Journal of Namibian Studies, 33(2023): 2128–2146 ISSN: 2197-5523 (online)

The Correlation Among University-Industry Collaboration (Uic) Predictors: The Results of Innovation Collaboration and University Performance

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Abstract

This piece of writing reveals how the factors influencing university-industry collaborations referred to as predictors in the text affect the results. Specifically, it looks at data collected from Indonesia's private universities and analyzes their results using a partial least squares structural equation model. The findings showed that research done at schools collaborating with industry sectors produced higher academic performance. "Finding ways to collaborate with other stakeholders outside the university, such as research institutions, competitors, customers and suppliers, led to more innovative ideas. This was due to universities being able to work with these groups to better enhance their ability to collaborate and create competitive advantages. Combining skills in research and development with innovation allows students to learn how to interact with the workforce while also increasing their understanding of science and math. Working alongside people with different life experiences, interests and perspectives helps students create more creative ideas.

Keywords: University-Industry Collaboration, learning organizational, innovation collaboration, university performance.

Introduction

University-business cooperation with national experts reporting a positive effect has recently become popular. This leads to new R&D and competitive business practices (Morisson & Pattinson, 2020). It's believed that the UIC generates a high amount of new ideas (Guan & Zhao, 2013; Iqbal et al., 2015). Universities provide essential research infrastructure that assists in making technological innovations (Etzkowitz, 2003). Universities should create a commercial business out of their research and developments (Kaloudis et al., 2019).

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Universities need to collaborate with each other in order to meet the three requirements of higher education. This is because they are required to implement the Tri Dharma of education a mandate that no one university can ignore. Creating programs focused on teaching and research won't improve education quality. Instead, universities need to focus on creating learning programs that lead to further understanding.

4.0 refers to a new approach to education called "student-centered". It requires students to develop new abilities so they can continue to improve the future of Indonesian education (Kemdikbud, 2020). This school produces graduates with a mindset to match the evolution and transformations in life (Bodas Freitas et al., 2013).

Innovations need learning organizations to be created. (García-Morales et al., 2012) understanding how learning structures impact organizational goals and performance leads to better overall results, (Y Wang & Lu, 2007) Learning how to organize supports professional success. People consider this a fact that inspires them, (Marquardt, 1996) Peter Senge (1990) defined a learning organization as an organization that continues to develop its capacity to create its own future amid the ever-changing business competition. This is necessary in order to improve innovation in a company and gain a sustainable competitive advantage. By encouraging the development of unique internal capabilities within a business, groups can work together to create more powerful results.

Leaked documents suggest public organizations often cooperate to create new ideas (Le Ba hong, 2019). Collaboration with other organizations, such as universities, universities and suppliers pushes an organization's innovation level higher (Xue et al., 2018). (Rosler, 2015) Highlighting the need to reestablish a knowledge-based structure for knowledge-intensive universities (Castilho & Quandt, 2019). Innovation collaboration presents a significant opportunity cost for knowledge-intensive companies. This is because it poses a chance of counterfeits and fakes (Miozzo et al., 2016).

This study examined university performance and innovation collaboration under the aegis of learning organization theory. This approach unites multiple disciplines and perspectives into one cohesive whole providing answers where there once was an information gap".

Literature Review

University Performance

Organizations need both tangible and intangible resources to achieve performance goals. (Talla et al., 2018) Universities with specific goals and visions always adapt their performance to improve the overall success rate. This is because a truly holistic approach to education incorporates student success, sustainability, and the ability to change with the environment. Colleges need to be competitively superior due to their accomplishments and achievements. These must be remarkable so that they can provide students with the latest management techniques and ideas (Talla et al., 2018).

Effective organizations require structures and systems to provide proper authority, create consistent processes and develop effective strategies. These determine the effectiveness of an organization by providing the proper direction for their performance. Other key factors include strategic leadership that determines the direction of the organization by implementing policies and strategies.

According to (Hidayanto & Setyady, 2014) defining performance standards is a scientific process that organizations use to evaluate their performance. These standards are based on the institution's experience and vary based on the environment it operates in. However, these standards are considered a standard that all institutions follow. Malcolm of the US National Benchmark set a series of sub-criteria for each benchmark that made up a set overall performance standards. The standards are used to evaluate university performance and determine their standard (NIST, 2014) “A certificate of appreciation can provide educational stability, improved student learning, improved employee performance and benefits for other beneficiaries. They can also improve workforce outcomes, leadership outcomes and governance, general budgeting and finance and market performance. There are five sub-criteria: 1) student learning outcomes and processes; 2). yield on beneficiaries; 3). results on the workforce; 3). leadership and governance outcomes; 4). budget, finance, and 5). market results.

Innovation Collaboration

To create new ideas, entrepreneurs must use a variety of methods to achieve a specific result (Guan & Zhao, 2013; Othman & Omar, 2012). Collaborations between universities and industry are encouraged through the creation of a model that encourages knowledge transfer between the two. This was accomplished through successful university-industry cooperation.

Businesses need to collaborate with each other in order to create new, innovative ideas. This is because the university-generated knowledge that they share helps facilitate this process. There are five stages to this collaboration process, with the first being identifying business opportunities and needs. Then, businesses should focus on meeting the needs and opportunities of their business partners. Additionally, these two groups should consider opportunities that both of them can take advantage of together. Creating opportunities for innovation through partnerships is a common goal; additionally, commercialization of new products or markets is typically the intention of industrial partners. The university and industry partners identify the elements that add value to the goals they work toward (Ivascu et al., 2016).

In the National Innovation System, innovation involves the creation of technology or new information (Metcalfe & Ramlogan, 2005). Innovation is key to organizational renewal (Murata et al., 2014). Technically, innovation comes from many different sources. (Gunday et al., 2011) Innovation is vital to any management system and organizational unit; proper effort and organization is necessary for innovation to succeed. (Sedziuviene & Vveinhardt, 2010) In order to create the best possible solutions, innovation involves multiple processes. In learning terminology for innovation, the main and fundamental purpose of innovation is stated (Guan & Zhao, 2013; Sanchez-Pay et al., 2022; Sebola & Khoza, 2022).

Higher education results in science studies, as previous research indicates (Boldt-christmas, 2015),and patents (Pouris, 2013) Patents can be considered indicators of research, innovation and knowledge accumulation. Due to this reason, they are valuable pieces of information when it comes to developing new technologies. People also use scientific articles to indicate technological progress and knowledge accumulation (Pouris, 2013). Patents are commercially available information that's hard to access, such as findings from academic research. Patents are used to protect original inventions that have operational tools in policy making; they're also used to promote the pace of innovative activities.

The findings (Diaconu, 2017) universities should be placed within an adaptive strategy to create a competitive economy through permanent innovation and research collaboration. This is key to their competitive nature in the economy due to their collaboration-oriented approach. By creating partnerships, students can learn research, development and collaboration skills. These skills can help them quickly integrate into the labor market and work with graduates with professional social and scientific research skills. Additionally, this would help universities support inclusion of everyone who benefits

from their research and collaboration efforts. Joint success in collaboration according to (Rosler, 2015) Integrating different perspectives, expertise, knowledge and viewpoints into new ideas.

Table 1: State of the art of university-industry collaboration in generating innovations

(Diaconu, 2017)	Technology transfer as a basis of innovation
(Mateos-garcia et al., 2011)	Industrial clustering
(Anatan, 2013)	A method of improving organization performance, creating competitive advantage, developing new products and innovation through collaboration. This process also creates technological capacity advancements, improves quality and creates a conceptual model on the technology transfer.
(Mateos-garcia et al., 2011)	Creating a spin-off company and securing patents are just some of the academic achievements students can earn

The first theory behind this study was created through the following process..

H1: Innovation collaboration positively affects university performance

Learning Organization

Learning organizations have seen an increase in popularity recently (Akkaya, 2020; Aranda et al., 2017; Kaya et al., 2020). According to (Marquardt, 1996), In rapidly changing business environments, organizations need to increase their learning capacity to have competitive advantage. (Yonggui Wang & Lo, 2003) Learning organizations help companies improve their core competencies by facilitating experimentation, improvement and innovation. This is because new and unique knowledge must be acquired, combined and applied in order to create new experiments, processes and ideas. Learning provides companies with new knowledge and insights to change their future behavior. This helps them overcome future uncertainties and maintain sustainable excellence. People at a company learn through four subprocesses (Draghici et al., 2015). Companies gain new information and knowledge by learning first. Additionally, sharing information with one another is done through knowledge sharing. People transform information into general knowledge when interpreting new information. Fourth, organizations maintain memory by storing and using information.

Table 2: The state of the art for understanding how learning organizations increase performance by creating new ideas is listed in Table 2

(Aranda et al., 2017)	The learning organization tests managers' understanding of their past performance by comparing it against the change in targets as the branch grows older. The results showed that as the branch grew older and more mature, managers decreased the weight of their past performance and increased its comparable performance.
(Kaya et al., 2020)	Effecting competitive advantage through collaboration is documented as an observed means of innovation. Effective inter-organizational communication can positively affect performance through collaboration by improving innovative performance
(Jiménez-Jiménez & Sanz-Valle, 2011)	Learning how to improve the organization and create new ideas led to positive business results. This was because learning organization improved both innovation and performance.
(Patky, 2020)	The growth of knowledge and organizational insights happens through related past and future operations. The learning organization affected performance and innovation thanks to leaders' cognitive abilities and the openness of resources.

Based on the explanation, the second and third hypotheses of this study were proposed as follows.

H2: Learning organization positively affects innovation collaboration

H3: Learning organization positively affects university performance

Method

This study incorporates both quantitative and qualitative methods. The research process used a sequential design that tested hypotheses discovered through qualitative research. Data were gathered through surveys, in-depth interviews, notes and reports. Triangulation was employed to provide further evidence of the data. (3) Expert tools included tape recorders, notebooks and standard instruments. Of the six sequential explanatory models, five needed both quantitative and qualitative data analysis. The sixth one only needed qualitative analysis. This was because sequential explanatory models need six samples at a time. The relationship between the researcher and respondents was distant yet intimate. This caused the tests to incorporate both qualitative and quantitative data.

The mixed method combined survey and experimentation to determine how university collaboration leads to improved performance. Researchers used probabilistic and non-probabilistic sampling methods to answer their questions. These methods included stratified random sampling and convenience sampling. Convenience sampling uses non-probabilistic methods such as self-survey or word of mouth.

Yamane (1967) calculated the sample size as proposed by him to be n = N /[1+Ne2]. This equation takes into account the population size, the level of precision, and e, which is the level of precision for n. N is the number of people in a population, and e is the level of precision for n. That's because n = N /[1+Ne2]. The study used information from 187 respondents who were surveyed using probability sampling. Qualitative research often requires selecting participants from specific criteria. For instance, guest (2006) stated that homogeneous groups of 12 participants often suffered from burnout. In this case, semi-structured interviews with 5 heads of study programs, 5 lecturers and 5 heads of research institutes were conducted".

The dimensions and operationalization of the Learning Organization concept were measured using indicators borrowed from Draghici et al. (2015). This included 4 dimensions – informational acquisition, knowledge dissemination, and knowledge interpretation – as well as 5 indicators and 6 indicators for organizational memory. University performance was measured using indicators borrowed from Rosler (2015) with 5 indicators. The collaboration variable was also measured using indicators borrowed from Diaconu (2017) with 5 indicators (Diaconu, 2017).

The analysis of qualitative data was performed with the ATLAS software, while a confirmatory factor analysis and hypothesis testing were performed with PLS software 3.0. To determine the role of the mediating variable, an Outer Model and Inner Model are created. Using the Partial Least Square (PLS) approach, these models examine the value of a latent variable that influences both the independent and dependent variables. Hypothesis testing is then performed to determine if there was indeed a relationship between the two variables.

Results of the Study

Participants

In order to determine a respondent's identity, questionnaires were distributed that ask about their age, sex, specialization, educational background, years of service as a professor and their published academic products or patents. A list of respondents' characteristics is shown in table 1.

Table 3. Respondents' socio-demographic characteristics (N = 187)

Gender	n%	Academic Title	n%	Specialization	n%	Academic Products	∑
Male	54.60%	Assistant	19.78%	Economics	18.75%	Articles published in reputable international journals	62
Female	45.40%	Lector	34.08%	Political sciences	6.59%	Articles published in accredited journals	107
		Head Lector	43.70%	Legal Studies	16.58%	Non-accredited journals books, patents	488
		Professor	2.44%	Medical Studies	3.70%		180
				English	7.90%		13
				Civil Engineering	4.60%		112
				Chemistry engineering	4.70%		
				Pedagogic Studies	11.10%		
				Psychology	8.30%		
				Informatics	8.60%		
				Agriculture	2.60%		
				Planology	3.70%		
				Others	2.88%		

Source: Primary Data Processed (2022)

Results

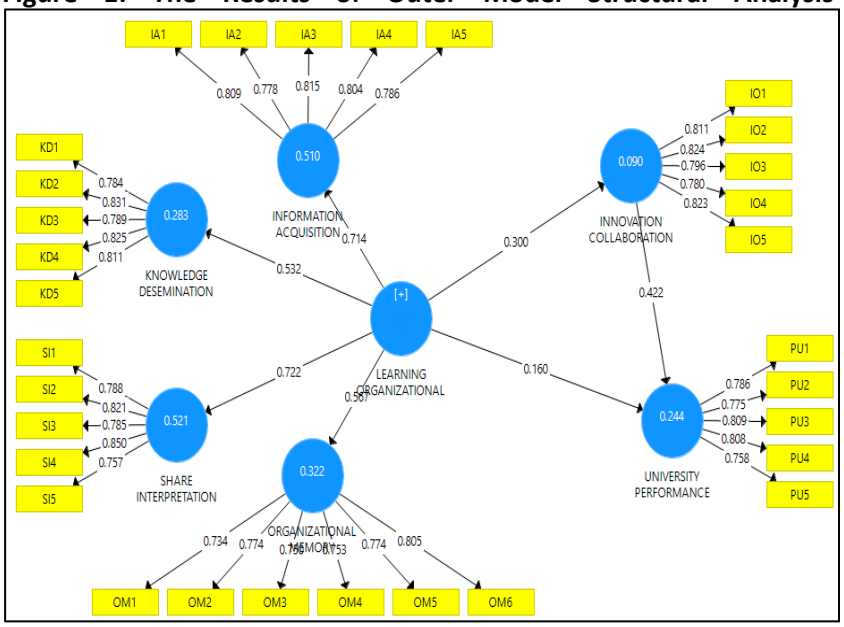
Measurement and Procedure

The organization's structure was measured in four categories (Draghici et al., 2015): informational acquisition (0.575) with 5 indicators (IA1. IA2. IA3. IA4. IA5), knowledge dissemination (0.435) with 5 indicators (KD1 , KD2. KD3. KD4. KD5), shared interpretation (0.444) with 5 indicators (SI1. SI2. SI3. SI4. SI5), and organizational memory (0.334) with 6 indicators (OM1. OM2. OM3. OM4. OM5. OM6). The 0.555 innovation collaboration utilized five indicators, including IO1, IO2, and IO3. "These five indicators are represented by PU1 - PU5. This university performance construct included IO4 and IO5. In addition to the PU1 to PU6, there are additional pouches labeled PU3 to PU5. Figure 1 represents the research model obtained from 167 respondents that used Smart PLS version 3.0. This model was created with a variance-based structural equation model and met recommended minimum requirements for sample size. The only

requirement is that the R2 value be 0.25 or lower for each independent variable (Linear Regression, 2014)..

Data from this study must meet a minimum threshold value of 0.6. All indicators in this outer layer that have lower loading factors than 0.600 were removed from the structure. Additionally, all indicators with higher values than 0.600 were considered valid for data analysis. Table 1 presents the discriminant validity measurements. Each construct had AVE values greater than 0.500, indicating that the model had high convergent validity. AVE values were used to measure discriminant validity, which is the ability to separate constructs into different groups. The bold diagonal figures indicate the square root of the AVE. If the number in bold diagonally is greater than the number listed horizontally, it indicates a strong indicator of discriminant validity. The table 2 lists all the numbers in bold diagonally that are greater than the numbers listed horizontally. This indicates a high degree of discriminant validity for the composite reliability and internal consistency of the test. A composite reliability score greater than 0.700 combined with a Cronbach's alpha value below 0.700 indicate poor internal consistency reliability. However, composite reliability scores above 0.700 combined with Cronbach's alpha values below 0.700 show good internal consistency reliability.

Figure 1: The Results of Outer Model Structural Analysis



Source: Primary Data Processed (2022)

Hair et al., 2014, stated that the reliability of indicators must meet or exceed 0.6 to .7 in studies meant to explore new ideas. This was

determined through an analysis of Cronbach's alpha or using the composite score.

Table 4: The construct validity and reliability testing

Variable	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Information Acquisition	0.858	0.898	0.638
Innovation Collaboration	0.867	0.903	0.651
Knowledge Dissemination	0.868	0.904	0.653
Learning Organizational	0.850	0.874	0.254
Organizational Memory	0.859	0.894	0.586
Share Interpretation	0.860	0.899	0.642
University Performance	0.847	0.891	0.620

Source: Primary Data Processed (2022)

The discriminant validity of a model is determined by comparing the "validity" of each variable. Fornell and Larcker (1981) state that the comparison should use the square root of AVEs. This gives them a sense of how similar or dissimilar each variable is to the overall model. Table 2 demonstrates the correlations between variables that are less than AVEs".

Table 5: Discriminant validity

Variable	Information Acquisition	Innovation Collaboration	Knowledge Desemination	Learning Organizational	Organizational Memory	Share Interpretation	University Performance
Information Acquisition	0.799						
Innovation Collaboration	0.250	0.807					
Knowledge Dissemination	0.216	0.058	0.808				
Learning Organizational	0.714	0.300	0.532	0.504			
Organizational Memory	0.219	0.207	0.067	0.567	0.765		
Share Interpretation	0.306	0.217	0.224	0.722	0.209	0.801	
University Performance	0.194	0.470	0.148	0.286	0.056	0.299	0.787

Source: Primary Data Processed (2022)

Structural Model

Figure 2 uses Smart-PLS to illustrate the results of hypothesis testing. It shows the Partial Least Square (PLS) Regression Based SEM results, which were done using the bootstrap procedure. This test measured the relationship between university performance, Formal Links with

other universities, Innovation Collaboration and the latent predictor variables that connect them.

Table 6: Hypothesis Testing

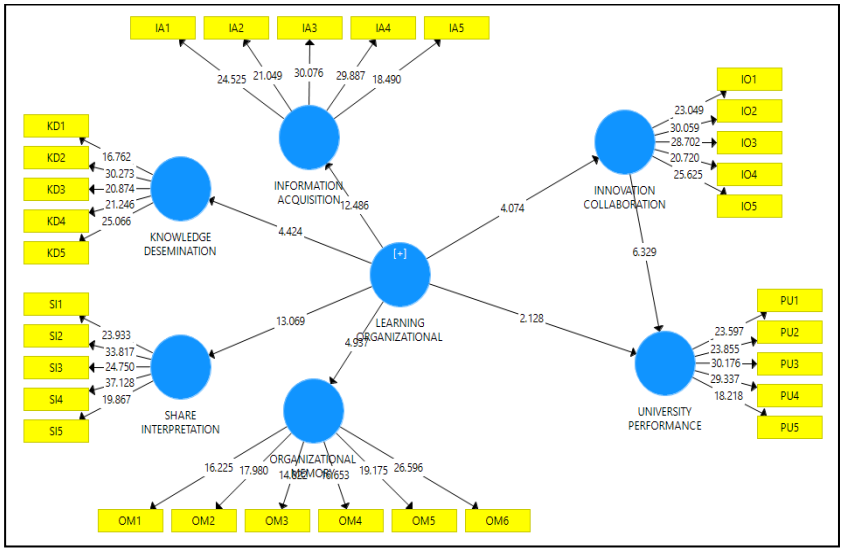
Paths	β	t Statistics	P Values	Results
Learning organization → University Performance	0.160	2.343	0.020	Supported
Learning organization → Innovation Collaboration	0.300	4.131	0.000	Supported
Innovation Collaboration → University Performance	0.422	6.400	0.000	Supported

Source: Primary Data Processed (2022)

The results displayed in Table 3 indicate the model's effectiveness. The model took bootstrap statistics into account to create Figure 2, which demonstrates the positive relationships between the independent and dependent variables. This figure also indicates the significant effect of independent variable t-statistics. If the T-statistic value exceeds 1.96, it indicates a significant effect. Additionally, any probability less than 0.5 must be considered significant according to p-values.

According to Table 3, hypothesis 1 has an original sample value of 0.160, which is considered a positive result. The greater-than sign in the t-table indicates that the t-statistic for hypothesis 1 is 2.343. This larger number means that the p-value of 0.020 is lower than the 1.96 t-table value. Because these results indicate empirical support, it's confirmed that university performance improves with students' lessons learned in organization. University performance is positively impacted by collaboration with other schools. This can be seen in hypothesis 3, which has a high t-statistic compared to the table 6.400. Furthermore, hypothesis 3 has an original sample value of 0.422 with a positive value, 4.131 t-statistics and p-value of 0.000. Compared to this, hypothesis 2's original sample value is 0.300 with a negative value, 4.131 t-statistics and p-value of 0.000. This indicates that collaboration with other schools leads to higher levels of innovation.

Figure 2: The Results of Inner Model Structural Analysis



Source: Primary Data Processed (2022)

Structural Model Assessment

Using a structured model assessment, researchers examined both direct and indirect effects of latent variables through the use of a hypothesis. This process was carried out in order to test the presence of path coefficients and specific indirect effects with a value of "t." After that, they tested correlation strength (f2), predictive significance (R2) and cross-validation redundancy (Q2). Table 4 lists the fact that f2 = 0.02 is considered small, 0.15 is considered moderate and 0.35 is considered strong. This was stated by Cohen in 1988. According to Cohen, Aiken and West (2013), R2 values equal to 0.25 to 0.50 and higher than 0.70 are considered strong. By this same measure, West, Aikin and Cohen (2013) found f2 values for all variables to be moderate.

The R2 Innovation Collaboration value is 0.154 and University Performance is 0.145 from Table 6. These results show how Table 6 blends data from all variables to yield a moderate predictive relevance or Q2 that ranges from 0.146 to 0.154 (Ringle et al., 2014) This study shows that the amount of money a person has to be greater than zero.

The results of this study contained three hypotheses with greater than 1.96 t-values. They were H1, H2 and H3. Table 6 reveals the mediation analysis (H4), which supports the findings of the PLS bootstrap SEM. The significance of this analysis is shown by a t-value greater than 1.96; this indicates that all hypotheses have been accepted. Additionally, Table 6 shows other findings from the analysis. This includes data

gathered by adding the PLS bootstrap (SEM) to the equation, which confirmed a significant mediating effect.

Table 6. The strength of correlation (f^2), predictive relevance (R^2) and cross-validation redundancy (Q^2)

Exogenous Variable	f^2	R^2	Q^2
Innovation Collaboration	0.214	0.190	0.154
University Performance		0.244	0.146

Source: Primary Data Processed (2022)

Discussions

Based on Makoto's (2018) previous research, people with high learning motivation improve their skills by learning new things. Allen (2016) also noted a strong correlation between increased learning motivation, improved performance after feedback and more significant experience. This led to him believing that these factors encourage people to develop work skills. These results were gathered from analyzing results of several tests and research projects. People with new experiences can grow and develop more than people without any new experiences. This is because the third hypothesis about learning organizations states that it helps people collaborate with each other to come up with new strategies for dealing with changes at work. Mitchinson and Robert (2014) also found this to be true. Abraham and Ari (2017) noted that failing at something can help motivate people with learning agility. This is because Carmeli, Abraham and Ari explain that getting a new perspective or idea on a problem can make people more creative..

In order to promote higher performance and college collaboration, this study discovered that organizations need to encourage their employees to improve their learning habits by creating a stimulating work atmosphere or challenging work culture. If an organization learns, then their employees will also become agile learners. (Draghici et al., 2015) Universities need systems that efficiently support their research projects, such as project management and effective communication. They also need effective supervision and a culture that supports open innovation. Add new collaborators by coordinating existing projects and recruiting young researchers. Then, bolster those efforts with economic awareness. In order to accept new collaborators, sharing research results is critically important. This is because of organizational culture's importance as a pillar.

Interviews with key University personnel revealed several factors that make collaboration with industry more effective. These included

curriculum development and job-ready graduates. They also include entrepreneurship education for students, continued education programs, and international student exchanges. Meanwhile, (Wilson, 2012) These collaborative efforts lead to Research & Development Collaboration, Student Mobilization, Commercialization of Academic Research Results, Curriculum Development, Lifelong Learning and Entrepreneurship, (Ivascu et al., 2016) The collaborative relationship between universities and industry contains 4 main categories: financial support, communication, sharing of scientific knowledge and cultural learning.

Some educational institutions receive funding from business partners for research grants, school programs, scholarships, and university departments. Other business partners offer self-development opportunities through company visits and training related to work dynamics and business. By combining efforts with other businesses, they can more effectively combine their research and development efforts. This leads to lower research costs and the ability to access new ideas that could improve processes and products (Fernandez, 2015). Superior performance can be achieved through superior skills. These unique competencies allow companies to gain a competitive edge that leads to satisfied customers and loyal employees. Working together can also lead to superior expertise, which can help businesses gain an edge in their field. In order to effectively collaborate, employees must exhibit innovative work behavior such as positive interpersonal relationships between team members and between coworkers, as well as between teams and their organizations (Zakaria et al., 2004). Doing so encourages both innovation and the attainment of organizational goals(Pudjiarti & Hutomo, 2020).

Conclusion and future work

This study looked at how universities can improve their performance by improving their learning organization and innovation collaboration. This was done by observing the work of professors through their publication of academic papers and patents. They found that collaboration between these two concepts leads to better performance. In order to encourage a culture of knowledge, universities with lifelong learning support generally perform better than those without. “Universities should also determine the agency, department or central office of their campus and explain the institutional practices and guidelines in detail. And they should incorporate intellectual property centers into the process of Downstreaming Research Results. These institutions are crucial to maintaining university performance because of their role in protecting intellectual property.

With the goal of sharing knowledge, universities and businesses work together as a scientific collaboration. This is a formalized cooperation between two or more people that encourages mutual growth and completion of projects (Sonnenwald, 2007). Modern management requires cooperation between multiple institutions. This is because programs developed through partnerships require a shared vision and mission as well as complementary management and program development. Therefore, one institution needs to lead the partnership to ensure success. All participating institutions need to be involved and highly motivated to perform collaboration. The lead institution must be dedicated to sharing new knowledge with other institutions. Institutions need to understand the strengths and weaknesses of each in order to create a cooperative spirit. This is why they need to look at every institution's positive and negative aspects, which will help them understand mutualism. This is a philosophy that promotes the idea that everyone needs to work together for the good of all. It emphasizes transparency, cooperation and participation in both institutions' operations. Most importantly, it stresses the importance of law enforcement rights and responsibilities, rewards and punishments in the form of obligations which leads to sustainable relationships between all partners (Healy et al., 2014).

Due to the short timeline of this research, cross-sectional analysis is necessary. Long-term innovation and performance concepts make it impossible to accurately interpret results from this study. Long-term studies are required in order to gather more accurate empirical data. A cross-sectional approach is also necessary, but time lags should be ignored.

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