Chapter 6
An Empirical Approach

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6.1 Introduction

The social, economic, and technological paradigms have transformed universities' missions, activities, capabilities, and interactions with multiple stakeholders (Chin et al., 2019; Guerrero et al., 2019; Guerrero & Pugh, 2022). Universities have enhanced and legitimized their contribution to the entrepreneurial innovation ecosystems where they share resources/capabilities and transfer/commercialize knowledge among multiple actors (Audretsch et al., 2022c; De Wit-de Vries et al., 2019). In the past few decades, due to the restrictions of public education budgets, higher education evaluation systems and policymakers have promoted "measuring" and "evaluating" socioeconomic benefits generated by the universities' entrepreneurial innovation initiatives (Audretsch et al., 2022; Bellini et al., 2019). Likewise, open innovation principles and practices have accelerated the debate on the "democratization model" of research and inventions generated by university research teams (Vicente-Saez et al., 2020), as well as new teaching-learning environments more

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adequate to the grand societal challenges (Bauer, 2018). Consequently, funding mechanisms have been oriented to reinforce individual, organizational, and regional innovation capabilities (Castro, 2019; Audtretsch et al., 2022a) by prioritizing themes and collaboration in the public agendas (Perkmann et al., 2013). Even though most European countries have positive innovation outcomes, members are facing multiple challenges regarding research impact, stakeholder integration, inclusiveness, and sustainability (Ávila et al., 2017; Dwyer & Gigliotti, 2017; European University Association, 2022a).

This study explores the European Union case which, through initiatives, organizations, and public agendas, aims to foster university innovation ecosystem. These objectives are not exempt from difficulties and challenges; in this chapter, we analyze the European Union case as a territory that has implemented collaborative innovation capacity-building programs among countries, universities, and public–private organizations. By using data from the European University Association, the European Commission, and Eurostat, we provide insights about the university innovation capabilities panorama. Results show funding is one of the main filters/barriers for materializing innovative capabilities, solutions, and research. In addition, results reveal inclusivity and sustainability challenges regarding university innovation capabilities. Interestingly, the chapter provides interesting insights regarding the public policy and management approach adopted by the European Union governments to facilitate university sustainable innovation capabilities. Finally, the main chapter contributes to the interplay of the pressures from public policy agendas, the pre-existence of university capabilities, and the advantage of regional competencies in re-building innovative European university capabilities.

The remainder of this chapter is organized as follows. Section 6.2 introduces the theoretical bases. In Sect. 6.3, we describe the methodological design and contextualize the case. Then, Sect. 6.4 describes the insights of university innovation capabilities in Europe, as well as their challenges. Finally, Sect. 6.5 concludes by outlining the main conclusions and implications.

6.2 Theoretical Foundations[1]

The understanding and reconceptualization of the universities' innovation capabilities respond to the emergence of new social and economic paradigms (Morrar et al., 2017). Based on the literature review presented in the previous chapter, Fig. 6.1 shows the proposed framework to understand how university innovation capabilities are materialized or re-building through the intersection of several components.

The re-building of university innovation capabilities includes:

[1] An in-depth theoretical review is presented in Chap. 5. To avoid theoretical duplicities, please consult it for further details.

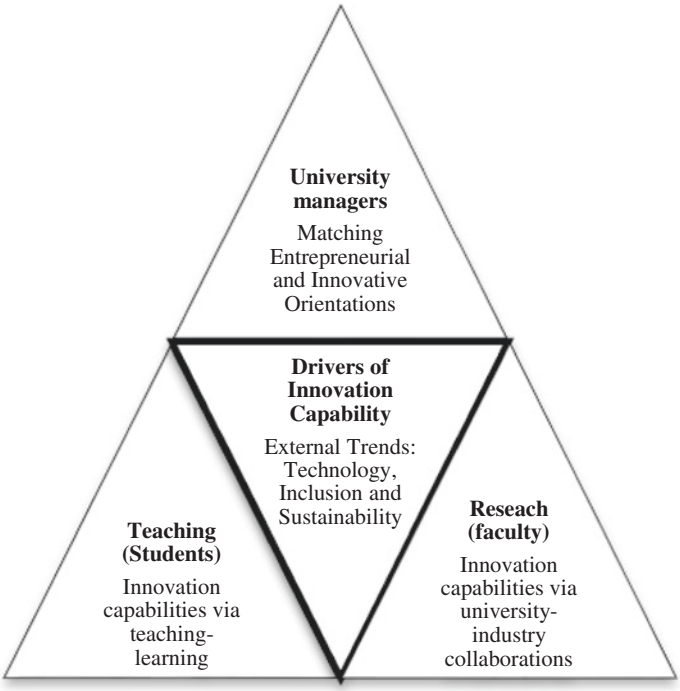

Fig. 6.1 University innovation capability framework. (Source: Authors)

(a) *Drivers*. Innovation capabilities are influenced by technological trends, changes, or intersections with other crucial societal themes (inclusion and sustainability). Indeed, university innovation capabilities represent the rapid adaptation and demand from the university community and multiple stakeholders (Balocco et al., 2019; Bozkurt et al., 2020; Guerrero & Pugh, 2022).

(b) *University managers*. The re-building of university capabilities demands entrepreneurial, innovative, and managerial leadership to transform routines into new ways to achieve stakeholders' needs (Lee et al., 2019). In this regard, several university managers have invested resources into specialized infrastructures (e.g., business creation centers, clusters, and science parks) to foster a strategic orientation toward innovation that has also been impregnated by an entrepreneurial orientation (Fischer et al., 2020, 2022). Thus, the implementation of strategic and clear property rights university norms (e.g., technology transfer offices) (Rådberg & Löfsten, 2023).

(c) *Research activities*. The link between faculty members (researchers) and strategic partnerships (e.g., companies, government agencies, or civil society groups) have reinforced the re-building of innovation university capabilities (Perkmann et al., 2013, 2021; Bellini et al., 2019). In other words, researchers have sensed

innovative opportunities as well as seized and transformed them into inventions and technologies that have created social value and public returns.

(d) *Teaching activities*. The continuity in the re-building process of innovative university capabilities have demanded the redesign of entrepreneurial innovation curricula with the most updated technical/specialized skills and content (e.g., industrial doctorates, Massive Open Online Courses, or MOOCs) (Kirby et al., 2011; Guerrero et al., 2021). Likewise, the fostering of entrepreneurial innovation mindsets/identities among students, teachers, and alumni (e.g., flexible learning pathways, project-based learning, and international classrooms) (Guerrero & Urbano, 2014; Hayter et al., 2022).

In the re-building process of university innovation capability, certain elements may act as complements but others as substitutions among the core university activities (teaching, research, social engagement) and university community (students, faculty, and university managers). Indeed, the externalities of innovation capabilities have been (in)direct translated into a more inclusive, sustained, and innovative university ecosystem (Chung, 2002; Guerrero et al., 2016; Dwyer & Gigliotti, 2017; Klofsten et al., 2019; Wakkee et al., 2019; Salmi & D'Addio, 2021).

6.3 Methodology

6.3.1 Contextualization

The European Union (EU) represents a unique economic, political, and geographical association of country members that share policy frameworks (European University Association, 2022a). Regarding innovation, the EU implemented the Horizon[2] 2020 program with a budget of €80 billion to enhance innovation capabilities among universities, research centers, and ventures (European University Association, 2022b). Concretely, this policy framework considered multiple initiatives to reinforce/develop innovation capacity-building among members.

At the higher education level, innovation and technology transfer become priorities in universities' research strategies (Beliaeva et al., 2019; European University Association, 2022a). It explains why European universities impregnated an innovative culture among activities, functions, and roles with internal/external stakeholders (Aguiar & Gagnepain, 2017; Huybrechts & Haugh, 2018; Van den Berg, 2018). According to Chin et al. (2019), European higher education strategy has been based on reinforcing innovation capabilities in three ways: (a) via qualified staff to fulfill all university missions and incentives to increase staff motivation to engage in innovation; (b) via investments to support both innovation directly and long-term

[2] For further information, visit: https://european-union.europa.eu/priorities-and-actions/actions-topic/research-and-innovation_es

oriented research, including curiosity-driven research as one of the fundamental drivers of innovation; and (c) via spaces where researchers and students from different disciplines and other actors in the innovation ecosystem can engage in a process of co-creation. Consequently, European universities have developed innovation and entrepreneurship capabilities that have contributed in new generation of inventors, reinforced regional smart specialization capabilities, reinforced regional innovation ecosystems, and produced innovative entrepreneurial solutions that satisfy societal needs (Audretsch et al., 2022a, b, c).

Nowadays, the democratization of research via open innovation policies and practices has also been an interesting debate among the country members (Younis et al., 2020). Likewise, the orientation toward sustainable initiatives to return to society via digitalization (Ávila et al., 2017; George et al., 2020). A good example was the accelerated response from many universities and actors collaborate together via innovative initiatives to support the European community during the COVID-19 pandemic (Barnes, 2020; Bozkurt et al., 2020; Guerrero & Pugh, 2022).

6.3.2 Methodological Design

To analyze university innovation capabilities, we focused on the European Union case using data from the European University Association (EUA) Survey and the European Commission Statistic (Eurostat). The EUA survey captures the different levels of innovation capabilities of universities, as well as how these levels contribute to a wide range of societal impacts and outcomes.

The EUA survey collects information from 166 organizations in 28 European countries. In this regard, we focused on the open responses provided by the survey participants, as well as additional statistical analysis obtained from the dataset. This unique body of evidence has enabled the association to develop recommendations for universities, policymakers, and funding agencies on how to further improve the contribution of universities to the innovation ecosystems (European University Association, 2022a; Kozirog et al., 2022).

In addition, the European Commission presents an annual report called the Education and Training Monitor, which presents an annual assessment of the education and training system across the EU. The report brings together the latest data, technical reports, technical reports, and studies, as well as examples of policy measures from different EU countries. The main theme of this year's Education and Training Monitor is education and well-being. The Monitor 2021 also analyzes the EU-level objectives adopted by the Council Resolution on a strategic framework for European cooperation in education and training toward the European Education Area and beyond (2021–2030) (European Commission, 2018).

Table 6.1 University innovation capabilities in Europe

University profile	University orientation	Perception about university innovation capacity	Evaluation of university innovation capacity	Conditions enhancing innovation capacity	Regional innovation capacity assessment system
Comprehensive: awards degrees in all three cycles and is multidisciplinary (i.e., offers programs in more than two subject areas/fields of science)	Research-intensive (4%)	P97: "Since the inception of the university Technology and Knowledge Transfer Office, the attention to research and innovation has grown exponentially"	Very high	(a) Cooperation (b) Connections (c) Funding	Yes
	Teaching-led (8%)	P140: "Given the definition you give of 'innovation', in all the main areas of activity (research, teaching, public outreach) university is pursuing innovation, mostly 'incremental' rather than 'radical'"	Neither high nor low	(a) Qualified staff (b) Funding (c) Autonomy (d) Governance	No
	Both (54%)	P21: "The university promotes innovative research in many areas, from technology to life sciences, from ethics and humanities to medical sciences and in the fields of Education, Social Sciences and International Studies. This strategy is accomplished through support to the participation to competitive research calls, to technological transfer (such as the creation of spin-off companies and the activation of collaborations, joint labs, and contracts with companies), to technological districts at a regional level. The university also allocates funds for PhD programs, support of applied and base research, and for new research infrastructures (such as competitive calls to acquire new equipment)"	High	(a) Qualified staff (b) Cooperation (c) Funding (d) IPR	No
		P137: "Innovation is core to the DNA of the university and this is reflected in our strategy. The vision of the strategy is for university to be recognized as an organization with a reputation for equity and innovation in education that empowers students and communities to transform their lives and society through teaching, learning, research and enterprise. The strategy is underpinned by four core themes – Education & Student Experience; Research & Impact; Global university; and Enterprise & Innovation"			

Specialized: awards degrees in all three cycles and specializes in a particular subject area/field of science, e.g., medical science, business, music or arts school)	Research-intensive (1,5%)	P143: "Creation of an incubator several years ago. The spirit of innovation and the sense of entrepreneurship are instilled in university – our students throughout their studies, especially through learning formats that focus on the project mode. In addition, the school encourages students to join associations and participate in humanitarian and societal projects in order to develop a taste for entrepreneurship."	High	(a) Qualified staff (b) Governance structures (c) Cooperation (d) Connections	Yes
	Teaching-led (1,5%)	P155: "Our university aims to become one of the main creative innovations hubs (focusing on Design innovation) in the region in the next 5 years. The university has created dedicated infrastructure and organizational units for innovation, with dedicated staff (researchers, innovation management, administration)"	High		
	Both (4%)	P111: "Research and development is one of the main values of university. However, university focuses on education of its student and their future worth on the labor market. The university has created Centre for Innovation and Technology Transfer in order to create a bridge between science and research and business, as well as to focus on innovation in medicine field".	Neither high nor low		
Applied Sciences: offers more career-orientated studies, usually in the first and second degree cycles	Both (11%)	P11: "In its mission statement, organization is committed to shaping social innovation. This strategically addresses all areas of the university. We are committed to fundamental knowledge-generating research and solution-oriented applications of science, as well as to critical reflection on the effects of application-related innovations. We promote inter- and transdisciplinary cooperation in research in order to address current challenges and urgent questions for the future by combining academic and practical expertise. We want to shape the social innovation processes induced by this in a partnership-based and interdisciplinary manner and reflect on their conditions, constructs and effects."	High	(a) Qualified staff (b) Cooperation (c) Funding	No

(continued)

Table 6.1 (continued)

University profile	University orientation	Perception about university innovation capacity	Evaluation of university innovation capacity	Conditions enhancing innovation capacity	Regional innovation capacity assessment system
Technological: awards degrees in all three cycles, and specializes in technology, and engineering	Both (13%)	P35: "Innovation is one of the main topics of Strategic Plan of the university. The university aims to play a driving role in research and innovation, combining cutting-edge technological contents with social issues. A flexible and interdisciplinary research that counts on structures of excellence and on the development of human capital, while successfully obtaining financing from European programs. Among the main objectives: a consolidated relationship with enterprises, also by supporting start-ups and enterprise development."	High	(a) Qualified staff (b) Cooperation (c) Funding	No

Source: Authors based on the European University Association survey (Kozirog et al., 2022)

6.4 Findings

6.4.1 University Innovation Capabilities in Europe

Table 6.1 shows evidence from the EUA survey on re-building innovative university capabilities in Europe. Concretely, our analysis reveals three important dimensions related to European university innovation capabilities re-building: (a) the *first dimension* is related to the innovative capabilities introduced/developed inside universities to achieve teaching activities; (b) the *second dimension* is related to innovative capabilities impregnated in the university community to obtain innovative outcomes; and (c) the *third dimension* is related to innovative capabilities impregnated in the regional ecosystems and often part of general university performance frameworks.

The *first dimension* is related to the innovative capabilities introduced/developed inside universities to achieve teaching activities (Vincent-Lancrin et al., 2017). In this regard, innovative university capabilities could be distinguished by pedagogical innovation capabilities (teaching pedagogies/techniques), work innovative capabilities (managerial procedures), and innovative external capabilities (engagement with parents and external actors). The most common practice is in the classroom, where universities have implemented innovative innovation pedagogies/techniques that introduce content/simulations in the curricula for students' innovative skills and digital practices. According to the European University Association (2022a) survey,[3] the university innovation capacity is understood as the organization's ability to transform knowledge and ideas into new products, processes, and systems with beneficial outcomes (Lawson & Samson, 2001). Most of the respondents agree that their universities have an innovative orientation orchestrated toward an innovative strategic plan where innovation capabilities are supported by policies, incentives, and abilities. Concretely, the respondents explained:

> P28 [Applied Science, Research-Teaching Intensive]: "The university has always paid particular attention to innovation. In particular, through participation in research and development projects funded by the European Commission, the establishment of an ad hoc office that deals with innovation, technology transfer and relations with local companies and manages joint laboratories where innovative research projects are carried out with companies and tailor-made research services are offered based on the requests received. Furthermore, relations between research groups and companies are encouraged for the carrying out of common R & D projects"

[3] Methodological note: The survey was divided into five sections comprising 32 open-ended, ranking, multiple and single-choice questions covering a wide variety of topics related to innovation at universities. The survey was open from 4 May to 28 June 2021. It was preceded by a pilot phase involving six organizations of different sizes, profiles and geographical locations. This study obtained 166 valid responses from organizations in 28 European countries. Concretely, of the total 166 responses, 134 are from EUA members, and 32 from non-member organizations. For further details, review European University Association (2022a, p. 12) and (Kozirog et al., 2022).

P48 [Comprehensive, Research Intensive]: "University aims a sustainable knowledge economy in the region to include (i) material and biomedical technologies, (ii) green and digital technologies and (iii) quantum technologies. Closely related to this main goal is the contribution to the development of social areas, including the care of an aging population (the so-called Silver Economy) and a healthy lifestyle for the working-age population"

P109 [Comprehensive, Research-Teaching Intensive]: "We promote innovation by favoring the transfer of research results onto the market through patents, spin-offs and start-Ups in various fields. We have established a joint initiative with other universities to foster technology transfer by building a bridge between research laboratories and the industry and by attracting international investors. We also pursue this aim through collaboration with firms and industrial clusters, problem-oriented training activities focusing on entrepreneurship, and various dissemination and public engagement initiatives such contribution to the European researcher's night, an innovation pub, an annual crowdfunding contest collaboration with a leading reward/donation platform, and organization of business plan contests"

P111 [Comprehensive, Research-Teaching Intensive]: "The university represents the main attraction for students of the region. Characterized by the multidisciplinary of the training offer and the scientific areas of research, responds to the task of generating in the young people who attend it that 'critical thinking' which, together with research and innovation, is the engine of the development of an inclusive society and capable of responding to the increasingly complex challenges of today's globalization. The university's strategic planning enhances the identity and the territory and gives a strong boost to the cultural, social and economic development of the Region. Pursue this through the quality of the training offer, thanks to a highly qualified and highly qualified teaching characterized by research, innovation and dissemination of knowledge and a support structure effective and efficient. It is an ambitious project which, in enhancing the importance of mutual contamination between the university and the territory, underlines the role and social responsibility of our organization."

P156 [Comprehensive, Teaching Intensive]: "Till now, low attention has been paid to innovation actions and a clear strategy to increase innovation capacities does not exist. It is now under development. The collaboration university/companies are not much developed, due to the lack of policies to boost innovation capacities, but also due to the economy profile of our region, which is majorly devoted to tourism."

The *second dimension* is related to innovative capabilities impregnated in the university community to obtain innovative outcomes. According to the European University Association (2022a, p. 19), most respondents perceived those three key organizational characteristics that enhanced their university innovation capacity were: the qualified staff, sustainable funding, and cooperation among the innovation ecosystem actors. Likewise, other relevant conditions that have reinforced innovation capabilities are related to governance structures, autonomy, and IP regulations (Kozirog et al., 2022). Most of these elements have been recognized by empirical studies (see Audretsch et al., 2022a, b, c; Guerrero & Urbano, 2012). Indeed, these mechanisms are responsible for the main university innovative outcomes. However, the recognition of multiple innovation staff activities is not considered common practice in career evaluation, particularly when innovation is considered in a broader sense beyond intellectual property, beyond the commercialization of intellectual property, and the creation of innovative ventures. Particularly, these elements were

reinforced by the respondents who evaluated very-high their university innovation capability as follows:

P11 [Very-high innovation capacity]: "Uni's capacity for innovation is very high, as we develop innovative approaches to a wide range of topics with a broad range of study programs in faculties. In addition, the Uni and its location are integrated into a highly innovative infrastructure of projects, companies, alliances, and other universities."

P26 [Very-high innovation capacity]: "The innovative capacity of our university lies in the number of quality professors and researchers, in the number of high-level students it has, in the administration and services staff and in the infrastructures of its campuses, all in a medium-sized university that promotes quality teaching, research excellence and the transfer of results to society and companies."

P28 [Very-high innovation capacity]: "The University considers innovation a conscious and proactive practice. This means that it can and must, be measured on an ongoing basis. We adopted Key Performance Indicators (KPIs) as performance metrics that measure how effectively the University is performing its innovation capacity. For instance, we consider as KPI: the participation in European projects, Future and Emerging Technologies actions, Marie Sklodowska-Curie actions, the number of relations between research groups and companies, and the number of framework agreements signed between research groups and companies."

P62 [Very-high innovation capacity]: "The innovation capacity at Uni is a high potential, in chemical sciences. This potential is measured by one of the highest scores in the number of patent applications among Polish technology universities. However, the researchers are still offered too little organizational support to apply in practice outcomes of their basic research. Uni creates and strongly supports academic entrepreneurship, e.g., by becoming actively engaged in the creation and development of new innovative companies based on the intellectual property of the University, as well as through the dissemination of knowledge regarding the commercialization of innovative technologies and cooperation between the academic community and the economic environment. Activities undertaken by Uni staff resulted in establishing spin-off companies and signing licensing agreements with industrial partners for technologies developed with the support from the 'Innovation Incubator'."

P101: "University has well-established processes with supporting services for innovation propositions, invention disclosures, innovation proposals, trademarks, patenting, IPR (Intellectual Property Right), commercialization, and technology transfer. Uni has an online electronic tool to manage, assess, evaluate and maintain all IP-related documents and decisions for the entire lifespan of research projects, from research ideas and invention disclosures to patenting to commercialization of the research results. Uni TTO (Technology Transfer Offices) also uses other public and commercial IP tools in evaluation and assessments. Uni TTO has published its own guide for Uni researchers, personnel, and students to help and advice with matters related to IP, inventions, and commercialization, as well as knowledge transfer and technology transfer. Uni also has a Legal Services unit that supports the functions of the Uni TTO unit. Business Development Manager leads the unit, and the Innovation Managers are responsible for IP Management and TTO functions of the university. The innovation activity and IP portfolio at the Uni are annually followed using the indicators shown in the below table. Furthermore, the IP portfolio consisting of over 50 patent families and more than 100 trademarks are extensively analyzed and evaluated quarterly, reflecting both the stage of patent prosecution and the technology transfer agreements

made. The patent portfolio is constantly moving: while patent families are commercialized from the other end, new priority applications are made in nearly double-digit numbers yearly. Uni TTO also coordinates new trademark applications and registrations and manages the whole trademark portfolio of university."

The *third dimension* is related to innovative capabilities impregnated in the regional ecosystems and often part of general university performance frameworks (Audretsch et al., 2022). Several cases are captured by university impacts measured by universities' knowledge transfer and commercialization activities, patenting activity, preparation of the ground for business start-ups, and academic entrepreneurship. In the European context, universities have contributed to the smart specialization through collaborations with multiple partners enrolled in the innovation ecosystem (Bukhari et al., 2021). The EUA survey shows that for universities to remain drivers of innovation in these ecosystems, it is necessary to close the gap between their strategic commitment to innovation and their innovation capacity (Kozirog et al., 2022). It usually happens if policymakers support universities to attract and develop human talent, ensure sustainable investments in research and innovation, and build spaces where universities can co-create with all actors in innovation ecosystems. Particularly, these elements were also reinforced by the respondents who explained how their university innovation capability is fostered across the European Union states' members, as follows:

P6: "In Switzerland, innovation parks; innosuisse, and different initiatives to promote innovation in collaboration between universities and SMEs."

P13: "In England, the newly introduced 'Knowledge Exchange Framework' covers a good fraction of the intent behind the question, and seems to be a useful mechanism for assessing innovation and knowledge exchange effectiveness across the sector."

P25: "In Spain, the National Agency for HE evaluation has a pilot program evaluating innovative capabilities. Moreover, indicators of innovation are included in a six-year program sent by each HE to the Ministry for HE and Research. Concretely, this pilot project assesses the individual capacity of each researcher, considering six-year periods, in knowledge transfer activities (the so-called 'sexenio de transferencia')."

P27: "In Italy, the Ministry of University and Research established the Agency for the Evaluation of the University and Research System (ANVUR) oversee the national public quality assessment system of universities and research bodies. It assesses the effectiveness and efficiency of public funding and incentive programs for research and innovation activities. It evaluates technology transfer activities and, in particular, academic research on an annual basis."

P64: "In Hungry, fundamentally, the Ministry for Innovation and Technology as well as the National Research, Development and Innovation Office deliver such activities to assess regularly universities' innovation capacity."

P76: "In Ireland, Knowledge Transfer is charged by the Government to undertake an Annual Knowledge Transfer Survey and a report of performance of all Irish universities is published annually. Its remit is specific to commercialization and doesn't incorporate innovation capacity in the broader sense."

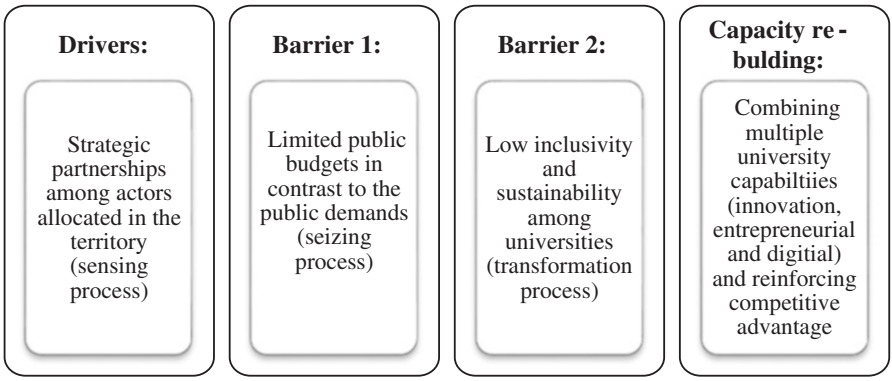

Fig. 6.2 Re-building innovation capability by European universities. (Source: Authors)

6.4.2 University Innovation Capabilities Challenges in Europe

According to the European University Association (2022a, pp. 48–50), the main challenges related to university innovation capabilities in Europe is the limited staff resources and the limited incentives to increase staff innovation motivation. The lack of sufficient funding, especially for long-term oriented strategies, defines the effectiveness of innovation outcomes (Tseng et al., 2020). Among EU members, the public investment in innovation varies from 3.1% GDP (e.g., Ireland) to 6.0% GDP (e.g., Belgium, Denmark, and Sweden). Likewise, another innovation capacity challenge is related to governance structures and autonomy among European higher education systems. Prior studies have evidenced that economic crises and natural disasters have stimulated innovative behaviors among individuals, organizations, governments, and universities (Hayat et al., 2018; Ibáñez et al., 2022).

With the COVID-19 pandemic, universities abruptly moved all activities toward the online scenario (Bormann et al., 2021; Brammer & Clark, 2020; Guerrero & Pugh, 2022) and reinforced innovative capabilities via developing new (open social innovation) solutions (Chesbrough, 2020; Dienel & Fava, 2021). As a result, the European Commission incorporated sustainable capacity innovation building into the policy framework agendas, such as the Innovation Union Flagship Initiative and the Recovery and the Resilience Mechanism (RRM). The RRM includes several reforms in six pillars: Green Transition; Digital Transformation; Social and Territorial Cohesion; Economic, Social and Institutional Health and Resilience; and Policies for the Next Generation, Children, and Youth. In addition, EU members have also mobilized funds to support digital innovation skills under the COVID-19 response investment initiative (e.g., Digital Education Action Plan 2021–2027). Another challenge is the role of the university in the maximization of the effectiveness of Strategies for Smart Specialization (RIS3) in developing regional innovation ecosystems. It is important to fully capitalize on tangible and intangible assets that universities offer to benefit the culture, society, and economy of their regions

(Bukhari et al., 2021; Temel et al., 2021). Likewise, it considers inclusiveness and equality across the university community (students, staff, researchers) and stakeholders (Guerrero & Pugh, 2022). Therefore, we hope this chapter provides some insights into the gaps that could be useful in future research for extending the understanding and empirical evidence about university innovation capabilities in different contexts.

6.5 Conclusions

Universities play a critical role in innovation (Castro, 2019), especially via developing innovation capabilities among research actors. Therefore, universities are enrolled in a privileged sector to improve skills through teaching and research programs (Mascarenhas et al., 2018; Vivar-Simon et al., 2022). It explains why universities are recognized for enhancing innovation skills via lifelong learning (Beliaeva et al., 2019; European University Association, 2022a, b).

Figure 6.2 shows the main conclusion of this chapter is that the European universities' innovative re-building of capabilities responds to the strategic partnerships among different actors allocated in their territory (Dienel & Fava, 2021). Likewise, by combining digital and innovative capabilities, university managers have responded to the most recently experienced COVID-19 crisis (Siegel & Guerrero, 2021). It is a very interesting interconnection between new challenges and previous experiences in sensing, seizing, and transforming (Teece et al., 1997) by reconfiguring business models (Teece, 2010; Teece & Leih, 2016) and ambidextrous tensions (Guerrero, 2021).

We identified two university challenges in the process of re-building of innovative capabilities. First, most universities are characterized by limited public budgets for innovation capabilities (Aguiar & Gagnepain, 2017) and transformative innovation policy (Švarc & Dabić, 2021). Therefore, taking advantage of regional innovation capabilities has been an alternative to compensate for this limitation among different innovation ecosystem actors (Fischer et al., 2018; Perkmann et al., 2013; Rippa & Secundo, 2019). For this reason, special attention should be paid to universities with lower innovation capacity to promote capacity building, networking opportunities, funding, incentives, and advice among those more experience in re-building innovative capabilities. Second, we identified a challenge associated with the low levels of inclusivity and sustainability among university innovation capabilities (Klofsten et al., 2019; Pugh et al., 2022). For example, universities should consider the high rates of migrant populations in European countries and the potential contribution to innovation processes (Dwyer & Gigliotti, 2017; Salmi & D'Addio, 2021). With scarce resources and uncertain socioeconomic environments, universities should adopt sustainable orientation in all strategies, particularly in developing innovative and technological solutions that benefit society and the environment (Dienel & Fava, 2021; Fischer et al., 2020, 2022; George et al., 2020; Schaeffer et al., 2021). It demands close collaboration between universities, civil

society organizations, and local public sector organizations (Klofsten et al., 2019; Teece et al., 2016).

Finally, regarding the university's role as a leader of the innovative system, efficient governance structures should be supported, and university autonomy should be promoted as a fundamental value (Peng et al., 2019; Dabić et al., 2022a, b). This will increase the universities' commitment to society by developing independent, high-quality, innovative solutions to current and future challenges. It explains the relevance of policy frameworks that promote open technology, open innovation practices, sustainability, and equality will create favorable conditions for frugal social innovations (Dabić et al., 2022a; Yáñez-Valdés & Guerrero, 2021, 2022). These are relevant pathways that universities should impregnate in their missions and activities. Likewise, future research should continue extending the academic conversation about re-building university innovation capabilities (Teece, 2023).

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References

Aguiar, L., & Gagnepain, P. (2017). European cooperative R & D and firm performance: Evidence based on funding differences in key actions. *International Journal of Industrial Organization, 53*, 1–31. https://doi.org/10.1016/j.ijindorg.2016.12.007. WE – Social Science Citation Index (SSCI).

Audretsch, D. B., Belitski, M., & Guerrero, M. (2022a). The dynamic contribution of innovation ecosystems to Schumpeterian firms: A multi-level analysis. *Journal of Business Research, 144*, 975–986.

Audretsch, D. B., Belitski, M., Guerrero, M., & Siegel, D. S. (2022b). Assessing the impact of the UK's research excellence framework on the relationship between university scholarly output and education and regional economic growth. *Academy of Management Learning & Education, 21*(3), 394–421.

Audretsch, D., Belitski, M., & Guerrero, M. (2022c). Seizing spin-offs' and parent universities' resources and capabilities: An intertemporal resilience. *In Academy of Management Proceedings, 2022*(1), 12882. Briarcliff Manor, NY 10510: Academy of Management.

Ávila, L. V., Leal Filho, W., Brandli, L., Macgregor, C. J., Molthan-Hill, P., Özuyar, P. G., & Moreira, R. M. (2017). Barriers to innovation and sustainability at universities around the world. *Journal of Cleaner Production, 164*, 1268–1278. https://doi.org/10.1016/j.jclepro.2017.07.025

Balocco, R., Cavallo, A., Ghezzi, A., & Berbegal-Mirabent, J. (2019). Lean business models change process in digital entrepreneurship. *Business Process Management Journal, 25,* 1520. https://doi.org/10.1108/BPMJ-07-2018-0194

Barnes, S. J. (2020). Information management research and practice in the post-COVID-19 world. *International Journal of Information Management, 55*, 102175.

Bauer, J. M. (2018). The internet and income inequality: Socio-economic challenges in a hyperconnected society. *Telecommunications Policy, 42*(4), 333–343.

Beliaeva, T., Ferasso, M., Kraus, S., & Damke, E. J. (2019). *Dynamics of digital entrepreneurship and the innovation ecosystem*. International Journal of Entrepreneurial Behavior & Research (Vol. 26, p. 266).

Bellini, E., Piroli, G., & Pennacchio, L. (2019). Collaborative know-how and trust in university–industry collaborations: Empirical evidence from ICT firms. *The Journal of Technology Transfer, 44*(6), 1939–1963.

Bormann, I., Brøgger, K., Pol, M., & Lazarová, B. (2021). COVID-19 and its effects: On the risk of social inequality through digitalization and the loss of trust in three European education systems. *European Educational Research Journal, 20*(5), 610–635.

Bozkurt, A., Jung, I., Xiao, J., Vladimirschi, V., Schuwer, R., Egorov, G., Lambert, S., Al-Freih, M., Pete, J., & Olcott, D., Jr. (2020). A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. *Asian Journal of Distance Education, 15*(1), 1–126.

Brammer, S., & Clark, T. (2020). COVID-19 and management education: Reflections on challenges, opportunities, and potential futures. *British Journal of Management, 31*(3), 453.

Bukhari, E., Dabic, M., Shifrer, D., Daim, T., & Meissner, D. (2021). Entrepreneurial university: The relationship between smart specialization innovation strategies and university-region collaboration. *Technology in Society, 65*, 101560.

Castro, R. (2019). Blended learning in higher education: Trends and capabilities. *Education and Information Technologies, 24*(4), 2523–2546. https://doi.org/10.1007/s10639-019-09886-3

Chesbrough, H. (2020). To recover faster from Covid-19, open up: Managerial implications from an open innovation perspective. *Industrial Marketing Management, 88*, 410–413.

Chin, T., Yang, Y., Zhang, P., Yu, X., & Cao, L. (2019). Co-creation of social innovation: Corporate universities as innovative strategies for Chinese firms to engage with society. *Sustainability, 11*(5), 1438.

Chung, S. (2002). Building a national innovation system through regional innovation systems. *Technovation, 22*(8), 485–491. https://doi.org/10.1016/S0166-4972(01)00035-9

Dabić, M., Vlačić, B., Guerrero, M., & Daim, T. U. (2022a). University spin-offs: the past, the present, and the future. *Studies in Higher Education*, 1–15. https://doi.org/10.1080/03075079.2022.2122656

Dabić, M., Obradović, T., Vlačić, B., Sahasranamam, S., & Paul, J. (2022b). Frugal innovations: A multidisciplinary review & agenda for future research. *Journal of Business Research, 142*, 914–929.

De Wit-de Vries, E., Dolfsma, W. A., van der Windt, H. J., & Gerkema, M. P. (2019). Knowledge transfer in university–industry research partnerships: A review. *The Journal of Technology Transfer, 44*(4), 1236–1255.

Dienel, H.-L., & Fava, V. (2021). Digital and sustainable innovation policies in Europe: Comparative lessons. *Innovation: The European Journal of Social Science Research, 34*(4), 423–425. https://doi.org/10.1080/13511610.2021.2000786

Dwyer, B., & Gigliotti, R. A. (2017). *From institutional diversity and inclusion to societal equity and justice: Higher education as a leadership training ground for the public good*. En Breaking the zero-sum game. Emerald Publishing Limited.

European Commission. (2018). *Proposal for a council recommendation on key competences for lifelong learning*. European Commission.

European University Association. (2022a). *Universities as key drivers of sustainable innovation ecosystems*. https://www.eua.eu/downloads/publications/innovation%20report.pdf

European University Association. (2022b). *Digital skills – Improving their provision*.

Fischer, B. B., Schaeffer, P. R., Vonortas, N. S., & Queiroz, S. (2018). Quality comes first: University-industry collaboration as a source of academic entrepreneurship in a developing country. *The Journal of Technology Transfer, 43*(2), 263–284.

Fischer, B., Guerrero, M., Guimón, J., & Schaeffer, P. R. (2020). Knowledge transfer for frugal innovation: Where do entrepreneurial universities stand? *Journal of Knowledge Management, 25*(2), 360–379. https://doi.org/10.1108/JKM-01-2020-0040

Fischer, B., Meissner, D., Vonortas, N., & Guerrero, M. (2022). Spatial features of entrepreneurial ecosystems. *Journal of Business Research, 147*, 27–36.

George, G., Merrill, R. K., & Schillebeeckx, S. J. D. (2020). *Digital sustainability and entrepreneurship: How digital innovations are helping tackle climate change and sustainable development*. Entrepreneurship: Theory and Practice. https://doi.org/10.1177/1042258719899425

Guerrero, M. (2021). Ambidexterity and entrepreneurship studies: A literature review and research agenda. *Foundations and Trends® in Entrepreneurship, 17(5–6), 436–650.*

Guerrero, M., & Pugh, R. (2022). Entrepreneurial universities' metamorphosis: Encountering technological and emotional disruptions in the COVID-19 ERA. *Technovation, 102584*, 102584.

Guerrero, M., & Urbano, D. (2012). The development of an entrepreneurial university. *The Journal of Technology Transfer, 37*(1), 43–74.

Guerrero, M., & Urbano, D. (2014). Academics' start-up intentions and knowledge filters: An individual perspective of the knowledge spillover theory of entrepreneurship. *Small Business Economics, 43*(1), 57–74.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M., & Mian, S. (2016). Entrepreneurial universities: emerging models in the new social and economic landscape. *Small Business Economics, 47*(3), 551–563.

Guerrero, M., Urbano, D., & Herrera, F. (2019). Innovation practices in emerging economies: Do university partnerships matter? *The Journal of Technology Transfer, 44*(2), 615–646.

Guerrero, M., Heaton, S., & Urbano, D. (2021). Building universities' intrapreneurial capabilities in the digital era: The role and impacts of Massive Open Online Courses (MOOCs). *Technovation, 99,* 102139.

Hayat, E., Liyanage, C., Haigh, R., & Amaratunga, D. (2018). Development of research and innovation capacity index of HEIs on disaster resilience related studies. *Procedia Engineering, 212*, 1249–1256.

Hayter, C. S., Fischer, B., & Rasmussen, E. (2022). Becoming an academic entrepreneur: how scientists develop an entrepreneurial identity. *Small Business Economics, 59*, 1469–1487.

Huybrechts, B., & Haugh, H. (2018). The roles of networks in institutionalizing new hybrid organizational forms: Insights from the European renewable energy cooperative network. *Organization Studies, 39*(8), 1085–1108.

Ibáñez, M. J., Guerrero, M., Yáñez-Valdés, C., & Barros-Celume, S. (2022). Digital social entrepreneurship: The N-helix response to stakeholders' COVID-19 needs. *Journal of Technology Transfer, 47*(2), 556–579.

Kirby, D. A., Guerrero, M., & Urbano, D. (2011). Making universities more entrepreneurial: Development of a model. *Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration, 28*(3), 302–316.

Klofsten, M., Fayolle, A., Guerrero, M., Mian, S., Urbano, D., & Wright, M. (2019). The entrepreneurial university as driver for economic growth and social change—Key strategic challenges. *Technological Forecasting and Social Change, 141*, 149–158. https://doi.org/10.1016/j.techfore.2018.12.004

Kozirog, K., Lucaci, S., & Berghmans, S. (2022). *Results of EUA survey on universities and innovation [data set]*. Zenodo. https://doi.org/10.5281/zenodo.5910909

Lawson, B., & Samson, D. (2001). Developing innovation capability in organisations: A dynamic capabilities approach. *International Journal of Innovation Management, 5*(03), 377–400.

Lee, J., Suh, T., Roy, D., & Baucus, M. (2019). Emerging technology and business model innovation: The case of artificial intelligence. *Journal of Open Innovation: Technology, Market, and Complexity, 5*(3), 44.

Mascarenhas, C., Ferreira, J. J., & Marques, C. (2018). University–industry cooperation: A systematic literature review and research agenda. *Science and Public Policy, 45*(5), 708–718.

Morrar, R., Arman, H., & Mousa, S. (2017). The fourth industrial revolution (Industry 4.0): A social innovation perspective. *Technology Innovation Management Review, 7*(11), 12–20.

Peng, F., Zhang, Q., Han, Z., Ding, Y., & Fu, N. (2019). Evolution characteristics of government-industry-university cooperative innovation network of electronic information industry in Liaoning Province, China. *Chinese Geographical Science, 29*(3), 528–540.

Perkmann, M., Salandra, R., Tartari, V., McKelvey, M., & Hughes, A. (2021). Academic engagement: A review of the literature 2011–2019. *Research Policy, 50*(1), 104114.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy, 42*(2), 423–442.

Pugh, R., Hamilton, E., Soetanto, D., Jack, S., Gibbons, A., & Ronan, N. (2022). Nuancing the roles of entrepreneurial universities in regional economic development. *Studies in Higher Education, 47*(5), 964–972.

Rådberg, K. K., & Löfsten, H. (2023). Developing a knowledge ecosystem for large-scale research infrastructure. *The Journal of Technology Transfer, 48*(1), 441–467.

Rippa, P., & Secundo, G. (2019). Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship. *Technological Forecasting and Social Change, 146*, 900–911.

Salmi, J., & D'Addio, A. (2021). Policies for achieving inclusion in higher education. *Policy Reviews in Higher Education, 5*(1), 47–72.

Schaeffer, P. R., Guerrero, M., & Fischer, B. B. (2021). Mutualism in ecosystems of innovation and entrepreneurship: A bidirectional perspective on universities' linkages. *Journal of Business Research, 134*, 184–197.

Siegel, D. S., & Guerrero, M. (2021). The impact of quarantines, lockdowns, and 'reopenings' on the commercialization of science: Micro and macro issues. *Journal of Management Studies, 58*(5), 1389–1394.

Švarc, J., & Dabić, M. (2021). Transformative innovation policy or how to escape peripheral policy paradox in European research peripheral countries. *Technology in Society, 67101705*, 101705. https://doi.org/10.1016/j.techsoc.2021.101705

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning, 43*(2–3), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Teece, D. J. (2023). The evolution of the dynamic capabilities framework. In *Artificiality and sustainability in entrepreneurship* (pp. 113–129). Springer.

Teece, D., & Leih, S. (2016). Uncertainty, innovation, and dynamic capabilities: An introduction. *California Management Review, 58*(4), 5–12.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.

Teece, D. J., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review, 58*(4), 13–35.

Temel, S., Dabić, M., Ar, I. M., Howells, J., Mert, A., & Yesilay, R. B. (2021). Exploring the relationship between university innovation intermediaries and patenting performance. *Technology in Society, 66*, 101665.

Tseng, F.-C., Huang, M.-H., & Chen, D.-Z. (2020). Factors of university–industry collaboration affecting university innovation performance. *The Journal of Technology Transfer, 45*(2), 560–577.

Van den Berg, C. (2018). Enriching the information systems curriculum to enable digital innovation capacity. *South African Journal of Higher Education, 32*(6), 215–233.

Vicente-Saez, R., Gustafsson, R., & Van den Brande, L. (2020). The dawn of an open exploration era: Emergent principles and practices of open science and innovation of university research teams in a digital world. *Technological Forecasting and Social Change, 156*, 120037. https://doi.org/10.1016/j.techfore.2020.120037

Vincent-Lancrin, S., Jacotin, G., Urgel, J., Kar, S., & González-Sancho, C. (2017). *Measuring innovation in education: A journey to the future*. OECD Publishing.

Vivar-Simon, M., Errasti, N., & Markuerkiaga, L. (2022). An analysis of the organisational factors that determine education-related university-business cooperation activities in manufacturing SMEs. *Studies in Higher Education, 47*(5), 982–989.

Wakkee, I., van der Sijde, P., Vaupell, C., & Ghuman, K. (2019). The university's role in sustainable development: Activating entrepreneurial scholars as agents of change. *Technological Forecasting and Social Change, 141,* 195–205.

Yáñez-Valdés, C., & Guerrero, M. (2021). Technology transfer policy framework in Chile. In *Technology transfer and entrepreneurial innovations* (pp. 103–113). Springer.

Yáñez-Valdés, C., & Guerrero, M. (2022). Technology transfer and frugal social innovations: Looking inside an emerging economy. In *Handbook of technology transfer* (pp. 249–265). Edward Elgar Publishing.

Younis, H., Katsioloudes, M., & Al Bakri, A. (2020). Digital entrepreneurship intentions of Qatar university students motivational factors identification: Digital entrepreneurship intentions. *International Journal of E-Entrepreneurship and Innovation (IJEEI), 10*(1), 56–74.