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Small Steps, Big Impact: Understanding University and Micro, Small and Medium Firms Collaborations for Future Growth.

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Abstract

Frame of the research. *The collaboration between universities and companies is widely regarded as mutually advantageous. Although Micro, Small, and Medium Enterprises (M&SMEs) are increasingly engaging with academic institutions, the majority of existing literature primarily focuses on large firms. Companies can achieve a competitive advantage through innovation, while universities can capitalize on research outcomes and refine their academic programs.*

Purpose of the paper. *This paper provides a systematic literature review on university-company collaborations, with a special focus on M&SMEs.*

Methodology. *The study adopts an integrated interpretative framework that examines four key perspectives: 1) who (the involved actors); 2) what (the inputs and outputs of the collaboration); 3) how (the modes of collaboration); and 4) why (the drivers, enabling factors, and barriers).*

Results. *A total of 69 Scopus-indexed journal articles published between 1987 and 2022 were selected and analyzed. Our analysis reveals a lack of a unified conceptualization of university-company collaboration, with limited use of theoretical frameworks.*

Originality of the paper. *The analysis identified a wide range of barriers and enabling factors, though their interdependencies are seldom explored. To guide future research, we propose 12 research avenues and discuss implications for academic managers, entrepreneurs, and policymakers.*

Key words: *Micro, Small, and Medium Enterprises; U-I collaboration; technology transfer*

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1. Introduction

The collaboration between universities and companies, commonly referred to as University-Industry collaboration (U-IC), has played a significant role in recent decades (El-Ferik and Al-Naser, 2021), leading to mutually beneficial outcomes (Pujotomo *et al.*, 2023). Such collaboration enables both actors to achieve their strategic aims and missions. For instance, companies can leverage unique technologies developed by universities, while universities can exploit research results and adapt curricula to meet firms' demands. University-industry collaboration (U-IC) also benefits the social and economic system, potentially boosting economic growth and sustainable development.

Albeit the U-IC may be implemented by every type of company, the extant literature is mainly focused on large firms (Parmentola *et al.*, 2021; Pereira and Franco, 2023). However, such companies are no longer the only ones to collaborate with universities (Rantala and Ukko, 2018). Although Micro and Small and Medium enterprises (M&SMEs) generally prefer to develop innovations through interactions with suppliers and providers (Garcia-Perez-de-Lema *et al.*, 2017), an increasing number of such firms are activating links with universities in order to create an adequate competitive advantage (Bishop *et al.*, 2011; Perkmann and Walsh, 2007). Focusing specifically on collaborations between universities and M&SMEs, rather than the broader spectrum of university-industry collaborations, can provide a more nuanced and comprehensive understanding of the issue for several reasons:

- M&SMEs often face different challenges compared to larger firms, such as limited financial resources and human resources to engage in collaboration (Lin and Yang, 2020); less formalized R&D processes, a greater need for external innovation, and often lack an adequate level of absorptive capacity (Cohen and Levinthal, 1990). Understanding these specific challenges can lead to more effective strategies for facilitating collaborations that address the unique needs of M&SMEs (Ranga *et al.*, 2008).
- M&SMEs may require different types of support from universities compared to larger companies. By focusing on this specific subset, researchers can develop tailored support mechanisms and frameworks that are better suited to the capacities and requirements of M&SMEs.
- M&SMEs are vital for local and regional economies, contributing significantly to job creation and economic diversification. Investigating their collaborations with universities can reveal insights into how these partnerships can drive regional economic development and innovation.
- The dynamics of collaboration between M&SMEs and universities can differ significantly from those involving larger firms. These dynamics include decision-making processes, relationship-building, and knowledge exchange practices. Understanding these distinct dynamics can help in designing better collaboration models.
- The barriers and enablers of successful collaboration may vary significantly between M&SMEs and larger companies. Focusing on M&SMEs allows for a detailed examination of these factors, leading to more specific and actionable recommendations for fostering successful partnerships.

Finally, Fransman (2008) states that the costs and benefits of U-IC are dependent on firms' size. Therefore, the collaboration between M&SMEs and universities emerges as a topic worth investigating as a specific focus within the broader field of study concerning U-IC. In this respect, recently, Pereira and Franco (2022) proposed a structured literature review aimed at investigating the characteristics of the collaboration between SMEs and universities. In so doing they analyzed 71 journal articles published only between 1995 and 2019. As recently pointed out by Bengoa *et al.* (2021) topics such as U-IC and technology transfer area are increasingly attracting the attention of scholars; therefore, "periodic literature reviews are necessary to recompile and synthesize the topics studied" (2021, p. 1542). Moreover, the analysis conducted by Pereira and Franco (2022) was mainly focused on bibliometric issues (e.g., most cited articles, most productive scholars) and offer a general description of the collaboration characteristics. Finally, it seems some of the selected sources refer to the more general U-IC phenomenon (see, for instance, Etzkowitz and Leydesdorff, 2000; Hewitt-Dundas, 2012; Lockett *et al.*, 2008).

Based on such evidence, a deeper and updated analysis of the extant literature on the relationship between Universities and M&SMEs is needed. Moreover, it should be based on an integrated explorative framework allowing the attention to be focused on the different issues characterizing such collaboration. In this respect, a useful approach is the one based on the 3W (Who, What, Why) and 1H (How) questions, which are often adopted to describe phenomena. More specifically, we suggest deepening the following research questions:

RQ1. Who are the actors involved in the collaboration between universities (e.g., public vs. private; regional vs. national vs. international) and M&SME (classified in terms of industries, size, etc.)?

RQ2. What contents are exchanged during the collaboration?

RQ3. How do universities and M&SMEs interact during the collaboration?

RQ4. Why do universities and M&SMES collaborate? Why may such collaboration result in either being effective or failing?

In order to answer these research questions, the rest of the paper is divided into four main sections, the first of which offers a detailed description of the methodology adopted to implement the structured literature review. The following section contains findings articulated according to the four research questions earlier described. After this, avenues for future research are proposed based on previous findings. Concluding remarks, implications and limitations are summarized in the last section.

2. Methodology

This paper aims to shed new light on the collaboration between M&SMEs and Universities according to the four different RQs earlier proposed. More specifically, to reach the paper's aims, the authors developed a systematic review of the extant literature (Fink, 2005) adopting the Seuring and Gold (2012) process model for content analysis which is articulated in four main steps. The first one - referred to as "material collection" - concerns documents to be analyzed in the following steps. In this regard, attention was focused on Scopus indexed articles published in academic journals, since such a dataset is recognized as one of the top databases (Greenwood, 2011). We considered journal articles published until 2022 and written in English, independently of the Scopus categories (e.g., Business and management, Humanities). Based on such an approach, 162 documents were found, of which 17 were duplications. Each co-author carefully analyzed the abstract, in order to include or exclude the single document. In the case of discordance, the entire text was read by all the authors and a common decision was taken based on the following exclusion criteria:

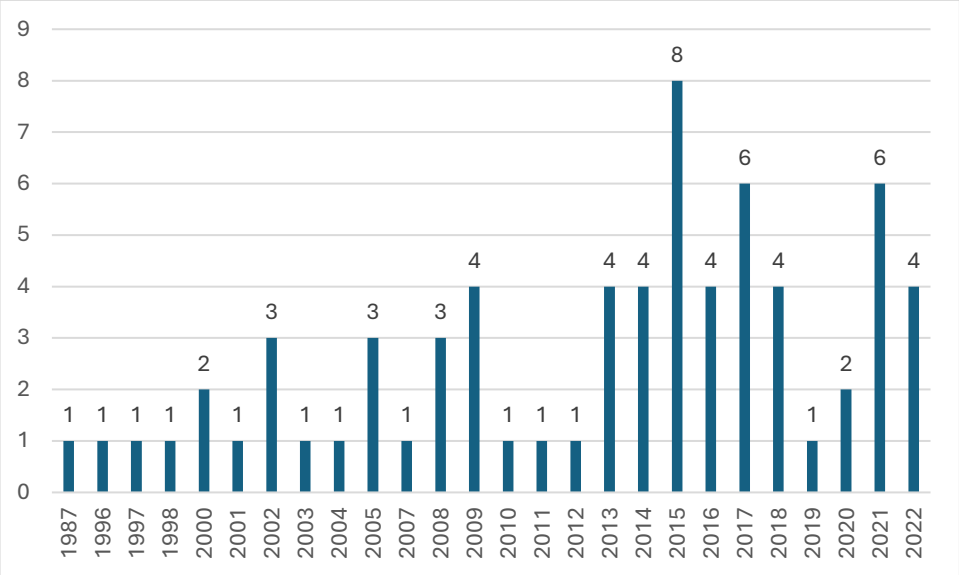
a) papers containing only a review of the extant literature (e.g., McCullogh, 2003; Pereira and Franco, 2022);
b) articles regarding research centers other than universities (e.g., Puglia *et al.*, 2020). Moreover, documents regarding both universities and other research centers were excluded if findings related to the academic side were not specifically available and mixed with the ones belonging to other research centers (e.g., Pinto *et al.*, 2015);
c) articles referring to both M&SMEs and large companies when findings were not split among the different sized categories (e.g., Pinto *et al.*, 2015; Serbanica *et al.*, 2015);
d) documents regarding collaborations where the relationships between the university and M&SMEs are "intermediated" by external actors (e.g., Battaglia and Neirotti, 2022; Foray and Woerter, 2021; Hassink, 1996; Kodama, 2008; Nishimura and Okamuro, 2011). However, direct relationships financed by third parties (e.g., national and regional governments) were included (e.g., Azzone and Maccarrone, 1997; Corsi *et al.*, 2022);

e) documents regarding technology transfer activities implemented through the creation of university spin-offs. However, collaborations with already established university spin-offs were included.

In adopting these criteria, 79 documents were excluded; at the same time, three more articles were included based on the snowball method (Wohlin *et al.*, 2022). The final list of documents included in the systematic literature review consisted of 69 documents published from 1987 to 2022 in 53 different journals. The time span is larger than the one earlier identified by Pereira and Franco (2022) which found documents only from 1995.

The second step of the Seuring and Gold (2012) process model concerns the "descriptive analysis". Therefore, the authors analyzed the formal characteristics of the selected documents. In this regard, the data summarized in Figure 1 show that the interest of scholars has considerably increased since 2013 (with the partial exception of 2019), confirming earlier findings by Pereira and Franco (2022).

Fig. 1 - Breakdown of sampled documents by year



Source: own elaboration

When considering the documents' source, only six out of the 53 sampled journals published more than one article in the considered time span (1987-2022) (Table 1). Moreover, journals belong to a large number of those in the Scopus Journal category; however, the two most relevant are the Social Science and Business, Management and Accounting ones. This finding is consistent with the ones previously proposed by Pereira and Franco (2022).

Tab. 1 - Breakdown of sampled documents by year

Journal	Number of documents
Industry and Higher Education	7
Technovation	6
European Journal of Innovation Management	4
Economics of Innovation and New Technology	3
Journal of Technology Transfer	3
Journal of Business and Industrial Marketing	2
Small Enterprise Research	2
Technological Forecasting and Social Change	2
Advanced Biomedical Engineering	1
ARPN Journal of Engineering and Applied Sciences	1
Asia Pacific Business Review	1
Asia Pacific Management Review	1
Asian Journal of Technology Innovation	1
British Journal of Management	1
Design Journal	1
Design Studies	1
Economic Development Quarterly	1
Education and Training	1
European Journal of Engineering Education	1
Frontiers of Business Research in China	1
Industrial and Commercial Training	1
Industrial Management and Data Systems	1
Industry and Innovation	1
International Journal of Manufacturing Technology and Management	1
International Journal of Advanced Manufacturing Technology	1
International Journal of Educational Management	1
International Journal of Entrepreneurship and Innovation	1
International Journal of Knowledge Management	1
International Journal of Management	1
International Journal of Technology, Knowledge and Society	1
Italian Economic Journal	1
Journal of Chinese Economic and Business Studies	1
Journal of Education and Work	1
Journal of Engineering Science and Technology Review	1
Journal of Food Engineering	1
Journal of Management and Organization	1
Journal of Regional Science	1
Journal of Rural Studies	1
Journal of Science and Technology Policy Management	1
Journal of Small Business and Enterprise Development	1
Journal of Technology Management and Innovation	1
Journal of the Knowledge Economy	1
Mediterranean Journal of Social Sciences	1
Prometheus (United Kingdom)	1
Quality - Access to Success	1
Science and Public Policy	1
Sustainability	1

Source: own elaboration

In terms of reference theories, the majority of sampled articles (42 out of 69) does not refer to any theoretical approach. Among the remaining 27 documents, 14 adopted a single theoretical framework, and 13 from two to four (Table 2). The most referred to framework is the Triple helix theory; however, in six out of eight documents it was integrated with other ones; in contrast, the Open innovation theoretical approach is mainly used as a single framework.

Tab. 2 - Breakdown of sampled documents by theoretical framework

Theoretical framework	Number of documents	Single framework	Multiple framework
Triple Helix Theory	8	2	6
Open Innovation	4	3	1
Absorptive capacity	4	2	2
Resource Based View	4		4
Design thinking	2	1	1
Innovation Systems	2	1	1
Institutional Theory	2	1	1
Competence-based Theory	1	1	
Knowledge-based (endogenous) economic growth theories	1	1	
Network analysis	1	1	
Social Capital Theory	1	1	
Adaptive Learning	1		1
Boundary Cross Concept	1		1
Co-design	1		1
Industrial Marketing & Purchasing	1		1
Innovation Management Perspective	1		1
Innovation theory	1		1
Knowledge-based view	1		1
Network-revised Uppsala Theory	1		1
New Product Development	1		1
Organizational learning perspective	1		1
Relational view	1		1
Semiotic Interaction Model	1		1
Transaction Cost Economy	1		1
Trust Theory	1		1

Source: own elaboration

In order to characterize the extant literature in terms of adopted research methodologies, a further analysis was developed showing that only two papers have a conceptual nature (Caputo *et al.*, 2002; Xu, 2013). Among the remaining articles, most of documents are based on qualitative methods, while mixed ones are very rarely adopted (Table 3). It is worth noting that these results are consistent with previous findings by Pujomoto *et al.* (2023) when they analyzed 176 articles referring to the university-industry collaboration topic, independently of the firms' size. Within the qualitative methods, single and multiple case studies were the most diffused, while the survey is the one most adopted among the quantitative ones.

Tab. 3 - Breakdown of sampled document by adopted research typology and methods

Research typology	Research methods	Number of documents
Qualitative	Single case Study	16
	Multiple case Study	11
	Interview	5
	Action research	1
	Desk research analysis + Documentary analysis	1
	Single case study + Action research	1
	Single case study + Auto ethnographic approach	1
	Total	*36*
Quantitative	Survey	16
	Secondary data	7
	Total	*23*
Conceptual	***Total***	*2*
Mixed methods	Survey + Interview	4
	Survey + Single case study	1
	Survey + Multiple case study	1
	Survey + Anecdotal evidence	1
	Survey + Single case study + Action research	1
	Total	*8*
Total		**69**

Source: own elaboration

A further useful insight emerges considering the time span of empirical analyses implemented in the extant literature. More specifically, only 13 out of the 67 empirical studies analyzed the phenomenon in at least a three-year period.

At the same time, Garcia-Alvarez-Coque *et al.* (2019) pointed out that universities relate differently from external actors on the basis of their nature (e.g., public vs. private ones) and the environment in which they are embedded. Therefore, further interesting evidence emerges when considering countries investigated in the 67 articles containing empirical analyses (Table 4). Differently from previous studies (Nsanzumuhire and Groot, 2020), scholars analyzed a differentiated set of countries (32), including some with a lower technological development. Moreover, investigated countries emerge as highly differentiated also in terms of the indicator "University-industry collaboration in R&D" (ranging from 1 to 7) reported by the World Economic Forum within "The Global Competitiveness Report". In Table 4 data for this indicator are reported for both the WEF 2014/2015 and WEF 2019 editions of the Report.

Tab. 4 - Breakdown of empirical sampled documents by country

Country	Number of documents	WEF 2014/15	WEF 2019	Δ 2014/15 -2019
UK	14	5.7	4.9	-0.8
Italy	9	3.7	3.7	0
Australia	6	4.8	4.3	-0.5
Japan	4	5	4.7	-0.3
Sweden	4	5.3	5.3	0
Taiwan	4	5.1	4.7	-0.4
Spain	3	3.8	3.6	-0.2
Austria	2	4.7	4.8	0.1
Croatia	2	3.4	3	-0.4
Denmark	2	4.9	5.2	0.3
Estonia	2	4.4	4.2	-0.2
Finland	2	6	5.3	-0.7
Germany	2	5.3	5.2	-0.1
Indonesia	2	4.5	4.6	0.1
USA	2	5.8	5.4	-0.4
Canada	1	4.9	4.8	-0.1
China	1	4.4	4.4	0
Colombia	1	3.9	3.7	-0.2
United Arab Emirates	1	4.7	4.8	0.1
France	1	4.6	4.5	-0.1
Hong Kong	1	4.6	4.9	0.3
Hungary	1	4.3	3.3	-1
Ireland	1	5.2	4.8	-0.4
Poland	1	3.5	3.2	-0.3
Romania	1	3.6	3.4	-0.2
Slovakia	1	3.4	3.6	0.2
Slovenia	1	4	4	0
South Africa	1	4.5	4.2	-0.3
Thailand	1	4	4.1	0.1
The Netherlands	1	5.4	5.4	0
Turkey	1	3.7	3.6	-0.1
Zimbabwe	1	2.8	3.2	0.4

Source: own elaboration on WEF data (WEF_GlobalCompetitivenessReport_2014-15.pdf (weforum.org); Global Competitiveness Report 2019 | World Economic Forum (weforum.org))

The choice of countries, however, seems not to be based on the percentage of M&SMEs on total firms, since it is generally more than 98% (European Commission, 2020). Finally, partially differently from Pereira and Franco (2022), the most investigated countries - after the UK are Italy, Australia, Japan, Taiwan and Sweden, while Spain has only two evidences. Moreover, differently from Pereira and Franco (2022), our data also show that scholars analyzed less developed regions, especially in

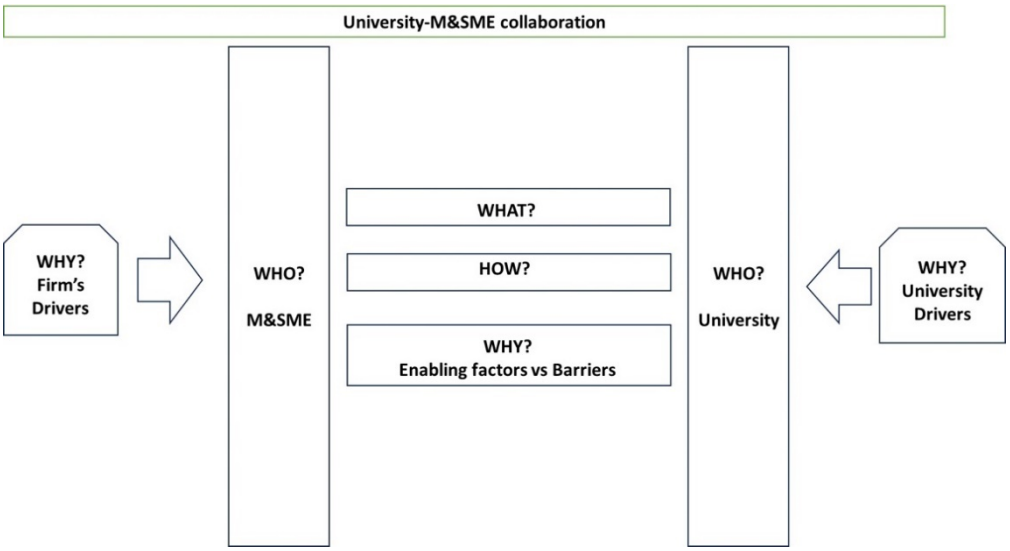
Asia. Finally, only four articles offer a comparison of the phenomenon among countries ranging from two to six.

A final characterization of the sampled articles is regarding the presence of definitions of the collaboration between universities and M&SMEs. The authors found that only seven out of the 69 chosen documents offer a clear definition of the investigated phenomenon. This finding is quite similar to the one reached by Bengoa *et al.* (2021) which investigated 3,218 journal articles analyzing the wider phenomenon of technology transfer, which includes the one investigated in this article. They explained such a limited result, stating the concept (technology transfer) is "a complex, difficult process that also needs time to evolve" (Bengoa *et al.*, 2021). Such an interpretation could also be adopted for the collaboration between M&SMEs and universities, since a large number of modes may be implemented, as will be shown when discussing the findings regarding RQ3.

The third step of the analysis was "category selection", which consists of defining the analytical categories to classify documents' contents. As already pointed out in the Introduction, the authors adopted a four questions approach analyzing the "Who", "What", "Why" and "How" dimensions of the investigated phenomenon, as earlier described when presenting the RQs. In Figure 2, the adopted interpretative framework is synthesized. In order to operationally describe the contents of each RQ, a short description of the investigated variables is provided as follows:

a) Who: RQ1 is in regard to the actors involved in the collaboration (universities vs. M&SMEs);
b) What: RQ2 concerns, first of all, the nature of inputs (e.g., the nature of the transferred/developed knowledge/technology) and outputs (e.g., typology of the innovation deriving from the transfer) characterizing the collaboration. Based on such analysis, the directionality of the relationships is classified, making it possible to find two main alternatives, namely unidirectional - as in the case of contract research commissioned by a M&SME to the University - and collaborative/joint agreement (Capaldo *et al.*, 2016) - when the research project requires the engagement of both partners;
c) How: RQ3 is related to the modes adopted by universities and M&SMEs to implement the collaboration and their possible classifications;
d) Why: RQ4 looks at three different issues. The first is related to factors inducing universities and M&SMEs to collaborate (drivers), the second refers to elements facilitating the relationships (enabling factors) and the third one concerns those hindering it (barriers).

Fig. 2 - The adopted interpretative framework



Source: own elaboration

The final step of Seuring and Gold's (2012) process model for content analysis is regarding material evaluation. This activity was performed by reading, analyzing and coding all selected documents according the four RQs presented earlier. The process reliability was improved by

discussion among authors (researcher triangulation) and by ensuring process documentation (Denyer and Tranfield, 2009).

3. Findings

3.1 The Who issue

RQ1 (Who?) concerns the actors involved in the investigated collaborations. On the academic side, three articles also direct their focus towards other higher education institutions and research centers (Azzone and Maccarrone, 1997; Cloutier and Amara, 2018; Collier *et al.*, 2011). Furthermore, while 41 out of 69 documents discuss universities in general terms, some authors specifically examine different types of these institutions (Table 5), primarily distinguishing between public and private entities. Additionally, specific actors within the university, such as Technology Transfer Offices (TTOs), were analyzed as distinct units.

Tab. 5 - Typologies of investigated universities and actors within them

Typologies of university	**Number of documents**	**Reference code in Appendix 1**
Universities in general	41	1;2;4;5;6;8;11;12;14;15;16;18;22;23;25;26;27;28; 29;30;35;36;37;38;39;40;42;49;50;53;54;56;57;58;59;60;61;63;64;68;69
Public University	6	7;9;13;32;55;66
Private University	4	7; 32; 55; 66
Regional & Small University	2	17; 55
Foreign University	2	17; 22
Interstate University	1	17
International branch campus	1	7
University of applied studies	1	46
Technical University & Polytechnic	1	19
Business School	1	20
Medical Research University	1	21
Type of actor within university	**Number of documents**	**Reference code in Appendix 1**
Technology Transfer Office	6	16; 17; 24; 31; 37; 62
Department	2	10; 48
Professional Innovation Support Officers	1	37
University Center of excellence	1	41
University technology station	1	51
University Design Research unit	1	65
Principal Investigator	1	52
Professors in Engineering Dept.	1	66
Professors in Biomedical Dept.	1	66

Source: own elaboration

When examining the perspective of firms, Lundberg and Öberg (2021) stand out as the sole authors to conceptualize companies not merely as recipients of technology/knowledge transfer or partners in joint research collaborations, but also as contributors of novel findings for the academic sphere. Furthermore, while 48 articles exclusively focus on Small and Medium Enterprises (SMEs), the remaining 21 also encompass micro-enterprises (Table 6). This discovery holds particular significance, as micro-enterprises constitute a vast majority within international economic systems. Additionally, while the majority of documents (54) address Micro, Small, and Medium Enterprises (M&SMEs) collectively, some authors scrutinize specific categories of companies. For instance, Ndabeni and Maharajh (2009) specifically examine low-tech companies, whereas Rajalo and Vadi (2021) focus on entities with limited innovation capacity.

Tab. 6 - Typologies of investigated M&SMEs

Classification based on the size	**Number of documents**	**Reference code in Appendix 1**
SME only	48	1;2;4;5;6;7;8;9;11;12;13;15;17;18;19;23;25;27;28; 30;32;35;36;37;39;49;40;42;43;44;45;46;47;48;50; 52;53;55;58;59;60;61;63;64;65;66;67;68;69
M&SME	21	3;10;14;16;20;21;22;24;26;28;31;33;34;38;41;49;51;54;56;57;62
Other firm's characteristics	**Number of documents**	**Reference code in Appendix 1**
SMEs in general	54	1;2;3;4;5;7;8;10;11;12;13;14;15;16;18;19;20;21;22;23;25;27;28; 29;31;32;33;34;36;37;38;39;40;41;42; 43;44;45;46;48;50;53;54;55;57;58;60;63;64;65;66; 67;68;69
Start up	3	47;52;59
Young firm	2	6;26
Spin-off	1	6
Old firms	1	26
Firm targeting national mkt	1	6
Academic firm	1	9
Science intensive firms	1	9
Firms purely dedicated to development	1	9
High technology	1	17
Innovative firms	1	24
Low technology but innovative firms	1	30
Rural SME	1	35
New technology firms	1	49
Patent applicant	1	49
Low tech	1	51
National vs. International SMEs	1	52
Low innovation capacity firms	1	56
Firms with R&D Department	1	61
High Growth	1	62

Source: own elaboration

A further useful characterization of investigated companies is the industry they belong to (Table 7). Excluding the two conceptual papers mentioned above, 34 documents concern only one industry, 15 concern two of them while only Asplund and Bengtsson (2020), Capaldo *et al.* (2016) and Garcia-Perez-de-Lema *et al.* (2017) offer a more longitudinal perspective (three sectors). More specifically, the most investigated sector is the manufacturing one (46), while the construction industry was analyzed by only two articles.

Tab. 7 - Breakdown of investigated M&SMEs by sector and industry

Sector/Industry		**Number of documents**	**Reference code in Appendix 1**
No specific sector		14	4;7;8;24;36;37;39;52;54;55;56;61;63;66
Manufacturing		46	
	Manufacturing in general		2;16;17;18;20;22;27;30;31;32;35;38;41;42;44;49;50; 67
	Manufacturing multi-industry		3;9;10;11;13;15;19;23;26;34;40;43;45;51;57;59;62
	Metal based industry		28;29;46
	Biomedical		1;5;47
	Life science		21
	Food industry		48
	Furniture		53
	Cosmetics		64
	Machinery		69
Construction		3	3;13;26
Service		25	
	Service multi-industry		3;9;10;23;26;33;34;57;62;67
	Service in general		13;20;27;38;49;51;58;60
	ICT		5;6;11;12;25;45
	Manufacturing services		65

Source: own elaboration

3.2 The What issue

RQ2 (What?) examines three distinct issues: the nature of inputs and outputs defining the collaboration, and its directionality. Regarding the latter, following Capaldo *et al.* (2016), documents were categorized into two alternatives: unidirectional technology/knowledge transfer and collaborative research projects. Only 49 out of the 69 articles explicitly address the relationship type, evenly distributed between the two alternatives; meanwhile, approximately one-third of the selected articles consider both simultaneously (Table 8).

Tab. 8 - Directionality of collaboration

Directionality	Number of documents	Reference codes in Appendix 1
Joint research	17	1;9;10;11;15;16;34;39;47;53;54;56;59;60;64;65;69
Unidirectional Technology Transfer	16	5;8;13;19;21;25;26;30;32;33;43;44;52;61;67;68
Both	16	2;4;6;14;17;27;31;36;38;40;42;48;49;55;57;62

Source: own elaboration

While investigations into inputs were relatively scarce (only 10 documents), they primarily centered around tacit knowledge (Table 9). However, a diverse range of output types were explored, encompassing ten different categories, with product and process innovation emerging as the most frequently cited (Table 10). Notably, certain studies delved into outputs associated with earlier stages of the innovation process, such as technology demonstration (three documents) and proof of concept (two documents). The significance of the former output is underscored in the context of Micro and Small and Medium Enterprises (M&SMEs), given their resource constraints and risk-averse tendencies. In this regard, the technology demonstration provided by universities may alleviate barriers impeding the innovation process for M&SMEs

Tab. 9 - Breakdown by collaboration input

Typology of knowledge	Number of documents	Reference codes in Appendix 1
Tacit knowledge	7	2;24;25;27;28;45;68
Technical knowledge	3	8;9;33
Codified knowledge	1	28
Basic knowledge	1	2
Codified scientific and technology knowledge	1	2

Source: own elaboration

Tab. 10 - Breakdown by collaboration output

Typology of innovation content	Number of documents	Reference codes in Appendix 1
Product innovation	15	3;16;19;22;30;35;36;37;43;44;51;52;64;67;69
Process innovation	9	3;16;19;22;29;30;36;44;51
Marketing innovation	6	3;22;33;36;43;64
Organizational innovation	4	3;22;64;67
Service innovation	3	35;60;67
Technology demonstration	3	8;44;51
Proof of concept	2	27;54
Managerial innovation	1	14
Technological innovation	1	14
Innovation activities (general/not specific)	1	46
Innovations to be adapted	1	14
New method	1	37

Source: own elaboration

3.3 The How issue

RQ3 (How?) refers to the modes of interaction that universities and M&SMEs use during the collaboration. Scholars identified 22 different alternatives, ranging from MSc and/or PhD theses and co-design projects. Therefore, it seems useful in implementing their analysis to classify them into

homogeneous categories (Table 11). In this regard, very few authors proposed specific classifications; moreover, such proposals differ in terms of adopted criteria. However, three main typologies of these criteria seem to emerge:

a) Collaboration aims: this classification criterion is regarding aims inducing M&SMEs and universities to collaborate. Such a criterion was initially proposed by Perkmann and Walsh (2007) who identified the following two alternatives: i) "academic engagement" - where the receiver aims to have access to the university base of knowledge (e.g., contract and/or collaborative research, training, consultancy); and ii) "commercialization" - where the receiver aims to have access to university research outputs (e.g., through patents sale and/or licensing). In other terms, while "academic engagement" is a form of knowledge-related collaboration between partners (Bozeman *et al.*, 2013), "commercialization" represents a sort of "market acceptance" for academic research results (Capaldo *et al.*, 2016; Markman *et al.*, 2008). The classification under investigation may be considered similar to the one proposed by Corral de Zubielqui *et al.* (2015), which differentiates between university-industry links and relationships. While in the former the receiver aims to access university resources and research outputs and/or activate human mobility transfer (e.g., graduate recruiting), the latter is regarding the development of new research outputs. Therefore, while "relationships" are consistent with the "academic engagement" alternative, "links" refer to the "commercialization" one. Finally, Jones *et al.* (2017) propose differentiating between "generic links" - which is regarding knowledge/technology transfer - and "relational links" - which includes either research services or research partnerships. Therefore, while generic links are more similar to the commercialization option, the relational links fit better with the academic engagement alternative;
b) Content-based: such a criterion concerns the content of the relationships between universities and M&SMEs. In this regard, Brimble and Doner (2007) identified three main categories, namely: training and education, consultancy services, and research. In contrast, Pinto *et al.* (2015) offer a more articulated set of contents, including: i) advanced services (e.g., consultancy and contract research); ii) collaborative research (e.g., joint R&D projects); iii) human resource-based activities (e.g., internships for graduates, exchange of personnel, training for employees); iv) commercialization activities (e.g., patent exploitation, participation in spin-offs); and v) informal relationships;
c) Degree of formalization/Governance mode: Garcia-Perez-de-Lema *et al.* (2017) differentiated the collaborations between universities and M&SMEs according to the mode by which they are governed. More specifically, they propose two alternative approaches, namely: contractual-based and relational-based. While the former typology includes collaboration modes such as research conventions, R&D development projects and innovation ones, the latter includes business alternatives such as business and/or technical training, consultancy and fellowships for students. More recently, Apa *et al.* (2021) suggested differentiating between collaborations according to the degree of formalization, i.e. differentiating between formal and informal ones. The formal category includes "personal formal collaborations" (e.g., student internships and use of university facilities), "formal non-targeted agreements" (e.g., endowed chairs and advisory boards), and "formal targeted agreements" (e.g., patenting and licensing agreements and cooperative research projects). In contrast, informal collaborations include a set of personal informal relationships (e.g., joint and individual lectures and academic spin-offs).

When considering the single mode universities and M&SMEs adopt to manage the collaboration, a large number of specific alternatives were proposed in the extant literature. In this respect, Apa *et al.* (2021) proposed the most complete list, which comprises 28 different alternatives, grouped according to the degree of formalization.

Based on Pinto *et al.*'s (2015) criteria, in Table 11, collaboration modes are classified according to their content; it emerges that the ones based on human resources are the most diffused. This may be, at least partially, explained by the lack of skilled personnel within M&SMEs, with innovation and R&D activity often being outsourced (Hojnik and Rebernik, 2012). In this regard, it is worth noting that Masters and PhD students are often adopted as providers of innovation, especially when academia

supports them as supervisors. However, Gold *et al.* (1996) claim that such a collaboration mode is not free of obstacles and failure risks. Finally, several articles point out the relevance of public financial support for this type of collaboration, especially in the UK (Humphries, 2005; Lipscomb and McEwan, 2001).

The second most frequent category of collaboration modes is regarding the supply of advanced services - especially research contracts. At the same time, commercialization concerns almost exclusively patent licensing/transfer, while collaborative research is rarely implemented. This evidence confirms the M&SMEs' propensity to buy knowledge/innovation more than to internally develop it (Brunswicker and Vanhaverbeke, 2015; Mas-Tur and Ribeiro-Soriano, 2014; Ribeiro-Soriano, 2017; Vahter *et al.*, 2014). Finally, it is worth noting that the informal provision of structured knowledge (e.g., publication) and even information, is a service often appreciated by M&SMEs.

Tab. 11 - Breakdown of collaboration modes by content

Classification (according Pinto *et al.*, 2015)	**Collaboration modes**	**Number of documents**	**Reference codes in Appendix 1**
Human resource-based activities	MSc and/or PhD Thesis	8	3;6;18;31;40;42;44;47
	Researcher's transfer to the SME	8	8;14;19;22;27;28;29;36
	Employing new graduate students	6	4;17;22;31;34;36
	Support in recruiting	1	6
	Academics in the SME board	1	17
	Adjunct Professor	1	17
	Short-term transfer program	1	28
	Collaboration for student training	1	36
Advanced services	Research contract	6	13;17;22;36;40;42
	Use of university facilities/equipment	4	4;8;22;36
	Manufacturing of prototype	1	51
	Technological audits	1	51
	Co-design	1	53
	Design and manufacturing of new products	1	63
Commercialization	Patent licensing and/or transfer	7	4;6;8;17;21;36;63
	Copyright licensing	1	6
	Transfer of plants	1	19
Collaborative research	Joint patent development	1	55
	Co-authorship	1	9
Informal relationship	Access to publications and reports	6	6;17;22;31;36;40
Informal relationship	Provision of information	4	5;6;8;31

Source: own elaboration

3.4 The Why issue

RQ4 (Why?) analyzes three different elements, namely *drivers* inducing collaboration, *enabling factors* and *barriers* which either facilitate or hinder the cooperation between universities and M&SMEs. In the following subsections findings related to these three elements will be discussed.

Drivers

In order to investigate the drivers, the analysis is articulated according to the collaboration partner; therefore, the ones inducing universities to cooperate are presented before those characterizing M&SMEs. In this respect, the findings show university-related drivers were rarely investigated by scholars. More specifically, only six out of the 69 selected articles proposed a total amount of 15 items ranging from one to six. In order to better analyze such elements, the authors divided them into two main categories, namely the "institutional level" - including 11 different drivers affecting the university as an organization - and the "single researcher level" - which embraces the remaining four elements referring to the motivations of the single researcher. It is worth noting only three drivers (testing new scientific resources in industrial contexts; obtaining financial resources for education and research missions; and increasing employment opportunities for students) are cited twice (Table 12).

Tab. 12 - Classification of drivers related to the university's side

Category	Driver	Number of documents	Reference code in Appendix 1
Institutional level	Testing new scientific resources in industrial contexts	2	10, 15
	Obtain financial resources for education and research missions	2	15, 25
	Increasing employment opportunities for students	2	15, 31
	Opportunity to combine complementary research	1	10
	Development of new scientific instruments	1	10
	Access to industrial data	1	10
	Broadening the students' experience	1	15
	Government pressure towards local development	1	25
	Willingness to contribute to local development	1	25
	Supporting the renewal/expansion of companies' technology	1	15
	Speed-up research activity	1	66
Single researcher level	Pleasure of the individual researcher to create knowledge	1	25
	Income increase for individual researcher	1	25
	Opportunity to publish in leading journals	1	25
	Researchers' willingness to participate in the project	1	26

Source: own elaboration

In contrast, 13 documents proposed a total amount of 46 drivers boosting M&SMEs to collaborate. Lam *et al.* (2013) is the single source containing the highest number of drivers (12). The single most cited items (three times each) are 'Strengthen competitive advantage' and 'Access to facilities/equipment'. In order to better analyze the 46 drivers, they were grouped into six homogeneous categories (Table 13), according to the driver nature. The 'Strategic and marketing' category resulted as being the most important in terms of number of drivers (13) and citing sources (seven).

Tab. 13 - Classification of drivers related to the M&SMEs side

Category	Driver (recipients)	Number of documents	Reference code in Appendix 1
Economic and financial driver	Profit	1	27
	Cost reduction	1	49
	Access to research fundings	1	66
	Minimizing costs (process)	1	16
	Attract financial resources	2	31
Human resources driver	Attract talents	1	31
	Access to skilled HR	1	66
	Recruit new employees	2	3
	Awareness of internal competence boundaries	2	40; 57
Knowledge driver	Solve problems	1	3
	Acquire knowledge on new technologies	1	3
	Get new ideas	1	3
	Learning from collaboration	1	10
	Add value based on university knowledge	1	25
	Exploitation of external knowledge	1	40
	Accessing university expertise	1	15
	Obtain new information	2	10
Relational & benchmark driver	Maintain contacts with higher education institutions	1	66
	Achieve new contacts	1	10
	Reputation management	1	40
	Become acquainted with other entrepreneurs	1	58
	Better understand other organizations	1	58
	Acquire familiarity with university	1	58
Strategic & marketing driver	Strengthen national/international market position	1	11
	Develop new/modified products/services	1	18
	Product adaptation to foreign markets	1	18
	Improve market penetration	1	18
	Customer request of innovative and user-friendly products	1	40
	Competition intensity	1	40
	Enabling the customers' and external stakeholders' voice	1	40
	Compliance with environmental and safety standards	1	40
	Shortening new product time to market	1	49
	Promoting and marketing own products/services	1	58
	Identify new (product) market opportunities	1	16
	Minimizing risk (process)	1	16
	Strengthen competitive advantage	3	31; 40; 57

Technological driver	Collaborating in R&D activities	1	18
	Technology complexity and integration	1	40
	Emerging culture for open innovation	1	40
	Upgrade basic R&D skills	1	49
	Commercialize firm's tech seeds	1	49
	Increasing precompetitive research level	1	15
	Explore new (product) technological trends	1	16
	Speeding up (process) R&D activities	1	16
	Access to facilities/equipment	3	15; 40; 66

Source: own elaboration

Comparing universities' and M&SMES' drivers, it is worth noting they are quite different. This finding could represent an obstacle to the implementation of an effective and efficient collaboration between the two partners, as will be discussed in the subsection devoted to the emerged barriers. Moreover, drivers boosting universities to collaborate are mainly related to the more "traditional" missions (namely, education and research) than the so-called "third mission" (e.g., willingness to contribute to local development). On the other hand, M&SMEs are mainly driven by the search for competitive advantage.

Enabling factors

When considering enabling factors, 144 different items were proposed in 43 documents. In order to better analyze such a huge amount of factors, they were divided according to the partner (university-related, M&SMEs-related and shared ones) and then grouped into 10 homogeneous categories. More specifically, the first two are regarding the (internal and external) context where the collaboration takes place; the next three concern preconditions; the following three the cooperation phases (namely, search, implementation and internalization); and the last two are regarding the characteristics of the innovation and the previous collaboration experience (Table 14).

Tab. 14 - Classification of enabling factors

	University		**MSMEs**		**Shared enabling factors**	
Category	**Items**	**Reference code in Appendix 1**	**Items**	**Reference code in Appendix 1**	**Items**	**Reference code in Appendix 1**
External context			6	16; 30; 35; 39; 50; 57; 63	4	2; 16; 19; 23; 39; 54
Internal context	3	3; 17; 32	3	16; 26; 30; 35; 50		
Cultural and managerial preconditions	4	13; 15; 27; 57; 61	10	5; 6; 13; 16; 19; 27; 30; 52; 57; 67	10	9; 27; 52; 56; 61; 67
Economic and financial preconditions			4	13; 19; 30; 50		
Organizational and knowledge-related preconditions	9	1; 3; 5; 7; 9; 13; 17; 33; 35; 37; 43; 62; 67	13	6; 10; 11; 13; 14; 15; 16; 30; 39; 49; 50		
Search	10	3; 9; 12; 13; 14; 23; 37; 41; 62	4	2; 6; 34; 39	4	2; 15; 29; 43
Implementation	5	2; 31; 43; 54; 60; 62	7	6; 13; 43; 67	17	5; 6; 10; 11; 13; 15; 16; 19; 27; 31; 37; 46; 48; 53; 54; 57; 67
Internalization phase			4	12; 17; 23; 26; 30; 46; 56; 57; 60; 61; 67		
Characteristic of type of innovation			2	3; 14		
Previous collaboration experience	3	3; 13; 18; 31; 52	12	9; 26; 30; 34; 35; 52; 64	9	9; 10; 11; 13; 16; 17; 19; 33; 43; 46; 52; 53; 57; 61; 67

Source: own elaboration

As far as the context categories are concerned, the external environment was considered relevant only for the M&SMEs (e.g., industry technological characteristics). At the same time, the most investigated category in terms of preconditions is the one regarding cultural and managerial issues (e.g. M&SME's ability to understand its technological needs vs. comprehension of M&SME's needs). In this respect, it is worth noting that economic and financial enabling factors (e.g. availability of tax incentives) are considered less relevant than the other preconditions. In addition, when

considering the collaboration phases, the large amount of enabling factors are regarding implementation (e.g. university's ability to codify scientific knowledge vs. M&SME's availability of data and information) followed by the search one (e.g., university ability to select M&SMEs truly willing to innovate vs. ability of the M&SME's network to select the focus university). In contrast, the internalization phase was less investigated in terms of enabling factors; in this respect it is worth noting that only the absorptive capacity was frequently cited as a helpful item. Finally, the previous collaboration between partners was supported by 24 enabling factors (from the more previous personal relationships between academics and firm's entrepreneurs/managers to the previous lecturing experience of M&SMEs' representatives). However, 12 of these enabling factors are with regard to the M&SMEs side, while nine are shared ones.

When considering the single enabling factor most cited for each partner, it emerges that the presence of focused organizational units (e.g. TTO and career offices) is the most critical on the university side, while - as earlier pointed out - the absorptive capacity is on the firm's side. Finally, common trust and personal relationships are the most cited enabling factors among the shared ones.

Barriers

When considering barriers, 103 different items were proposed in 29 documents. Also in this case, in order to better analyze such a huge number of elements, they were divided according to the partner (university-related, M&SMEs-related and shared ones) and then grouped into nine of the homogeneous categories already adopted for the enabling factors (Table 15). More specifically, the one concerning the characteristics of the innovation typology was not considered in the extant literature.

Tab. 15 - Classification of barriers

Category	**University**		**MSMEs**		**Shared barriers**	
	Items	**Reference code in Appendix 1**	**Items**	**Reference code in Appendix 1**	**Items**	**Reference code in Appendix 1**
External context			6	30; 35; 40	1	23
Internal context	3	7; 8				
Cultural and managerial preconditions	20	7; 8; 9; 13; 17; 19; 23; 25; 31; 41; 52; 59	13	2; 5; 7; 8; 22; 25; 40; 59; 68	13	8; 9; 10; 12; 14; 15; 17; 19; 37; 45; 47; 57
Economic and financial preconditions			3	19; 23; 31;41; 49;52	2	14
Organizational and knowledge-related preconditions	3	7; 13; 31; 41	5	31; 40; 49; 59	3	10; 14: 49
Previous collaboration experience			1	10		
Search phase	6	7; 13; 19; 23; 25; 31	3	17; 19	2	25
Implementation phase	5	9; 10; 12; 17; 19; 23; 46; 52	3	8; 25; 45	9	6; 8; 10; 14; 19; 25; 49; 68
Internalization phase			2	2; 14; 31; 49; 59		

Source: own elaboration

As earlier noted for the enabling factors, the external context appears as more relevant as a source of barriers (e.g., M&SME's location in a rural area). At the same time, the cultural and managerial preconditions (university lack of focus on knowledge transfer vs. M&SMEs' lack of perception of collaboration needs) emerge as the more relevant. In contrast, economic and financial barriers are less cited. Finally, the implementation phase emerges again as the most investigated one; in this respect, orientation to perfection and the lack of practical perspective were cited as the most relevant for the university side, while lack of patience in conducting research projects was the most relevant barrier on the M&SME's side.

When considering the single barrier most cited for each partner, it emerges that university bureaucracy is perceived as the most critical issue hindering cooperation, together with the M&SME's lack of absorptive capacity. Finally, conflicting aims (publications vs. products) emerges as the most relevant shared barrier.

Comparing evidence related to enabling factors and barriers, a certain level of reciprocity clearly emerges; in other terms, several of the selected factors supporting the collaboration may reduce - and even overcome - the barriers found in the extant literature. For instance, the development of mutual trust (e.g., based on previous collaborations) may counterbalance the M&SME's lack of confidence in universities' capabilities and the university's reluctance to deal with local small business.

The analysis of the extant literature also allowed the authors to identify some best practices - different from the enabling factors - which may support the effective and efficient collaboration between the investigated partners. In Table 16, such items were classified according to the collaboration phase, differentiating between the search and implementation ones. As already noted in the case of enabling factors and barriers, the internalization phase has rarely been investigated. At the same time, it is worth noting that all the best practices regarding the search phase belong to the university side. To the best of our knowledge, Ran *et al.* (2020) are the only authors suggesting criteria M&SMEs may adopt to, first of all, select the most cooperative universities and then find the most appropriate research team.

Tab. 16 - Best practices breakdown by collaboration phase

Collaboration phase	Best practice	Number of documents	Reference codes in Appendix 1
Search	Meetings U-I (ex ante)	6	13;15;29;37;45;53
	Networking events (e.g. workshop, conferences, round table)	4	27;29;40;62
	First meeting realized at the company	1	31
	Availability of University voucher for Masters Thesis	1	3
Implementation	Periodic meetings U-I during the project	8	15;27;31;43;45;47;53;68
	Incremental approach based on trial and error learning process	4	10;11;14;47
	KPI for monitoring U-I collaboration	2	3;58
	Pilot project	1	14
	Involvement of SME's R&D people since the beginning	1	31
	Interdisciplinary composition of students' team	1	18
	Effective communication	1	27
	Evaluation by external experts	1	54
	Team building	1	67
	Use of project management tool	1	57
	Build a list of a joint research themes	1	13

Source: own elaboration

Finally, even if enabling factors and best practices were addressed by some of the selected documents, very few scholars paid specific attention to the evaluation of the collaboration performances. More specifically, 22 documents investigate such an issue but only seven of them offer quantitative data regarding the collaboration projects' success.

Based on the findings discussed earlier, a set of future research avenues will be proposed in the next section.

4. Future avenues for research

The findings presented earlier offer significant insights into the dynamics of the examined collaboration, providing valuable guidance for scholars in terms of future research directions. This study contributes by proposing potential avenues for further investigation, which will be presented in the form of Future Research Avenues (FRA). Methodological considerations are paramount, as only a limited number of selected journal articles offer explicit definitions of the phenomena under investigation. Building upon Bengoa *et al.*'s (2021) suggestion for a broader research scope in technology transfer, future studies should strive to establish a unified conceptual framework for understanding collaborations between universities and M&SMEs (FRA 1), acknowledging the heterogeneous nature of these companies (Ranga *et al.*, 2008).

At the same time, the findings presented above show that only 27 out of the 69 studies adopted a theoretical framework, which may result in being a limitation in new knowledge development. Therefore, *future research should be implemented on single theoretical backgrounds and, even more, on their combination (FRA 2)*. For instance, the integration of the Absorptive capacity lens (Cohen and Levinthal, 1990) and the Triple helix approach (Etzkowitz and Leydesdorff, 2000) may offer a strong theoretical base on which to develop new knowledge that would also be useful for policy makers. This, in turn, could activate a spillover effect which would enable further collaborations

between universities and M&SMEs. In this respect, Ranga *et al.* (2008) and Jones and Corral de Zubielqui (2017), suggest that publicizing the success of relationships between the investigated partners may stimulate the development of further collaborations.

Since only four of the sampled empirical studies adopt a comparative perspective, a third methodological advice suggests *investigating the relationship between University and M&SMEs, comparing the phenomenon in different geographical areas (FRA 3)*. This is consistent with Garcia-Alvarez-Coque *et al.* (2019) who pointed out that universities relate differently to external actors on the basis of the environment in which they are embedded. More specifically, Grimaldi *et al.* (2021 highlight that university participation in the local economy is affected both by regional and national policies and legislation. Therefore, three alternative approaches should be implemented, namely, comparing: a) different countries (e.g., Biro, 2015), different regions within the same country (e.g., Amano-Ito, 2020; Capaldo *et al.*, 2016); and regions with similar features (e.g., in terms of the Regional Innovation Scoreboard) in different countries.

At the same time, only 13 out of the analyzed empirical studies investigate the phenomenon over at least a three-year period. Therefore, *future research should adopt a longitudinal approach in order to verify any evolution in terms of factors affecting the U-ICs in general and/or the single actor (FRA 4).* As far as the U-IC phenomenon is concerned, changes could be enacted by innovations in legislation (e.g., university evaluation systems including also the so-called "third mission") but also in technologies, as in the case of digital ones (Adomako and Nguyen, 2023). In contrast, at the single actor level, changes could be related to the institution of specific organizational units devoted to the U-IC (e.g. TTO) or to changes in the M&SMEs' governance (e.g. in the case of entrepreneurial succession).

The Who Issue

The findings previously presented clearly show the large majority of selected documents analyzing universities and M&SMEs as general categories (see Table 5 and 6), albeit some scholars investigated specific typologies of such actors (e.g., public vs. private university; hi-tech vs. low tech companies). Therefore, *future research should investigate different typologies of both actors and even perform comparisons between them (FRA 5).* For instance, universities including engineering departments (as in the case of Capaldo *et al.*, 2016) could be compared with a Medical Research University (Dahlborg *et al.*, 2017) and/or Business school (Dabic *et al.*, 2016). This approach is consistent with the assumption that there does 'not exist a single mode or template that fits for all universities' (Grimaldi *et al.*, 2021, p. 863). At the same time, the experience of young firms (Bellini *et al.*, 2019) could be compared with the older ones (Garcia-Perez-de-Lema *et al.*, 2017). Once again, this is consistent with Ranga *et al.* (2008).

With a specific focus on the university side, findings clearly show that only TTOs were analyzed in more than one selected document (six in total), while other organizational units (Centers of excellence) and/or actors (e.g., Principal investigators) were addressed very rarely (Table 5). Therefore, *future research should further investigate the single university components interacting with M&SMEs in the different phases of the collaboration (FRA 6).* However, TTOs also deserve further investigation; in this respect, qualitative methods should be adopted in order to improve the knowledge of such an unit of analysis (Pratt, 2009).

On the other hand, with respect to the M&SMEs side, *future research should be implemented by adopting a comparative approach in terms of industry (FRA 7),* since 34 out of the 67 empirical studies focus on only one industry.

The What issue

Regarding RQ2 (What?), an interesting FRA occurs when considering the output of the collaboration. More specifically, in terms of collaboration outputs, it emerged that all the four innovation typologies of the so-called OECD Eurostat (2018) "Oslo Manual" were investigated (Table 10). However, *future research should specifically verify if such outputs influence the way involved actors interact in the different steps of the collaboration (FRA 8).* For instance, the fear of

IP rights disclosure (emerged as one of the barriers on the firm's side) seems to be more relevant in the case of product and/or process innovation, while easiness to copy innovations could be more relevant in the case of organizational and marketing innovation. At the same time, universities hosting different Departments (e.g., business vs. engineering ones) may interact in a diverse way with M&SMEs.

The How issue

The conducted analysis showed 22 different collaboration modes proposed in the extant literature. Based on the Ranga *et al.* (2008) suggestion that M&SMEs are a quite heterogeneous category of firms, *future research avenues should verify if their choice is influenced by specific firms' characteristics (FRA 9)*, such as size, technology level, and industry. For instance, co-authorship is mainly expected in hi-tech industries employing human resources who obtained a PhD; at the same time, MSc students transfer could be easier for micro and small companies.

The Why issue

Pereira and Franco (2023) pointed out that scholars generally emphasize the barriers which hinder the collaboration between universities and M&SMEs. However, specific knowledge of such barriers is still in its infancy. Moreover, it seems there is no adequate debate on how to overcome them. Therefore, *future research should implement a holistic approach which simultaneously considers enabling factors and barriers (FRA 10)*, also taking into account the firms' features (e.g., industry and relative size). Moreover, a specific analysis could be implemented considering separately collaborations regarding the joint research and those based on a unidirectional transfer.

At the same time, it emerged that very few studies examined the performance of the collaboration (only 22 with only seven also offering quantitative data). Therefore, *future research should further investigate the degree of success of the collaboration and also identify best practices for its different phases (FRA 11)*.

Finally, *further research should devote specific attention to the internalization phase (FRA 12)* since its positive result could also induce the single M&SME to enact further collaboration with the specific university and/or academic systems in general.

5. Concluding remarks

This study is aimed at shedding new light on the collaboration between M&SMEs and universities. This research aim was reached through a systematic literature review of 69 Scopus indexed articles published between 1987 and 2022. Collected data were analyzed according to four RQs referring to the following perspectives: 1) who (involved actors); 2) what (collaboration directionality, inputs and outputs); 3) how (collaboration modes) and 4) why (drivers, enabling factor and barriers). By concentrating on the specific interactions between universities and M&SMEs, it is possible to uncover unique insights and develop targeted strategies that might be overlooked in broader studies of university-industry collaborations. This focused approach allows for a deeper and more detailed exploration of the specific factors that drive successful partnerships and innovation within this crucial segment of the economy.

A first contribution of this article is represented by the comprehensive interpretative framework adopted to investigate the Who, What, How and Why dimensions of the collaboration (Figure 2). This methodology allowed us to identify very heterogeneous positions among scholars, with the proposition of several different variables influencing the collaboration, especially in the case of enabling factors and barriers. Moreover, it highlighted the lack of a shared conceptualization of the investigated phenomenon, associated with a relatively scarce adoption of theoretical frameworks. In contrast, a diversified set of research methodologies was adopted, including both quantitative and qualitative approaches. Due to the fragmentation of empirical evidence and the lack of a common

perspective, a further contribution, on the academic side, is represented by the 12 FRAs proposed to support future research efforts.

However, the research also has useful insights for university managers (especially those involved in TTOs), M&SMEs entrepreneurs and managers, and policy makers. Among the implications that emerge for the first two categories, the most important is regarding the relevance of cultural preconditions, often due to the inadequate perception of the counterpart perspectives in terms of aims (e.g., publication vs. new product and process) and owned competences. Therefore, networking activities should be intensively promoted not only by universities but also by entrepreneurs' association, in order to develop mutual knowledge, appreciation and trust. At the same time, universities should carefully select academics really interested in collaborating with M&SMEs, evaluating not only their technical and technological capabilities but also their relational ones. Moreover, university managers should develop the ability to carefully select M&SMEs with a relevant willingness to participate (Caputo *et al.*, 2002), and look for companies having the same technological needs the university has already solved. In this way, those previous companies may represent an useful reference.

For policymakers, it is evident that economic and financial factors hold some importance, but establishing initial contact and fostering mutual trust are crucial for the success of future collaborations. An incremental approach is also deemed effective, where involving Master of Science students in companies, supported by academics experienced in prior collaborations, serves as an initial step. Policymakers could bolster such exchange programs with sufficient funding, encouraging selected students to remain within Micro and Small and Medium Enterprises (M&SMEs) for extended durations.

The primary limitation of this study is its reliance solely on the Scopus database, thus excluding other databases such as Web of Science, JSTOR, and EBSCO. Furthermore, the study's focus on English-language publications in peer-reviewed journals constitutes another limitation. Additionally, the subjective nature of the interpretative framework presents another potential limitation.

Based on the extant literature review, it is confirmed that collaboration between universities and firms may represent a win-win relationship (Pujotomo *et al.*, 2023) also for M&SMEs. However, adequate efforts should be implemented to cope with the large amount of barriers that may hinder that relationship. Therefore, enabling factors and best practices should be adequately taken into account by all the involved actors.

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