



UWS Academic Portal

Chief Digital Officer and organizational creativity toward digitalization

Scuotto, Veronica ; Magni, Domitilla ; Theofilos, Tzanidis; Del Giudice, Manlio

Published in:
IEEE Transactions on Engineering Management

DOI:
[10.1109/TEM.2022.3153395](https://doi.org/10.1109/TEM.2022.3153395)

E-pub ahead of print: 08/04/2022

Document Version
Peer reviewed version

[Link to publication on the UWS Academic Portal](#)

Citation for published version (APA):
Scuotto, V., Magni, D., Theofilos, T., & Del Giudice, M. (2022). Chief Digital Officer and organizational creativity toward digitalization. *IEEE Transactions on Engineering Management*.
<https://doi.org/10.1109/TEM.2022.3153395>

General rights

Copyright and moral rights for the publications made accessible in the UWS Academic Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact pure@uws.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Scuotto, V., Magni, D., Theofilos, T., & Del Giudice, M. (2022). Chief Digital Officer and organizational creativity toward digitalization. *IEEE Transactions on Engineering Management*. <https://doi.org/10.1109/TEM.2022.3153395>

“© © 2022 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.”

Chief Digital Officer and Organizational Creativity Toward Digitalization

Veronica Scuotto , Domitilla Magni , Tzanidis Theofilos , and Manlio Del Giudice 

Abstract—Through the microfoundation lens, this article explores how dynamic capabilities (DCs) of Chief Digital Officers (CDOs) trigger digitalization and organizational creativity of 2124 small to medium enterprises (SMEs) across 39 different European countries. As a result, the significant DCs are substantive and adaptive capabilities, which are offering new solutions, seizing new opportunities, and coping with changes. Besides, those two DCs also assume a mediator role in triggering organizational creativity within SMEs. In terms of theoretical and managerial implications, threefold contributions are provided: the first one offers a fresh study on the digital transformation context of SMEs through a microfoundation perspective; the second emphasizes the crucial role of CDOs as supported and remarked upon previous studies; and, then, the third one stresses out the importance of the individual leverage to generate creativity by the moderating role of DCs. By highlighting the originality of the research, since CDOs are seen to be the spark of unique ideas and innovations in the organization, further insights are proposed to position the need for conceptualizing new paths for developing technologies toward organizational creativity and humanity.

Index Terms—Chief Digital Officer (CDO) organizational creativity, digital transformation (DT), dynamic capabilities (DCs), microfoundation.

I. INTRODUCTION

IN THE era of business humanization, digital transformation (DT) is addressing the focus of scholars and practitioners toward individual dynamic capabilities (DC). Such capabilities are classified as substantive, adaptive, and change [28], [77] that can be embraced in the new business digital role of Chief Digital Officers (CDOs). CDOs influence organizational strategy [51]

Manuscript received October 2, 2021; revised November 26, 2021 and January 12, 2022; accepted February 11, 2022. The work of Manlio Del Giudice was supported by the Basic Research Program of the HSE University. Review of this manuscript was arranged by Department Editor A. Messeni Petruzzelli. (Corresponding author: Veronica Scuotto.)

Veronica Scuotto is with the Research Center, Leonard de Vinci, Pole Universitaire, 92916 Paris La Défense, France, and also with the Department of Economics, Management, Institutions, University of Napoli Federico II, 80138 Naples, Italy (e-mail: veronica.scuotto@unina.it).

Domitilla Magni is with the Department of Economics and Management, University of Catania, 95124 Catania, Italy (e-mail: domitilla.magni@unict.it).

Tzanidis Theofilos is with the School of Business and Creative Industries, University of the West of Scotland, G72 0LH Scotland, U.K. (e-mail: theo.tzanidis@uws.ac.uk).

Manlio Del Giudice is with the Department of Research, Link Campus University, 00165 Rome, Italy, with the HSE University, 101000 Moscow, Russia, and also with Paris School of Business, 75013 Paris, France (e-mail: m.delgiudice@unilink.it).

Color versions of one or more figures in this article are available at <https://doi.org/10.1109/TEM.2022.3153395>.

Digital Object Identifier 10.1109/TEM.2022.3153395

to achieve businesses' goals [57]. They also assume a leadership role in evolving a business toward a digital mindset by employing digital technologies. The use of digital technologies is the core skill in the DT era. DT is defined as a way to enclose digitalization by using digital technologies to improve business performance, customers' relationship, organization structure, and so business models [10], [73] but nothing seems to illustrate or explore the impact of DT on individual creativity. The impact of DT has been studied mostly on the organizational point of view [8], [17], [36], [50], [55], [64] along with the impact on society [72], but none on the individual perspective. In this sense, the present research questions if individuals such as CDOs can drive new trajectories for emerging technologies and so overpassing risk and resistance but generating more creative ideas. On this basis, through the microfoundation lens and going beyond the mere human resources analysis, this article investigates the substantive, adaptive, and change of DCs belonging to CDOs in the DT context and their impact on organizational creativity. Moreover, such a context is researched on a sample of 2124 small to medium enterprises (SMEs) across 39 different European Countries. To test our conceptual model, we run an ordinary least squares (OLS) regression analysis using the statistical package IBM SPSS 25.0. Findings support our hypotheses regarding the role of CDOs' substantive and adaptive capabilities on digitalization, which has also a positive mediation role on organizational creativity in European SMEs.

The present analysis offers three distinctive contributions. First, studies on DT are extended offering a microfoundation perspective by looking into DCs. CDO's capabilities are made of microfoundations relating to substantive and adaptive capabilities, which highlight the need to provide a rapid response to the market and be flexible driven by individuals rather than organizational settings as [17] and [66] postulate. In particular, CDOs are more prone to get new solutions [71] and adaptive to changes, which circumvent periods of inactivity and stagnation that can be usual in SMEs.

Second, we remark the crucial role of the decision-makers in building DCs [77] and more specifically, the relevant role of CDOs to trigger digitalization within SMEs. The quantitative analysis enlarges insights emerged by a qualitative and case-based study [57], [58], [62] and can encourage new theory—testing research. Yet, if it is well demonstrated that large companies have already embraced the CDO role [37], [75], this article offers an overview on SMEs that is unexplored. It shows a new job position, which is diverse from another related role as chief information officer [7].

Third, this article suggests how to stimulate creativity in an organizational environment. In fact, it shows digitalization significantly positively mediates the effect of CDOs' individual DCs (substantive and adaptive capabilities) on organizational creativity. In turn, the current business is moving toward "the right-brained intuitive and creative world instead of a left-brained logical thinking world" [58, p.167] to increasingly become more antagonistic and pushing the more traditional roles into extinction and placing greater demand for more creative and entrepreneurial skills. CDOs are therefore seen to be the catalyst and the trigger of novel ideas and innovations in an enterprise. Overall, we emphasize the key role of CDOs in triggering digitization and consequently organizational creativity. This overcomes individual and organizational reluctance in exploring emerging technologies but shows new trajectories to facilitate the dissemination of those technologies.

II. THEORETICAL BACKGROUND

A. Digitization, Digitalization and DT

As our economies slowly drift into a new era, defined by virtuality, digitization, and real-time user interactions and data availability, it is hard not to assume that this evolving trend leads to some kind of "technological singularity" moment. We see digital platforms and the fast intervention of artificial superintelligence changing how we do business, how we interact, buy, and communicate in our efforts to integrate machine input in our daily business. This is not the first technological acceleration as we now live through the third epoch of technological transformation following the Information Age (1947–1995), the Digitization Age (1997–2007) and it is termed as the Age of Acceleration. This rapidly growing 21st century phenomenon is built around digital platforms and cloud ecosystems that aim to assist DT and create sustainable business societies.

The transformative effects of digitization, digitalization, and consequently DT is felt fully by marketers and the wider organization, with the ever-accelerating process creating more channels for customer and business interaction, as well as opening new avenues for data utilizing products and services [67]. The digitization, digitalization, and DT of the communication process have allowed for the reduction in costs of measuring communications data, with costs becoming lower while increasing the requisite specialisms from marketing communications professionals to operation managers working to the factory floor [35].

According to [49], digitization is an evolutionary process toward Industry 4.0 and Industry 5.0 frameworks, a journey from analog to digital for the organization. The authors provide an interesting metaphor presenting DT as a spectrum whereby overtime the options of digital technology use, the assorted complexity, and the development of both hardware and human resource move into cyclical revolutions. That suggests that the main stages along the DT spectrum [70] are that of an analog state of being and that of digitization or digitalization.

Autio [5, p.1] defined digitization as the transformation of physical entities into digital objects, or in his own words "technical conversion of analog information into digital form." A good

example here is handwriting on paper (analog) and evolving into using a stylus pen to write on a word document. Digitization is linked to a dwindling number of digital technologies implemented in an organization. Digitization as a stage along the DT spectrum is often historically linked with 1960s and 1970s growth in computational processing and application in industry [22], [52], [76].

Tilson *et al.* [68] defined digitalization as being the term that refers to describe the sociotechnical processes surrounding the use of most digital technologies that have an impact on social and institutional contexts that require and increasingly rely on digital technologies. Autio [5] pinpointed 1980s and 1990s as the period during which the growing interconnectivity and increased digitalization of businesses and consumer markets led to the era of the fourth industrial revolution otherwise known as Industry 4.0 [40], [60]. According to [2], the growth of sensors for real-time data collection led to the transformation of many technologies that developed the capacity to communicate autonomously leading to the Internet of Things and artificial intelligence.

Digitalization is broadly defined as the application of digital technologies and infrastructures in business, economy, and society [5]. The impact of digitalization can broadly be said to be a disruptive one, especially at this point in history, as the accelerated nature of digitalization has a consequential effect on business, society, and the economy at large. This has been most significantly felt through the advent of 'Web 2.0' in 2004, which ushered in the introduction of smartphones and the subsequent establishment of cloud computing technologies, algorithms, performance analytics, digital communications, and big data technologies [5]. Furthermore, organization-wide engagement with these digital tools and technologies can result in the development of an embedded digital culture within the organization.

According to [67], this growth of adoption and evolution of a business process and modeling was beneficial to many SMEs but was not equally fertile to everyone. Many organizations that were both established and had long-standing traditions in their respective industries were found to be struggling to change on time failed to adapt and retain their market share and, in many cases, they have vanished from the marketplace. These companies relied on an older belief system [26] and insisted on attempting to engage with modern problems using solutions fit for non-digital environments. Given the accelerated nature of technologically fueled change, many businesses are forced to revise their business models and attempt to creatively integrate digital technology into their businesses. That creative organization's technologically driven change is known as DT.

As previously articulated, in this article, DT is a multidimensional phenomenon and it manifests differently for every business. Some businesses may be about adopting innovative technologies (e.g., Internet of Things or Industrial Internet of Things) [27], [73], for other businesses may be about harnessing social media to engage with clients and prospect sales or leads [30]. These multiple dimensions of DT may differ in various ways depending on the type of the organization, size, and goal of each stage of their transformation cycle. Some use DT to optimize a business and production process, create cost

efficiencies, create value by enhancing products and services new to the market and sometimes some businesses see it as a natural way to evolve forward. The glue that binds this together is also often the missing element that allows companies to integrate and embed DT as part of their business model and approach evolution is organizational creativity.

B. Building Individual DCs on Microfoundation Lens

DT is addressing the focus of scholars and practitioners toward individual DC that are classified as substantive, adaptive, and change [28] that can be embraced in the new business digital role of CDO. CDOs aim to achieve businesses' goals [57] influencing organizational strategy [51]. They also assume a leadership role in evolving a business toward a digital mindset by employing digital technologies. The CDO is defined as the principal frontrunner responsible for evolving processes and the clear communication of a holistic DT strategy across the organization, advocating for the company's digital initiatives to internal and external stakeholders and consequently leading DT [23], [48], [58]. Fitzgerald *et al.* [20] showed how the digital capability productively engages with digital technology capability and expedites the innovation process by integrating and mobilizing both human and technological strengths and resources. According to [8], a digital strategy has to leverage digital resources to develop a differential value.

Resources such as digital experience and expertise (human resource), digital strategy (management and leadership), digital infrastructure (hardware and software), and digital business process and procedure shape what we call digital capabilities that according to [5] digitization definition make up the definition of digitalization. These resources and capabilities are essential for the development of the digitization process in SMEs. Crupi *et al.* [11] highlighted the impact of digitization and DT to an organization of a larger size and its effects on processes, routines, capabilities, and organizational structure. Raymond *et al.* [47] asserted that DT is providing a competitive advantage to an SME in comparison to larger organizational entities given the slower adoption rates due to larger organizational structures, size of operations, and capacity to deliver change with minimum disruption. On the other hand, for this competitive advantage to be achieved the need for SME tailored planning is essential to encompass gaps in capacity and skills required to drive the transformation process. Isensee *et al.* [29] identified several links with strategic orientation, internal capabilities, management amongst other capabilities that drive and enable digitization in an SME and affirm the importance of a central role in the business to drive digitization.

The authors of this study will employ the microfoundation viewpoint aiming to engage and transcend the HR dimension that often brands CDOs DC as potential organization creativity triggers within SMEs. The microfoundation lens evaluates individual elements in an organizational environment [18], which is shifting toward the DT [61]. By adopting this perspective, it is possible to explore the DCs capabilities to enhance the DT process by focusing on creativity at an individual level and organizational creativity at an organizational level. As Scuotto *et al.* [54]

stated, the microfoundation approach describes organizational learning capabilities and microlevel components. This is referenced in some of the first studies using microfoundations, that reflect on the importance of the microeconomic behaviors of individual agents, and this has been remarked upon numerous studies [13], [21], [64]. Sousa-Zomer *et al.* [61] further highlighted the importance of microfoundation lens in studying how SMEs in comparison to larger organizations build processes around those DC capabilities. The authors indicate that there is a need for more research in this area to understand how building and maintaining DC can be linked to microlevel elements, and how these elements in turn affect substantive capabilities, digitalization, and DT.

C. Substantive Capabilities and Digitalization

Substantive capabilities refer to an individual's problem-solving skills, the adaptation of capabilities is the capacity to adjust the behavior in line with changes, and the change capability concerns the mode to resolve an issue. Those DCs are analyzed on a microlevel point of a view as defined by Zahra *et al.* [77] "as the abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision-maker(s)" (p. 918). The great relevance of DCs is that they enhance competitive advantage [64] and foster innovations, looking beyond the mere operational activities [64].

In this vein, we consider that the substantive capability in this case refers to the CDOs problem-solving skills. Venkatakrishnaiah and Ramanathan [71] highlighted the complexity and multidimensional role of a CDO and the role's tendency to often employ problem-solving to fill evolutionary technological or procedural organizational voids during the process of digitization or digitalization of an SME. Pool [46] indicated that CDO's role and goal achievement of their innovations is often being driven by experimentation. Usually, one of their main tasks include the development of stakeholder value through the generation of new streams from leveraging data and novel technology. These tasks indicate that problem solving is the core substantive capabilities.

Therefore, we deem that

Hp1—CDOs' substantive capabilities drive digitalization within SMEs.

We affirm that CDOs adaptive capabilities consist of the individuals' willingness to change, ability to adapt change and the individual tendency to avoid extended times of inactivity and stagnation. As this is the ability to reshape companies' resources and operational routines in the way intended by decision-makers [77]. Those decision-makers are prone to undertake changes and be adaptive [45]. In this sense, CDOs are considered agents of change and the existence of the role in a company alone represents the willingness of the organization to progressively engage with continuous change that follows DT [14]. Overall, CDOs are able to manage digital technologies to create business values. They focus on grasping new opportunities, evaluating the variety of data. Yet, CDOs build DCs by observing the market of emerging digital technologies. However, they do not know the

results of their actions and so to accomplish digitalization they need to be familiar with iterative experimentations and cope with indeterminacy [63]. This is confirmed by many authors [33], [57], [62], that point to resilience, change leadership, and change management skills as some of the core adaptation capabilities.

Consequently, we consider that

Hp2—CDOs' adaptation capabilities steer digitalization within SMEs.

To enable digitalization, the need for a new centralized responsibility role for DT led to the development of the CDO. According to [19], a centralization of responsibility is essential to avoid lags of activity during the process of DT and facilitate and accelerate progress and direction during times of change. This is a change from caterpillar to butterfly that is ongoing and cyclical, while the acceleration rate of digital and technological change will only increase over time and this highlights that buying just technology (digitization) or converting analog process into digital (digitalization) without having a central human resource to manage this perpetual metamorphosis will inevitably steer away the company from DT. Del Giudice *et al.* [13] highlighted that managers and leaders have to support and develop new capabilities and knowledge over time. According to [34], practitioners themselves are not aware of the target state, although they must decide the goals on the DT journey, so it is imperative that someone cast an eagle eye perspective over the DT operation within an SME for the DT process to progress and push further with change.

With this background, we retain that

Hp3—CDOs' change capabilities push digitalization within SMEs.

Therefore, we suggest that CDOs change capabilities have a direct effect on the pace of change and digitalization of SMEs. According to Woodman *et al.* [78], organizational creativity is the creation of value that can be useful or the development of innovation in products and services, ideas, and procedures that originate from individuals who work together in a complex social context. de Vasconcellos *et al.* [15] added that organizational creativity is an outcome of social interaction between employees' creativity that makes up the organization. Moreover, AlNuaimi *et al.* [3] noted that leadership roles are core in influencing and directing change in an organization, and usually that leadership focus is around transformational leadership. They showed that transformational or transactional leadership styles influence innovation capability. Ogbeibu *et al.* [41] talked about the need of firm direction and leadership as well as interdependence between a team in an organization and the necessity to be efficiently supported by the appropriate digital capabilities needed to push changes in the organization. Becker *et al.* [79] asserted that the CDO position has been developed to face the aforementioned challenges that occur during a business model undergoing DT. Their study shows that in SMEs CDOs can be assigned to categories of digitization and strategic management that may involve (leaving the main task of the overall DT aside) developing new business areas, producing new digital solutions, and working in evolving new business models [32].

The CDO also engages with strategic management planning and implementation while at the same time may engage in HR to appraise and emit the notion of cultural change to the organization. Managing stakeholders and partners may be also part of the tasks involved. The authors of this study conclude that CDOs are critical in mediating and triggering change to the organization in SMEs as they are involved in every aspect of it.

In turn, we state that

Hp4—By the mediating effect of digitalization CDOs' capabilities trigger organizational creativity.

III. METHODOLOGY

A. Research Scenario and Data Sample

By applying the lens of the microfoundation theory, this study explores how the DCs of CDOs trigger organizational creativity within European SMEs. The managerial literature has observed that individual DCs can benefit firms to achieve competitive goals, especially in the new business digital era [15], [57]. Indeed, the choice of considering the technology as a fundamental driver for the firms' development and advantage is relevant in the age of digitization [49], [67].

This article focuses on the European scenario to assess the impact of DT on individual perspectives of DCs and suggests new ways to trigger creativity within SMEs to be more competitive.

In Europe, SMEs operate heterogeneously for various reasons, mainly depending on the European countries in which they set off [16].

- 1) Some European countries make fewer investments in digital technologies (e.g., Bulgaria, Greece, and Romania) than other countries (e.g., Finland, Sweden, and Denmark), which mainly linked to the widespread diffusion of medium and small digital enterprises
- 2) Some countries (e.g., Italy and Greece) are characterized by low digital skills in their human capital, whereas others (e.g., Germany) invest a lot of capital in digital training
- 3) Some (e.g., Poland, Hungary, and Bulgaria) have low attractiveness for the most qualified human capital, whereas others (e.g., Ireland, Belgium, and Denmark) can attract the most qualified digitized human resources.

For this reason, the choice of considering CDOs in Europe's SMEs is consistent with the aim of the research to investigate the role of individual DCs to develop digitalization and organizational creativity in several context analyses. Indeed, the research is based on a sample of 2124 CDOs operating in SMEs of 39 different European countries (see Table I). The sample was collected from Eurostat and it refers to the years 2019 and 2020.

B. Measures

This article uses a quantitative approach, collecting data from SMEs via a structured survey by Eurostat to identify the dimensions that trigger the digitalization and organizational creativity in Europeans' SMEs. The measure used is a seven-point Likert scale ranging from "strongly disagree" to "totally agree."

The empirical section is explored by the theoretical lens of DCs, which is explicated in the form of substantive, adaptation,

TABLE I
NUMBER OF CDOs¹ IN EUROPEAN SMES

Countries	CDOs in SMEs	Countries	CDOs in SMEs
Belgium	61	Poland	44
Bulgaria	29	Portugal	52
Czechia	62	Romania	31
Denmark	70	Slovenia	55
Germany	70	Slovakia	54
Estonia	62	Finland	76
Ireland	53	Sweden	72
Greece	51	Iceland	85
Spain	57	Liechtenstein	54
France	57	Norway	83
Croatia	53	Switzerland	77
Italy	42	United Kingdom	74
Cyprus	45	Montenegro	54
Latvia	43	North Macedonia	32
Lithuania	56	Albania	21
Luxembourg	65	Serbia	46
Hungary	49	Turkey	36
Malta	56	Bosnia and Herzegovina	24
Netherlands	79	Kosovo	28
Austria	66	TOTAL CDOs	2,124

and change capability [28]. As stated above, the substantive capability explicates the dynamic ability of individuals to find a solution, the adaptation capability is the capacity to adjust the behavior in line with changes, and the change capability concerns the mode to resolve an issue. In this analysis, we have also included the level of digitalization in European SMEs. Indeed, the DT refers to a process in which digital technologies cause disruptions that force organizations to respond strategically [72]. We employed “digitalization” as a mediating variable able to condition the effect of CDOs’ individual DCs on organizational creativity [15], [19], [34]. Finally, in our model our dependent variable is the organizational creativity dimension that, according to [59], triggers firms to increase innovative digital solutions. Each investigated variable is shown in Table II.

Those individual DCs are analyzed on a microlevel point of view as defined by Zahra *et al.* [77] “as the abilities to reconfigure a firm’s resources and routines in the manner envisioned and deemed appropriate by its principal decision-maker(s)” (p. 918). The great relevance of DCs is that they enhance competitive advantage [64] and foster innovations, looking beyond the mere operational activities [64], [65].

C. Research Model

To the best of our knowledge, this is the first attempt at empirical research that investigates the role of CDO’s individual

TABLE II
SCALES DIMENSIONS AND ITEMS

Construction	Dimensions	Variable	Items	Supporting sources
Individual Dynamic Capabilities	CDOs’ substantive capabilities	SC1	Being a problem solver Get a solution	[28]
		SC2		
		CDOs’ adaptation capabilities	AC1 AC2 AC3	
Digital Transformation	Digitalization	CC1 CC2	Using new digital technologies Digital skills Virtualize individual work	[74], [38], [72]
		CDOs’ change capabilities		
		D1 D2 D3		
Creativity	Organizational creativity	OC1 OC2 OC3	Doing things better Peer group project Supportive supervision	[59]

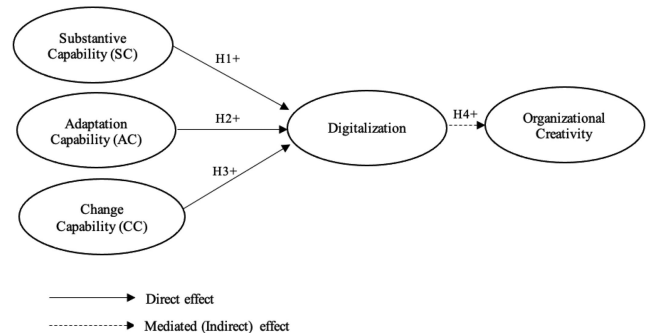


Fig. 1. Research model.

DCs on the SMEs digitalization level and, at the same time, analyzes how digitalization mediates the SMEs organizational creativity in Europa. According to the developed hypotheses, Fig. 1 shows our conceptual framework. To evaluate the model, we used an OLS regression analysis using the statistical package IBM SPSS 25.0. Moreover, we adopted mediation analysis for testing H4. In this case, we used SPSS 25.0 and PROCESS 3.5 Model 4. This investigation permits the test of an indirect path in the model by bootstrapped distributions [25].

D. Data Analysis

To test our model, we define two main regression equations.

Direct Effect (H1, H2, H3): $\text{Digitalization} = \beta_0 + \beta_1 \text{Substantive Capability (SC)} + \beta_2 \text{Adaptation Capability (AC)} + \beta_3 \text{Change Capability (CC)} + \varepsilon$.

TABLE III
CORRELATIONS, MEANS, AND STANDARD DEVIATIONS

Measures	N	Mean	Standard Deviation	Correlation Matrix				
				(1)	(2)	(3)	(4)	(5)
(1) Substantive Capability (SC)	39	4.17	0.412	1				
(2) Adaptation Capability (AC)	39	3.07	0.641	0.384*	1			
(3) Change Capability (CC)	39	2.93	0.258	0.191	0.380*	1		
(4) Digitalization	39	5.70	0.237	.423**	0.543**	0.197	1	
(5) Organizational Creativity	39	3.76	0.733	.275	0.469**	-0.013	0.549**	1

**Significant at 0.01 Source: Authors' development.

*Significant at 0.05

TABLE IV
DIRECT EFFECTS ANALYSIS

Hypothesized direct path	Standardized beta coefficient (β)	<i>t</i> -value	Statistical significance	Variance Inflation Factor (VIF)
H1 Substantive Capability (SC) → Digitalization	1.985	1.711	0.096*	1.177
H2 Adaptation Capability (AC) → Digitalization	2.293	2.896	0.006**	1.325
H3 Change Capability (CC) → Digitalization	-0.297	-0.240	0.873	1.172

***p*-value < 0.05 Source: Authors' development.

**p*-value < 0.1

Indirect Effect (H4): Organizational Creativity = $\beta_0 + \beta_1$ Substantive Capability (SC) + β_2 Adaptation Capability (AC) + β_3 Change Capability (CC) + β_4 Digitalization + ϵ .

The first equation involves the direct effect between the CDOs' individual DCs composed by substantive, adaptation, and change capabilities. Here, we assume a positive effect for each DC to digitalization. The second equation supposes that digitalization mediates the relationship between individual DCs and organizational creativity. Even in this case, we assume a positive role of digitalization in the mediation analysis.

IV. RESULTS

Table III presents the first descriptive results between the dimensions. Specifically, the table provides findings of the correlation coefficients, means, and standard deviation of variables.

The results showed that organizational creativity, as a dependent variable, is significantly correlated with some of the antecedent variables (especially with digitalization). While several associations appeared to be significant, we follow the suggestions from academics to use a formal analysis to prevent multicollinearity in the model [12]. Indeed, we launch a detection-tolerance analysis to evaluate the variance inflation factor (VIF) among the variables. Since all the VIFs obtained in our analysis are less than 5, our model can be considered as having no multicollinearity issue [24]. Details of the multicollinearity analysis can be seen in Table IV. Moreover, Table IV also provides findings of regression analysis for direct effects (H1, H2, and H3).

To test the hypotheses about the direct effect (H1, H2, and H3) we launch a regression analysis with all the independent variables of CDOs' individual DCs and, as a dependent variable, the digitalization. For H1, we found a significant and positive relation between substantive capability and digitalization

TABLE V
MEDIATION ANALYSIS

Hypothesized indirect path	Individual DCs (X)	Direct effect (X→Y)	Direct effect (X→M)	Mediation Effect (X→M→Y)					
				Effect	<i>t</i> -value	Statistical significance	LLCI	ULCI	
H4	X: Individual DCs	Substantive Capability (SC)	0.219 (0.436)	1.985 (0.096*)	0.396	1.736	0.098*	0.0797	0.7074
	Y: Organizational Creativity	Adaptation Capability (AC)	0.581 (0.004**)	2.293 (0.006**)	0.535	3.227	0.002**	0.1993	0.8719
	M: Digitalization	Change Capability (CC)	-0.654 (0.149)	-0.297 (0.873)	-0.359	-0.009	0.936	-1.169	0.4501

Note: *p*-values for direct effect are in the brackets

LLCI= Lower-level confident interval

ULCI= Upper-level confident interval

****p*-value < 0.001

***p*-value < 0.05

**p*-value < 0.1

($B = 1.985$, t -value = 1.711; $p = 0.096^*$). By observing the results, our study supports H1. This finding is consistent with those presented in [46] and [71].

A significantly positive relationship is also found for adaptation capability and digitalization (H2) ($B = 2.293$, t -value = 2.896; $p = 0.006^{**}$). Once more, finding support H2, in line with managerial and business literature [33], [57], [62], [63]. Instead, the relation between change capability and digitalization in European SMEs results is not significant ($B = -0.297$, t -value = -0.240 ; $p = 0.873$).

Thus, H1 and H2 are supported, whereas H3 is not significant.

Regarding the indirect effect of digitalization on organizational creativity, Table V presents the results of the mediation analysis.

For the mediation hypothesis (H4), we have followed the suggestions presented in [25], having this method's several advantages with respect to the traditional method provided by Baron and Kenny [6]. Indeed, the Hayes method allows the use of bootstrap procedures in the analysis and thus permits the model to be more effective in assessing indirect effects.

As demonstrated in Table V, to conduct a mediation analysis, we have followed four main steps. First, we have proved that the causal variable is related to the outcome. In this case, we assume our Y (organizational creativity) as the dependent variable in the regression equation and our X (individual DC) as the predictor variable. This step highlights that there is just a significant and positive relationship between adaptation capability and organizational creativity ($B = 0.581$; $p = 0.004^{**}$). Substantive and change capabilities have no significant direct effect on organizational creativity. Second, we need to prove that the causal variable is related to the mediator. Hence, we launch a regression analysis with X (individual DC) as our independent variable and M as our outcome variable. The findings here prove a positive and significant relation between substantive and adaptation capability with digitalization ($B = 1.985$, $p = 0.096^*$; $B = 2.293$, $p = 0.006^{**}$). Third, we have demonstrated that digitalization, i.e., the mediator variable (M), influences the organizational capability, i.e., the dependent variable (Y). Indeed, we have found a significant and positive relationship between

TABLE VI
SUMMARY OF RESULTS

Hypotheses	Effect	Assumption	Findings
H1	Direct	Positive relationship between substantive capability and digitalization	Supported
H2	Direct	Positive relationship between adaptation capability and digitalization	Supported
H3	Direct	Positive relationship between change capability and digitalization	Not Supported
H4	Indirect	The mediating effect of digitalization CDOs' capabilities trigger organizational creativity	Supported for substantive and adaptation capability, not supported for change capability

the variables ($B = 0.124$, t -value = 3.997; $p = 0.000^{***}$). Finally, we have estimated the complete indirect path of mediation, assuming that by the mediation effect of digitalization, CDOs' capabilities trigger organizational creativity. Specifically, we have found a positive mediation effect on two variables, i.e., substantive and adaptation capabilities. This demonstrate that the digitalization significantly positive mediates the effect of CDOs' individual DCs (substantive and adaptation capabilities) on organizational creativity (Effect = 0.396, t -value = 1.736, $p = 0.098^*$; Effect = 0.535, t -value = 3.227; $p = 0.002^{**}$). Furthermore, as shown in Table V, we measure the strength of the indirect (mediation) effect by bootstrap procedures (5000 samples). This bootstrapped 95% confidence interval supports that the indirect effects of digitalization in the relationship between substantive and adaptation capabilities with organizational creativity were significant because the range does not contain zero (LLCI = 0.0797, ULCI = 0.7074; LLCI = 0.1993, ULCI = 0.8719). Instead, the bootstrap confidence interval calculated for the mediation effect of change capability and organizational creativity is not significant (LLCI = -1.169, ULCI = 0.4501). These results lead us to support H4, having assumed the mediation role of digitalization on the impact of CDOs' capabilities (substantive and adaptation capabilities) toward organizational creativity.

Table VI shows a summary of the tested hypotheses.

V. DISCUSSION

As emerged, the empirical analysis shows a positive relationship between substantive and adaptive capabilities and digitalization; however, change capabilities appear not to have a significant effect on digitalization. Yet, the mediating effect of CDOs' capabilities triggers organizational creativity appears to be positive with digitalization. It emphasizes the key role of substantive and adaptive capabilities in developing organizational

creativity. The lens of microfoundation is useful to evaluate both individual and organizational perspectives and offers a wider overview of the DT phenomenon. Indeed, by applying the microfoundation lens, the CDO assumes the specific role to support a firm, organization, or public institution to face DT, using new technologies and managing Big Data to achieve faster business improvement and growth objectives. Due to the peculiar DC, CDO perceives digital as the new challenge to bring the firm to a higher level of efficiency, speed of response to market needs, and experience of the users who interact with it.

By looking back to previous studies, the results extend the literature on DT and DCs as well. Whereas those studies have primarily evaluated the organizational and strategic role of DCs in general [8], [17], [55], [64] and more recently in the DT era [73] but nothing seems to illustrate or explore the impact of DT on individual creativity.

The results shed light on the individual DCs in the DT era. Their focus is on "domain-specific" DT capabilities along with functional activity as creativity. Previously, scholars have discussed the DT impacts on value chain and business models [9], [20], whereas we estimate its effect on organizational creativity; especially, this article reveals individual and organizational facets of SMEs to managing digitalization and more in general DT.

In addition, the article can trigger a new research stream and fills the current gap in the literature about the responsible innovation in the digital era. As a matter of fact, previous scholars [43], [56] have argued that responsible innovation must be analyzed on the social and ethical dimensions of and DT throughout the decision-making process, in the selection of data itself and construction of technological and digital infrastructures.

Furthermore, this article provides other threefold contributions. First, digitalization requests substantive and adaptive capabilities, which mean being able to respond rapidly to the market and being flexible. Differently than those in [17] and [66], the individual action is remarked to obtain new solutions and avoid inactivity and stagnation.

We support the theoretically individual point of view [77] and, so, we underpin the consideration that those DCs reshape routines and resources by going beyond operational routines ([80], [65], [81]). In fact, digitalization goes beyond the mere routines and so the employment of substantive capabilities facilitates such digital processes (as demonstrated by the significant value of the *Hp1—CDOs' substantive capabilities drive digitalization within SMEs*). According to [71], CDOs act to solve problems and cope with a complex and multidimensional position. They observe the market data to understand how to employ emerging digital technologies to get business value [63]. They also need to be comfortable with iterative experimentations and multidimensional approaches [46]. In the same line, adaptive capabilities involve an individual attitude to being flexible and cope with changes. CDOs, so, reconfigure routines and resources. They are crucial agents of changes or decision-makers who circumvent organizational inactivity and stagnation but enhance the level of companies' engagement with progressive changes [14]. This is enforced by the positive significance of the *Hp2—CDOs'*

adaptive capabilities steer digitalization within SMEs that supports other studies on CDOs' role that relies on resilience, change leadership, and change management skills [33], [57], [62].

Second, the relevant role of CDOs within SMEs is remarked upon in previous studies. In turn, the analysis extends previous studies focused on CDOs' capabilities in large companies [37], [75] and qualitative and case- base analysis [57], [58], [62]. As already stated by [77] decision-makers assume a crucial role in the DC process. In fact, CDOs have a key role in the current DT era.

Third, the microfoundation view offers an individual and an organizational point of view by demonstrating the positive significance of *Hp4—By the mediating effect of digitalization CDOs' capabilities trigger organizational creativity*. Organizational creativity represents the “right-brained intuitive” and innovative side of a company [59] by the high embracement of substantive and adaptive capabilities. We support that value creation stems from the innovative part of an organizational setting where interactions between employees' creativity and decision-makers [15]. Surprisingly, even SMEs are moving toward creativity to be more innovative and competitive. They assume CDOs to deal with the DT challenges ([79]) generating new digital solutions, developing new business areas, and evolving existing business models. Furthermore, according to [41], DTs are changing the dynamics of business competitiveness, leading to a rethinking of the levels of responsible innovation driven by the creativity of employees and the organization as a whole. So, in line with the latter literature, this article supports the relevant role of CDOs' capabilities on organizational creativity, especially when organizational creativity promotes responsible innovation processes.

A. Theoretical Implications

Contributions of this article are in line with prior, innovative, and interdisciplinary studies between the field of digitization [11], [35], [49], [69], the issue of the absorptive capacity of disruptive technologies [67], [53], the microfoundation theory [13], [54], and the business model innovation [1], [58]. By combining the theoretical framework with a quantitative research protocol about DCs on digitalization and consequently on organizational creativity, this article follows the implications of scientific research theories on disruptive topics, such as CDOs abilities, digital technologies, and organizational creativity. Our findings highlight theoretical implications in the field of organization management [7], [11], [29] by leveraging the theoretical lens of microfoundations, which is highly innovative and fitting with such a stream of research [54]. Specific findings emphasize the role of individual DCs' as a crucial foundation of processes related to the digital development of European SMEs, as well as in the mediating role between digitalization CDOs' capabilities and organizational creativity.

This new theoretical framework we propose overcomes the limitations of previous research that considered only the processes of digitalization, DCs, and the figure of CDOs in large enterprises [37], [75]. In fact, this article theoretically

investigates the role of individual DCs of CDOs within SMEs digitalization level and, at the same time, analyzes how digitalization mediates the SMEs organizational creativity in Europe. Yet, the results of the analysis validate this new theoretical and practical approach in the European context. Indeed, findings emphasize the key role of substantive and adaptive capabilities in developing digitalization approach within European SMEs. Moreover, this article highlights theoretical implications about the mediating effect of digitalization CDOs' capabilities on organizational creativity. This implies that, through the theoretical lens of microfoundations, theories of SMEs management must also include the individual role which specific actors play in the firms' digitalization processes [13], [53]. Furthermore, through the theory of DCs, this article reinforces the theoretical implications on processes of getting new solutions to trigger organizational creativity within SMEs. Even in this case, this article supports previous studies on organizational creativity [59], and, at the same time, exceeds the theoretical limits by providing a new theoretical framework to offer new solutions, seize new opportunities, and cope with changes in the DT era.

B. Managerial Implications

The need of employing CDOs is becoming a key priority for business in general. In this scenario, SMEs are proactively engaging with this new role to enhance their business performance. With this background, the current research offers new insights to practitioners, managers, and entrepreneurs to assess CDO's abilities. They are entailed to observe the diverse range of CDOs' facets and understand the opportunities to be grasped.

While organizational factors are continually evaluated, the demand for those abilities becomes a new aspect to evaluate. Such demand is relevant to undertake DT processes and so develop new digital strategies. Alongside, CDOs can be the driver for innovation and more specifically for ecoinnovations that are becoming increasingly essential to all businesses [42], [44] and CDOs tend to cope not just with functional activities but even with general duties. They are experts in digital amenities that allow digitalization throughout the whole business journey. Hence, the matter is not having or not a CDO within the company but how to exploit his/her DCs to get a competitive advantage. Offering new solutions and seizing business opportunities are their key role along with the adaptability to changes by using the appropriate digital technologies. Given the advances in digital technologies, the key decision-makers of SMEs are demanded to:

- 1) avoid inactivity and stagnation;
- 2) promote creativity;
- 3) being more innovative;
- 4) anticipate new trends using digital technologies;
- 5) dedicate operational routines to technologies; and
- 6) exploiting DCs to build the most effective team to deal with the DT process.

In this vein, CDOs are considered the agents of the change [14] adopting iterative experimentations and offering new insights by data management.

VI. FINAL REMARKS

A. Research Limits and New Suggestions

This article brings out several future research avenues. Indeed, in line with our insights, academic research can value the original theme of responsible innovation. According to Silva *et al.* [56], responsible innovation is a concept that incorporates ethical and social concerns into the innovation process from the stage of inception. It is defined as the process of democratization of innovation [4], [39], [43] by involving stakeholders and the public early in the innovation process. Moreover, following [31], the cross-functional nature of CDOs and their frequent contacts with various stakeholders place them in an advantageous position for organizational change management in the context of DT. This suggests that, in addition to acting as agents of change, CDOs may promote the democratization of innovation and transformation as viewed from the lens of responsible innovation. Although viewing CDOs through the lens of responsible innovation is an intriguing research perspective, in this article, we use a microfoundational lense to investigate how specific skills and DCs of CDOs trigger digitalization and organizational creativity [53].

Although we offered new theoretical and managerial insights, there still is the need to enlarge our study with further research that can overcome its limits. Those limits can be grouped in four categories: company size, quantitative analysis, territory constraints, and CDOs' role.

For instance, only SMEs are examined even though the sample is large, the role of individual DCs can be explored in other company structures and dimensions. It can be interesting to explore if the new digital-born companies automatically employ CDOs to introduce their business idea in the market. Yet, the empirical analysis is quantitative and so it can be enlarged by a qualitative study to deeply understand the CDO role. We contemplate another limit that concerns territory constraints because the research examines only European SMEs. Therefore, new exploration can take into consideration emerging and other developed countries to extend the present research and provide differences and similarities country by country. In doing so, the microfoundation lens is expanded by the macro perspective. Finally, since CDOs are also equated with chief information officer or chief innovation officer, it would be interesting to map out differences and similarities among all those roles and understand if some of them are more important than others.

B. Conclusion

DT is not just about the use of certain technologies, but first and foremost involves a real cultural change within the firm, starting with the people who make it up and work for it. The greatest responsibility of a CDO remains to guide the organization through the transformation and accompany it in the adoption of the right tools and the best processes to increase efficiency and optimize business strategies. Thus, the digital era has stimulated new business models design [1], and has included in the processes the concepts of responsible innovation [56],

disruptive capabilities [53], and organizational creativity [41]. In this case, applying the lens of microfoundations, the DCs of a CDO have a strategic impact both in the microlevel, i.e., the levels of digitalization of employees, and in the meso level, i.e., with respect to the whole organization.

As stated, the research provides threefold theoretical contributions and new recommendations for managers. To summarize, the DT literature is expanded by offering a microfoundation overview of CDOs' DCs within SMEs. The key role of substantive and adaptive capabilities is also remarked by the positive effects on digitalization and consequently on organizational creativity. This is demonstrated by a quantitative analysis of a large sample composed of 2124 CDOs operating in SMEs of 39 different European countries. In turn, the study shed light on individual capabilities to cope with DT challenges and so it emphasizes the need of investing more and more on such capabilities to be more creative.

The purpose of this study was to present an innovative and integrated framework based on the interdependencies between the individual DCs of CDOs within European SMEs, the level of digitalization in the organizations, and the mediating effect of digitalization CDOs' capabilities on organizational creativity. This article contributed to develop, both theoretically and practically, a new framework for digitalized SMEs in the European context. In addition, the contribution of this article can also be seen in the identification of the interdependencies at the microlevel of CDOs' decision making and the DT of SMEs. Thus, by adopting the lens of microfoundation theory, this article opens up further lines of research on the theme of digitization, on the role of new figures in the firms (i.e., CDOs), on the relationship between the individual behavior and the enabling technologies, and, last but not least, on innovative organizational creativity design for digitized enterprises.

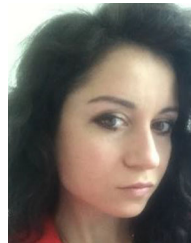
We conclude that a strengthening of the DT paradigm is needed, where individual DCs become an integral part of entrepreneurial digitization processes and organizational creativity of firms, especially for European SMEs.

REFERENCES

- [1] B. Abdulkader, D. Magni, V. Cillo, A. Papa, and R. Micera, "Aligning firm's value system and open innovation: A new framework of business process management beyond the business model innovation," *Bus. Process Manage. J.*, vol. 26, no. 5, pp. 999–1020, Sep. 2020, doi: [10.1108/BPMJ-05-2020-0231](https://doi.org/10.1108/BPMJ-05-2020-0231).
- [2] E. Alm *et al.*, "Digitizing The Netherlands: How The Netherlands can drive and benefit from an accelerated digitized economy in Europe," Boston Consulting Group, Boston, MA, USA, Jun. 2016. [Online]. Available: https://image-src.bcg.com/Images/BCG%20Digitizing%20the%20Netherlands%20June%202016_tcm9-41490.pdf
- [3] B. K. AlNuaimi, S. K. Singh, and B. Harney, "Unpacking the role of innovation capability: Exploring the impact of leadership style on green procurement via a natural resource-based perspective," *J. Bus. Res.*, vol. 134, pp. 78–88, Sep. 2021, doi: [10.1016/j.jbusres.2021.05.026](https://doi.org/10.1016/j.jbusres.2021.05.026).
- [4] M. Armstrong *et al.*, "Towards a practical approach to responsible innovation in finance: New product committees revisited," *J. Financial Regulation Compliance*, vol. 20, no. 2, pp. 147–168, May 2012, doi: [10.1108/13581981211218289](https://doi.org/10.1108/13581981211218289).
- [5] E. Autio, "Digitalisation, ecosystems, entrepreneurship and policy," in *Perspectives Into Topical Issues Is Society and Ways to Support Political Decision Making, Government's Analysis, Research, and Assessment Activities, Policy Brief 20/2017*. London, U.K.: Imperial College Business School, 2017.

- [6] R. M. Baron and D. A. Kenny, "The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations," *J. Pers. Soc. Psychol.*, vol. 51, no. 6, pp. 1173–1182, Dec. 1986.
- [7] B. Bertoldi, C. Giachino, C. Rossotto, and N. Bitbol-Saba, "The role of a knowledge leader in a changing organizational environment. A conceptual framework drawn by an analysis of four large companies," *J. Knowl. Manage.*, vol. 22, no. 3, pp. 587–602, Apr. 2018, doi: [10.1108/JKM-09-2017-0422](https://doi.org/10.1108/JKM-09-2017-0422).
- [8] A. Bharadwaj, O. A. E. Sawy, P. A. Pavlou, and N. Venkatraman, "Digital business strategy: Toward a next generation of insights," *MIS Quart.*, vol. 37, no. 2, pp. 471–482, Jun. 2013, doi: [10.25300/MISQ/2013/37.2.3](https://doi.org/10.25300/MISQ/2013/37.2.3).
- [9] J. Birkinshaw, "How is technological change affecting the nature of the corporation?," *J. Brit. Acad.*, vol. 6, no. 1, pp. 185–214, Sep. 2018, doi: [10.5871/jba/006s1.185](https://doi.org/10.5871/jba/006s1.185).
- [10] A. Correani, A. De Massis, F. Frattini, A. M. Petruzzelli, and A. Natalicchio, "Implementing a digital strategy: Learning from the experience of three digital transformation projects," *California Manage. Rev.*, vol. 62, no. 4, pp. 37–56, Jul. 2020, doi: [10.1177/0008125620934864](https://doi.org/10.1177/0008125620934864).
- [11] A. Crupi *et al.*, "The digital transformation of SMEs—A new knowledge broker called the digital innovation hub," *J. Knowl. Manage.*, vol. 24, no. 6, pp. 1263–1288, Jul. 2020, doi: [10.1108/JKM-11-2019-0623](https://doi.org/10.1108/JKM-11-2019-0623).
- [12] J. I. Daoud, "Multicollinearity and regression analysis," *J. Phys.: Conf. Ser.*, vol. 949, no. 1–6, Dec. 2017, doi: [10.1088/1742-6596/949/1/012009](https://doi.org/10.1088/1742-6596/949/1/012009).
- [13] M. Del Giudice, Z. Khan, M. De Silva, V. Scuotto, F. Caputo, and E. Carayannis, "The microlevel actions undertaken by owner-managers in improving the sustainability practices of cultural and creative small and medium enterprises: A United Kingdom–Italy comparison," *J. Org. Behav.*, vol. 38, no. 9, pp. 1396–1414, Oct. 2017, doi: [10.1002/job.2237](https://doi.org/10.1002/job.2237).
- [14] D. Dumeresque, "The chief digital officer: Bringing a dynamic approach to digital business," *Strategic Direction*, vol. 13, no. 1, pp. 1–3, Jan. 2014, doi: [10.1108/SD-12-2013-0104](https://doi.org/10.1108/SD-12-2013-0104).
- [15] S. L. de Vasconcellos, J. C. da Silva Freitas, and F. M. Junges, "Digital capabilities: Bridging the gap between creativity and performance," in *The Palgrave Handbook of Corporate Sustainability in the Digital Era*, S. H. Park, M. A. Gonzalez-Perez, and D. E. Floriani, Eds. Cham, Switzerland: Palgrave Macmillan, 2021, ch. 21, pp. 411–427.
- [16] European Commission, "The Digital Economy and Society Index (DESI)," European Commission, Brussels, Belgium, 2020. [Online]. Available: <https://digital-strategy.ec.europa.eu/en/policies/desi>
- [17] K. M. Eisenhardt and J. A. Martin, "Dynamic capabilities: What are they?," *Strategic Manage. J.*, vol. 21, no. 10/11, pp. 1105–1121, Oct. 2000, doi: [10.1002/1097-0266\(200010/11\)21:10/11<1105::AID-SMJ133>3.0.CO;2-E](https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E).
- [18] T. Felin, N. J. Foss, K. H. Heimeriks, and T. L. Madsen, "Microfoundations of routines and capabilities: Individuals, processes, and structure," *J. Manage. Stud.*, vol. 49, no. 8, pp. 1351–1374, Mar. 2012, doi: [10.1111/j.1467-6486.2012.01052.x](https://doi.org/10.1111/j.1467-6486.2012.01052.x).
- [19] S. Firk, A. Hanelt, J. Oehmichen, and M. Wolff, "Chief digital officers: An analysis of the presence of a centralized digital transformation role," *J. Manage. Stud.*, vol. 58, no. 7, pp. 1800–1831, Nov. 2021, doi: [10.1111/joms.12718](https://doi.org/10.1111/joms.12718).
- [20] M. Fitzgerald, N. Kruschwitz, D. Bonnet, and M. Welch, "Embracing digital technology: A new strategic imperative," *MIT Sloan Manage. Rev.*, vol. 55, no. 2, pp. 1–12, Dec. 2013.
- [21] G. Gavetti, "Cognition and hierarchy: Rethinking the microfoundations of capabilities' development," *Org. Sci.*, vol. 16, no. 6, pp. 599–617, Dec. 2005, doi: [10.1287/orsc.1050.0140](https://doi.org/10.1287/orsc.1050.0140).
- [22] J. Greenwood, *The Third Industrial Revolution: Technology, Productivity, and Income Inequality*. Washington, DC, USA: Amer. Enterprise Inst., 1997.
- [23] I. Haffke, B. Kalgovas, and A. Benlian, "The role of the CIO and the CDO in an organization's digital transformation," in *Proc. 37th Int. Conf. Inf. System*, 2016, pp. 1–20.
- [24] J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate Data Analysis*, 7 ed. Upper Saddle River, NJ, USA: Prentice-Hall, 2010.
- [25] A. F. Hayes, *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. New York, NY, USA: Guilford Press, 2018.
- [26] R. M. Henderson and K. B. Clark, "Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms," *Administ. Sci. Quart.*, vol. 35, no. 1, pp. 9–30, May 1990.
- [27] T. Hess, C. Matt, A. Benlian, and F. Wiesböck, "Options for formulating a digital transformation strategy," *MIS Quart. Executive*, vol. 15, no. 2, pp. 123–139, Jun. 2016.
- [28] J. J. Hou and Y. T. Chien, "The effect of market knowledge management competence on business performance: A dynamic capabilities perspective," *Int. J. Electron. Bus. Manage.*, vol. 8, no. 2, pp. 96–109, Jun. 2010.
- [29] C. Isensee, F. Teuteberg, K. M. Griese, and C. Topi, "The relationship between organizational culture, sustainability, and digitalization in SMEs: A systematic review," *J. Cleaner Prod.*, vol. 275, Dec. 2020, Art. no. 102061, doi: [10.1016/j.jclepro.2020.122944](https://doi.org/10.1016/j.jclepro.2020.122944).
- [30] A. M. Kaplan and M. Haenlein, "Users of the world, unite! The challenges and opportunities of social media," *Bus. Horiz.*, vol. 53, no. 1, pp. 59–68, Jan. 2010, doi: [10.1016/j.bushor.2009.09.003](https://doi.org/10.1016/j.bushor.2009.09.003).
- [31] L. Kessel and L. Graf-Vlachy, "Chief digital officers: The state of the art and the road ahead," *Manage. Rev. Quart.*, to be published, doi: [10.1007/s11301-021-00227-8](https://doi.org/10.1007/s11301-021-00227-8).
- [32] C. Klos, P. Spieth, T. Clauss, and C. Klusmann, "Digital transformation of incumbent firms: A business model innovation perspective," *IEEE Trans. Eng. Manage.*, to be published, doi: [10.1109/TEM.2021.3075502](https://doi.org/10.1109/TEM.2021.3075502).
- [33] A. Kutnjak, S. Križanić, and I. Pihir, "Educational and practical view of knowledge, skills and experience needed by a chief digital officer," in *Proc. 11th Int. Conf. Educ. New Learn. Technol.*, 2019, pp. 5711–5718.
- [34] J. Kossowski, E. Heumüller, and S. Richter, "Digital fitness - Goal for the chief digital officer," in *Proc. IEEE Int. Conf. Eng., Technol. Innov.*, 2020, pp. 1–7.
- [35] P. Kilimis, W. Zou, M. Lehmann, and U. Berger, "A survey on digitalization for SMEs in Brandenburg, Germany," *IFAC-PapersOnLine*, vol. 52, no. 13, pp. 2140–2145, Aug. 2019.
- [36] B. Kump, A. Engelmann, A. Kessler, and C. Schweiger, "Toward a dynamic capabilities scale: Measuring organizational sensing, seizing, and transforming capacities," *Ind. Corp. Change*, vol. 28, no. 5, pp. 1149–1172, Oct. 2019, doi: [10.1093/icc/dty054](https://doi.org/10.1093/icc/dty054).
- [37] S. Kunisch, M. Menz, and R. Langan, "Chief digital officers: An exploratory analysis of their emergence, nature, and determinants," *Long Range Plan.*, vol. 55, no. 2, Apr. 2022, Art. no. 101999.
- [38] C. Legner *et al.*, "Digitalization: Opportunity and challenge for the business and information systems engineering community," *Bus. Inf. Syst. Eng.*, vol. 59, no. 4, pp. 301–308, Aug. 2017, doi: [10.1007/s12599-017-0484-2](https://doi.org/10.1007/s12599-017-0484-2).
- [39] P. Macnaghten *et al.*, "Responsible innovation across borders: Tensions, paradoxes and possibilities," *J. Responsible Innov.*, vol. 1, pp. 191–199, Mar. 2014, doi: [10.1080/23299460.2014.922249](https://doi.org/10.1080/23299460.2014.922249).
- [40] U. Meyer, "The emergence of an envisioned future. Sensemaking in the case of 'Industrie 4.0' in Germany," *Futures*, vol. 109, pp. 130–141, Mar. 2019, doi: [10.1016/j.futures.2019.03.001](https://doi.org/10.1016/j.futures.2019.03.001).
- [41] S. Ogebeibu *et al.*, "Responsible innovation in organisations—unpacking the effects of leader trustworthiness and organizational culture on employee creativity," *Asia Pacific J. Manage.*, to be published, doi: [10.1007/s10490-021-09784-8](https://doi.org/10.1007/s10490-021-09784-8).
- [42] B. Orlando, L. V. Ballestra, V. Scuotto, M. Pironti, and M. Del Giudice, "The impact of R&D investments on eco-innovation: A cross-cultural perspective of green technology management," *IEEE Trans. Eng. Manage.*, to be published, doi: [10.1109/TEM.2020.3005525](https://doi.org/10.1109/TEM.2020.3005525).
- [43] R. Owen, J. Stilgoe, P. Macnaghten, M. Gorman, E. Fisher, and D. H. Guston, "A framework for responsible innovation," in *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, R. Owen, J. Bessant, and M. Heintz, Eds. Chichester, U. K.: Wiley, 2013, pp. 27–50, doi: [10.1002/9781118551424.ch2](https://doi.org/10.1002/9781118551424.ch2).
- [44] A. Parmentola, A. Petrillo, I. Tutore, and F. De Felice, "Is blockchain able to enhance environmental sustainability? A systematic review and research agenda from the perspective of sustainable development goals (SDGs)," *Bus. Strategy Environ.*, vol. 31, no. 1, pp. 194–217, Jan. 2022, doi: [10.1002/bse.2882](https://doi.org/10.1002/bse.2882).
- [45] E. Penrose, *The Theory of the Growth of the Firm*. Oxford, U.K.: Oxford Univ. Press, 1959.
- [46] H. Pool, "The chief digital officer: Building dynamic capabilities for digital transformation," Doctoral dissertation, Gordon Inst. Bus. Sci., Univ. Pretoria, Pretoria, South Africa, 2020.
- [47] L. Raymond, F. Bergeron, A. M. Croteau, A. O. de Guinea, and S. Uwizeyemungu, "Information technology-enabled explorative learning and competitive performance in industrial service SMEs: A configurational analysis," *J. Knowl. Manage.*, vol. 24, no. 7, pp. 1625–1651, Sep. 2020, doi: [10.1108/JKM-12-2019-0741](https://doi.org/10.1108/JKM-12-2019-0741).
- [48] F. Reck and A. Filaster, "Four profiles of successful digital executives," *MIT Sloan Manage. Rev.*, vol. 60, no. 2, pp. 1–7, Apr. 2019.
- [49] K. Rijswijk *et al.*, "Digital transformation: Ongoing digitisation and digitalisation processes," EU Horiz., Desira, Wageningen Univ. Res., Wageningen, Netherland, 2020.

- [50] C. Rocha, C. Quandt, F. Deschamps, S. Philbin, and G. Cruzara, "Collaborations for digital transformation: Case studies of industry 4.0 in Brazil," *IEEE Trans. Eng. Manage.*, to be published, doi: [10.1109/TEM.2021.3061396](https://doi.org/10.1109/TEM.2021.3061396).
- [51] V. Sambamurthy and R. W. Zmud, "Research commentary: The organizing logic for an enterprise's IT activities in the digital era—A prognosis of practice and a call for research," *Inf. Syst. Res.*, vol. 11, no. 2, pp. 105–114, Jun. 2000, doi: [10.1287/isre.11.2.105.11780](https://doi.org/10.1287/isre.11.2.105.11780).
- [52] K. Schwab, *The Fourth Industrial Revolution*. New York, NY, USA: Crown Bus., Inc., 2017.
- [53] V. Scuotto, D. Magni, R. Palladino, and M. Nicotra, "Triggering disruptive technology absorptive capacity by CIOs. Explorative research on a micro-foundation lens," *Technol. Forecasting Social Change*, vol. 174, Jan. 2022, Art. no. 121234, doi: [10.1016/j.techfore.2021.121234](https://doi.org/10.1016/j.techfore.2021.121234).
- [54] V. Scuotto, M. Nicotra, M. Del Giudice, N. Krueger, and G. L. Gregori, "A microfoundational perspective on SMEs' growth in the digital transformation era," *J. Bus. Res.*, vol. 129, pp. 382–392, May 2021, doi: [10.1016/j.jbusres.2021.01.045](https://doi.org/10.1016/j.jbusres.2021.01.045).
- [55] L. Selander and S. L. Jarvenpaa, "Digital action repertoires and transforming a social movement organization," *MIS Quart.*, vol. 40, no. 2, pp. 331–352, Jan. 2016.
- [56] H. P. Silva, P. Lehoux, F. A. Miller, and J. L. Denis, "Introducing responsible innovation in health: A policy-oriented framework," *Health Res. Policy Syst.*, vol. 16, no. 1, pp. 1–13, Sep. 2018, doi: [10.1186/s12961-018-0362-5](https://doi.org/10.1186/s12961-018-0362-5).
- [57] A. Singh and T. Hess, "How chief digital officers promote the digital transformation of their companies," *MIS Quart. Executive*, vol. 16, no. 1, pp. 1–17, Mar. 2017.
- [58] A. Singh, P. Klarnar, and T. Hess, "How do chief digital officers pursue digital transformation activities? The role of organization design parameters," *Long Range Plan.*, vol. 53, Jun. 2020, Art no 101890.
- [59] E. Smailhodžić and D. Berberović, "Digital creativity: Upgrading creativity in digital business," in *Digital Entrepreneurship*, M. Soltanifar, M. Hughes, and L. Göcke, Eds. Cham, Switzerland: Springer, 2021, pp. 165–182.
- [60] L. Sommer, "Industrial revolution - industry 4.0: Are German manufacturing SMEs the first victims of this revolution?," *J. Ind. Eng. Manage.*, vol. 8, no. 5, pp. 1512–1532, Sep. 2015, doi: [10.3926/jiem.1470](https://doi.org/10.3926/jiem.1470).
- [61] T. T. Sousa-Zomer, A. Neely, and V. Martinez, "Digital transforming capability and performance: A microfoundational perspective," *Int. J. Oper. Prod. Manage.*, vol. 40, no. 7/8, pp. 1095–1128, Nov. 2020, doi: [10.1108/IJOPM-06-2019-0444](https://doi.org/10.1108/IJOPM-06-2019-0444).
- [62] V. S. Tumbas, N. Berente, and J. V. Brocke, "Digital innovation and institutional entrepreneurship: Chief digital officer perspectives of their emerging role," *J. Inf. Technol.*, vol. 33, no. 3, pp. 188–202, Sep. 2018, doi: [10.1057/s41265-018-0055-0](https://doi.org/10.1057/s41265-018-0055-0).
- [63] S. Tumbas, N. Berente, and J. vom Brocke, "Three types of chief digital officers and the reasons organizations adopt the role," *MIS Quart. Executive*, vol. 16, no. 2, pp. 121–134, Jun. 2017.
- [64] D. J. Teece, "Explicating dynamic capabilities: The nature and micro-foundations of (sustainable) enterprise performance," *Strategic Manage. J.*, vol. 28, pp. 1319–1350, Aug. 2007, doi: [10.1002/smj.640](https://doi.org/10.1002/smj.640).
- [65] D. J. Teece, "Dynamic capabilities: Routines versus entrepreneurial action," *J. Manage. Stud.*, vol. 49, no. 8, pp. 1395–1401, Aug. 2012, doi: [10.1111/j.1467-6486.2012.01080.x](https://doi.org/10.1111/j.1467-6486.2012.01080.x).
- [66] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Manage. J.*, vol. 18, no. 7, pp. 509–533, Dec. 1997.
- [67] Z. Tekic and D. Koroteev, "From disruptively digital to proudly analog: A holistic typology of digital transformation strategies," *Bus. Horiz.*, vol. 62, no. 6, pp. 683–693, Nov./Dec. 2019, doi: [10.1016/j.bushor.2019.07.002](https://doi.org/10.1016/j.bushor.2019.07.002).
- [68] D. Tilson, K. Lyytinen, and C. Sørensen, "Research commentary—Digital infrastructures: The missing IS research agenda," *Inf. Syst. Res.*, vol. 21, no. 4, pp. 748–759, Nov. 2010, doi: [10.1287/isre.1100.0318](https://doi.org/10.1287/isre.1100.0318).
- [69] N. Urbach and M. Röglinger, "Introduction to digitalization cases: How organizations rethink their business for the digital age," in *Digitalization Cases*. Cham, Switzerland: Springer, 2019, pp. 1–12.
- [70] P. C. Verhoef *et al.*, "Digital transformation: A multidisciplinary reflection and research agenda," *J. Bus. Res.*, vol. 122, pp. 889–901, Jan. 2021, doi: [10.1016/j.jbusres.2019.09.022](https://doi.org/10.1016/j.jbusres.2019.09.022).
- [71] L. Venkatakrishnaiah and K. Ramanathan, "The evolving role of chief digital officer," *Int. J. Adv. Res. Comput. Sci. Manage. Stud.*, vol. 7, no. 7, pp. 1–12, Jul. 2019.
- [72] G. Vial, "Understanding digital transformation: A review and a research agenda," *J. Strategic Inf. Syst.*, vol. 28, no. 2, pp. 118–144, Jun. 2019, doi: [10.1016/j.jsis.2019.01.003](https://doi.org/10.1016/j.jsis.2019.01.003).
- [73] K. S. Warner and M. Wäger, "Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal," *Long Range Plan.*, vol. 52, no. 3, pp. 326–349, Jun. 2019, doi: [10.1016/j.lrp.2018.12.001](https://doi.org/10.1016/j.lrp.2018.12.001).
- [74] G. Westerman, D. Bonnet, and A. McAfee, "The nine elements of digital transformation," *MIT Sloan Manage. Rev.*, vol. 55, no. 3, pp. 1–6, Jan. 2014.
- [75] R. Whittington, B. Yakis-Douglas, K. Ah, and L. Cailluet, "Strategic planners in more turbulent times: The changing job characteristics of strategy professionals, 1960–2003," *Long Range Plan.*, vol. 50, no. 1, pp. 108–119, Feb. 2017, doi: [10.1016/j.lrp.2015.12.021](https://doi.org/10.1016/j.lrp.2015.12.021).
- [76] B. Xing and T. Marwala, "Implications of the fourth industrial age for higher education," *Think*, vol. 73, no. 4, pp. 10–15, Aug. 2017.
- [77] S. A. Zahra, H. J. Sapienza, and P. Davidsson, "Entrepreneurship and dynamic capabilities: A review, model and research agenda," *J. Manage. Stud.*, vol. 43, no. 4, pp. 917–955, May 2006, doi: [10.1111/j.1467-6486.2006.00616.x](https://doi.org/10.1111/j.1467-6486.2006.00616.x).
- [78] R. W. Woodman, J. E. Sawyer, and R. W. Griffin, "Toward a theory of organizational creativity," *Acad. Manage. Rev.*, vol. 18, no. 2, pp. 293–321, 1993.
- [79] W. Becker, O. Schmid, and T. Botzkowski, "Role of CDOs in the digital transformation of SMEs and LSEs—An empirical analysis," in *Proc. 51st Hawaii Int. Conf. Syst. Sci.*, Jan. 2018.
- [80] C. E. Helfat and S. G. Winter, "Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world," *Strategic Manage. J.*, vol. 32, no. 11, pp. 1243–1250, 2011.
- [81] C. E. Helfat and R. S. Raubitschek, "Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems," *Res. Pol.*, vol. 47, no. 8, pp. 1391–1399, 2018.



Veronica Scuotto received the B.A. (Hons.) degree in communication science, the M.B.A. degree in institutional communication science, and the Ph.D. degree in marketing and enterprise management from Milan Bicocca University, Milan, Italy, in 2006, 2008, and 2013, respectively.

She is currently an Associate Professor with the Department of Economics, Management, and Institutions, University of Napoli Federico II, Napoli, Italy. Previously, she was with the University of Turin, Turin, Italy, the University of the West of Scotland, Glasgow U.K., and then at the Pôle Universitaire Léonard de Vinci in Paris, Paris La Défense, France, as an Associate Professor in Entrepreneurship and Innovation. She received the Italian National qualification as a Full Professor in 2020. She has been invited as a guest speaker to GfWM Knowledge Camp, World Young Forum, and PDW at the AoM Conference, among others. In 2018, she organized a conference on "Cognitive Perspective in Entrepreneurship Research" jointly with IPAG University in Paris. She teaches entrepreneurship and loves encouraging young student entrepreneurs to develop new, creative business ideas. She has also combined this interest with her research focus on small to medium enterprises, knowledge management, and digital technologies. Her research interests include SMEs, entrepreneurship, knowledge management, and digital technologies, which have resulted in the publication of several articles featured in peer-to-peer journals, such as the *Journal of Product Innovation Management* (4*), *Journal of World Business* (4*), *Journal of Organizational Behaviour* (4*), *Journal of Business Research* (3*), *Production Planning & Control* (3*), *Technological Forecasting and Social Change* (3*), *International Marketing Review* (3*), and *IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT* (3*). She has authored three books.

Dr. Veronica is the Editorial Assistant for the *Journal of Intellectual Capital* and an Editorial Board member of the *Journal of Knowledge Management*. She is also a Member of the International Council for Small Business and is a mentor for the Techstars Smart Mobility Accelerator, Turin, Italy. In 2021, she was the recipient of the "Gold Award Best Paper" at the IEEE ICTMOD 2021. In 2020, her work on JOB was awarded as the tenth most cited article. She was also the recipient of two awards as the Best Paper of the EuroMed/SIMA track 'New Challenges in Open Innovation' in 2016 and the "best-commended paper" in 2017 at the annual EuroMed Academy of Business conference. In 2018, she was recognized by the International Council for Small Business as a global partner of excellence. She also has an industrial background. She was a Commercial Manager at GNS China (consultancy company), Beijing China, a Marketing Consultant for a fashion publishing and advertising agency, Ichnos Srl, Naples, Italy, and a Digital Account Manager at P.O.S.H. (a marketing agency), Glasgow, U.K.



Domitilla Magni received the Ph.D. degree in management, banking, and commodity sciences from Sapienza, University of Rome, Rome, Italy, in 2018.

She is currently a Researcher in Management with the University of Catania, Catania, Italy. She is also a Visiting Professor at various top-tier universities across the world (e.g., New York University, Montpellier Business School, South-Western University of Finance and Economics, and La Salle University). She is an Adjunct Professor at Link Campus University, Rome, Italy, for the class of neuromarketing and the

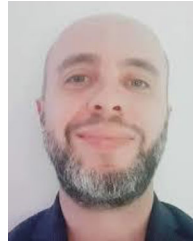
University of Bergamo, Bergamo, Italy, for the class of international business. She is also a Professor of Master of International Business with the Università Cattolica del Sacro Cuore, Milan, Italy. Her research interests include knowledge management, innovation and technology management, and open innovation.

Dr. Magni is a part of the Editorial Board for the *Journal of Intellectual Capital* (Emerald), *Journal of Knowledge Management* (Emerald), and *International Journal of Learning and Intellectual Capital* (Inderscience).



Tzanidis Theofilos He is currently an Associate Professor with the University of the West of Scotland, Glasgow, U.K. He is also a Guest Professor and an external examiner with Birmingham City University, Birmingham, U.K. He is a Senior Member of Digital Marketing Institutes Global Industry Advisory Council, and also a UWS Digital Media and Communications Lead. Previously, he was heavily involved in digital transformation

consulting and research projects that focus on digital marketing automation, digital communications, digital business, and corporate transformation via the use of digital social and transformational technologies. Previously, as the Head of Marketing for a large construction firm, he led and implemented digital transformation in 2011. He had launched and successfully directed UWS M.Sc. Digital Marketing program, now a leading postgraduate program in U.K. in its discipline. He is the Principal Investigator (PI)/Lead Academic on numerous Innovate U.K. funded Digital Transformation Projects, He pioneered a digital revolution of higher education via the use of creative new technology. He cocreated, with Matthew Frew, the accelerated and Immersive Education method that was nominated for the 2018 Guardian, Herald, and Pioneer awards for the creative use of VR/AR/Digital to integrate technology and redefine how students are taught at UWS.



Manlio Del Giudice received the Ph.D. degree in management from the University of Milano-Bicocca, Milan, Italy, in 2005.

He is currently a Full Professor of Management with the University of Rome "Link Campus," Rome, Italy, where was a Deputy Chancellor of the LCU Campus of Naples and the Director of the CERMES Research Centre. He was the Director of the LCU Master in Smart Public Administration. He did build up his academic and scientific career outside of Italy for more than 12 years, in a wide number of worldwide renewed universities, before coming back to Italy in 2014, having won the National Scientific Qualification as an Associate Professor in 2013. As witnessed by his publications, he had been widely recognized as a worldwide leading scientist with distinguished research affiliations in top universities worldwide. He had been hired as a Full Professor in 2018 as one of the 20 youngest professors in Italy, in every scientific field.

Prof. Del Giudice is the Editor-in-Chief for the top-tier *Journal of Knowledge Management* (Class A ANVUR, Impact Factor 2019: 4.805, ranked 13th in the management field for Scopus) and holds key editorial positions in several international mainstream scientific journals on management. His scholarly profile shows more than 150 peer-reviewed articles, more than 70 of them ranked in the highest "A Class" within the Italian ANVUR ranking, and 12 international monographs by flagship publishers such as Springer, Palgrave Macmillan, and Elsevier. His research works have been published or are forthcoming on such flagship top tier peer-reviewed journals ABS ranked such as *MIS Quarterly* (4* Elite), *Journal of Product Innovation Management* (4*), *Journal of Organizational Behavior* (4*), *Journal of World Business* (4*), *Long Range Planning* (3*), IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT (3*), *Journal of Technology Transfer* (3*), *Journal of Business Research* (3*), *R&D Management* (3*), *Technological Forecasting and Social Change* (3*), *Production, Planning & Control* (3*), and *International Marketing Review* (3*). His studies had been internationally recognized by significant impact, as evidenced by the thousands of citations and by his H-index (= 46, in March 2021) and from his more than 50 publications in only ABS 3* and 4* Journals during 2018–2020. He is widely invited to serve as a keynote speaker of top global conferences on management (about 30 per year). Recently, it has been indicated among the most influential scientific profiles in research worldwide according to the data for updated science-wide author databases of standardized citation indicators 2019 developed by Stanford University, ranking 1st among the Italian Full Professors in the field of managerial research in the whole "Macrosector 13B Economics and Business Sciences" and at the 37th place in the homologous category, worldwide. He was an International Evaluator for several institutions for applied research-funded projects. His main research interests deal with knowledge management, technology transfer, foresight management, innovation, and technology management. He was the first Italian scholar to be appointed an Associate Editor of the prestigious international journal *Journal of Business Research* for the section "Strategic Management and Organizational Behaviour."