issues related to the use of IT and telematics (with reference, among others, to security problems, protection of confidentiality, legal validity);
- be able to interpret innovation within companies and administrations and to design new solutions for the use of information and communication technologies (ICT) in these areas;

Technovation, n. 102, 2021, 102217.; PARVIAINEN P., TIHINEN M., KÄÄRIÄINEN J., TEPPOLA S., PARVIAINEN P., TIHINEN M., KÄÄRIÄINEN J., TEPPOLA S., "Tackling the digitalization challenge: how to benefit from digitalization in practice", in *International journal of information systems and project management*, Vol. 5, n. 1, 2017, pp. 63-77.; STOLTERMAN E., FORS A.C., "Information technology and the good life", in *Information systems research*, Springer, Boston, MA, 2004, pp. 687-692.

[17] Cfr. PARVIAINEN P., TIHINEN M., KÄÄRIÄINEN J., TEPPOLA S., "Tackling the digitalization challenge: how to benefit from digitalization in practice", in *International journal of information systems and project management*, Vol. 5, n. 1, 2017, pp. 63-77; NORMANN R., "Organizational innovativeness: product variation and reorientation", in *Administrative Science Quarterly*, n. 16, 1971, pp. 203-215; HENDERSON R. M., CLARK B., "Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms", in *Administrative Science Quarterly*, n. 35, 1990, 9-30.

[18] Cfr. http://attiministeriali.miur.it/media/155598/dmcdl_magistrale.pdf

- be able to use fluently, in written and oral form, at least one language of the European Union in addition to Italian, with reference also to disciplinary lexicons.

With Ministerial Decree no. 146/2021, the Italian Ministry of University and Research has established a new class of Master's Degrees in *Data Science*, defined with the title of LM-Data, whose cultural objectives for students are shown below[19]:

- have a preparation that includes both specific technical knowledge and fundamental knowledge of business, legal and/or social context;
- know how to combine mathematical-statistical and IT technologies and methodologies with specific methods and techniques of the field in which they will operate;
- know how to use the techniques and methodologies learned to formulate, even in an innovative way, qualitative and quantitative answers to complex problems or those that require an interdisciplinary approach;
- be able to effectively assist technological and organizational change and innovation in companies and in public and private bodies or administrations, in particular in aspects involving the use and processing of large amounts of data, numerical or textual.

Therefore, the current Italian educational scenario is characterized by two distinct Master's degree classes with the same educational purposes: addressing the issues and problems of Digital Transformation and Digital Divide.

Coherently with the reflections proposed so far, the objective of the contribution is to analyse the participation of *Italian Universities in the formalization and dissemination of educational and training courses aimed at forming professional profiles consistent with the Digital Transformation process.*

In line with the above-mentioned objective of the work and considering the reference period of the analysis (from the academic year 2019-2020 to the academic year 2022-2023, for a total of 4 Academic Years), the research questions to which we want to provide an answer are listed below:

RQ1a: what was the distribution over time of the different macro-disciplinary areas in the CoS LM-91 in the defined time frame (2019-2022)?

RQ1b: are there any differences in terms of the composition of the study plan of the LM-91 Degree Classes determined by the characteristics of the University, only for the Academic Year 2022-23?

RQ2a: in the defined time frame (2019-2022), is it possible to identify a process of "isomorphism" of the LM-91, intended as a *homogenization* of training courses to the detriment of "Hard Sciences", based on computer science, engineering, mathematics and statistics?

RQ2b: can the creation of the LM-Data Master's degree class be considered a ministerial response to the possible action of this *isomorphic* process, in order to restore the centrality of the "Hard Sciences"?

RQ3: what are the macro-disciplinary areas that discriminate the newly established LM-Data compared to the LM-Data deriving from a transformation of the previous LM-91?

3. The strategic role of Italian Universities in the higher education process based on Digital Transformation

Starting from what has been said so far about the new professions of the digital age combined with the recent expectations of the labour market and with the configuration of new public spaces for democratic confrontation on the theme of Digital Transformation, it is impossible not to focus on the *organizations*, responsible for education and vocational training that overcomes the 'fence' of disciplinary membership and seizes the opportunity and the need to promote the structuring of

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[19] Cf. https://www.mur.gov.it/sites/default/files/2021-04/Decreto%20Ministeriale%20n.146%20del%2009-02-2021%20-%20Allegato.pdf

training courses consistent with the profound social and economic change induced by Digital Transformation.

In this regard, to face and manage Digital Transformation, Venier identifies, from an organizational point of view, a hybrid approach, both scientific and pragmatic, supported by the construct of organizational capability, operationally anchored to three basic components: the ability to situational analysis and monitoring the technological context; the ability to organizational design in the light of available technologies; the ability to implement technology-based changes.

The three skills configure the necessary 'toolbox' for those who decide, at an organizational level (public or private, large, medium or small), the direction of the evolution of the company. With this in mind, the professions within the organization should be trained so as to be able to bring greater agility and speed to the existing, already reliable and efficient system.

The attention of those who study, analyze and design advanced training courses focuses, therefore, on the ability of the university system to choose valuable objectives, as well as achieve them through the adoption of behaviours necessary to measure and improve the objectives/results to be achieved.[20] The quality of the provided service becomes an expression of the satisfaction of the reference market, with respect to the characteristics of the training.

In particular, the ability of higher education institutions (HEIs) to plan and obtain 'adequate' and 'valuable' results is strictly related with: requests from institutional bodies, responsible for designing the University's educational offer (Ministry of Education, University and Research, from now on MIUR); political guidelines provided at European level; requests from other actors who, although not part of the university system, are able to guide their own direction. This turns into a necessity for universities to adapt to ministerial directives, consistent with the supranational direction, designing their offer in line with the provisions of the changed institutional framework, launching programs consistent with the expectations of the reference market and, therefore, with the requests coming from the labour market.

This is the institutional pressure exerted by the actors who support change, widely formalized in the process of adapting the choices made within the universities. Italian Universities, in fact, acting with margins of autonomy and responsibility recognized by the MIUR, operate without separating their action from the influence of actors apparently not belonging to the organizational field dedicated to education and training, but that exert, at the same time, institutional pressures on educational planning through the definition of 'innovative' training courses, as a result of a process of *isomorphism* and, at the limit, of *hybridization* between 'canonical' paths.

The proposed reflections suggest that if, on the one hand, the strategic alignment of universities to the dynamics of the context is combined with that of educational responsibility, on the other hand it is possible to read such behaviours in the *governance* of universities as an attempt to exert pressure on the local context, to the point of influencing the configuration of the existing institutional framework. That is to say that in the Italian University system the power to define the guidelines of the process of formation and use of the acquired knowledge for the development of the various economic sectors, in concert with other political and institutional actors, can be recognized. [21]

Universities, in this perspective, play a key strategic role in the process of spreading knowledge, evaluating in advance its relative effectiveness with respect to the socio-economic context in which it will be used[22]. And the context to which reference is made in the contribution is clearly described by the pervasive Digital Transformation towards which the same training paths planned by higher education institutions must necessarily look. The Digital Transformation, widespread in different contexts (political-institutional, socio-economic and entrepreneurial) becomes, in fact, the increasingly invasive process and, therefore, indispensable for those organizations that intend to

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[20] Cfr. G. SIRILLI (edited by), *The production and dissemination of knowledge research, innovation and human resources*, CRUI Foundation, 2010.

[21] Cfr. C. NIGRO, E. IANNUZZI, M. LAMBRESA, "An empirical analysis of governance dynamics in the Italian State Museums", in *Proceedings of Heritage, Tourism and Hospitality: International Conference HTHIC 2014*, pp. 322-337.

[22] Cfr. C. NIGRO, E. IANNUZZI, F. CORTESE, M. PETRACCA, "Isomorphism and decoupling in the dynamics of governance of Italian University", in *Proceeding of the 16th Toulon-Verona Conference*, 2013.

characterize themselves for a high degree of professionalization, to guarantee the relative competitive dynamism with a view to modernization.

In the outlined scenario are placed the training courses that, in line with the emerging measures for the enhancement of the use of ICT (or *hyper communication*), suitable for promoting innovation and economic growth, aim at the dissemination of digital culture and the development of digital skills in organizations that take complexity as a paradigm and that invest in the innovation of process and system.

4. Research Design

The research aims to focus on the participation of *Italian universities in the formalization and dissemination of educational and training courses aimed at the formation of professional profiles consistent with the Digital Transformation process.*

To this end, the research group has identified in the LM-91 Master's Degree Classes "*Techniques and methods for the Information Society*" (ex-Ministerial Decree 270/2004_MIUR) and LM-Data "*Data Science*" (ex-Ministerial Decree n.146 of 9-02-2021 – MUR), the scope of the analysis conducted.

With reference to the two Master's degree classes, the data relating to them have been identified using the www.universitaly.it database, which gives access to the *University Single Sheets* of all the Course of Studies activated from the academic year 2019-2020 to the academic year 2022-2023. The choice of the database has constrained the reference period of the survey conducted, thus not being able to retrieve the data relating to the previous two years (remember that the LM-91 has been established starting from the Academic Year 2017-18).

The *Study Plans* of all the Programmes of the two selected Master's degree classes activated in the reference time frame for the reconstruction of the training system attributable to the various disciplinary areas were also analysed. It should be noted that not all the LM-91 courses were activated in the 2019-2020 academic year and that LM-Data courses were activated in the 2022-2023 academic year.

Below are reported, in tabular format (Table 1), the scientific-disciplinary areas identified in the analysed *Study Plans*, with the respective encodings associated during the analysis and with the number of Scientific Disciplinary Sectors (SDS) for each area.

Tab 1 – Scientific Disciplinary Areas

Scientific-Disciplinary Areas	Code	Num. SDS
Hard Sciences	TOT1_SCI	31
Law Sciences	TOT2_GIU	11
Sociological Sciences	TOT3_SOC	7
Economical Sciences	TOT4_ECO	12
Humanities	TOT5_LET	25
Psychological Sciences	TOT6_PSI	6
Medical Sciences	TOT7_MED	21
Architectural Science	TOT8_ARC	13

Source: our elaboration

The grouping of the Scientific-Disciplinary Areas did not take place through the canonical ministerial criteria, but followed a logic of coherence of the contents of the individual teachings by didactic affinities. Below are the compositions of the scientific-disciplinary areas of Table 1.

Table 2a – The scientific-disciplinary sectors of the "Hard Sciences" macro-area

"*Hard Sciences*" Macro-Area

1	INF_01	12	MAT_03	23	SECS-S_05
2	ING-INF_01	13	MAT_04	24	SECS-S_06
3	ING-INF_02	14	MAT_05	25	SECS-S_07
4	ING-INF_03	15	MAT_06	26	SECS-S_08
5	ING-INF_04	16	MAT_07	27	SECS-S_09
6	ING-INF_05	17	MAT_08	28	SECS-S_10
7	ING-INF_06	18	MAT_09	29	SECS-P_05
8	ING-INF_07	19	SECS-S_01	30	M-PSI_03
9	ING-INF_13	20	SECS-S_02	31	MED_01
10	MAT_01	21	SECS-S_03		
11	MAT_02	22	SECS-S_04		

Source: our elaboration

Tab 2b – The scientific-disciplinary sectors of the "Law Sciences" macro-area

"*Law Sciences*" Macro-Area

1	IUS_01	5	IUS_07	9	IUS_14
2	IUS_02	6	IUS_09	10	IUS_17
3	IUS_04	7	IUS_10	11	IUS_20
4	IUS_05	8	IUS_13		

Source: our elaboration

Tab 2c – The scientific-disciplinary sectors of the "Sociological Sciences" macro-area

"*Sociological Sciences*" Macro-Area

1	SPS_02	4	SPS_08	7	SPS_11
2	SPS_04	5	SPS_09		
3	SPS_07	6	SPS_10		

Source: our elaboration

Tab 2d – The scientific-disciplinary sectors of the "Economic Sciences" macro-area

"*Economic Sciences*" Macro-Area

1	SECS-P_01	5	SECS-P_07	9	SECS-P_11
2	SECS-P_02	6	SECS-P_08	10	ING-IND_35
3	SECS-P_03	7	SECS-P_09	11	ICAR_22
4	SECS-P_06	8	SECS-P_10	12	M-GGR_02

Source: our elaboration

Tab 2e – The scientific-disciplinary sectors of the "Humanities" macro-area

"*Humanities*" Macro-Area

1	M-FIL_01	10	L-LIN_07	19	L-OR_05
2	M-FIL_02	11	L-LIN_09	20	L-OR_21
3	M-FIL_03	12	L-LIN_12	21	M-STO_02
4	M-FIL_04	13	L-LIN_14	22	M-STO_04
5	M-FIL_05	14	L-LIN_21	23	M-STO_07
6	L-FIL-LET_10	15	L-ART_03	24	M-STO_08
7	L-FIL-LET_12	16	L-ART_04	25	M-GGR_01
8	L-LIN_01	17	L-ART_05		
9	L-LIN_04	18	L-ART_06		

Source: our elaboration

Tab 2f – The scientific-disciplinary sectors of the "Psychological Sciences" macro-area

"*Psychological Sciences*" Macro-Area

1	M-DEA_01	3	M-PSI_02	5	M-PSI_06
2	M-PSI_01	4	M-PSI_05	6	M-PED_03

Source: our elaboration

Tab 2g – The scientific-disciplinary sectors of the "Medical Sciences" macro-area

"*Medical Sciences*" Macro-Area

1	BIO_05	8	BIO_19	15	FIS_06
2	BIO_09	9	CHIM_02	16	FIS_07
3	BIO_10	10	FIS_01	17	FIS_08
4	BIO_11	11	FIS_02	18	MED_04
5	BIO_13	12	FIS_03	19	MED_06
6	BIO_14	13	FIS_04	20	MED_11
7	BIO_18	14	FIS_05	21	MED_42

Source: our elaboration

"*Architectural Sciences*" Macro-Area

1	ICAR_05	6	ICAR_20	11	ING-IND_31
2	ICAR_06	7	ING-IND_11	12	AGR_01
3	ICAR_12	8	ING-IND_13	13	AGR_10
4	ICAR_17	9	ING-IND_15		
5	ICAR_18	10	ING-IND_17		

Source: our elaboration

4.1 The Population of Italian Universities with Digital Transformation-based Courses and the Dataset

As previously clarified, the field of investigation consisted of the degree courses belonging to the two classes of Master's Degree LM-91 – *Techniques and methods for the Information Society* – and LM-Data – *Data Science* – activated in the period 2019-2022 in the population of Italian Universities, both public and private.

Table 3 below shows the details of the Italian Universities within the population, with a focus on the courses activated with reference to the chosen classes, and with the indication of the course denomination and the year of activation.

Tab 3 – Degree courses in Techniques and Methods for the Information Society (LM-91) and in Data Science (LM-Data) activated by Italian Universities from 2019-2020 to date

University	Course Denomination	Year of Activation
Master's Degree Class in *TECNICHE E METODI PER LA SOCIETÀ DELL'INFORMAZIONE (LM-91)*		
UNIFG	Innovazione e comunicazione digitale	2021
LUMSA	Comunicazione, innovazione ed experience design	2021
IULM	Intelligenza Artificiale, impresa e società	2021
LUISS	Data Science and Management	2021
Politecnico TORINO	Digital Skills for Sustainable Societal Transitions	2021
"Ca' Foscari" VENEZIA	Data Analytics for Business and Society	2020
Cattolica del Sacro Cuore	Applied data science for banking and finance	2020
BOCCONI	Cyber Risk Strategy and Governance	2019
UNIVAQ	Data Science Applicata	2019 (deactivated in 2022)
UNIUPO	Intelligenza Artificiale e Innovazione Digitale	2022
UNITUS	Informazione digitale	2019
UNIBA	Data Science	2019 (deactivated in 2022)
UNIBO	Digital Transformation Management	2021
UNICA	Data Science, Business Analytics e Innovazione	2019
UNICT	Data Science for Management	2019 (deactivated in 2022)
UNIMI	Data Science and Economics	2019 (deactivated in 2022)
UNIMIB	Data Science	2019

		(deactivated in 2022)
UNINA	Data Science	2019
UNIPD	Data Science	2019
UNIROMA1	Data Science	2019
UNISA	Data Science and Innovation Management	2020 (deactivated in 2022)
UNITN	Data Science	2019
UNIVR	Data Science	2020
UNIVERSITÀ EUROPEA DI ROMA	Management della Transizione Digitale	2022
UNIVPM	Data Science per l'Economia e le Imprese	2020
Master's Degree Class in *DATA SCIENCE (LM-DATA)*		
UNIVAQ	Data Science Applicata	2022 (*conversion*)
UNIBA	Data Science	2022 (*conversion*)
UNICT	Data Science	2022 (*conversion*)
UNIMI	Data Science and Economics	2022 (*conversion*)
UNIMIB	Data Science	2022 (*conversion*)
UNISA	Data Science e Gestione dell'Innovazione	2022 (*conversion*)
POLIBA	Trasformazione Digitale	2022 (*new activation*)
UNIBS	Analytics and Data Science for Economics and Management	2022 (*new activation*)
UNIME	Data Science	2022 (*new activation*)
UNIPI	Data Science and Business Informatics	2022 (*new activation*)
UNICAMPANIA	Data Science	2022 (*new activation*)

Source: our elaboration

With respect to the population of the Italian universities under investigation, the dataset was built on the basis of the following items:

1. size of the University (expressed by the number of students enrolled in 2021-2022), using the ministerial database www.ustat.miur.it, distinguished as shown in Table 4;
2. geographical area of reference, divided into North, Center, South & Islands;
3. property, distinguishable in State and no-State Universities.

Tab 4 – Classification of Universities per dimension and ownership

Type of University	Dimension	Number of students enrolled
State University	Mega	Over 40000
State University	Big	20000-40000
State University	Medium	10000-20000
State University	Small	Up to 10000
Non-state University	Big	Over 10000
Non-state University	Medium	5000-10000
Non-state University	Small	Up to 5000

Source: our elaboration

For each Course of Study (CoS), we have considered the following items:
a. whether the CoS was of new institution in 2022 or not;
b. whether it was a LM-91 or LM Data CoS;
c. number of ECTS credits for each SDS, classified by the macro-areas indicated in Tab 2.

For data processing and analysis, the software IBM-SPS Statistics® has been used. In Table 5 are reported all the items in the dataset processed by the software.

#	Item	#	Item	#	Item	#	Item	#	Item	#	Item
1	Activation	28	MAT_03	55	IUS_10	82	ICAR_06	109	MGGR_01	136	MED_11
2	Cod	29	MAT_04	56	IUS_13	83	ICAR_22	110	MDEA_01	137	MED_36
3	University	30	MAT_05	57	IUS_14	84	MGGR_02	111	MPSI_01_A	138	MED_46
4	Dimension	31	MAT_06	58	IUS_17	85	MFIL_01	112	MPSI_02	139	MED_42
5	Area	32	MAT_07	59	IUS_20	86	MFIL_02	113	MPSI_05	140	ICAR_05
6	Status	33	MAT_08	60	SPS_02	87	MFIL_03	114	MPSI_06	141	ICAR_06_A
7	Year	34	MAT_09	61	SPS_04	88	MFIL_04	115	MPED_03	142	ICAR_12
8	Year_activation	35	SECSS_01	62	SPS_07	89	MFIL_05	116	BIO_05	143	ICAR_17
9	TOT1_SCI	36	SECSS_02	63	SPS_08	90	LFILLET_10	117	BIO_09	144	ICAR_18
10	TOT2_LAW	37	SECSS_03	64	SPS_09	91	LFILLET_12	118	BIO_10	145	ICAR_20
11	TOT3_SOC	38	SECSS_04	65	SPS_10	92	LLIN_01	119	BIO_11	146	ICAR_22_A
12	TOT4_ECO	39	SECSS_05	66	SPS_11	93	LLIN_04	120	BIO_13	147	INGIND_11
13	TOT5_LET	40	SECSS_06	67	SECSP_01	94	LLIN_07	121	BIO_14	148	INGIND_13
14	TOT6_PSY	41	SECSS_07	68	SECSP_02	95	LLIN_09	122	BIO_18	149	INGIND_15
15	TOT7_MED	42	SECSS_08	69	SECSP_03	96	LLIN_12	123	BIO_19	150	INGIND_17_A
16	TOT8_ARC	43	SECSS_09	70	SECSP_05_A	97	LLIN_14	124	CHIM_02	151	INGIND_31_A
17	INF_01	44	SECSS_10	71	SECSP_06	98	LLIN_21	125	FIS_01	152	AGR_01
18	INGINF_01	45	SECSP_05	72	SECSP_07	99	LART_03	126	FIS_02	153	AGR_10
19	INGINF_02	46	MPSI_01	73	SECSP_08	100	LART_04	127	FIS_03	154	NN
20	INGINF_03	47	MPSI_03	74	SECSP_09	101	LART_05	128	FIS_04	155	TOT_ECTS
21	INGINF_04	48	MED_01	75	SECSP_10	102	LART_06	129	FIS_05	156	Den_course
22	INGINF_05	49	IUS_01	76	SECSP_11	103	LOR_05	130	FIS_06	157	Department
23	INGINF_06	50	IUS_02	77	SECSP_13	104	LOR_21	131	FIS_07	158	Prof_figures
24	INGINF_07	51	IUS_04	78	INGIND_17	105	MSTO_02	132	FIS_08		
25	INGINF_13	52	IUS_05	79	INGIND_31	106	MSTO_04	133	MED_01_A		
26	MAT_01	53	IUS_07	80	INGIND_33	107	MSTO_07	134	MED_04		
27	MAT_02	54	IUS_09	81	INGIND_35	108	MSTO_08	135	MED_06		

(*) The items from #17 up to #154 refer to the ECTS for each course. The totals for each macro-area are reported into the items from #9 to #16.

Source: our elaboration

4.2 Methodology

Prior to the elaborations aimed at providing a response to the RQs, the research group has elaborated some tables showing the distribution of ECTS credits by macro-areas through a descriptive approach, based on the size of the university, the geographical area and the type of ownership of the University, between state and non-state.

To answer the research questions RQ1a and RQ1b, the working group conducted a descriptive analysis aimed at showing the evolution of the CoSs attributable to LM-91 and LM-Data in the reference period, as well as the relative distribution of ECTS credits in the identified scientific-disciplinary areas. In this regard, the group has produced a table containing, for each of the 8 macro-scientific areas, the average number of ECTS credits and the relative standard deviation for each of the years in the reference period.

To respond to RQ2a and RQ2b, in order to identify, in the defined time frame (2019-2022), a process of "isomorphism" of the CoS LM-91, descriptive elaborations were carried out with the aim of verifying whether or not a process of *homogenization* of training courses has occurred over the years, where the insertion of SDSs belonging to different macro-areas has reduced the average number of ECTS credits to the detriment of disciplines belonging to the "Hard Sciences" macro-area.

To respond to RQ3, a comparative analysis was conducted between the ECTS credits averages for each macro-area, using the Fisher F test.

4.3 Findings

First of all, the research group intended to reconstruct the classification of the universities for the academic year 2022-2023 (the last year of the investigated time frame), based on their size, geographic affiliation and properties.

The results obtained (shown in Table 6) allowed to detect a greater incidence of the scientific-disciplinary area Hard Sciences in Mega Universities, followed immediately by Large Universities, regardless of the degree classes investigated. Conversely, Small Universities show, on average, a lower incidence of ECTS credits in the same area. This condition appears justified by the wide availability of financial funds for Mega Universities to be invested in support equipment for the provision of teaching and research in the Hard Sciences.

At the same time, the analysis allowed us to detect a surprising incidence of Sociological Sciences, Humanities and Psychological Sciences (which, jointly, can also be defined as *Soft Sciences*) in Small Universities, probably because of a lower need for hardware and software instrumentation to support the provision of teaching and the development of research in the sectors of origin.

Further evidence concerns the presence of ECTS credits in the Medical Area in Mega universities, to underline the growing attention on the effect of Digital Transformation in modern medicine.

Finally, the attention of the Polytechnics to the scientific disciplinary Economic Area is indisputable: in fact, the distribution of ECTS credits between Hard and Economic Sciences appears balanced and, at the limit, all-encompassing.

Tab 6 – Distribution of ECTS credits according to the size of the University

Dimension	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
Mega	**86,26**	7,30	0,00	15,00	1,96	2,09	7,48	0,00
Large	79,48	7,70	1,83	33,00	2,22	0,00	4,17	0,78
Medium	60,11	10,58	8,32	25,84	2,74	0,63	2,21	0,00
Small	31,09	6,36	11,82	17,09	23,45	6,18	0,00	2,91
Polytechnic	46,50	6,00	7,00	36,50	0,50	0,00	0,00	6,00

Source: our elaboration

Table 7 summarizes the results of the analysis on the incidence of ECTS credits for universities classified by geographical area of reference. With regard to this last aspect, it emerges that the universities located in Northern Italy record the highest incidence of the scientific-disciplinary area of Hard Sciences, followed by the Universities in the South & Islands, with a lower incidence in the universities of Central Italy. The latter, in particular, show a more balanced distribution of ECTS credits in the scientific disciplinary areas Soft Sciences.

Table 7 – ECTS credits breakdown by Programme according to the geographical area of the University

Geographic Area	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
North	75,86	10,70	3,89	22,59	2,68	2,27	5,68	1,46
Center	58,00	7,33	5,90	28,10	11,43	2,10	0,29	1,52
South & Islands	64,58	4,25	4,33	24,00	2,92	0,00	3,92	0,00

Source: our elaboration

Last preliminary consideration refers to the distribution of ECTS credits for CoS based on the ownership (State and non-State) of the University (Table 8). With reference to this last aspect, it seems noticeable the indisputable prevalence of ECTS credits in Hard Sciences for CoS in State Universities against a more equitable distribution of ECTS credits per CoS between Hard, Economic and Soft Sciences in Private Universities which, in the population under investigation, refer to Bocconi University in Milan and to Luiss Guido Carli in Rome, both of strong economic matrix.

Table 8 – Distribution of ECTS credits according to University ownership

Ownership	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
State	74,51	7,97	4,50	23,40	4,10	1,35	4,56	1,26
Non-State	36,29	7,86	4,71	29,36	9,29	2,57	0,00	0,00

Source: our elaboration

After the analysis of the aggregated data, attributable to both the degree classes, the results relating to the incidence of ECTS credits per CoS, distinguished by degree class (LM-91 and LM-Data), compared to the reference period, are presented below. In this regard, it should be clarified that the LM-Data degree class, born in 2021, for some universities of the investigated population configures a *conversion* instead of the deactivation of the LM-91 (as shown in Table 2); the reference is to 6 universities out of a total of 11 that register the presence of a CoS in LM-Data in the academic year 2022-2023. For this reason, the results in the following tables will be presented distinguishing the CoS in LM-Data in *new institution* (first activation) and *conversion* (from LM-91 to LM-Data).

As shown in Table 7, it is immediate to find, in the period under investigation (2019-2022), with particular reference to the CoS in LM-91, that the average incidence of ECTS credits per CoS of the scientific disciplinary area Hard Sciences records a contraction, compared to an increase in the incidence of ECTS credits for Soft Sciences. At the same time, there has been an increase, albeit limited, in the incidence of Medical Sciences, demonstrating the interest of the sector in the recent process of Digital Transformation.

Interesting data is relevant with reference to the CoS in LM-Data emerging from the conversion process of CoS LM-91. In this case, in fact, there is a reversal of the trend in the incidence of ECTS credits by scientific disciplinary area, recording a substantial increase in the presence of Hard Sciences against a substantial contraction of Soft Sciences. This condition must be traced back to the

opportunity traced by the new Master's degree class, evidently more focused on Hard Sciences, to recover the canonical nature of training courses in Data Science.

In line with what was previously noted, the average distribution of ECTS credits by scientific disciplinary area for newly activated LM-Data Degree Programme shows a prevalent presence of Hard Sciences, followed by Economic Sciences; moreover, it confirms, as for the CoS emerging from the conversion from the LM-91, the lower incidence, at the limit of cancellation, of the Soft Sciences. Finally, it should be emphasized the growing incidence of Medical Sciences in both degree classes for courses of the year 2022.

Tab 9 – Distribution of ECTS credits in LM-91 e LM-Data courses

Course Activation	CoS MD	Year	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
Conversion	LM-91	2019	72,42	7,17	2,83	19,83	4,08	1,67	4,33	0,67
		2020	71,94	8,76	3,06	28,06	3,76	1,18	3,41	0,82
		2021	64,00	7,78	5,57	26,04	5,35	1,91	2,52	1,39
		2022	59,63	8,42	7,68	25,63	7,79	2,32	4,95	1,68
	LM-DAT	2022	84,83	7,00	2,00	23,00	3,67	0,00	4,00	0,00
New Activation	LM-DAT	2022	73,80	7,20	0,00	12,60	0,60	0,00	4,80	0,00

Source: our elaboration

To complete what has been noted so far, Table 10 proposes a comparison between the distribution of ECTS credits for LM-91 and LM-Data programmes, overcoming the distinction between 'new institution' and 'conversion'. In this case, comparing only the last two rows of the table (referring to the two classes in the academic year 2022-2023), it clearly emerges that: the weight of Hard Sciences in LM-Data far exceeds that relating to LM-91; in the transition from LM-91 to LM-Data, Sociological Sciences and Humanities suffer a strong contraction and Psychological Sciences cancel themselves out altogether. To reinforce the previous reflections, it is interesting to observe the surprising presence of the Medical Sciences in both the degree classes.

Tab 10 - Distribution of ECTS in LM-91 e LM-Data courses (aggregated)

CoS MD	Year	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
LM-91	2019	72,42	7,17	2,83	19,83	4,08	1,67	4,33	0,67
	2020	71,94	8,76	3,06	28,06	3,76	1,18	3,41	0,82
	2021	64,00	7,78	5,57	26,04	5,35	1,91	2,52	1,39
	2022	59,63	8,42	7,68	25,63	7,79	2,32	4,95	1,68
LM-DAT	2022	79,82	7,09	1,09	18,27	2,27	0,00	4,36	0,00

Source: our elaboration

For the sole purpose of better clarifying the distribution of ECTS credits for LM-91 and LM-Data Programmes, with reference to the last academic year available in Universitaly.it, it was considered appropriate to filter the results obtained from the elaborations with respect to the academic year 2022-2023. Table 11 summarizes what was found.

To confirm what has already been found, the LM-91 CoS recorded a lower average incidence of ECTS credits in Hard Sciences compared to the LM-Data CoS, with an average distribution of the remaining ECTS credits that rewards the Economic Sciences, but above all the Soft Sciences.

Tab 11 - Distribution of ECTS in LM-91 e LM-Data courses (a.y. 2022-2023)

Activation	CoS MD	TOT1_ SCI	TOT2_ LAW	TOT3_ SOC	TOT4_ ECO	TOT5_ LET	TOT6_ PSY	TOT7_ MED	TOT8_ ARC
Conversion	LM-91	66,15	8,08	5,07	25,37	5,41	1,80	3,69	1,21
	LM-DAT	84,83	7,00	2,00	23,00	3,67	0,00	4,00	0,00
New Activation	LM-DAT	73,80	7,20	0,00	12,60	0,60	0,00	4,80	0,00
Total	LM-91	66,15	8,08	5,07	25,37	5,41	1,80	3,69	1,21
	LM-DAT	79,82	7,09	1,09	18,27	2,27	0,00	4,36	0,00

Source: our elaboration

The results obtained from the analysis conducted on the population of the courses belonging to the LM-91 and LM-Data Degree Classes allow to positively respond to the research questions.

In line with what has been noted so far, in the defined time frame (2019-2022), the courses belonging to the LM-91 Master's Degree Class show a reduction in the incidence of the scientific disciplinary area (RQ1a and RQ1b) and, at the same time, highlight a distribution among all the other scientific-disciplinary areas investigated which, for larger universities, means an average increase of ECTS in the Economic Sciences, while for smaller universities, an average increase of ECTS in the Soft Sciences. This condition contributes to configuring training paths emerging from processes of disciplinary *hybridization*, to underline the different 'soul' that inspires the training courses, no longer structured mainly on technical-quantitative scientific-disciplinary areas (Hard Sciences), and the start of a substantial process of *hybridization* between canonical training courses (RQ2a and RQ2b).

At the same time, the answer to RQ3 is also positive, since, as shown in Table 8, the LM-Data shows a significantly higher incidence of the scientific disciplinary area than the incidence of the same area in the LM-91.

The following table (Table 12) shows the results obtained from a comparison analysis between averages (Fisher F Test), aimed at identifying the macro-disciplinary areas that discriminate the newly established LM-Data courses compared to the LM-Data deriving from a transformation of the previous LM-91. From the analysis, it emerges how the disciplinary sector of the "Sociological Sciences" proves to be discriminating and impacting on the differentiation between new and old institution courses. The difference between averages is significant with a standard error of 5%. Statistically relevant for the objectives of the research in terms of difference between averages, although significant with a standard error of 10.8%, is the "Hard Sciences" sector, whose discriminating impact between courses is reduced in the face of an increase in the difference of the standard error.

Tab 11 – Average Comparisons between LM-Data (Old and New Institution)

	F	Sign.
TOT1_SCI	**3,187**	**0,108**
TOT2_GIU	0,066	0,802
TOT3_SOC	**32,727**	**0,000**
TOT4_ECO	0,476	0,507
TOT5_LET	**4,826**	**0,056**
TOT7_MED	1,751	0,218

Source: our elaboration

5. Discussion and Conclusions

In the light of the previously proposed reflections, the *growing trend* that characterizes the proliferation of study courses aimed at disseminating knowledge in the field of issues related to Digital Transformation should be previously emphasized (see Table 2). Although intuitively, it is possible to hypothesize that the *trend* configures a clear response to the pressures coming from the actors of the context and, therefore, represents a synthesis of institutional isomorphic processes activated by universities on the national territory. In particular, if on the one hand the activation of these processes emphasizes the role of social actors and the weight of the relative pressures in directing the study paths provided by Italian universities to change (consider, for example, the presence of Steering Committees, composed of third parties), on the other hand it orients organizations to adopt homogeneous behaviours, standardizing and at the same time strengthening the structuring/destructuring of the rules with the activation of isomorphic behaviours.

In the outlined scenario, we should be led to believe that socio-cultural evolution has led universities to rethink their educational offer, in order to preliminarily create those conditions of professionalism necessary for the exchange and sharing of *fluid* and *participatory knowledge* between the different social actors, thus allowing the networking of increasingly dense relationships and, therefore, supporting economic growth and knowledge itself. It should be added that what is highlighted, with particular reference to the structuring of the training courses related to LM-91 in the period under analysis, is a planning of professionalizing training activities emerging from the *hybridization* between canonical paths, realized through the recognition of a strategic weight to *trans-disciplinarity*. In fact, there is a clear change of course that sees the first courses activated by the class (referring to the year 2019-2020) strongly structured around the development of technical-IT skills and competences and the most recent clearly emerging from the recent process of updating the same skills and competences, reinterpreted in a *transdisciplinary* key. This is because universities, as cognitive infrastructures, perform the function of bridge between past, present and future, and, faced with a constantly evolving market and context dynamics, sometimes unpredictable, recognize the need to contribute to the creation of a competitive scenario through the value of multi/inter / and trans/ disciplinarity of training[23]. In this scenario, the hybridization of knowledge, technological, socio-

economic and humanistic, evidently constitutes the turning point for the design of new university training courses.

At the same time, the birth of Master's Degree in LM-Data leads us to reflect on the *hybridization* process underway in the LM-91 training courses, even more so if we take into account that 6 of the 11 LM-Data Degree Programmes activated in the 2022-2023 academic year follow the deactivation of as many LM-91 Programmes of the same, configuring a 'conversion' choice aimed at recovering the canonical vision of training in *Data Science*.

In summary, the training courses activated with reference to classes LM-91 and LM-Data appear to be an expression of the clear tendency to create professional profiles of experts in the digital world. This condition of context is reinforced by the recent political-institutional vision, at multiple hierarchical levels. If only we stop to consider the transnational direction, it becomes evident that the education and training system is called to support the direction of social and, even more, economic digitalization[24]. Digital technologies appear indispensable, among other aspects, *"in the world of work, learning, entertainment, to socialize, shop and access any service, from health to culture".*[25] A brief reference to the *National Recovery and Resilience Plan – Piano Nazionale di Ripresa e Resilienza* (PNRR) cannot be missing. The plan gives the priority to the digital transition and, more generally, to the objectives of relaunching the economy at European Union level; it provides the additional stimulus to business investments in the dual perspective of contingent response to the current economic difficulties and relaunching their business model through new strategies and new professional figures[26].

In response to the obvious pressures, if universities want to actively contribute to the process of social and economic modernization, they must legitimately worry about training in digitalization, in line with the impact that it will presumably generate in the various sectors of communication, managerial skills, entrepreneurship.

A further remark arises from the observation of a link between the courses with the greatest impact of the macro-area "Hard Sciences" with disciplines in the field of "Medical Sciences". This aspect is a concrete indicator of how new technologies (especially those related to Artificial Intelligence) find wide application in the medical field. Therefore, Italian Universities embedded with a department of medical area are investing in study courses and laboratories that can support Digital Transformation. Finally, an aspect that is not present in the paper and whose investigation could represent an opportunity to deepen the dynamics underlying innovation in university teaching regards the political rationality adopted in designing the degree courses. This is to underline that the presence of some SDS in the courses is linked not so much to the logic of "opportunity" and "consistency" with the outgoing professional figures, but to the political weight of teachers belonging to different macro-areas in inserting their teachings in the training courses.

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[24] We could limit ourselves to summarizing the recent interventions of the EU Commission: in July 2020 the publication of the "*New Skills Agenda*" – Agenda for Skills for Europe for sustainable competitiveness, social fairness and resilience, which finds its natural completion[24] in the "*Digital Education Plan*", launched by the EU Commission in September 2020. And so, in line with the action plan, the new document *"Digital Compass 2030: the European model for the digital decade" comes to life,* which integrates and strengthens the European digital strategy, providing it with defined quantitative objectives and clear time limits, in the belief that the European digitalization model is a fundamental key to open the door to recovery.

[25] Cfr. COM (2021) 118 Final, EU Commission, Brussels, 9 March 2021.

[26] Excelsior *Information System* 2021, *Digital skills. Analysis of the demand for digital skills in companies*, Survey 2021.

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