Maria Vivar-Simon, Nekane Errasti & Leire Markuerkiaga (2022) An analysis of the organisational factors that determine education-related university-business cooperation activities in manufacturing SMEs, Studies in Higher Education, DOI: 10.1080/03075079.2022.2055322

An analysis of the organisational factors that determine education-related university-business cooperation activities in manufacturing SMEs

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Abstract

Cooperation between universities and business is manifest in a wide range of activities related to the three missions of the entrepreneurial university: education, research and entrepreneurship. However, the vast majority of University-Business Cooperation (UBC) literature has focused on R&D-related activities. This bias has given rise to a lack of knowledge of the organisational context-related factors that shape businesses' cooperation with universities. In order to address this research gap, this quantitative study, by means of a series of multivariate linear regression models, identifies the organisational context-related factors that determine manufacturing SMEs' cooperation levels in education-related UBC activities. Applying a questionnaire to a sample of 332 manufacturing SMEs located in the Autonomous Community of the Basque Country (Spain), the impact is analysed of organisational context-related factors – general business characteristics, business openness, R&D, innovation, and UBC willingness and support – on 5 types of UBC activities that have been identified and classified in the field of education, namely, mobility of students, dual education, curriculum co-design, curriculum co-delivery and lifelong learning.

Key words: University-Business Cooperation, Mobility of students, Dual education, Curriculum co-development, Lifelong learning, Organisational context-related factors

Introduction

Given the importance of University-Business Cooperation (UBC) as an R&D input to innovation, this body of literature has mainly focused on R&D cooperation (Santos *et al.*, 2021). This bias shows a major shortcoming in UBC knowledge as cooperation between businesses and universities can be developed through different activities on which determining factors may generate different effects (Alunurm, Rõigas and Varblane, 2020).

UBC activities such as lifelong learning, internships or curriculum co-design and co-delivery, i.e. education-related UBC activities, are essential for improving both the employability of individuals and the competitiveness of enterprises (Guimón, 2013). Therefore, the development of studies that analyse educational cooperation activities is necessary for all the stakeholders involved in UBC. Nevertheless, education-related UBC has been an almost neglected topic in the literature (Plewa, Galán-Muros and Davey, 2015; Kunttu, 2017). With a view to filling this gap, this paper identifies and explores the organisational context-related factors that determine manufacturing SMEs' cooperation levels in education-related UBC activities.

Education-related UBC activities

According to the classification and compilation proposed by Davey *et al.* (2018), UBC activities are classified by the fields of (i) education, (ii) research, (iii) valorisation and (iv) management. Following this classification, mobility of students, dual education, curriculum co-design, curriculum co-delivery and lifelong learning are the UBC activities classified in the field of education. Although these activities are grouped in the same domain, it should be noted that they are very different from each other.

Mobility of students and dual education correspond to the work integrated learning (WIL) area and are recognised as essential, since these activities (i) increase student's employability, (ii) provide graduates with the necessary business experience to innovate successfully and (iii) enable the transition from academic environment to work practice (Rampersad, 2015). Despite the fact that these activities are both based on WIL, they nonetheless differ significantly from one another. Cooperation in dual education programmes requires companies to have greater commitment and knowledge alignment with universities than mobility of students (Pogatsnik, 2018).

While education used to focus on the instruction that people receive throughout their childhood and youth, in today's fast-changing working environment education and skill development is critical throughout life (Barroso-Hurtado and Chan, 2019). Lifelong learning responds to the needs of industry with regard to its constant need to acquire knowledge and develop the necessary skills in workers to remain competitive (Grubliauskaite, 2017).

UBC activities regarding curriculum co-design and curriculum co-delivery are related to the joint design and delivery of educational programmes and improve students' employability, as they prepare students for the world of work by better aligning education with business needs and allowing companies to identify future employees through academic involvement (Bruno *et al.*, 2021; Orazbayeva and Plewa, 2022).

Organisational context-related factors

Corporate characteristics, capacities and resources are considered UBC determinant contextual elements since these can shape businesses' engagement and cooperation levels (Galán-Muros and Plewa, 2016). After an extensive review of the UBC literature, it was observed that there are a large number of corporate characteristics, capacities and resources that may determine cooperation with universities such as business size (Davey

et al., 2018), exports level (Alunurm, Rõigas and Varblane, 2020), business openness (Guerrero, Urbano and Herrera, 2019), R&D intensity (Kobarg, Stumpf-Wollersheim and Welpe, 2018), innovation capacity (Carrasco-Carvajal and García-Pérez-De-Lema, 2020) and UBC willingness and support (Davey *et al.*, 2018).

Methodology

A questionnaire was sent to a random list of 664 Basque Manufacturing SMEs, and data was gathered from September 2019 to January 2020. Out of 664 companies, 332 complete and valid answers were gathered, a statistically significant sample with a margin of error of 5% and a confidence level of 95%. The questionnaire was addressed to company managers. However, depending on the company, the email was redirected internally to the person with the most knowledge of UBC. The vast majority of the respondents were company managers (42.9%), with far lower percentages for R&D managers (8%), industrial managers (6.6%), and HR managers (5.2%); the remaining 37.3% corresponding to other profiles.

The study followed a quantitative research methodology and data was analysed through statistical tests, making use of IBM's SPPS Version 23 and Mplus Version 7.

Drawing on the UBC activity classification developed by Davey *et al.* (2018), and following a ten-point "1=Strongly disagree; 10=Strongly agree" Likert-type scale, respondents were asked to indicate their degree of agreement or disagreement with the following statement: *"Our company cooperates or cooperated with the university to a large extent in…"* with regard to the following UBC activities: curriculum co-design, curriculum co-delivery, mobility of students, dual education programmes and lifelong learning. With regard to the predictor variables included in the study (see Table 1), the organisational context-related factors identified in the literature were classified into the

following categories: (i) general business characteristics, (ii) business openness, (iii) research and development (R&D), (iv) innovation and (v) UBC willingness and support.

Category	Factor	Shortcut	Authors
General business characteristics	Business group	*Business_group*	Ferrer-Lorenzo, Abella-Garcés and Maza-Rubio (2018); Komera, Jijo Lukose and Sasidharan (2018)
	Size	*Size*	Davey *et al.* (2018); Alunurm, Rõigas and Varblane (2020)
	Exports	*Market_BC*	Rodil, Vence and Sánchez (2016); Alunurm, Rõigas and Varblane (2020)
	Technological level	*Tech_level*	Verbano, Crema and Venturini (2015); Parmentola, Ferretti and Panetti (2021)
	Employees' qualification	*HD_emp*	García-Pérez-de-Lema *et al.* (2017); Kobarg, Stumpf-Wollersheim and Welpe (2018)
	Gender	*Female*	Carli and Eagly (2016); Zhang, Yuan and Wang (2019)
Business openness	External search breadth	*LLL_coop_tot*	Laursen and Salter (2004), (2006); De Fuentes and Dutrénit (2012); Guerrero, Urbano and Herrera (2019)
	Cluster association	*Clus_yes_no*	D'Este, Guy and Iammarino (2013); Alpaydın and Fitjar (2021)
	Informal interactions	*Inf_int_tot*	Plewa, Korff, Johnson, *et al.* (2013); Azagra-Caro *et al.* (2017); García-Pérez-de-Lema *et al.* (2017); Mascarenhas *et al.* (2018)
R&D	R&D intensity	*RD_int*	Kobarg, Stumpf-Wollersheim and Welpe (2018); Rõigas, Mohnen and Varblane (2018)
Innovation	Innovation capacity	*IC*	De Fuentes and Dutrénit (2012); Samson and Gloet (2014); Carrasco-Carvajal and García-Pérez-De-Lema (2020)
	Innovation degree	*ID*	Lin (2017); Vega-Jurado, Kask and Manjarrés-Henriquez (2017); Guerrero, Urbano and Herrera (2019)
UBC willingness and support	UBC resources	*UBC_resources*	Galán-Muros *et al.* (2017); Davey *et al.* (2018)
	Cognitive closeness	*Cogni_closeness*	
	UBC beliefs	*UBC_beliefs*	

Table 1: Classification of the organisational context-related factors that may have an impact on UBC

Variables

Business group (*Business_group*): Respondents were asked to indicate whether they belonged to a business group or not by means of a binary variable. Size (*Size*): Company size was accessed on the SABI (Iberian Balance Sheet Analysis System) database. Exports (*Market_BC*): Respondents were asked to indicate their percentage of sales in the Basque Country by means of a ratio scale. Technological level (*Tech_level*): Based on Eustat's (2020) technology classification by NACE, an ordinal scale was generated, classifying companies according to their technology level: Low/Medium-Low technology or Medium-High/High technology. Employees' qualification (*HD_emp*): Drawing on Kobarg, Stumpf-Wollersheim and Welpe (2018), through an interval scale, respondents were asked to indicate the percentage of employees with a higher degree in their company. Gender (*Female*): Respondents were asked to indicate the percentage of female workforce by means of a ratio scale. External search breadth (*LLL_coop_tot*): In order to operationalise external search breadth, drawing on Laursen and Salter (2004), companies were first asked by means of a binary variable to indicate whether they cooperated in lifelong learning activities with any of the following partners: suppliers, customers, competitors, consultants, vocational training centres, public research organisations, associations. Once the partners with whom the company cooperated for the development of lifelong learning activities were known, a ratio variable was generated through the sum of the partners with whom the company cooperated. Cluster association (*Clus_yes_no*): Respondents were asked to indicate whether they belonged to a cluster. Informal interactions (*Inf_int_tot*): Drawing on D'Este and Patel (2007) respondents were asked through a binary scale to indicate whether they took part in any of the following types of informal interactions: (i) events, forums, and/or meetings, (ii) conferences and/or congresses, and (iii) workshops and/or symposia. Once the informal interaction types

developed by companies were known, a ratio variable was generated, adding all the types of informal interactions developed. R&D intensity (*RD_int*): Based on Kobarg, Stumpf-Wollersheim and Welpe (2018), R&D intensity was measured by means of a ratio scale. Companies indicated their share of R&D investment. Innovation capacity (*IC*): In order to operationalise innovation capacity, the construct developed by Calik, Calisir and Cetinguc (2017) was applied. To standardise the questionnaire, its measurement was transformed from a five-point Likert-type scale to a ten-point Likert-type scale "1=Strongly disagree; 10=Strongly agree". Innovation degree (*ID*): For the measurement of innovation degree, the scale proposed by Gatignon *et al.* (2002) and employed by Flor, Cooper and Oltra (2018) was adapted. In order to avoid problems with reverse coded items, one of the items was modified. In turn, to standardise the questionnaire, its measurement was transformed from a seven-point Likert-type scale to a ten-point Likert-type scale "1=Strongly disagree; 10=Strongly agree". UBC willingness and support: in order to operationalise UBC willingness and support, the scale developed by Davey et al. (2018) was used. It was measured through a ten-point Likert-type scale "1=Strongly disagree; 10=Strongly agree". In the case of the latent variables (*IC*, *ID* and UBC willingness and support), the scales identified in the literature were revalidated by means of a dimensionality, reliability and validity assessment. In the case of *IC* and *ID*, the measurement was based on the mean of the items and dimensions validated in the study. In the case of UBC willingness and support, the identified three dimensions were included in the study.

To identify the determining factors of UBC levels, 5 multiple linear regression models were run (stepwise method). With a view to obtaining more robust estimate parameters and standard errors while avoiding heteroscedasticity problems, the bootstrapping technique was employed. Thus, for each of the models analysed, the regression results

were checked against the bootstrapping results. In turn, a goodness of fit assessment was carried out to find and assess the models that best fitted data; R^2, multiple R and F-test values were checked. After assessing the goodness of fit of the models, the quality of the models was ensured by examining residuals (outliers and leverage points). In addition, the multicollinearity of each model was assessed.

Results

As can be seen in Table 2, the final model (Nº4) showed that manufacturing SMEs' cooperation levels in mobility of students were positively related to *UBC_resources* ($p < .001$), RD_int ($p < .01$), *Inf_int_tot* ($p < .05$) and negatively related to *Market_BC* ($p < .001$). With regard to curriculum co-design, the final model (Nº2) showed that manufacturing SMEs' cooperation levels were positively related to *Size* ($p < .001$) and *UBC_resources* ($p < .001$). As regards curriculum co-delivery, the final model (Nº2) showed that manufacturing SMEs' cooperation levels were positively related to *Inf_int_tot* ($p < .001$) and *Cogni_closeness* ($p < .001$). As to dual education, the final model (Nº3) showed that manufacturing SMEs' cooperation levels were positively related to *UBC_resources* ($p < .001$), *Size* ($p < .001$) and *Cogni_closeness* ($p < .01$). As can be seen in Table 2, the final model (Nº4) showed that manufacturing SMEs' cooperation levels in mobility of students were positively related to *UBC_resources* ($p < .001$), *Inf_int_tot* ($p < .001$), *RD_int* ($p < .05$), and negatively related to *Market_BC* ($p < .01$).

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
Mobility of students	1	(Constant)	-.070	.418		-.167	.868	-.893	.753
		UBC_resources	.754	.076	.479	9.919	.000	.604	.904
	2	(Constant)	1.983	.531		3.732	.000	.938	3.028
		UBC_resources	.666	.074	.423	8.998	.000	.520	.812
		Market_BC	-.265	.045	-.275	-5.847	.000	-.354	-.176
	3	(Constant)	1.346	.555		2.424	.016	.254	2.439
		UBC_resources	.640	.073	.407	8.736	.000	.496	.784
		Market_BC	-.225	.046	-.234	-4.888	.000	-.316	-.134
		RD_int	.690	.202	.162	3.410	.001	.292	1.088
	4	(Constant)	1.206	.553		2.180	.030	.118	2.294
		UBC_resources	.581	.076	**.369**	7.635	**.000**	.431	.731
		Market_BC	-.203	.046	**-.211**	-4.368	**.000**	-.294	-.112
		RD_int	.645	.201	**.151**	3.202	**.001**	.249	1.041
		Inf_int_tot	.431	.167	**.127**	2.580	**.010**	.103	.760
Curriculum co-design	1	(Constant)	1.174	.139		8.425	.000	.900	1.448
		Size	.012	.003	.222	4.053	.000	.006	.018
	2	(Constant)	.521	.225		2.311	.021	.077	.965
		Size	.011	.003	**.198**	3.670	**.000**	.005	.017
		UBC_resources	.140	.038	**.197**	3.640	**.000**	.064	.215
Curriculum co-delivery	1	(Constant)	1.236	.107		11.555	.000	1.025	1.446
		Inf_int_tot	.515	.083	.326	6.210	.000	.352	.678
	2	(Constant)	.527	.226		2.332	.020	.083	.972
		Inf_int_tot	.409	.087	**.258**	4.706	**.000**	.238	.580
		Cogni_closeness	.152	.043	**.195**	3.542	**.000**	.067	.236
Dual education	1	(Constant)	.147	.392		.374	.709	-.624	.917
		UBC_resources	.526	.071	.377	7.388	.000	.386	.666
	2	(Constant)	-.374	.387		-.964	.336	-1.136	.388
		UBC_resources	.456	.069	.326	6.559	.000	.319	.592
		Size	.021	.004	.273	5.493	.000	.014	.029
	3	(Constant)	-.959	.432		-2.220	.027	-1.809	-.109
		UBC_resources	.309	.085	**.221**	3.642	**.000**	.142	.476
		Size	.019	.004	**.249**	5.005	**.000**	.012	.027
		Cogni_closeness	.267	.091	**.180**	2.932	**.004**	.088	.447
Lifelong learning	1	(Constant)	.358	.311		1.154	.249	-.253	.969
		UBC_resources	.395	.056	.360	7.001	.000	.284	.506
	2	(Constant)	.373	.300		1.242	.215	-.218	.964
		UBC_resources	.297	.058	.270	5.113	.000	.183	.412
		Inf_int_tot	.615	.126	.259	4.896	.000	.368	.862
	3	(Constant)	1.426	.395		3.611	.000	.649	2.203
		UBC_resources	.269	.057	.245	4.691	.000	.156	.382
		Inf_int_tot	.509	.126	.214	4.049	.000	.262	.756
		Market_BC	-.136	.034	-.203	-3.991	.000	-.203	-.069
	4	(Constant)	1.110	.415		2.676	.008	.294	1.926
		UBC_resources	.259	.057	**.236**	4.539	**.000**	.147	.371
		Inf_int_tot	.483	.125	**.204**	3.858	**.000**	.237	.730
		Market_BC	-.117	.035	**-.174**	-3.368	**.001**	-.186	-.049
		RD_int	.354	.151	**.119**	2.346	**.020**	.057	.651

Table 2: Linear regression models

Discussion and conclusions

Mobility of students is probably the most common and best-known UBC activity (Davey *et al.*, 2018), and the results of the study corroborated this statement. This activity turned out to be the one most developed in sample 3.73 (SD=3.46). Even if the promotion and implementation of dual education programmes is one of the lines of action of the *I 2022 Basque University-Business Strategy* (Basque Government, 2017), the results indicated that dual training was developed to a lesser extent than student mobility 2.80 (SD=3.07). With the exception of *UBC resources*, the results of the regression models showed huge differences regarding the determining factors of these activities. First, unlike the results for mobility of students, *Size* and *Cogni_closeness* were positively associated with the development of dual education programmes. This finding supported dual education programmes' requiring higher levels of knowledge alignment (characterised by cognitive closeness) and commitment (characterised by size and resource availability). Second, it was surprising to see that mobility of students was determined by the same factors as lifelong learning, i.e. *UBC_resources*, *Inf_int_tot*, *Market_BC* and *RD_int.* According to the results of the descriptive analysis, despite the low levels 2.35 (SD=2.41), lifelong learning proved to be one of the most developed cooperation activities in the sample after mobility of students and dual education. Mobility of students and lifelong learning seemed to be developed to a larger extent by companies with higher R&D expenditures, which in turn might have had higher UBC resource levels due to the alignment between both partners and the benefit they considered to obtain from cooperation. Moreover, these companies might have developed more informal interactions with universities because they had the absorptive capacity (AC) required to take part in events in which universities participate. Even if further research is required, the negative impact of *Market_BC* might be explained by the fact that companies with higher local sales could be non-technological

or industrial subcontracting SMEs; that is to say, companies that, unlike export-oriented companies, seemingly require neither university knowledge, which is characterised by being more basic and long-term oriented, nor highly-skilled employees (Henderson, McAdam and Leonard, 2006; Bruneel, D'Este and Salter, 2010; Perkmann, Neely and Walsh, 2011; Davey *et al.*, 2018).

As regards curriculum co-design 1.68 (SD=1.64) and curriculum co-delivery 1.68 (SD=1.67), the descriptive analysis noted that both activities were one of the least developed UBC activities by the manufacturing SMEs in the sample. In accordance with the results of the models, these UBC activities were determined by different organisational context-related factors. On the one hand, curriculum co-design was positively related to *Size* and *UBC_resources*. These findings suggested that larger companies (possibly regional driving-force companies) with strong relationships with universities were the ones that cooperated to a greater extent in curriculum co-design. On the other hand, curriculum co-delivery was positively related to *Inf_int_tot* and *Cogni_closeness*. These findings indicated that companies cooperated to a greater extent in curriculum co-delivery when (i) they were in closer cognitive proximity to a university and considered themselves more capable of absorbing the knowledge of the university and more able to offer knowledge to universities both in education and R&D, and (ii) they developed informal interactions to a greater extent (companies that were more open and proactive to participate in different kinds of events with university participation). That is to say, these companies' knowledge was aligned with university knowledge and were willing to interact with external agents to acquire and disseminate knowledge.

Limitations and future lines of research

The fact that the questionnaire was filled in by a sole respondent could have led to common method bias (CMB). In order to lessen the effect that this limitation might have

had, special attention was paid to avoiding social desirability bias (SDB). Furthermore, as for the variable *Exports*, it must be stressed that the use of a measurement of the percentage of the local sales of the SMEs in the absence of a direct measurement of SMEs' export orientation led to an important limitation. Finally, it is necessary to point out that the data analysed was prior to the Covid-19 crisis.

It should be noted that, although these limitations determined the scope of the present study, they also guided future research to generate greater knowledge of UBC. Firstly, it would be interesting to carry out studies that clarify the role of export orientation in UBC. Future studies should also examine the relationship between the development of informal interactions and cooperation levels in diverse UBC activities. As regards the importance of the variable *UBC resources*, a prominent line of research would focus on the identification of the types of companies that have the highest and lowest levels. Finally, it is particularly important to develop studies with post-pandemic data to assess the changes that may have occurred in UBC as a result of the Covid-19 pandemic.

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