

The mediating role of absorptive capacity on innovation among technology business incubators in the Philippines

TBIs in the
Philippines

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Abstract

Purpose – The paper aims to explore the knowledge management and innovative outputs (IO) of university-based technology business incubators (TBIs) funded by Department of Science and Technology (DOST) in the Philippines.

Design/methodology/approach – The respondents, which include heads, managers, coordinators, and staff, were reached out via email using a database. The instrument was generally adopted from various related studies in the literature. Data were analyzed quantitatively using partial least squares – structural equations modeling (PLS-SEM).

Findings – The main findings reveal that the mediated relationship between potential absorptive capacity (PACAP), realized absorptive capacity (RACAP) and IO explained 38.7% of the variance both predicted by PACAP and mainly explained by RACAP. Among new organizational antecedents measured, slack resources (SR) and willingness to cannibalize (WC) did not predict PACAP, while tolerance for failure (TF) and external openness (EO) predicted PACAP. Consequently, PACAP and RACAP positively mediated the relationship between significant organizational antecedents and IO.

Originality/value – The validation of the positive and significant link of absorptive capacity (ACAP) and innovation with an emphasis on the Philippine context. The study pointed out the unidimensionality of PACAP and RACAP as a single ACAP variable and not two separate constructs.

Keywords Academic entrepreneurship, Technology business incubators, Absorptive capacity, Knowledge management, Innovative outputs

Paper type Research paper

Introduction

In light with the emergence of academic entrepreneurship to commercialize innovations developed by universities (Siegel and Wright, 2015), several countries adopted TBI in their national innovation and entrepreneurship policies to facilitate economic development (Wonglimpiyarat, 2016). It was proven that having an innovative environment, such as an industrial garden or incubated resource, contributed to the success of technology transfer (Ortega and Bagnato, 2015). One indication of academic entrepreneurship is the establishment of a university-based TBI, which serves as an essential component in the proliferation of knowledge transfer and innovation commercialization (Bakouros *et al.*, 2002). TBIs are primarily created to provide startups (or spinoffs) with technological, business, and other support services during early development and critical stage (Lalkaka, 2002).

As many higher educational institutions transitioned to newer missions in promoting economic and social development while preserving sustainability (Schmitz *et al.*, 2017), many



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universities set up TBIs to promote technology-based startups within their backyards (Link and Scott, 2017). In the Philippines, the DOST rolled out the TBI program in the 1990s and was revived in 2009 to create jobs, develop entrepreneurs and promote public-private partnerships (DOST, 2014). To intensify the TBI program, DOST launched the Higher Education Institution Readiness for Innovation and Technopreneurship (HeIRIT) to guide and equip select higher educational institutions (HEIs) to plan, implement, build and start embracing the emerging startup community in their own university (DOST, 2018). To date, there are more than 30 university-based TBIs in the country.

Although the most successful TBIs were patterned from the Western models, however, when adopted in the emerging countries, it cannot be plainly copied because of several factors affecting business creation and performance (Manimala and Vijay, 2012). In the study conducted by Macdonald and Joseph (2001) on the TBIs and Science and Technology Parks in the Philippines, they concluded that there were pragmatic, *ad hoc* and operational adjustments needed in the implementation of TBIs. Moreover, Yancha (2016) also noted that there were inadequate support mechanisms prompting the need to reevaluate processes for better results (Yancha, 2016). Hence, there is a need to investigate factors that may influence the knowledge management and innovation of TBIs in the Philippines.

Using the reconceptualized dimensions of ACAP: PACAP and RACAP as proposed by Zahra and George (2002), this study aims to investigate the link between new organizational antecedents, ACAP and IO to help TBI management team, university administrators and policymakers in understanding academic entrepreneurship in general and TBI operations in particular. Results will show that new organizational antecedents particularly SR, TF, WC and EO are positively related to PACAP and RACAP, which, in turn, significantly influence IO.

Since the study is employing cross-sectional and descriptive design using SEM, results may be valid for this particular timeframe and will be limited to a quantitative perspective only. This paper is a firm-level study, and therefore, individual characteristics of the key staff, such as human and social capital indicators, are not included as antecedents.

Literature review and hypotheses development

Technology business incubators

In a recent study of Hayter *et al.* (2018), technology transfer studies are now shifting toward understanding the factors influencing academics to engage in entrepreneurship such as entrepreneurial environment, financial resources, technical and product characteristics and academic entrepreneurship programs including technology-based entrepreneurship (Kim, 2018). One indication of academic entrepreneurship is the establishment of university TBI. It serves as an essential component in the proliferation of knowledge transfer and innovation commercialization (Bakouros *et al.*, 2002) with the main goal of assisting start-ups (or spin-offs) in their early development and critical stage (Lalkaka, 2002). Today, TBI functions include the creation of an entrepreneurial environment, access to advanced laboratory and technical equipment, management consulting, access to financing, support for early-stage development, rationalization of costs, selection of incubates and support for business plan development (Jamil *et al.*, 2016).

In this paper, the definition of TBI is adopted from Macdonald and Joseph (2001) and expanded specifically as an incubator set up by the university as a project funded by the DOST, offering co-working space, technical services, intellectual property management and legal counseling services, analytical laboratory services, business development and marketing assistance and other administrative services (DOST, 2014) to potential academic entrepreneurs (students, faculty and staff) in the formation of their entrepreneurial endeavor.

While TBIs started in the USA, they are now well propagated around the world. In Asia, the biggest developing region in the world, there are more than 2,000 TBIs (Jamil *et al.*, 2016). In the Philippines, the Technology Application and Promotion Institute (TAPI) of DOST implemented the TBIs in the 1990s. Seven original TBI facilities were put up, two of which were located inside the DOST headquarter in Bicutan, Manila, while the other five were spread across the country in University of the Philippines (UP) Diliman, UP Los Baños, Bohol, Pangasinan and Negros Occidental. Four additional TBI locations were put up in Central Luzon State University, Agusan del Sur, Visayas State College of Agriculture and UP Visayas (Macdonald and Joseph, 2001). In 2009, the initiative was revived to create jobs, develop entrepreneurs and promote public-private partnerships by upgrading five second generation TBIs, which offer professional support, networking services and seed capital. These were UP Diliman Enterprise Center for Technopreneurship, UP Cebu Business Incubator for Information Technology, DOST Technology Resource Center Open TBI, UP Los Baños Center for Technology Transfer and Entrepreneurship and Central Luzon State University managed by DOST Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) (Pili, 2017).

In 2018, the HEIRIT program launched additional 20 TBIs among qualified HEIs in the country (DOST-PCIEERD, 2018). In a similar program, the TBI 4.0 aims to place the Philippines in the global map through partnership and collaboration with incubators and accelerators in other countries. 12 HEIs qualified in the TBI 4.0 program including Asian Institute of Management's AIM-Dado Banatao Incubator, Batangas State University's Center of Technopreneurship and Innovation, Caraga State University's Navigatú, De La Salle University's Animo Labs, Mindanao State University – Iligan Institute of Technology's iDEYA Center of Innovation and Technopreneurship, Palawan State University's International TBI, QBO Innovation Hub, UP Cebu's Business Incubator for Information Technology, UP Los Baños' SIBOL, UP Diliman's UPSCALE Innovation Hub, University of Science and Technology of Southern Philippines' CDO bites and West Visayas State University's Green TBI (Resurreccion, 2019). Currently, there are more than 30 university-based TBIs in the Philippines.

Absorptive capacity (ACAP)

This paper subscribed to ACAP as a theoretical lens in exploring knowledge management and innovation. Many researchers explored the use of ACAP in various specific fields like patent intensity and new innovation sales intensity (Howell, 2020), open data (Huber *et al.*, 2020), geographical and relational proximities (Presutti *et al.*, 2019), human behavior (Rafique *et al.*, 2018), business performance and innovation (Liu *et al.*, 2018) and need knowledge (Schweisfurth and Raasch, 2018), while other researchers studied TBIs and university technology transfer using theoretical approaches such as competitiveness system (Lalkaka, 2003), structural support theory (Manimala and Vijay, 2012), the resource-based view (Somsuk *et al.*, 2012), social capital (Redondo and Camarero, 2019), fuzzy cognitive mapping (Quiñones *et al.*, 2019) and multiple case studies (Jamil *et al.*, 2016; Wonglimpiyarat, 2016). There are, however, limited studies that deal with the knowledge management of TBIs using ACAP.

Cohen and Levinthal (1990), defined ACAP as the firm's ability to identify, assimilate, transform and apply valuable external knowledge. Therefore, it links external knowledge and internal competencies to produce IO (Palmberg, 2004) making it an essential factor of IO at the firm level (Koch and Strotmann, 2008). Zahra and George (2002) argued that despite its rigorous application to various fields, ACAP is still hard to measure due to its vagueness in terms of components, antecedents and outcomes, thus prompting the need to clarify the domain and operationalization of ACAP. They reconceptualized ACAP and highlighted the proactive dimension of knowledge creation and utilization suggesting that ACAP can be divided into two dimensions: PACAP and RACAP. PACAP involves the acquisition and

assimilation of new external knowledge, while RACAP assumes the abilities to transform and exploit them.

New organizational antecedents

[de Araújo Burcharth et al. \(2015\)](#) argued the proactive dimensions of ACAP emphasizing the inclusion of organizational antecedents that stimulate experimentation. Based on insights from prior research in the fields of organization studies, technology management and strategic management, such key organizational antecedents include SR, a climate of TF, WC and EO.

Slack resources. Slack resources are those human and financial resources unutilized in the daily operation, thus allowing firms to earmark resources to new projects important for absorptive activities. On the other hand, when resources are limited, organizations veer off from novel, non-routinized and risky activities to improve IO (Cyert and March, 1963 as cited by [de Araújo Burcharth et al., 2015](#)). Therefore, H1 is posited as follows:

H1. SR influence PACAP.

Tolerance for failure. The acquisition and assimilation of ideas from external sources may contain a high degree of failure due to their inherent uncertainty and ambiguity, while tolerance for mistakes is very critical in the early phases of external knowledge evaluation (Grant, 1996; Nickerson and Zenger, 2004; Macher, 2006 as cited by [de Araújo Burcharth et al., 2015](#)). By creating an atmosphere where success tension is lessened, a tolerant environment increases employees' potential to engage in ambiguous search endeavors (Farson and Keyes, 2009 as cited by [de Araújo Burcharth et al., 2015](#)). With this, H2 states as follows:

H2. TF influences PACAP.

Willingness to cannibalize. This refers to the firm's willingness to engage in alternative learning trajectories at the expense of the current processes and systems, including social capital, to start new acquisition and assimilation process deemed highly valuable. In other words, the WC requires the organization to stay sharp to new competitors, technologies and customers to ensure future market ([Chandy and Tellis, 1998](#)). Hence, the hypothesis as follows is proposed:

H3. WC influences PACAP.

External openness. External openness refers to the degree of importance a firm puts on external knowledge for innovative activities (Kale et al., 2000 as cited by [de Araújo Burcharth et al., 2015](#)). External technology acquisition permits firms to recognize external information ([Zanjirchi et al., 2019](#)). Additionally, these external sources improve the ability to identify new and unfamiliar knowledge and provide distinct informational advantages, which may lead to experimental behavior and knowledge accumulation ([Hagedoorn et al., 2011](#)). Hence, H4 is posited as follows:

H4. EO influences PACAP.

Potential absorptive capacity

As argued by [Zahra and George \(2002\)](#), PACAP constitutes the process of scanning, adding and understanding externally obtained knowledge capacitating firms to engage in the acquisition and assimilation of that knowledge ([Lane and Lubatkin, 1998](#)). Exchange of knowledge and ideas can be productive if members can effectively process the ideas and reflect on them after ([Ouedraogo and Koffi, 2018](#)). Hence, PACAP requires an atmosphere of change culture through creativity and flexibility ([Leal-Rodríguez et al., 2014](#)). With this, H5 states the hypothesis as follows:

- H5a. PACAP mediates the relationship between SR and RACAP.
- H5b. PACAP mediates the relationship between TF and RACAP.
- H5c. PACAP mediates the relationship between WC and RACAP.
- H5d. PACAP mediates the relationship between EO and RACAP.

Realized absorptive capacity and innovative output

The exploitation of knowledge leading to IO requires acquisition and assimilation of knowledge; however, if the organization fails to transform and exploit this knowledge, they cannot create and deliver value. In this effect, PACAP and RACAP should be seen as a complementary function rather than independent functions. If PACAP requires openness and change culture, RACAP demands high stability, order and control. RACAP deals mainly with the process of transforming, exploiting and applying valuable knowledge. Thus, an organization's ACAP relies heavily on its capacity to acquire and assimilate (PACAP) knowledge and then transform and exploit (RACAP) to produce IO (Leal-Rodríguez *et al.*, 2014).

A firm's ability to acquire, assimilate, transform and exploit knowledge increases its capacity to produce IO. Meanwhile, the process of applying new knowledge in creating new products, services or processes leads to innovation outcomes, which are expected to improve existing ones (Fiol, 1996). Therefore, H6 is posited as follows (see Figure 1):

H6. RACAP mediates the relationship between PACAP and IO.

However, in the Philippines, TBIs require adjustments in their operations (Macdonald and Joseph, 2001) and the inadequate support mechanisms prompted the need to reevaluate processes for better results (Yancha, 2016). Hence, there is a need to intensify academic entrepreneurship in the country, especially that there are still members in the academic community who have not yet considered commercializing their research outputs (Novino, 2020). It is, therefore, imperative to explore and understand the dynamics and how these operational adjustments are being carried out among the TBIs in the country in their quest to be innovative and knowledge specialist to help university administrators, TBI management team and policymakers.

Methodology

Data collection and measures

This paper took the study population of 31 university-based TBIs funded by DOST. Respondents include center managers, directors, coordinators and staff who were reached out via email using a database acquired from DOST. A total of 105 useful responses were received and analyzed.

The measures were adopted from various related studies. The new organizational antecedents measures, which include SR, TF, WC, and EO, were adapted from the works of

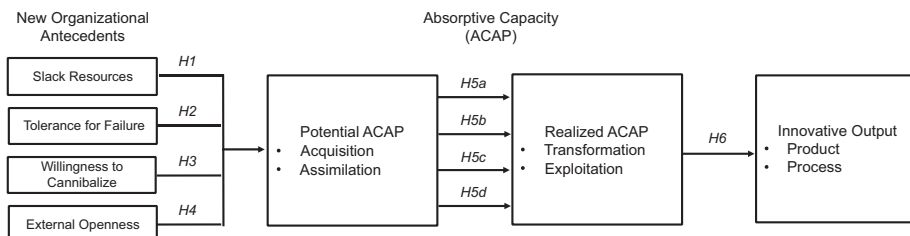


Figure 1.
Research model

Daneels (2008) as cited by [de Araújo Burcharth et al. \(2015\)](#) using a Likert scale ranging from 1 to 7 or strongly disagree to strongly agree. For the ACAP, the PACAP, which includes acquisition and assimilation, while RACAP involves transformation and exploitation, were adapted from [Jansen et al. \(2005\)](#) following a seven-point Likert scale, while the IO measures, which include product and process innovation, were based from the work of [Prajogo and Ahmed \(2006\)](#) using a five-point Likert scale ranging from 1 to 5 or worst in the industry to best in the industry.

Data analysis

Results were analyzed using descriptive and inferential statistics via PLS method, which is a variance-based SEM. PLS-SEM is appropriate for this study since the objective of the study is predictive rather than theory or parametric oriented ([Hoelter, 1983](#)). This paper involves the mediating effects of PACAP and RACAP and thus PLS-SEM ensures correct and valid terms of theoretical justification and variable prediction ([Henseler and Chin, 2010](#) as cited by [Nasar et al., 2019](#)). For smaller sample size, PLS is a good method to use in SEM ([Wong, 2013](#)).

Results and discussion

[Table 1](#) presented the demographic characteristics of the sample. The average year of operation of TBIs was 2.33 (standard deviation (SD) = 1.99). Among the respondents, 55.2% were staff, while 44.8% were head, director, manager or coordinator. In the 31 TBIs in the country, 51.6% were in Luzon, 25.8% in the Visayas and 22.6% in Mindanao.

To test the convergent validity, Cronbach's alpha and composite reliability (CR) of the constructs should be equal to or higher than 0.70 to indicate high reliability ([Fornell and Larcker, 1981](#); [Nunnally, 1978](#) as cited by [Lacap et al., 2018](#)), while average variance extracted (AVE) should have a value of equal to or higher than 0.50 to indicate convergent validity ([Fornell and Larcker, 1981](#)). In this study, the values of Cronbach's alpha range from 0.256 to 0.595 indicating a not so reliable convergence. However, when compared to CR, the values in this study as shown in [Table 2](#) indicated high reliability. In measuring convergent validity, CR is a more acceptable measure than Cronbach's alpha ([Peterson and Kim, 2013](#)), while AVE values ranging from 0.419 to 0.634 showed a good convergent validity. Meanwhile, the variance inflation factor (VIF) test with an acceptable VIF threshold of equal to or lower than 3.3 ([Kock, 2015](#)) revealed the variables measured no multicollinearity.

To show discriminant validity, the AVE of each latent variable should be higher than the squared correlations with all other latent variables being measured ([Kock, 2015](#)) as shown by the [Fornell and Larcker \(1981\)](#) criterion. [Table 3](#) presented all latent variables in the study that have displayed discriminant validity except for PACAP and RACAP. This implies the unidimensionality of PACAP and RACAP as a single ACAP variable and not two separate constructs.

IO explained 38.7% of the variance with PACAP (55.9%) and RACAP (77.5%) positively and significantly predicted IO all things held constant. According to [Chin \(1998\)](#), R^2 with values at least 0.33 or higher indicate moderate to substantial explanatory power. The Stone-

Demographics		Mean	SD	Frequency	% of total
N	105				
Years of operation		2.33	1.99		
Position	Head/Director/Manager/Coordinator			47	44.8
	Staff			58	55.2
TBI location	Luzon			16	51.6
	Visayas			8	25.8
	Mindanao			7	22.6

Table 1.
Demographic characteristics of sample

Geisser's Q^2 test the model's predictive relevance with Q^2 values larger than zero indicates the predictive relevance of the endogenous latent variable in the structural model (Hair *et al.*, 2016 as cited by Lacap *et al.*, 2018). Hence, the model has predictive and moderate explanatory power.

At the structural level, SR ($\beta = 0.087$ and $p = 0.311$) did not significantly predict PACAP, hence hypothesis 1 was not supported, while TF ($\beta = 0.227$ and $p = 0.004$) positively and significantly predicted PACAP, thereby supporting hypothesis 2. On the other hand, WC ($\beta = 0.159$ and $p = 0.055$) did not significantly predict PACAP at the 95% confidence level, indicating failure to support hypothesis 3. And lastly, EO ($\beta = 0.528$ and $p < 0.001$) positively and significantly predicted PACAP, supporting hypothesis 4. The mediation analysis further revealed that since SR did not predict PACAP, it did ($\beta = 0.076$ and $p = 0.310$) not significantly mediate the relationship between SR and RACAP as well, failing to support hypothesis 5a. Meanwhile, PACAP ($\beta = 0.201$ and $p = 0.005$) positively and significantly mediated the relationship between TF and RACAP supporting hypothesis 5b. Since WC did not predict PACAP, consequently PACAP ($\beta = 0.139$ and $p = 0.055$) did not mediate the relationship between WC and RACAP at the 95% confidence interval, failing to support hypothesis 5c, while PACAP ($\beta = 0.465$ and $p < 0.001$) positively and significantly mediated the relationship between EO and RACAP, supporting hypothesis 5d. Furthermore, RACAP ($\beta = 0.546$ and $p < 0.001$) positively and significantly mediated the relationship between ACAP and IO, thereby supporting hypothesis 6 (see Table 4).

The standardized root mean square residual (SRMR) with acceptable values of less than 0.10 or 0.08 and normed fit index (NFI) with value closer to 1 (Bentler and Bonett, 1980) were used to indicate goodness of fit in the model. The structural model showed SRMR and NIF values of 0.093 and 0.508, respectively, indicating a good model fit.

As shown in Figure 2, among the new organizational antecedents studied, SR did not significantly predict PACAP as well WC at the 95% confidence interval. According to Liao *et al.* (2003), SR are critical for organizations to enter into new endeavors; however, when

Variable	Loadings	VIF	Cronbach's α	CR	AVE
SR	0.087	1.415	0.595	0.783	0.553
TF	0.227	1.269	0.579	0.766	0.544
WC	0.159	1.337	0.256	0.648	0.419
EO	0.528	1.153	0.925	0.936	0.554
PACAP	0.880	1.000	0.808	0.858	0.445
RACAP	0.620	1.000	0.858	0.888	0.454
IO			0.915	0.931	0.634

Table 2. Loadings, collinearity and convergent validity

Note(s): VIF = variance inflation factor; CR = composite reliability and AVE = average variance extracted

	EO	IO	PACAP	RACAP	SR	TF	WC
EO	<i>0.744</i>						
IO	0.460	<i>0.796</i>					
PACAP	0.639	0.542	0.665				
RACAP	0.648	0.614	<i>0.877</i>	<i>0.672</i>			
SR	0.317	0.470	0.393	0.422	<i>0.746</i>		
TF	0.295	0.374	0.462	0.506	0.346	<i>0.745</i>	
WC	0.146	0.295	0.337	0.289	0.439	0.328	0.650

Table 3. Discriminant validity using Fornell-Larcker criterion

Note(s): Italic values represent that the AVE of each latent variable is higher than the squared correlations with all other latent variables

Hypothesis	R^2	Q^2	B	SE	p -value	Decision
<i>New organizational antecedents</i>						
H1: SR → PACAP			0.087	0.080	0.311	Not supported
H2: TF → PACAP			0.227	0.080	0.004	Supported
H3: WC → PACAP			0.159	0.078	0.055	Not supported
H4: EO → PACAP			0.528	0.068	<0.001	Supported
PACAP	0.559	0.209				
H5a: SR → PACAP → RACAP			0.076	0.070	0.310	Not supported
H5b: TF → PACAP → RACAP			0.201	0.072	0.005	Supported
H5c: WC → PACAP → RACAP			0.139	0.068	0.055	Not supported
H5d: EO → PACAP → RACAP			0.465	0.063	<0.001	Supported
RACAP	0.775	0.336				
H6: PACAP → RACAP → IO			0.546	0.057	<0.001	Supported
IO	0.387	0.225				
<i>Model fit measures</i>						
SRMR	0.093					
NFI	0.508					
Note(s): SRMR = standardized root mean square residual and NFI = normed fit index						

Table 4.
Structural model
results, path
coefficients and model
fit quality indices

resources are tight, organizations ability to be creative and to experiment decrease and hence limiting their PACAP ability. In this study, TBIs are funded by DOST for the first two years intended toward essential activities. Respondents also identified sustainability of financial resources as the most challenging problem they face, which is further implying that in this study, SR did predict PACAP. Similarly, the WC did not predict PACAP at the 95% confidence level as well. It is important to note that the TBIs under study are relatively new (2.33 mean years) thus still developing their systems and processes or the “old ways”. Interestingly, since this variable is considered in the boundary limit of the 95% confidence interval ($\beta = 0.159$ and $p = 0.055$), it is important to note the changes of this particular variable as the TBIs mature over time.

On the other hand, TF and EO positively and significantly predicted PACAP. It implies that for starting TBIs, a highly tolerant climate for mistakes is necessary (Farson and Keyes, 2009 as cited by de Araújo Burcharth *et al.*, 2015) to effectively acquire and assimilate information. At the same time, EO from the market, institutional and other sources also positively and significantly predicted PACAP. External technology acquisition permits firms to recognize external information (Zanjirchi *et al.*, 2019) and allows a chance to get a glimpse of the emerging markets and technologies (Perkmann and Walsh, 2007).

Moreover, this paper supported that PACAP, which involves scanning, adding and understanding of externally obtained knowledge (Lane and Lubatkin, 1998), positively and

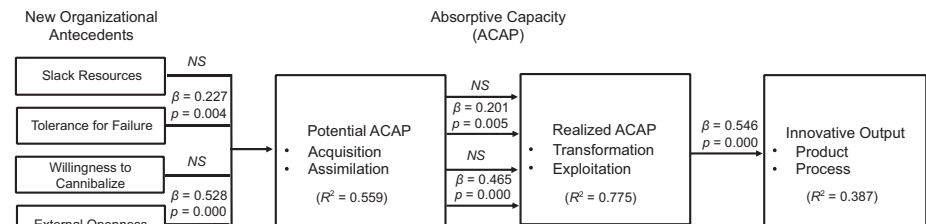


Figure 2.
Model summary

significantly mediated new organizational antecedents, particularly TF and EO and RACAP. However, PACAP does not always convert to knowledge exploitation, while RACAP captures the firm's capacity to transform and exploit knowledge (Leal-Rodríguez *et al.*, 2014). Similarly, RACAP positively mediated the relationship between PACAP and IO. Hence, an organization's ability to acquire, assimilate, transform and exploit knowledge increases its capacity to apply new knowledge in creating new products or processes, leading to innovative outcomes (Fiol, 1996). Note that PACAP does not automatically result in an innovative organization unless PACAP positively influences RACAP (Leal-Rodríguez *et al.*, 2014). For university-based TBIs, they need to develop their PACAP and RACAP abilities at an optimal rate to unlock innovative potential in order to produce top-grade products and processes.

Conclusion

The present study explored the knowledge management and IO of university-based TBIs in the Philippines using organizational antecedents and the two dimensions of ACAP: PACAP and RACAP. The main findings revealed that the mediated relationship between PACAP, RACAP and IO explained 38.7% of the variance both predicted by PACAP and mainly explained by RACAP. Among new organizational antecedents, SR and WC did not predict PACAP, while TF and EO predicted PACAP. Consequently, PACAP and RACAP positively mediated the relationship between significant organizational antecedents and IO. The main contribution of this paper is the validation of the positive and significant link of ACAP and innovation similar to the studies of Cepeda-Carrion *et al.* (2012) and Leal-Rodríguez *et al.* (2014) with an emphasis on the Philippine context. Further, this paper pointed out the unidimensionality of PACAP and RACAP as a single ACAP variable and not two separate constructs as evidenced by the model's divergent validity.

Although PACAP and RACAP proved to have significant and strong abilities, TBIs' level of IO remains moderate. Hence, the recommendations as follows are proposed: first, an efficient internal system, which includes a documented manual of operations where systems and processes are clearly in placed, should be adopted. This will help create not just a climate of tolerance but a culture of efficiency as well. Second, to improve EO, TBIs must improve their marketing and networking skills to strengthen collaboration and linkages for better access to market information. Third, PACAP, particularly acquisition and assimilation abilities, can be improved through management team's capacity building on environmental scanning and marketing intelligence. Lastly, TBIs may consider the accelerator model to focus on intangible, knowledge intensive and support services in incubation services (Uhm *et al.*, 2018).

Similar to other cross-sectional and exploratory studies, establishing the causal relationship between and among variables would become a challenge especially if the variables measured only reflect a portion of the complex system. Hence, future research should conduct a longitudinal study among mature TBIs. Moreover, since this model only captured 38.7% of the variance using ACAP-related variables, future studies should incorporate other explanatory variables such as leadership and organizational culture in the equation.

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