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ARTICLE

Study of the factors facilitating or hindering collaboration between small and medium-sized enterprises and universities in research, development, and innovation: Application to Wallonia

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Abstract

This study examines the factors facilitating and hindering collaboration bet ween small and medium-sized enterprises (SMEs) and universities in research, development, and innovation (RDI), with a focus on Wallonia. Based on a literature review and a survey of 26 SMEs and three participating universities, the study identifies key collaboration factors, barriers, and outcomes. SME responses were analyzed using descriptive statistics and exploratory bivariate tests, while university responses were analyzed descriptively.

The findings indicate that internal RDI expertise, prior experience, management commitment, access to funding, collaboration networks, public funding, and external financial support are among the factors associated with collaboration experience. Major barriers include administrative complexity, limited resources, and divergence between academic research and SME needs. Product and service improvement is the only collaboration outcome showing a statistically significant exploratory association with collaboration experience. Geographical proximity and alignment between partners did not reach conventional statistical significance. The findings also highlight coordination challenges within the Walloon innovation ecosystem.

The study suggests strengthening coordination among existing innovation-support structures, improving SME access to academic expertise and funding, and developing proportionate mechanisms for monitoring collaboration outcomes. Given the small and unbalanced sample, the findings should be interpreted as exploratory rather than causal or generalizable.

Keywords: University–SME collaboration; Research, Development and Innovation (RDI); Wallonia; Collaborative innovation; Barriers and drivers; Regional ecosystem

I. INTRODUCTION

Wallonia, historically a major economic engine of Belgium due to its early industrialization in the 19th century, has experienced significant post-war deindustrialization. This has resulted in structural unemployment, reduced competitiveness, and a lag behind regions such as Flanders and Brussels [1,2]. The region still exhibits a relatively low employment rate (68.1% in 2024), a GDP per capita below the national average, and pronounced socio-economic inequalities [3].

SMEs, which account for 99.9% of the Walloon economic fabric, play a central role in employment and wealth creation. However, they face significant constraints, including limited financial resources, insufficient RDI capabilities, and restricted access to funding and innovation networks [1,3]. In this context, universities emerge as strategic partners by providing knowledge, infrastructure, and access to international networks [4].

In 2023, Wallonia had 295,897 companies, of which 295,570 were SMEs (representing 24.5% of Belgian SMEs), the majority being micro-enterprises (78.8% employing fewer than 10 people). In contrast, large firms (2%) account for nearly 40% of total employment. Despite the presence of dynamic sectors such as biotechnology, aeronautics, and green technologies, the region remains characterized by

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a relatively low GDP per capita (72% of the Belgian average in 2022) and high youth unemployment (20% in 2024) [3].

Since 2005, competitiveness clusters (e.g., BioWin, SkyWin) have stimulated innovation through publicly funded projects evaluated by international juries. These initiatives have contributed to economic growth and job creation but remain dependent on public subsidies [5,6]. Compared to Flanders, which benefits from stronger private investment, integrated clusters, and more developed innovation ecosystems, Wallonia still faces structural challenges such as administrative complexity, limited resources, and weaker international openness [2].

The region is also investing in eco-innovation and circular economy models, although progress is hindered by limited engagement from financial institutions and insufficient environmental diagnostic tools [7]. Fragmented governance further reduces the overall impact of R&D and reinforces dependence on public funding [8,9]. Policy recommendations consistently emphasize the need to strengthen support for innovative SMEs [1,9], promote internationalization [2], increase investment in green technologies, and improve institutional coordination [3].

Wallonia invests approximately 2% of its GDP in R&D (with a target of 3%), mobilizing over 7,000 university researchers through knowledge valorization structures (LTTO, Interface Entreprises, Mosaic, ImpacThéo) [10,11]. Incubators (CAP Innove, WSL, I-Tech, Galaxia, ID2Move, LeanSquare) and networks (Réseau LIEU, Wal-Tech) support business creation and technology transfer [12-14]. Competitiveness clusters and professional federations (UWE, Agoria, Essenscia, Fevia) also play a structuring role in the innovation ecosystem [10].

University–SME collaborations take various forms, including research projects, technology transfer, training programs, and spin-offs [15,16]. These collaborations help reduce innovation costs and risks, improve product development, and enhance the institutional legitimacy of SMEs [17-19]. They also enable universities to diversify funding sources and increase their visibility [16,20]. Furthermore, they support adaptation to environmental changes and business model innovation [21], while strengthening SMEs' absorptive capacity [22]. However, they remain constrained by diverging priorities and organizational barriers [19].

The objective of this study is twofold: (i) to identify, based on the literature, the main factors that facilitate or hinder university–SME partnerships; and (ii) to confront these theoretical insights with empirical evidence from a field survey conducted in Wallonia, in order to highlight regional specificities and propose avenues for improvement.

2. FACTORS, BARRIERS, AND SUCCESS DRIVERS IN UNIVERSITY–SME COLLABORATION

Several authors have identified key enabling factors, barriers, and success conditions influencing collaborations between universities and SMEs. Table 1 presents facilitating factors, Table 2 outlines barriers, and Table 3 summarizes key success drivers.

Table 1. Classification of factors facilitating university–SME collaboration

Category	Factor	Details	Authors
Firm characteristics	Firm size	- Small firms: high absorptive capacity but limited resources - Large firms: greater financial and organizational resources - Micro-enterprises: resource constraints limiting participation	Jung & Andrew (2014); Fontana et al. (2006); Teirlinck & Spithoven (2013)
	Innovation strategies and openness	- Process-innovating firms collaborate more than product-focused ones - Patents signal expertise and attract universities	Fontana et al. (2006)

		- Participation in fairs, conferences, and funded projects enhances collaboration	
Industry-related factors	Nature of the industry	- Technology acquisition/adaptation industries collaborate less - Higher innovation activity increases collaboration relevance	Jung & Andrew (2014); Fontana et al. (2006)
Structural and geographical factors	Geographical proximity	- Regional proximity facilitates tacit knowledge transfer - Distance collaborations more effective with suppliers than universities	Audretsch et al. (2023)
	Network structure	- Closed networks ("4-cycles") foster dense and long-term relationships	Gallagher et al. (2023)
Relational and management factors	Trust and goal alignment	- Initial trust based on cost–benefit evaluation. Evolving trust strengthens long-term relationships - Academic integrity and competencies are critical	Darabi et al. (2021) ; András et al. (2026)
	Communication and project management	- Clear communication, realistic goals, and professional management are essential	Arzabe (2023)
	Institutional support	- Tax incentives and institutional support foster collaboration	Ankrah & Omar (2015)
University and researcher factors	Academic experience	- Experienced researchers collaborate more. Less reliance on repeated partnerships	Gallagher et al. (2023) ; Livieratos et al. (2026)
	Skills and signaling	- SMEs value technical expertise- Universities emphasize conceptual knowledge - Patents/publications increase attractiveness	Darabi et al. (2021); Fontana et al. (2006)
Other facilitators	Educational programs and incubators	- Incubators and joint projects strengthen collaboration	Arzabe (2023)
	Institutional support	- Fiscal incentives and institutional backing are key	Ankrah & Omar (2015)

Table 2. Classification of barriers to University–SME collaboration

Category	Barrier	Details	Authors
SME challenges	SME limitations	- Lack of qualified staff- Risk of knowledge loss - Regulatory barriers and limited competencies	Teirlinck & Spithoven (2013); Jones et al. (2014)
	Cultural differences and	- Gap between fundamental and applied research	Jung & Andrew (2014); Iles & Yolles

Cultural and organizational barriers	conflicting priorities	- Academic freedom constraints - Limited understanding of SME needs	(2002); Karlsdottir et al. (2023)
	Institutional orientation of universities	- Teaching prioritized - Long-term research misaligned with SME needs	Karlsdottir et al. (2023); Bruneel et al. (2010)
Financial barriers	Access to funding	- High borrowing costs- Sensitivity to economic fluctuations	Darwish et al. (2014); Mrva & Stachová (2014)
Technological and digital barriers	Technology transfer issues	- Difficulty adapting academic technologies to SMEs	Rossoni (2024)
	Lack of digitalization	- Traditional models poorly adapted to digital environments	Tereshchenko et al. (2024)
Skills and training barriers	Inadequate training	- Lack of entrepreneurial skills - Skill gaps in micro-enterprises	Darwish et al. (2014); Jones et al. (2014)
Academic and disciplinary barriers	Individual and disciplinary differences	- Limited support for young researchers - Stronger impact in social sciences	Karlsdottir et al. (2023)
Coordination and management barriers	Lack of coordination and expectation management	- Poor coordination with support programs - Ineffective communication and expectation mismatch	Darwish et al. (2014); Jung & Andrew (2014)
Relational barriers	Lack of trust	- Weak social networks - Low affective trust	Rossoni (2024); Darabi et al. (2021)
	Low partner motivation	- Limited willingness to collaborate	Karlsdottir et al. (2023)
Resource barriers	Insufficient SME resources	- Financial, human, and technical constraints - Dependence on incremental innovation	Jung & Andrew (2014); Buganza et al. (2014); Jones et al. (2014)
	Insufficient university resources	- Lack of funding and institutional support	Karlsdottir et al. (2023)
Administrative and legal barriers	Bureaucracy and administrative burden	- Complex funding procedures - Intellectual property issues	Jones et al. (2014); Tereshchenko et al. (2024); Bruneel et al. (2010) ; András et al. (2026); Zabudkina et al. (2026)

Table 3. Key success factors in University–SME collaboration

Category	Key Factor	Details	Authors

Alignment of objectives	Goal alignment	- Alignment between SME needs and academic research	Jung & Andrew (2014) ; András et al. (2026)
	Experience and routines	- Established practices reduce barriers - SME recommendations facilitate collaboration	Bruneel et al. (2010); Darabi et al. (2021) ; Livieratos et al. (2026)
Institutional support and governance	Strong institutional support	- Adequate infrastructure and incentives - Clear governance	Rossoni (2024); Jung & Andrew (2014)
	Role of experienced researchers	- Facilitate collaboration - Support involvement of young researchers	Gallagher et al. (2023)
	Role of public agencies and clusters	- Subsidies, guarantees, and intermediaries strengthen partnerships	Jung & Andrew (2014)
Public policies and incentives	Financial incentives	- Public funding and tax incentives support collaboration	Jung & Andrew (2014); Rossoni (2024); Buganza et al. (2014)
Trust and relationships	Trust development	- Trust overcomes transactional barriers - Small projects build long-term relationships	Bruneel et al. (2010); Rossoni (2024)
	Relational capabilities	- Skills help overcome cultural differences	Buganza et al. (2014)
Networking and awareness	Formal and informal networking	- Helps identify competencies - Encourages dynamic networks	Darabi et al. (2021); Gallagher et al. (2023) ; András et al. (2026); Zabudkina et al. (2026)
Adaptive approaches	Collective institutional approach (CIA)	- Standards and certifications reduce coordination costs	Jung & Andrew (2014)
	Flexible governance	- Formalization without excessive rigidity	Bruneel et al. (2010) ; Zabudkina et al. (2026)

Recent developments in the literature further reinforce the importance of examining university–SME collaboration as a multidimensional and context-dependent process. Cao et al. [30], in a systematic review of the SME–university collaboration literature, identify three broad collaboration logics—technology transfer, knowledge co-development, and value co-creation—highlighting the diversity of objectives and interaction modes involved in university–SME relationships. This perspective suggests that collaboration outcomes cannot be understood solely through the presence or absence of individual facilitating factors, but should also consider how partners organize and develop their relationships over time.

Recent empirical research also emphasizes the dynamic nature of SME collaboration strategies. Livieratos et al. [29], based on 106 European SMEs, show that the sequencing of collaboration activities and the timing of partner involvement can influence innovation outcomes. This reinforces the importance of prior experience, organizational capabilities, and the progressive development of collaborative relationships identified in earlier research.

At the regional level, András et al. [28] show that university participation in regional innovation ecosystems is influenced by supply–demand matching, available resources, openness, trust, communication, and divergent interests among ecosystem actors. These findings are consistent with the importance attributed in the present study to trust, alignment of objectives, networking, and institutional support. They also reinforce the need to consider collaboration within a broader regional ecosystem rather than as a purely bilateral university–SME relationship.

This ecosystem perspective is particularly relevant to Wallonia. Zabudkina et al. [31], studying industrial SMEs in Wallonia, show that firms interact with overlapping regional innovation support mechanisms and that engagement depends not only on the availability of support but also on its accessibility, usability, and perceived relevance to firm-specific needs. This finding provides a recent regional perspective that complements the present study's observations concerning administrative complexity, limited use of intermediary structures, networking, and the fragmentation of innovation support.

3. METHODOLOGY

The objective of this study is to apply the factors identified in the literature review to an empirical survey conducted among SMEs and universities in Wallonia, in order to identify the main drivers and barriers to R&D collaboration.

Two structured questionnaires were designed based on the literature and used to collect quantitative data on the experiences, perceptions, and expectations of the actors involved. The survey was distributed online in order to maximize its reach. University contact details were collected from official institutional websites, while SME contacts were obtained via the Walloon public service (SPW) portal. No selection criteria were applied.

For the SME survey, the same set of facilitating-factor and barrier items was presented to both collaborating and non-collaborating SMEs. Respondents were asked to indicate whether each factor or barrier was present or perceived in their situation. The collaboration-experience variable was then used to distinguish SMEs with previous university collaboration from those without such experience.

The quantitative analysis aims to identify trends and frequencies related to the factors under investigation.

3.1. Sample Size

A total of 3,019 SMEs were contacted, of which 26 responded, corresponding to a response rate of 0.86%. Among the five universities contacted, three participated in the survey (UNamur, ULiège, UCLouvain).

The final sample therefore consists of 26 SMEs and 3 universities. This sample remains very limited in relation to the size of the regional ecosystem. In addition, it is unbalanced: 17 out of 26 SMEs and all participating universities reported having engaged in RDI collaborations, which reduces the possibility of comparison with non-collaborative cases.

The bivariate analysis was conducted only on the SME responses (n = 26). The three university responses were used for descriptive analysis and were not included in inferential statistical testing because of the very small number of participating institutions.

3.2. Sampling Limitations

The use of a voluntary sample limits external validity, as it is neither random nor stratified. A self-selection bias is likely, as respondents are often already structured for innovation (e.g., dedicated RDI departments, access to funding, engaged management), which may lead to an overestimation of the maturity of collaborations.

Technological sectors are overrepresented, to the detriment of more traditional sectors such as crafts or commerce. Non-collaborating SMEs provided few open-ended responses, limiting comparative insights, while collaborating SMEs contributed more extensively to the analysis.

On the academic side, some responses remain highly formal, reflecting institutional discourse rather than actual practices.

3.3. Methodological Challenges Related to Small Samples

Small sample sizes raise recurring methodological issues, including low statistical power, increased risks of Type I and Type II errors, and limited external validity [32-36]. They also amplify selection bias [35] and complicate modeling processes (e.g., non-convergence, biased estimates, negative variances) [37-40].

To address these limitations, several methodological strategies can be employed. Stratified sampling and case–control designs can improve representativeness [33], while regression models adapted to small samples, such as Poisson or penalized regression, provide more robust estimates [36,40].

Alternative approaches include randomized single-case experiments [41], penalized estimation techniques, MIIV-2SLS methods [39], and Bayesian estimation with informative priors [37,36], all of which help stabilize results.

Univariate analysis describes the characteristics of a single variable, while bivariate analysis examines relationships between two variables using correlations, mean comparison tests, or chi-square tests. However, with small samples, exact tests such as Fisher's exact test or the mid-p value are preferable [33,36]. For continuous variables, non-parametric tests such as Mann–Whitney or Wilcoxon tests provide greater reliability [36,42].

An additional limitation concerns the strong imbalance between collaborating and non-collaborating SMEs in the bivariate analysis. Seventeen SMEs reported previous RDI collaboration with universities, compared with only nine non-collaborating SMEs. Moreover, the non-collaborating group reported very few positive responses to the facilitating-factor and barrier items, producing several zero cells in the contingency tables. Consequently, the Fisher exact tests should be interpreted as exploratory tests of association rather than as evidence of causal or predictive relationships. The observed p-values indicate differences in response patterns between the two groups, but they do not establish that the identified factors cause or increase the likelihood of university–SME collaboration.

4. RESULTS

4.1. Univariate Analysis of Results

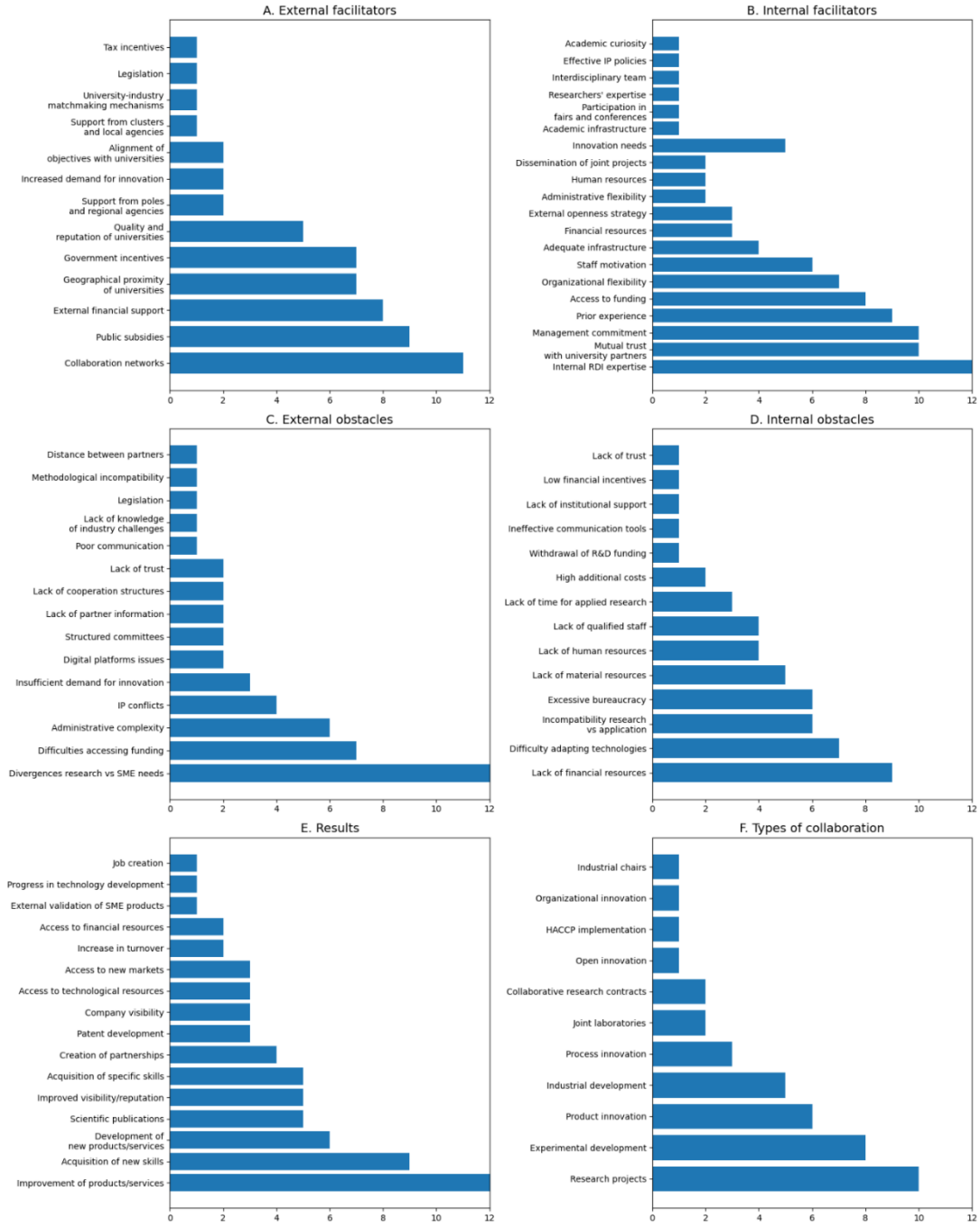

Figure 1. Overview of SME–University collaborations (by question). The horizontal scale represents the number of SMEs.

The survey was conducted among SMEs operating across a wide range of sectors. The responding firms were active in industries such as perfumery, R&D and textiles, software development, bakery and pastry production, IT, freshwater aquaculture, manufacturing, biotechnology, consulting and expertise, construction, healthcare (dietary supplements), industrial machinery, mineral research centers, paper-based food packaging, LED lighting for agronomic research and large buildings, food production, wood heating systems, interaction design, agriculture, design and manufacturing of interactive attractions for theme parks and museums, biotechnology, construction expertise, cheese production, small-scale metallurgy (brick-making machines), and adapted work enterprises.

The size of the responding firms ranged from 1 to 200 employees. Some were micro-enterprises (fewer than 10 employees), while others, although classified as SMEs, employed more than 100 workers.

Annual turnover ranged from €100,000 to €85 million. Distances between SMEs and their partner universities varied between 5 km and 200 km.

This diversity of sectors highlights that RDI collaboration spans a broad range of activities, but also suggests that challenges may differ significantly depending on the industry. The variation in firm size indicates that collaboration with universities is not limited to larger SMEs. Moreover, no clear relationship emerges between firm turnover and the ability to engage in RDI collaborations.

The survey reveals that 9 out of 26 SMEs have never collaborated with a university. Among those that have, collaboration experiences vary (Figure 1A). The most common forms of collaboration include research projects, followed by experimental development, product innovation, and industrial development. These findings suggest that while SMEs recognize the value of academic collaboration, such partnerships remain largely project-specific. The higher prevalence of product innovation compared to organizational or marketing innovation may reflect SMEs' preference for technological solutions over organizational transformation.

Regarding internal factors, in-house RDI expertise and top management commitment were frequently reported as facilitating factors. Trust-based relationships were also mentioned in respondents' qualitative accounts, particularly in relation to establishing contacts and developing collaborations. These results underline the importance of internal capabilities and strategic willingness in establishing successful partnerships. Access to funding and organizational flexibility are also highlighted, emphasizing the need for adequate resources and adaptability (Figure 1B).

External factors such as collaboration networks, public subsidies, external financial support, and geographical proximity were frequently reported as external facilitating factors. Public funding and external financial support emerge as major drivers, highlighting the perceived importance of financial support for cooperation between SMEs and universities (Figure 1C).

The main internal barriers include lack of financial resources, difficulties in adapting university technologies to SME needs, misalignment between fundamental research and applied needs, and excessive bureaucracy. These obstacles point to a gap between SME expectations and academic offerings (Figure 1D).

Regarding external barriers, the divergence between academic research and industrial needs is reported by 12 SMEs, confirming the difficulty of obtaining directly applicable solutions. Other major constraints include limited access to funding, administrative complexity, and intellectual property conflicts, highlighting persistent legal and financial uncertainties (Figure 1E).

When asked about the outcomes of their collaborations, respondents provided the results summarized in Figure 1F.

Only a limited number of SMEs (11 respondents) provided measurable indicators of collaboration outcomes (Table 4). This may reflect difficulties in quantifying impacts, a lack of structured monitoring systems, or the recent nature of some collaborations

Table 4. Outcomes of SME–University Collaborations

Company	Sector	Impact indicators
A	R&D + Textile	Jobs created, scientific publications
B	Industry	3 projects – 1 new product
C	Biotechnology	Too early to observe changes
D	Construction	3 projects leading to process improvements, new products, and new processes
E	Industrial machinery	1 project
F	Mineral research center	>10 projects
G	LED lighting (agronomy & buildings)	~5 research projects, continuous product improvement, stable turnover, employment maintained, 36 scientific publications

H	Wood heating systems	2 patents, 3 new products
I	Biotechnology	1 project
J	Cheese production	2 projects
K	Adapted work enterprise	2 research projects (no new product yet), 2 jobs created

SMEs propose several actions to improve collaboration with universities. Key recommendations include simplifying administrative procedures, enabling combined funding mechanisms, and strengthening university support for businesses. Enhancing SME representation within university structures, ensuring intellectual property protection, and preventing conflicts of interest are also considered essential.

Improved networking and communication between stakeholders are needed, along with a better mutual understanding of competencies and expectations. Additional recommendations include organizing regular meetings, promoting long-term internships, and encouraging SMEs to host students. Finally, strengthening collaborations with non-profit organizations (ASBLs) through simplified mechanisms, financial incentives, and regional liaison offices is also suggested.

SMEs report diverse collaboration experiences. Professional networks and trust-based relationships facilitate contacts, particularly for internships and project development. Some firms directly approach universities to meet specific needs, such as accessing specialized laboratories or expertise (e.g., vaccine testing or animal studies). Initiatives such as WIN2WAL or support from SynHERA have helped structure collaborations, although mutual awareness between academia and industry remains limited.

Access to funding reduces innovation risks and encourages collaboration. Win–win partnerships combining technological expertise from firms and scientific competencies from universities are frequently mentioned. However, some respondents criticize universities for operating in relative isolation. Entrepreneurial mindset, prior academic management experience, and participation in professional events also facilitate collaboration.

Taken together, these responses point to a need for better coordination between existing support mechanisms rather than simply the creation of additional initiatives. In the Walloon context, the challenge therefore appears to be not only the availability of support structures, but also their visibility, accessibility, and coordination from the perspective of SMEs.

The three participating universities reported that their collaborations with SMEs mainly relied on collaborative research contracts, technology transfer, and, to a lesser extent, open innovation. These formal and legally structured mechanisms appeared more common than flexible approaches such as marketing or organizational innovation and industrial chairs (Figure 2A).

Among the three participating universities, reported internal drivers included researchers' expertise, prior experience with industry, and the presence of support structures such as technology transfer offices and incubators (Figure 2B). Reported external drivers included public funding, geographical proximity, goal alignment, and mutual trust (Figure 2C). These responses suggest that collaboration may depend not only on financial resources but also on relationship quality and shared objectives.

Reported internal barriers included administrative burden, limited human and financial resources, and a lack of incentives for researchers (Figure 2D). External barriers reported by the participating universities included the complexity of collaboration schemes, limited access to funding, and misalignment between academic research and SME expectations (Figure 2E). These observations point to potential institutional, financial, and coordination challenges, but should not be interpreted as representative of universities in Wallonia as a whole.

The three participating universities reported several collaboration outcomes, including patents, acquisition of new skills, access to external funding, scientific publications, and participation in European projects (Figure 2F). These responses illustrate the range of outcomes associated with university–SME collaboration, although the absence of inferential analysis and the very small number of participating institutions limit the generalizability of these observations.

The participating universities recommended several measures to improve collaboration, including starting with small-scale projects to build trust, simplifying administrative procedures, increasing the

visibility of academic competencies, and improving access to public support mechanisms. They also reported that contacts with SMEs were mainly established through alumni networks, professional events, and clusters.

Because only three universities participated in the survey, these findings should be interpreted as illustrative of the perspectives reported by the participating institutions rather than as representative evidence for universities in Wallonia as a whole. The university-side results are therefore presented descriptively and are not subjected to statistical inference.

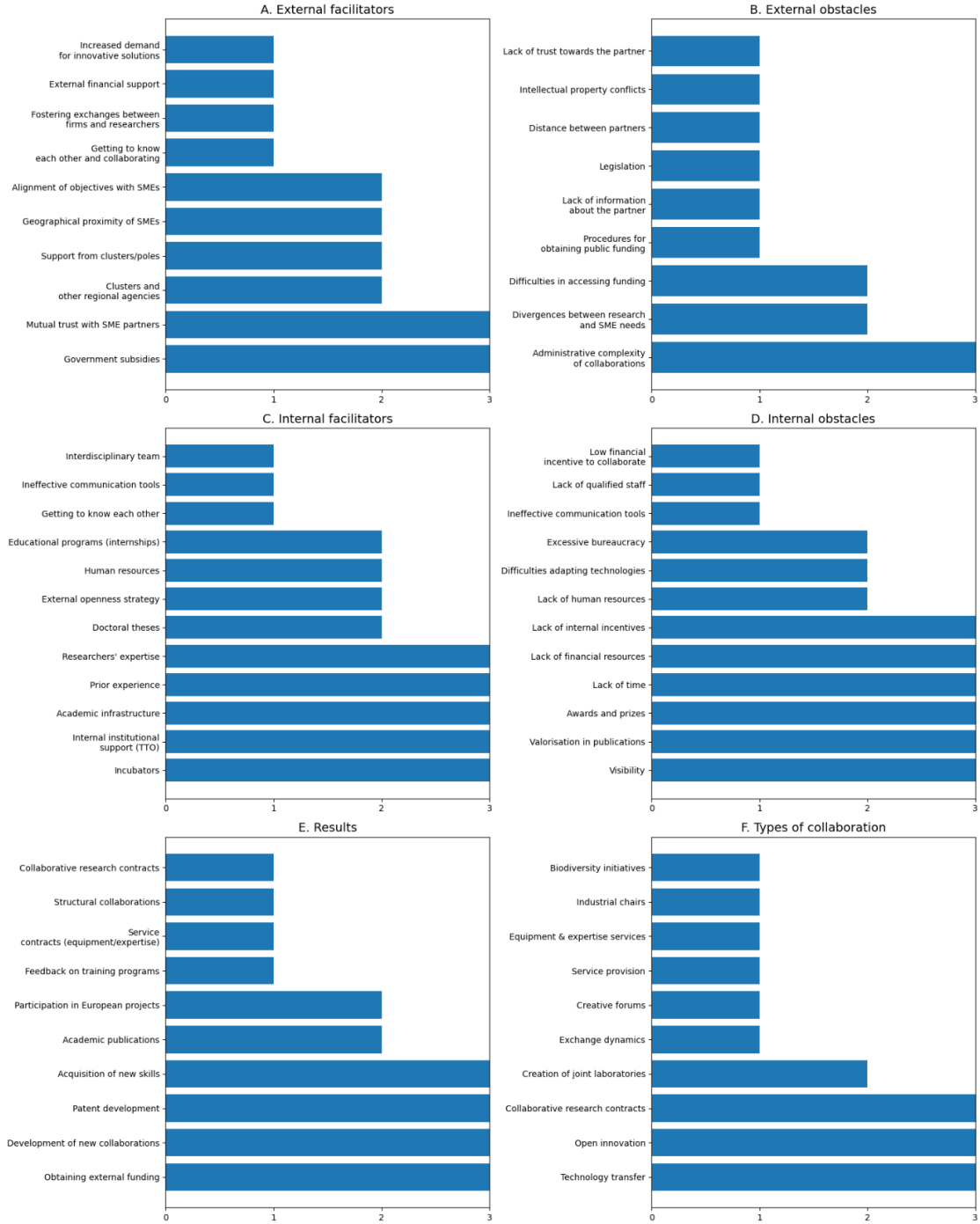

Figure 2. Synthesis of university–SME collaboration responses reported by the three participating universities. The horizontal scale represents the number of participating universities.

4.2. Bivariate Analysis of Results

To examine the relationship between two qualitative variables (e.g., collaboration with a university and the identification of a factor or barrier), Fisher's exact test was used. This test is recommended for

small samples (26 SMEs) and when contingency table counts are low, making the chi-square test less reliable [33,36].

This test, applied to 2×2 contingency tables, assesses whether two binary variables ("yes/no") are independent. The p-value indicates the probability that the observed distribution is due to chance. If $p < 0.05$, the null hypothesis of independence is rejected, suggesting a statistically significant association [33,36].

The variables from the questionnaire were transformed into binary variables (presence or absence) and then compared according to collaboration experience. Fisher's exact test was applied separately to internal factors, such as RDI expertise or innovation culture, and to external factors, such as public funding or collaboration networks, as well as to internal barriers (e.g., lack of time or skills) and external barriers (e.g., administrative complexity, academic divergences).

The resulting contingency tables are highly unbalanced. In particular, most non-collaborating SMEs reported the absence of the facilitating factors considered in the questionnaire, resulting in zero or near-zero counts in the "Non-Collab & Yes" cells. This pattern should be taken into account when interpreting the Fisher exact tests, because the comparison is based on a small non-collaborating group and does not provide a balanced representation of the two collaboration-status groups.

The results (Tables 5 and 6) show that, among internal factors, RDI expertise shows the strongest observed association with collaboration experience ($p < 0.01$), followed by management commitment and prior experience ($p < 0.05$), while access to funding shows a statistically significant exploratory association with collaboration experience ($p = 0.0233$), whereas staff motivation and organizational flexibility do not reach the conventional 5% significance threshold ($p = 0.0634$ for both).

Regarding external factors, public funding, external financial support, and membership in collaboration networks show statistically significant associations with reported collaboration experience in this exploratory sample ($p < 0.05$), while geographical proximity to universities and government incentives show a positive trend toward significance.

Concerning barriers (Tables 7 and 8), internal obstacles such as excessive bureaucracy and lack of financial resources are frequently cited, but only one external barrier appears statistically significant: the divergence between academic research and the concrete needs of SMEs. This result highlights a major issue of strategic and operational alignment between academic and industrial actors.

Table 5. Collaboration vs. Internal Facilitating Factors

Factor	Collab & Factor Yes	Collab & Factor No	Non-Collab & Factor Yes	Non-Collab & Factor No	p-value	Significance
Internal RDI expertise	12	5	0	9	0.0007	***
Prior experience	9	8	0	9	0.0094	**
Management commitment	9	8	0	9	0.0094	**
Access to funding	8	9	0	9	0.0233	*
Staff motivation	6	11	0	9	0.0634	—
Organizational flexibility	6	11	0	9	0.0634	—
Mutual trust	0	17	0	9	1	—
Innovation needs	5	12	0	9	0.1286	—
Adequate infrastructure	4	13	0	9	0.2631	—
Human resources	2	15	0	9	0.5292	—

Financial resources	3	14	0	9	0.5292	—
IP policies / interdisciplinarity	0	17	0	9	1	—

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Fisher's exact tests are exploratory and should be interpreted cautiously given the small and unbalanced sample, particularly the small number of non-collaborating SMEs.

Table 6. Collaboration vs. External Facilitating Factors

Factor	Collab & Yes	Collab & No	Non-Collab & Yes	Non-Collab & No	p-value	Significance
Alignment with SMEs	1	16	0	9	1	—
Alignment with universities	2	15	0	9	0.5292	—
Demand for innovation	1	16	1	8	1	—
Tax incentives	1	16	0	9	1	—
Government incentives	7	10	0	9	0.0578	—
Legislation	1	16	0	9	1	—
Matching mechanisms	1	16	0	9	1	—
SME proximity	1	16	0	9	1	—
University proximity	7	10	0	9	0.0578	—
University reputation	5	12	0	9	0.1286	—
Collaboration networks	10	7	1	8	0.0362	*
Cluster support	1	16	0	9	1	—
Regional agency support	2	15	0	9	0.5292	—
External financial support	8	9	0	9	0.0233	*
Government subsidies	1	16	0	9	1	—
Public funding	9	8	0	9	0.0094	**

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Fisher's exact tests are exploratory and should be interpreted cautiously given the small and unbalanced sample, particularly the small number of non-collaborating SMEs.

Table 7. Collaboration vs. Internal Barriers

Barrier	Collab & Yes	Collab & No	Non-Collab & Yes	Non-Collab & No	p-value	Significance
Lack of trust	1	16	0	9	1	—
Excessive bureaucracy	6	11	0	9	0.0634	—
High additional costs	2	15	0	9	0.5292	—
Tech adaptation difficulties	6	11	1	8	0.3574	—
Low researcher incentives	1	16	0	9	1	—
Research misalignment	5	12	1	8	0.3798	—
Lack of qualified staff	3	14	1	8	1	—
Lack of financial resources	8	9	1	8	0.0977	—
Lack of human resources	4	13	0	9	0.2631	—
Lack of material resources	4	13	1	8	0.6279	—
Lack of institutional support	1	16	0	9	1	—
Lack of time	3	14	0	9	0.5292	—
Ineffective communication tools	1	16	0	9	1	—
Withdrawal of R&D funding for partnerships with universities of applied sciences	1	16	0	9	1	—

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Fisher's exact tests are exploratory and should be interpreted cautiously given the small and unbalanced sample, particularly the small number of non-collaborating SMEs.

Table 8. Collaboration vs. External Barriers

Barrier	Collab & Yes	Collab & No	Non-Collab & Yes	Non-Collab & No	p-value	Significance
Lack of trust	2	15	0	9	0.5292	—
Lack of cooperation structures	2	15	0	9	0.5292	—
Administrative complexity	5	12	1	8	0.3798	—
IP conflicts	4	13	0	9	0.2631	—
Low demand for innovation	3	14	0	9	0.5292	—
Funding access difficulties	6	11	1	8	0.3574	—
Distance	0	17	1	8	0.3462	—
Academic–industry divergence	11	6	1	8	0.0145	*

Method incompatibility	1	16	0	9	1	—
Legislation	0	17	1	8	0.3462	—
Lack of industrial awareness	1	16	0	9	1	—
Lack of information	2	15	0	9	0.5292	—
Poor communication	1	16	0	9	1	—
Digital platforms	2	15	0	9	0.5292	—

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Fisher's exact tests are exploratory and should be interpreted cautiously given the small and unbalanced sample, particularly the small number of non-collaborating SMEs.

The analysis of collaboration outcomes (Table 9) shows that only the improvement of products or services is significantly associated with collaboration experience, with a p-value of 0.014. Two other outcomes—namely the development of new products or services ($p = 0.063$) and the acquisition of new skills ($p = 0.098$)—did not reach the conventional 5% significance threshold.

In contrast, more academic outcomes, such as scientific publications or the acquisition of specific competencies, do not show statistically significant associations. These findings suggest that, in the Walloon context, RDI collaborations between SMEs and universities primarily generate concrete, market-oriented outcomes, with product and service improvement being the main benefit for participating firms.

Table 9. Collaboration vs. Outcomes

Outcome	**Collab & Yes**	**Collab & No**	**Non-Collab & Yes**	**Non-Collab & No**	**p-value**	**Significance**
New markets	2	15	1	8	1	—
Financial resources	2	15	0	9	0.5292	—
Technological resources	3	14	0	9	0.5292	—
Specific skills	5	12	0	9	0.1286	—
New skills	8	9	1	8	0.0977	—
Reputation	4	13	1	8	0.6279	—
Product/service improvement	11	6	1	8	0.0145	*
Visibility	2	15	1	8	1	—
Turnover increase	1	16	1	8	1	—
New partnerships	3	14	1	8	1	—
Job creation	0	17	1	8	0.3462	—
Patents	3	14	0	9	0.5292	—
New products/services	6	11	0	9	0.0634	—
Technology development	1	16	0	9	1	—
Scientific publications	5	12	0	9	0.1286	—

External validation of products developed by the SME	1	16	0	9	1	—

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Fisher's exact tests are exploratory and should be interpreted cautiously given the small and unbalanced sample, particularly the small number of non-collaborating SMEs.

The comparison between the Walloon survey findings and the literature shows broad consistency, while also highlighting several regional specificities. The importance of mutual trust is consistent with previous research [27], alignment of objectives between industrial needs and academic research [17], geographical proximity facilitating exchanges and trust [25], as well as external financial support, particularly subsidies [16,18]. Researchers' experience [26] and SMEs' internal RDI expertise also promote cooperation, although interface structures remain underutilized.

Certain theoretical factors appear to be less present, such as the institutional collective approach (ICA) [17] or the systematic use of incubators [21]. The barriers identified in the literature are confirmed: lack of resources [17], bureaucracy and administrative burdens [19,46], and cultural misalignment between academic timelines and entrepreneurial logic [43]. The importance of trust is also consistent with previous research [20,27].

The bivariate analysis indicates differences in the recognition of facilitating factors between SMEs with and without previous university collaboration. However, these associations should be interpreted cautiously because of the small and highly unbalanced groups, as well as the concentration of "No" responses among non-collaborating SMEs. The results are therefore considered indicative rather than confirmatory and should not be interpreted as evidence that these factors causally determine collaboration.

These findings are consistent with recent research emphasizing that SME–university collaboration is a dynamic and ecosystem-embedded process rather than a purely bilateral relationship [30,29]. At the regional level, recent evidence from Wallonia further shows that SMEs engage selectively with overlapping innovation-support mechanisms according to their accessibility, usability, and relevance to firm-specific needs [31]. This finding reinforces the importance of institutional accessibility, networking, and coordination identified in the present study.

Previously identified success factors—such as goal alignment, institutional support, the gradual building of trust through small-scale projects [45], and financial incentives—are also observed. However, the survey highlights specific gaps in the Walloon context: the absence of performance indicators, limited use of clusters and incubators, and a persistent asymmetry between SMEs' economic expectations and universities' scientific valorization.

This finding is particularly relevant in Wallonia, where the innovation ecosystem involves multiple universities, competitiveness clusters, incubators, technology-transfer structures, public funding mechanisms, and intermediary organizations. The coexistence of these actors provides substantial support capacity, but may also create coordination and navigation challenges for SMEs. The issue is therefore less a lack of institutional resources than the need to make these resources more visible, connected, and accessible to firms.

The findings suggest that improving university–SME collaboration in Wallonia requires not only general administrative simplification but also better coordination among the existing actors of the regional innovation ecosystem. Rather than creating additional support structures, a more appropriate approach would be to strengthen the coordination of existing universities, technology-transfer offices, incubators, competitiveness clusters, and intermediary organizations. A regional coordination mechanism or single-entry interface could help SMEs identify relevant academic competencies, available funding schemes, potential university partners, and appropriate support organizations through a more integrated pathway. This would reduce the institutional fragmentation that can make the innovation support system difficult to navigate, particularly for SMEs with limited internal RDI resources.

A second mechanism would be to strengthen the intermediary role of clusters, incubators, and technology-transfer structures in initiating and managing university–SME relationships. These organizations could provide structured matchmaking, preliminary needs assessment, and support during

the early stages of collaboration, when differences in expectations, timelines, and organizational cultures are most likely to create difficulties. This recommendation is consistent with the empirical finding that professional networks and intermediary initiatives already facilitate contacts, while mutual awareness between academia and industry remains limited.

Finally, the Walloon support system could benefit from a common and proportionate monitoring framework for university–SME collaborations. Rather than relying exclusively on traditional scientific outputs, such a framework could track indicators relevant to both partners, including new or improved products and services, patents, jobs created or maintained, external funding mobilized, collaborative projects completed, and subsequent collaborations. Such monitoring would make it possible to assess the practical and regional effects of publicly supported collaborations and to identify which support mechanisms generate the most sustained partnerships. These mechanisms would translate the study's findings on administrative burden, limited networking, underused intermediary structures, and weak impact monitoring into more operational, region-specific policy actions.

5. CONCLUSION

This study analyzed the factors facilitating and hindering collaboration between SMEs and universities in the field of research, development, and innovation (RDI) in Wallonia. In a regional economic context seeking renewal, the introduction highlighted the strategic role that SMEs—representing 99.9% of the economic fabric—and universities, as centers of scientific expertise and innovation, can play.

The literature review identified several facilitating factors, including SMEs' RDI expertise, researchers' experience, geographical proximity, mutual trust, and institutional support. It also highlighted major barriers, notably administrative burden, lack of resources within SMEs, divergences in priorities between fundamental research and applied needs, and difficulties in adapting academic technologies to industrial realities.

The empirical application to Wallonia, based on a survey of 26 SMEs and 3 universities, provided exploratory evidence that was broadly consistent with and helped contextualize these findings. The univariate analysis showed that collaborations mainly involve research projects, experimental development, and product innovation, particularly in technological sectors. Internal factors such as technical expertise, management commitment, and organizational flexibility, as well as external factors such as geographical proximity and public funding, were widely reported as facilitating factors. Conversely, the most frequently cited barriers include lack of financial resources, excessive bureaucracy, and misalignment between academic and industrial timelines.

In terms of outcomes, collaborations have generated measurable effects for some SMEs, including the development of new products, patent applications, job creation, and stabilization of turnover. However, structured monitoring of impacts remains limited, restricting the ability to assess long-term effects.

The exploratory bivariate analysis identified several statistically significant associations between collaboration experience and reported facilitating factors. However, given the small and unbalanced sample and the concentration of negative responses among non-collaborating SMEs, these associations should be regarded as indicative rather than confirmatory. They provide useful hypotheses for future research based on larger and more balanced samples.

The findings suggest that university–SME collaboration may contribute to innovation-related activities and knowledge exchange in Wallonia, particularly through RDI projects, product and service development, and access to external expertise and funding. However, given the exploratory design, small and self-selected sample, these findings should be interpreted as descriptive and indicative rather than as evidence of causal effects on regional competitiveness or sustainable economic growth.

Nevertheless, the study presents important methodological limitations. The small sample size, the self-selection bias favoring firms already engaged in RDI, and the heterogeneity of responses require cautious interpretation. These limitations do not invalidate the findings but suggest that they should be considered as indicative trends rather than generalizable conclusions.

Several avenues for improvement are proposed. These include simplifying administrative procedures, strengthening mediation mechanisms between universities and firms, better aligning research and development timelines, promoting long-term internships to enhance mutual understanding, and establishing stronger intellectual property protection mechanisms to secure SME investments.

In addition, future research could adopt a qualitative approach. Conducting in-depth interviews with university representatives would allow verification of whether the findings reflect actual academic practices. Similarly, interviews with SMEs—both collaborating and non-collaborating—would help assess the consistency of the survey results. This approach would complement the quantitative analysis with a more contextual and reflective perspective, which could not be implemented in this study due to time constraints.

From a policy perspective, the findings suggest that strengthening university–SME collaboration in Wallonia requires more than general administrative simplification. Priority could be given to improving coordination among existing innovation-support actors, establishing more accessible entry points for SMEs seeking academic expertise or funding, strengthening the intermediary role of clusters and technology-transfer structures, and introducing shared indicators to monitor collaboration outcomes. Such mechanisms could help reduce the coordination burden faced by SMEs while making better use of the support capacity already present within the Walloon innovation ecosystem. Given the exploratory nature and limited size of the sample, these recommendations should be considered as context-specific policy avenues rather than as empirically validated causal interventions.

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