

Digital academic entrepreneurship: theory and practices

Digital academic entrepreneurship represents a particular research context because of the increasing and disruptive roles of digital technologies on use within the academic context (Secundo *et al.*, 2020a). Present day universities are expected not only to provide knowledge-intensive outputs but also to contribute to economic growth and regional development through knowledge-based start-ups and spin-offs (Audretsch, 2014). If the creation of start-ups and spin-offs has been considered among the initial forms of academic entrepreneurship outcomes, a wider conceptualization of the phenomenon should be based on the evolving missions of university (Martin, 2012; Rothaermel *et al.*, 2007; Siegel and Wright, 2015).

Recently, the university's missions of education and research evolved toward the so called third mission, that according to Laredo (2007) entails a variety of activities, including not only (applied) research, development and innovation but also social engagement with the surrounding society. Third mission activities comprise three dimensions performed by universities in relation to the external environment: technology transfer and innovation, continuing education and social engagement (E3M, 2010). More broadly, the third mission includes teaching, research as well as entrepreneurship, commercially oriented activities and deals with the entrepreneurial aspect of universities for socioeconomic development (Etzkowitz, 2016; Jonglboed *et al.*, 2008; Laredo, 2007). This has meant that universities now are more entrepreneurial in offerings, commercialization of their research and culture (Miller *et al.*, 2018).

The implications of the digital revolution (Yoo *et al.*, 2010) for academic entrepreneurship are likely to be addressed concerning a variety of issues. Still, how digital technologies are affecting the way individuals face innovation processes and, eventually, new academic firms' creation, is yet to be addressed. Over the past decade, several studies have shown that the individual academic entrepreneur, their entrepreneurial motivations and growth ambitions (Lam, 2011), social networks (Chang, 2017; Rasmussen *et al.*, 2015), backgrounds (O'Gorman *et al.*, 2008), access to resources (Wright *et al.*, 2007), capabilities (Hayter *et al.*, 2017; Huynh *et al.*, 2017), knowledge spillovers (Audretsch and Lehmann, 2005) and scientific legitimacy (Civera and Meoli, 2018) are critical factors in the function and long-term success of university spin-offs. Moreover, other studies investigated the mechanism to connect and align stakeholders in the context of academic entrepreneurship where different expertise and interests work together in joint endeavors (Simeone *et al.*, 2017a, b). Digital technologies could leverage all these aspects, the way academia is pursuing entrepreneurship process with a pervasive effect on the rationale, processes and forms of academic entrepreneurship as well as on the stakeholders involved toward the achievement of university entrepreneurship goals (Rippa and Secundo, 2019).

Digital technologies become the dominant source for innovation in all the activities characterizing the academic entrepreneurship. Digital technologies, such as big data, business analytics, Internet of Things (IoT), blockchain technology, advanced manufacturing, social media, 3D printing, cloud computing and cyber-solutions are nowadays supporting digitization and digitalization (Cohen *et al.*, 2017; Nambisan, 2017; Rayna *et al.*, 2015) in all the relevant forms of academic entrepreneurship, so opening up

The guest editors would like to thank the Editor In Chief Prof. Paul Jones for his valuable support, all the authors for their contributions and the reviewers for their efforts in providing detailed reviews to the manuscripts.



innovation opportunities for academic innovators and overhauling the traditional mission of commercializing academic research (Holley and Watson, 2017; Kalar and Antoncic, 2015).

More than ever before, universities are challenged in the way they adopt digital technologies for sustaining different activities of academic entrepreneurship like research collaborations with industry and institutions, patent applications, transformation of innovative ideas in spin-offs, entrepreneurial education of highly skilled individuals, technology transfer or business idea incubators (Birtchnell *et al.*, 2016; Mian *et al.*, 2016; Horta *et al.*, 2016; Shane, 2004; Somsuk and Laosirihongthong, 2014) with significantly different characteristics and socioeconomic impacts (Giones and Brem, 2017).

Developments in the context of digital technologies call for a revision and advancement of the academic entrepreneurship concept toward a digital focus, i.e. *Digital academic entrepreneurship* defined as the utilization of new digital technologies to improve and modify the emerging forms of academic entrepreneurship, such as the development of digital spin-offs and alumni start-ups, the creation of entrepreneurial competence supported by digital platforms and a broader range of innovation development that goes beyond the local ecosystem. *Digital academic entrepreneurship* engages more stakeholders through the use of digital technologies to develop the academic entrepreneurial process (Rippa and Secundo, 2019). A holistic perspective about academic entrepreneurship is indeed required to posit new directions for research about the impact of digital technologies (Secundo *et al.*, 2020a). The possible combinations of digitization and digitalization in the academic entrepreneurship results in a diversity of phenomena that allow to improve this novel research field.

Even if leveraging digital technologies to shift the traditional way of creating and doing business in the digital era has been already addressed (Giones and Brem, 2017; Nambisan *et al.*, 2017; Elia *et al.*, 2020), to the best of our knowledge the impact of digital transformation on academic entrepreneurship remains not sufficiently addressed. Accordingly, this special issue is focused on the identification and description of academic entrepreneurship in the times of digital transformation, encompassing theoretical and empirical research on academic entrepreneurship to take account these changes to improve the rigor and relevance of future studies on this topic for academics, managers and policymakers. In this special issue we present a variety of international studies at the forefront of the adoption of a combination of several digital technologies for supporting the academic entrepreneurship. Overall nine papers have been selected to accomplish the above rationale and to illustrate the premises and future potential for such interdisciplinary and cross-level research agenda on how digital technologies could sustain the process of academic entrepreneurship. In the following section we highlight the contents of the selected papers. Finally a discussion of the overall contributions is provided and the future research avenues are outlined.

Identifying theory and practices for digital academic entrepreneurship

In presenting the contributions of this special issue we follow Secundo *et al.* (2020a), who systematically reviewed the literature at the interceptions of digital technologies and academic entrepreneurship, providing for the identification of four major research streams: *Digital technologies for discovering entrepreneurial opportunities*; *The “maker space movement” for academic entrepreneurship*; *Digital technologies for entrepreneurship education* and finally, *Creating entrepreneurial competences in the digital “university-based” entrepreneurial ecosystems*.

Research area: digital technologies for discovering entrepreneurial opportunities

This area focuses on the discusses the key pillars of the transformations provided by the new digital technologies for discovering entrepreneurial opportunities in the university context.

Pardede and Tomy (2020) in the paper “*An Entrepreneurial Career Intention Model Focussing on Higher Education*” discuss the importance of entrepreneurial intention in graduate entrepreneurship by proposing an entrepreneurial intention model based on four propositions identified from the literature. The proposed model is then implemented as a practical digital application for students to enhance their entrepreneurial self-efficacy and thus entrepreneurial intention. This application offers interesting guidance to universities as to how online systems can be used to create an environment that fosters individual intentions to select entrepreneurship as a career option. A survey was conducted with 138 students enrolled in an undergraduate or postgraduate course at an Australian university. Correlation analysis was then performed, and entrepreneurial awareness was found to have a positive effect on entrepreneurial intention.

Singh *et al.* (2020) in the paper “*Potential of Digital Technologies in Academic Entrepreneurship – A Study*” propose a work aimed at identifying opportunities and challenges faced by academic start-ups through the means of digital technologies. They adopt a qualitative approach composed of semi-structured interviews with academic start-ups. The main idea is to find challenges that new academic entrepreneurs faced with social media platforms to start their business. Results give remarkable insights into the business perspective of academic entrepreneurship start-ups using digital technologies, making their businesses operational. The outcome would encourage and lead activities, particularly emerging start-ups adopting specific digital technology platforms for promoting their businesses.

Quinto *et al.* (2020) in the paper “*Why do academics become entrepreneurs? How do their motivations evolve? Results from an empirical study*” investigate the motivations that lead an academic to establish a spin-offs. Results reveal how the motivations change over time: time, experience and financial gain overcome financial aspects as main motivation of the evolution of a spin-off. This research studies digital technologies as a way to expand the impact and the opportunities of academic entrepreneurship by reducing the barriers between invention and new venture creation. Results are based on the interviews collected with 151 Italian Academic Spin-offs, and data have been analyzed with cluster and ANOVA analysis. The results suggest that motivations change over time; while financial aspects become less important, academics give more importance to other issues. Time, experience and financial gain influence the evolution of academic entrepreneurs’ motivations over time.

Research area: the maker space movement for academic entrepreneurship

This area identifies the role of the maker space movement for enhancing the academic entrepreneurship. Monllor and Soto-Simeone (2020), contributes to the discussion on the so-called “maker space movement” for academic entrepreneurship. This work investigates if and how exposure to digital fabrication technologies plays a role in the development of students’ entrepreneurial self-efficacy and intentions. Data were collected from 131 students enrolled in a business administration undergraduate program at a large university in the United States. Confirmatory factor analysis and a structural equation model served to derive the results of this research. Initiatives by business schools and entrepreneurship programs to invest in digital manufacturing technology help increase students’ confidence in their technological and entrepreneurial abilities. Individuals might eschew partaking in entrepreneurial activities not because they lack the necessary skills to do so, but because they believe they do.

Research area: digital technologies for entrepreneurship education

This area focuses on the strategies and processes to create entrepreneurially equipped students through the adoption of digital learning technologies.

Linzalone *et al.* (2020) in the paper “*Connecting Universities with Entrepreneurship through Digital Learning Platform: functional requirements and education-based knowledge exchange activities*” investigate the functional elements of a digital learning platform (DLP), aiming to support education-based knowledge exchange activities between academia and enterprise, by leveraging on the multiple, multisided network effects of digital platforms. Although the literature has extensively investigated DLP, there is a lack of understanding of the role of DLP in supporting digital AE. Adopting a single case study methodology (Baxter and Jack, 2008; Yin, 2009), focusing on a DLP called Blending Academic and Entrepreneurial Knowledge in Technology Enhanced Learning (BAEKTEL) the key functional dimensions that a DLP has to present are outlined. A DLP provides the advantages of network effects (Brokaw, 2014), by accessing same side (enterprises’) knowledge sources and cross-side (universities’) ones.

Gentile *et al.* (2020) in the paper “*E-learning design and entrepreneurship in three European universities*” adopt a mixed method to investigate how universities approach e-learning design. The work aimed to understand whether the e-learning design of teaching courses within selected European universities, both in general and on entrepreneurship in particular, uses the process steps of learning outlined by Ghiringhelli and Quacquarelli (2003). This approach helped verify aspects related to teaching and therefore analyze how to create and deliver courses through e-learning in universities. The paper shows that the 100 best European universities in the Quacquarelli Symonds Rankings all use e-learning methods. The case study universities were selected from this list. The semi-structured interviews with managers of e-learning services highlighted the importance of the design of e-learning courses. However, most focused on the professional figures involved, rather than the process for e-learning and the overall design of the course.

Research area: creating entrepreneurial competences in the digital “university-based” entrepreneurial ecosystems

Finally, the fourth research area includes papers aimed to understand and explore how to create entrepreneurial competences in the digital “university-based” entrepreneurial ecosystem.

The study proposed by Massaro *et al.* (2020) in the paper “*A grounded theory study for digital academic entrepreneurship*” a grounded theory approach serves to explore “how” digital academic entrepreneurship develops from a micro- to a macro-perspective. Digital academic entrepreneurship develops and regenerates through a virtuous cycle, supported by digital technologies, which starts from single individuals and their networks, reaches a broader ecosystem and ends once back to individuals. This evolutionary pattern has been derived through the lens of intellectual capital theory, where different ontological dimensions are interplayed. Results come from the analysis of the case study of “strategy innovation”, a digital spin-off of Ca’Foscari University.

Secundo *et al.* (2020b) in the paper “*Digital Transformation in Entrepreneurship Education Centres: Preliminary Evidences from the Italian Contamination Labs Network*” report whether the entrepreneurship education centers introduced by the Italian Ministry of Higher Education and Research in 2012 (the Italian Contamination Labs – CLabs) are effectively adopting the emergent digital technologies for nurturing their entrepreneurship education activities and dissemination of knowledge contamination practices among university’s students. Findings provide some insights into the strategic role of some categories of digital technologies inside the CLabs. The main results show a weak use of digital technologies except for social media and digital platforms, mainly used for promotion scope and communication of the entrepreneurial outputs achieved by the students.

Conclusions and avenue for a research agenda

To conclude this special issue on digital academic entrepreneurship, the Guest Editors want to encourage a further expansion of the academic entrepreneurship research in the novel context of the digital technologies that could be the suitable tools to develop novel strategies and processes for the entrepreneurship at academic level. The special issue presents the first attempt to provide a comprehensive and holistic overview of the current debate dealing with how to valorize the emerging digital technologies to enhance the entrepreneurial process at university level.

Universities are now viewed as key social and economic actors within regions and are central actors in shaping and influencing entrepreneurial ecosystems. This has meant that universities now have to become more entrepreneurial in offerings, outlook and culture (Miller *et al.*, 2018) thus requiring novel approaches and modalities to manage their research and technology assets. Universities develop strategies to fulfill their historic mission of teaching and research and they also undertake a significant role in producing, creating and diffusing new knowledge in present day's ever-changing world (Olcaý and Bulu, 2017).

Despite the increasing literature, this research area is still fragmented and undertheorized, thus requiring further systematic studies, considering both the organizational, economic and the social aspects of digital technologies tools and platforms within universities to sustain the expansion of the academic entrepreneurship. It is important to recall the initial motivation of this special issue was based on the argument that, while the impact of digital technologies has been already analyzed for the entrepreneurship at corporate level, their key role and potentialities for the academic context represents a particular research context because more and more universities are involved into the creation, sharing, diffusion and commercialization of knowledge and research.

We expect this issue to foster the development of further research. While these papers have largely made use of case studies and conceptual arguments, integrated with longitudinal methods, multiple case studies and quantitative research, further research will possibly provide integrative research, preferably presented as dynamic models, in order to advance the field. As a whole, we believe that the contributions in this special issue have allowed a better understanding of the effects of digital technologies on the wide activities included within academic entrepreneurship, i.e. research collaborations with industry, patent applications, development of prototype, transformation of innovative ideas in spin-offs, entrepreneurial education of highly skilled individuals, technology transfer or business incubators supported by digital technologies.

Starting from the development of the theoretical model of digital academic entrepreneurship proposed in Rippa and Secundo (2019), the identification of articles in the field of study concerning the intersection of the academic entrepreneurship field (now consolidated in literature) and that of the diffusion and implementation of digital technologies (also stabilized in the literature mainly referring to information systems) allows highlighting first of all the evident and growing interest in the topic. The impact of digital technologies on academic entrepreneurship processes is certified by the numbers of articles that propose applicative examples of how digital technologies can foster entrepreneurial initiatives in university contexts (Secundo *et al.*, 2020a).

Among the main technologies, big data analytics, MOOCs and 3D printing are certainly the main vehicles through which sustain the involvement of all the academic stakeholders involved into the processes of academic entrepreneurship. Furthermore, also the creation of ad hoc students entrepreneurship centers such as the Italian Contamination Labs could represent a novel context where the business idea behind students' new venture creation is grounded. What is highlighted is that digital technologies are not only a lever for the growth of new spin-offs, but it is an opportunity to review some organizational processes within the

universities to obtain more performing results in terms of patents production, technology transfer activities, spin-off creation and everything that can be considered within the academic entrepreneurship domain.

The analysis of papers included in these areas allowed to derive a more robust awareness on state of the art on digital academic entrepreneurship as a field that can be organized around the following research areas (Secundo *et al.*, 2020a): *Digital technologies for discovering entrepreneurial opportunities; The “maker space movement” for academic entrepreneurship, Digital technologies for entrepreneurship education and finally, Creating entrepreneurial competences in the digital “university-based” entrepreneurial ecosystems.* Avenues for future research can be expressed in terms of following questions:

- (1) Which digital technologies better support the interplay between academia and external stakeholders such as industry, government institutions, investment funds and TTOs?
- (2) How is it possible to assess the impact of digital technologies on entrepreneurial competence acquisition for the academic entrepreneurs?
- (3) What forms of entrepreneurship competence acquisition could be better supported by digital technologies (MOOCs, social media, etc.)?
- (4) How do digital technologies support knowledge opportunity recognition for academic entrepreneurs?
- (5) Which typologies of research collaboration between universities and industry are better supported by digital technologies such as 3D printing, IoTs, social media platforms, etc.?
- (6) Who are the main stakeholders contributing to the creation of a digital entrepreneurship ecosystem for universities?

All findings confirm the vision that academic entrepreneurship cannot forget the disruptive role of the digital technologies such as MOOCs, cloud computing, big data analytics, 3D printing, business analytics, advanced manufacturing, social media and cyber-solutions that are able to generate a wide involvement of the university's stakeholders within the process of academic entrepreneurship.

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