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Governance of Research Fund: Modelling Innovation Capital of Malaysian Public Universities

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ABSTRACT

The current study reviews the concepts and measurements of extant literatures in the area of innovation capital in the universities. In addition, based on empirical evidence, the current study produces a measurement model on innovation capital which is applicable to all public universities in Malaysia regardless of their status of research, comprehensive, or focused universities. As of now, the indicators for measuring innovation capital in universities are wide and not focused. Thus, the current study offers some dimensions, which represent the internal and external dynamics of the universities in innovation capital. The internal dynamics signify the innovation competency, innovation capacities, and innovation culture of the universities whereas the external dynamics via innovation linkages indicate the universities' relationships with industries and the government., The model can act as a monitoring tool to govern public funds, which have been awarded and spent by the universities for research and development activities. Questionnaires are distributed to academics in four Malaysian public universities. Factor analysis is applied to produce the four constructs of innovation capital model namely innovation culture and linkages, innovation competency, innovation capacities and innovation intellectual property which comprises a total of fifty nine (59) indicators.

JEL Classification: O16, G30, E24

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Keywords: Innovation Capital, Public Universities, Innovation Culture, Innovation Competency, Innovation Capacities, Innovation Linkages, Intellectual Property

INTRODUCTION

In the past, research on innovation capital has been focused from the perspective of companies. Given the fact that innovation is viewed as one of the most important sources of sustainable competitive advantage (Delgado, 2011) and has been proven as an avenue for organizations to survive and make continuous improvements (Liu *et al.*, 2005), this growing interest has been extended to public universities globally. The innovation capital composition is still subject to debate (Ramirez *et al.*, 2011), as the pillar of competition for most of the organizations is innovation, especially in technology and knowledge-based industries (Delgado, 2011).

In this competitive environment, one of the most significant challenges faced by any organization (profit or non-profit organization) is coming out with various alternatives in creating value within an organization. Knowledge-based organizations,such as a university, often rely more on intangible resources as such resources act as the source of strength for creating higher value creation (Saad & Kamaluddin, 2015). Consequently, innovation capital assists in the survival of an organization's continuous improvement(Liu, Chen, &Tsai, 2005). Hence, most organizations have started to invest more in establishing external relationships, research development, innovation, and human resources rather than investing in tangible assets (Juma &Payne, 2004).

OECD (2003) asserts that since innovation significantly contributes to economic growth and social welfare, they are under increasing pressure to reform in response to new challenges. Relevant to the public spending, the government needs greater efficiency in its research spending. The society demands for greater public accountability on research priorities and outcomes.

In response to the above, the OECD government initiated changes in the governance structure and organizational settings, e.g., in the allocation mechanism for funding public research in order to account for and balance the diversity of stakeholders' interest.

In Malaysia, 70% to 90% of the total funds for research and innovation come from the government, which indicates the government's concern in the importance of continuity in research and innovation activities. This is to ensure that the output achieves the expected commercialization and competitiveness in global education market, which in turn will contribute to additional sources of income (Amran *et al.*, 2014)

The international context of higher education institutions nowadays have to deal with a number of changes, which in turn enhance the number of functions of universities such as: (1) the appearance of new demands and aspirations of different stakeholders;(2) decreasing public funding for research and growing competition from education offered by companies;(3) new focus on knowledge production and the implementation of new research methods; and(4) the growing level of internationalization of education and research and pressure for harmonization of different national university systems (Ramirez *et al.*, 2011). The universities are not only

expected to provide training and research, but are also expected to provide lifelong learning opportunities (Canibano & Sanchez, 2009). In addition, they are also expected to help organizations to improve their innovation capacities and solve the social problems (Canibano & Sanchez, 2009).

The development of useful conceptual tools or models for analyzing universities as being economic within the knowledge-based economy is seriously hampered by the lack of data on the roles of universities that enable comparisons across time or across national innovation systems. Indicators that enable longitudinal analysis of the roles of universities in training scientists and engineers, contributing to "public knowledge," or transferring inventions to industrial firms are scarce. The absence of broader longitudinal and cross-nationally comparable indicators of university-industry interaction impedes both the formulation and the evaluation of policies (Mowery & Sampat, 2010).

In Malaysia, the National Higher Education Strategic Plan (NHESP) was formed based on the Second Thrust of the Ninth Malaysia Plan, in line with Vision 2020. NHESP was created with the aim to produce human capital that supports the thrusts of National Mission, which is to develop knowledge and innovation capacity, and to produce first-class mentality (MOHE, 2013). Among the seven (7) thrusts in the NHESP is enhancing research and innovation in the public and private universities. This relevant thrust is aimed atdeveloping a critical mass of researchers, six (6) research universities, twenty (20) world class Centres of Excellence (CoE), innovation culture among students, having at least three (3) universities among the one hundred (100) best universities, and one (1) university among the top fifty (50) best universities in the world in the year 2020 (MOHE, 2013).

The Malaysian government has pursued to increase the rate of transfer of academic research advances to industry and to facilitate the application of these research advances by local firms as part of a broader effort to improve national economic performance. The Ministry of Higher Education has spent millions to sponsor and support the research agenda in the Malaysian public universities. Thus, it is the right time to propose a comprehensive model of innovation capital, which would later form the base to develop the national university-industrial innovation capital index.

Consistent with the aspiration of the universities as producers of knowledgeable human capital and its vital role to inculcate innovation culture in ensuring continuous development of new ideas and knowledge, the main objective of this paper is to propose a comprehensive model of innovation capital from the public universities' perspective. The paper offers some dimensions of measuring innovation capital, which are currently wide and not focused in many universities. Based on the empirical evidence, the current study proposes that the model comprises four dimensions including innovation competency, intellectual property, capacities, and culture and linkages.

The current study is motivated to review the concept and measurement of innovation capital from the public universities' viewpoint coherent with the role of the universities as research centres and the place for production and diffusion of knowledge. The proposed model can act as a monitoring tool to govern the public funds, which have been awarded and spent by the universities for research and development activities. The proposed model offers guidelines to the university's management in evaluating its innovation achievements. The respective ministry

is able to benchmark the innovation activities achievements of various universities if a standard model is produced. It may also assist the government in making decisions and in setting future strategies relevant to the innovation policy in the higher education system.

The remainder of the paper is structured as follows. The following section reviews prior literature. This section discusses the definitions of innovation capital from various perspectives. The next section describes the research design, which includes the sample and the discussion of the survey instrument. The following section offers a discussion of the results and presents the data analyses. The final section concludes the paper.

LITERATURE REVIEW

Definition of Innovation Capital

Innovation can be defined as "all the scientific, technological, organizational, financial, and commercial activities necessary to create, implement, and market new or improved processes" (OECD, 1997). Chen *et al.* (2004) define innovation as "the introduction of new combinations of essential factors of production into a system". Innovation capital is the capability of an organization to innovate and to create new products and service (Van Buren, 1999). Wu *et al.* (2010) argue that innovation capital is a process that not only provides new and tangible products, but also provides intangible new ideas. By enhancing the knowledge, innovation capital can become a powerful driver for an organization's continuous or going concern (Chen *et al.*, 2004).

Al-Dujaili (2012) emphasizes that innovation capital is a fundamental source of value creation in an organization particularly in technology and knowledge-based industries. This is consistent with Chen *et al.* (2004) who highlight that innovation capital is the pivotal link of intellectual capital and a powerful drive for a company's continuous development.

Innovation Capital Constructs and Indicators

The following paragraphs reveal some of the constructs developed by various researchers of innovation capital.

Wu *et al.* (2010) assert that innovation capital comprises intellectual property and tangible assets. They propose the indicators for intellectual property as innovative reference (the exploration of undiscovered knowledge), innovative culture (organization encourages providing new ideas), and numbers of new ideas. Meanwhile, tangible assets consist of numbers of publications, financial support (research fund, monetary donation, and other tuition), and research performance (number of teachers, and domestic and international journals).

Chen *et al.* (2004) classifyinnovation capital into three parts including innovational achievements, innovational mechanism, and innovational culture. The authors explain that innovational achievements are the new products, patents, and technologies obtained through technical innovation, which reflects the historical information of the innovation capital of a company. Effective innovation needs sufficient innovational mechanism involving investments

in both human and material resources, resolute strategic policy-making, and good cooperation between departments and outsiders to win the technical support. However, sound innovational mechanism requires strong innovational culture as a foundation to drive a company to make adjustments in its strategy, organization,and personnel according to the specific unfavourable conditions in the innovation process in order to ensure the company holds its ground at the forefront in innovation management.

Reviews of extant literatures show various measurements or indicators applied by researchers for example new market and customer development (Dzinkowski, 2000); number of new ideas (Van Buren, 1999); number of R&D workers, and patent income (Guthrie &Petty, 2000) as proxies of innovation capital.

Innovation capital can also consist ofintellectual property and other intangible assets (McElroy, 2002; Wu *et al.*,2010). The components that fall under intellectual property comprise innovative reference, innovative culture, and number of new ideas (Wu *et al.*, 2010).

Wu *et al.* (2010) suggest that innovative reference is an exploration of undiscovered knowledge, while innovative culture is encouragement that has taken place within the organization in providing original ideas. The number of original ideas refers to the value of new ideas produced. As for tangible assets, the indicators are the number of publications in terms of the number of reference books produced, financial support such as monetary donations, research funds, and other tuitions and also research performance including number of teachers and domestic and international journals (Wu *et al.*, 2010).

Some researchers propose that innovation capital be measured using research and development expenses and number of new products. According to Canibano *et al.* (2000), to achieve competitive advantages, the allocation amount for R&D should improves in order to achieve higher levels of knowledge and technological improvement. Hall (1999) argues that the R&D expenses varyover time and is significant towards the market value.

A study that has been done by Kelley and Rice (2002) revealed that there is a significant positive relationship between organization's rate of alliance formation and product innovation. The alliance performance can lead to better capacity for producing a number of new products. Besides that, they also suggest that forming a high rate of alliance amongthe organizations will more likely lead to a high rate of product innovation.

Past studies have offered the measurement of innovation capital from perspective of companies. Premised on the above literature reviews, the current study offers a strategic and aligned measurement of innovation capital which can be applied in assessing the public universities performance on innovations. Thus, this would fill in the gap of how to measure innovation capital from the academia perspective.

RESEARCH DESIGN

This study used questionnaire as the research instrument. The questionnaire consists of seventy (70) items on innovation capital, measured using a five-point scale from strongly disagree of '1' to strongly agree of '5'. The questionnaire was adapted from Leitner (2002); Chen *et al.* (2004); Secundo *et al.* (2010); Kok (2007); Benzhani (2010), and Kamaluddin *et al.*

(2015). Part One of the questionnaires consists of twenty nine (29) items related to innovation competency. This is followed by Part Two that requests the respondents to response on twelve (12) items related to innovation capacities. Part Three comprises twelve (12) items relevant to innovation culture. Part Four contains seven (7) items related to innovation linkages. Finally, the respondents are requested to complete the last part of the questionnaire, which is the demographic profile consisting of ten (10) items.

The survey was administered over a 6 month period starting from January until June 2015. A total 300 questionnaires were distributed to the academics in four public universities in Malaysia ranging from junior lecturers, senior lecturers, associates professors, and professors. One hundred and ten were returned which resulted in a response rate of 37%.

Initially, the current study proposes that the innovation capital ofauniversity should possess both the internal and external dynamics. The internal dynamic consisted of three main constructs namelyInnovation Competency, Innovation Capacities, and Innovation Culture. In addition, the external dynamic comprised three construct including national and international collaborations, university-industry linkages, and university-government relationships.

RESULTS AND DISCUSSIONS

Table 1 illustrates that majority of the respondents are female (74.3%) and only 25.7% of them are male. Most of them are less than 30 years old (30.8%), followed by the age of 41 to 50 years (29.7%), less than 30 years (27.5%),and more than 50 years old (12%). Most of the respondents are Malay (89%), followed by other races (8%) and Chinese (4%). 65.4% of respondents hold positions as junior lecturer, senior lecturer (28%), and associate professor (6.5%). Majority of the respondents hold a master degree (79.9%) and have been attached with the university for more than five years (58%). Most of the universities selected for the current study have been established for more than 30 years (75%). The highest most active research grant that the academics received is within RM 20,001-RM 50,000 (internal and external grant) (44.7%). Most of the respondents have published less than 5 publicationsinthe last 5 years including journal publication, conference proceeding, books, etc. (65%).

Table 1: Respondent's Profile

Characteristics	Categories	No	%
Gender	Male	28	26
	Female	81	74
	Total	110	100
Position	Lecturer	70	65
	Senior lecturer	30	28
	Associate professor	7	6.5
	Total	107	100

Table 1 (Cont.)

Age	Less than 30 years old	25	28
	31 to 40 years old	28	31
	41 to 50 years old	27	30
	More than 50 years old	11	12
	Total	91	100
Race	Malay	97	89
	Chinese	4	3.7
	Others	8	7.3
	Total	109	100
Education Background	Master	87	80
	Doctoral degree	20	18
	Degree	2	1.8
	Total	109	100
Years with the university	less and equal to 5 years	44	42
	> 5 years < 10 years	21	20
	> 10 year < 20 years	28	27
	> 20 years	11	11
	Total	104	100
The number of years the university has been established	less and equal to 10 years	2	2
	> 10 years < 20 years	23	22
	> 20 year < 30 years	1	1
	> 30 years	79	75
	Total	105	100
Total current active research grant (internal and external)	None	6	6.4
	Less than RM20,000	14	15
	RM 20,001-RM 50,000	42	45
	RM 50,001- RM 100,000	13	14
	Above RM 100,000	19	20
	Total	94	100
Publication for the last 5years (journal publication, conference proceeding, book and etc.)	Less than 5	66	65
	6-10	23	22
	11-15	8	8
	16-20	4	4
	More than 20	1	1
	Total	102	100

Table 2: Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Innovation competency	0.101	110	0.008	0.969	110	0.012
Innovation intellectual property	0.11	110	0.002	0.972	110	0.019
Innovation capacities	0.075	110	0.164	0.982	110	0.14
Innovation culture and linkages	0.156	110	0.000	0.94	110	0.000

a. Lilliefors Significance Correction

Normality test as shown in Table 2 is tested by using the Kolmogorov-Smirnov (K-S) and Shapiro Wilk. In the K-S test, a significant value (sig > .05) indicates normality. Based on Table 2, the K-S test for innovation competency was df (110) = 0.101 (p=.008) and innovation capacities was df (110) = 0.075 (p=.164), (p > .05), indicating that the distributions are normal. Meanwhile in the Shapiro Wilk test, innovation competency p=.012, innovation intellectual property, p=.019, and innovation capacities, p=.140, which indicates that the sample size of the study isnormally distributed. However, the K-S and Shapiro Wilk tests have their own limitations.

With a larger sample size, it is very easy to get significant results on small deviations from normality, and so a significant test does not necessarily tell us whether the deviation from normality is enough to bias any statistical procedures that have been applied to the data (Pallant, 2010). Rather than referring to the Shapiro-Wilk, Skewness and Kurtosis can also determine if thedata is normally distributed. The z-values for skewness and kurtosis,which fall between 2.58 and -2.58, meansthat the normality can be assumed significant at 0.01 (Hair *et al.*, 2010). As Skewness and Kurtosis fall between +2 and-2, all the independent variables in the current study, are found to be normally distributed.

Table 3: Reliability Coefficients: Innovation Capital

Items	Cronbach's Alpha	Cronbach's Alpha based on standardized items	N of items
Innovation culture and linkages	.964	.964	23
Innovation competency	.919	.919	12
Innovation Intellectual Property	.943	.943	13
Innovation capacities	.908	.911	11

Reliability measures the internal consistency among the items or indicators in the summated scale to ensure that all the indicators are measuring the same construct and arehighly related (Hair *et al.*, 2014). Moreover, it is reliable when it produces a consistent outcome under consistent conditions (Hair *et al.*, 2014). To be considered acceptable, the Cronbach'salpha coefficient of scale should be above 0.70. However, a value of above 0.80 is preferable (Pallant, 2010). Since the reliability coefficient, as indicated in Table 3 for innovation culture and linkage, innovation competency, innovation intellectual property, and innovation capacities areabove 0.80,itindicates that the data used for this study has good internal consistency and reliability level required for significant analyses. Some of the innovation capital items were dropped as

they achieved low coefficient values. Only 59 items were retained for further analyses.

Table 4 depicts the Varimax Rotated Factor Matrix for Innovation Capital.A principal component analysis (PCA) was conducted on the 70 innovation capital items. A Varimax with Kaiser Normalization exploratory factor analysis produced four dimensions, which are culture and linkage, competency, intellectual property, and capacities. The Kaiser-Meyer-Olkin measure of sampling Adequacy was 0.870, which is more than the recommended value of 0.06 and the Bartlett's Test of Sphericity is significant in supporting the factorability of the correlation matrix.

Table 4: Varimax Rotated Factor Matrix for Innovation Capital

Indicators	Factors			
	Culture and linkage	Competency	Intellectual Property	Capacities
The leaders in our university are generally considered to exemplify a result-oriented focus	.806			
The researchers understand the university's mission pertaining to research	.765			
The leadership in our university is generally considered to exemplify innovating activities	.742			
The researchers understand the vision for what the university is working to become	.738			
The management style in the organization is characterized by teamwork	.735			
The leadership in our university is generally considered to exemplify entrepreneurship	.734			
The management declares openly their decision to enhance knowledge via research works	.703			
The researchers clearly define strategies in place that supports the mission and vision	.677			
Our university gives opportunity to have collaboration with industry in doing research works	.655			
Our university gives opportunity to have collaboration with international institutions in doing research works	.641			

Table 4 (Cont.)

Our university gives opportunity to have collaborations with government agency in doing research works	.636	
Our university vision and mission is to focus on research work	.630	
Our university gives opportunity to have collaborations with other universities in doing research works	.584	
Our university gives an opportunity to present their work in national and international conferences	.554	
The faculty management provides support to conduct research works	.553	
Our university offers internal grants for the researchers	.535	
Other universities collaborate with our university for consultancy work	.519	
The researchers' competency is at maximum ideal level	.505	
Our university provides research administration to manage intellectual property protection and commercialisation	.498	
Other universities collaborate with our university for research work	.488	
The management style in the organization is characterized by hard-driving competitiveness, high demands, and achievement	.472	
The management style in the organization is characterized by individual risk-taking, innovation, freedom, and uniqueness	.439	
Our university provides opportunity to the researchers to attend research training (i.e. data analysis workshop)	.430	
Our university has a number of research assistants		.721
Our university has a number of lecturers who receive grants		.693
Our university has a number of research fellows and associate fellows		.663

Table 4 (Cont.)

Our university has a number of research officers	.662	
Our university has a number of graduate research assistants	.647	
Our researchers are creative and innovative	.602	
Our university has a number of associate professors who are expert in their research areas	.561	
Our university has a number of professors who are expert in their research areas	.536	
Our university publishes in conference proceedings	.470	
Our university has educational experts	.469	
Our university gives an opportunity to do research collaboration with other institutions	.466	
Our researchers produce high quality research work	.442	
The intellectual properties are hard to be imitated by the competitors		.647
Our university has a number of printed newsletters and professional		.602
Our university has a number of copyrights awarded to the researchers		.561
Our university publishes a lot of articles in refereed journals		.536
The researchers' work are difficult to be imitated by others		.470
Our university has a number of patents awarded to the researchers		.469
Our university has published a number of articles in educational magazine		.466
The intellectual property can obtain certain financial gains for the company		.442
Our university publishes a lot of academic books		.647
The intellectual property can be possibly used by many other trading partners		.602
The researchers do their best in differentiating their research from others		.561

Table 4 (Cont.)

Our researchers learn from one another			.536	
Our researchers are satisfied with the university's policy regarding opportunity to do research			.470	
Our university has a number of libraries				.648
Our university provides research labs				.635
Our university has a number of multi-disciplinary online databases				.589
Our university provides research workstations				.585
Our university provides research administration to manage research and consultancy				.548
Our university provides a number of software licenses for research purposes				.535
Our university has substantial opportunity to receive grants from external institutions (ministries and other local institutional grant)				.527
Our university has the opportunity to receive grant from international institutions				.504
Our university sets up a number of research institutes				.487
Our university sets up a number of research institutes and centres of excellence				.467
Our university provides excellence internet access to assist in assessing information from the search engines				.415
Eigenevalues	44.377	6.469	4.496	4.376
Cum % of Variance	19.730	33.832	46.875	56.862

Extraction Method: Principal Axis Factoring
Rotation Method: Varimax with Kaiser Normalization
Bartlett's Test of Sphericity: Chi-Square: 5349.407, df= 1711, p= .000
Kaiser-Meyer-Olkin Measure of Sampling Adequacy= .870

Initially, the measurement of innovation capital comprised of four dimensions being innovation competencies, capacities, culture and linkages. The factor analysis conducted as depicted in Table 4 has also produced four dimensions. Two of the dimensions have been renamed as culture and linkage and intellectual property. This is consistent with Wu *et al.* (2010) and Chen *et al.* (2004) that have included culture in their innovation capital framework.

Secundo *et al.* (2010), incorporate collaborations with national and international universities, university-industry relations and also university-government relations in the

innovation capital measurement. In addition, Wu *et al.* (2010) and Mc El roy, 2002) have incorporated intellectual property dimension as part of innovation capital. Kostopulos *et al.* (2010); Wang & Chang (2005) and Benzhani (2010) embrace the competency indicators such as human capital expertise and experience, number of researcher and research officers as part of innovation measurement. Consistent with Benzhani (2010), the current study includes availability of research centres and research laboratories as part of the research capacities items.

The first dimension which is culture and linkages has produced 23 indicators. The competency dimension has generated 12 indicators, The third dimension which is intellectual property comprises 13 items and finally the fourth dimension capacities is represented by 11 items. Total items generated is 59.

CONCLUSION

Sourced from the above findings, the current study proposes an innovation model that best suitsthe Malaysian public universities. In Malaysia, currently, there are twenty (20) public universities, which are divided into three clusters including research university, focused university, and comprehensive university. Each cluster has its own function and expectation. Nevertheless, the innovation agenda remains the core activityof all universities.

The current study proposes that the innovation capital (see Figure 1.0) of the university should possess four main constructs includingInnovation Competency, Innovation Capacities, Innovation Linkage and Culture, and Innovation Intellectual Property. Innovation Competency reflects the universities' ability to carry the research and innovation activities from the angle of human capital such as the educational experts, the number of researchers, research officers, assistants, and postgraduate students. Further, innovation competency can be measured by the capability development, which can be proxied by the number of in-house training organized and attended by the researchers. The next proposed construct is Innovation Capacities, which corresponds to the research facilities and resources of the universities, which can be classified into three sub-constructs includingstructural support, grants, and research centres. Structural support is the tangible assets relevant to research and innovation such as the technical support, technology, and availability of research laboratories. Grants which are in monetary forms represent the funding contributed by the ministries (national) or international resources and the internally generated funds, such as through consultancy. Further, the research centres can be measured by the number of research institutes and centres of excellence set up by the universities.

Another construct proposed as part of the innovation capital, which denotes the intangible element is the Innovation Linkages and Culture. It is vital to every organization to ensure the growth and sustainability of development of new ideas and knowledge. This dimension can be indicated by the vision and mission (directions) of the universities, the leadership of the top management in each faculty i.e. whether research and innovation is given priority compared toteaching and also the organizationalculture towards the innovation agenda. Innovation linkages and culture symbolize the relationships between the national and international universities through collaborations, university-industry linkages, and university-government relationships.

Finally, Intellectual property is also significant to the universities since they can claim their right for novel ideas that they have created and developed. The number of output, new ideas, new products, and services as well as number of journals and publications would signify the innovation output of the universities.

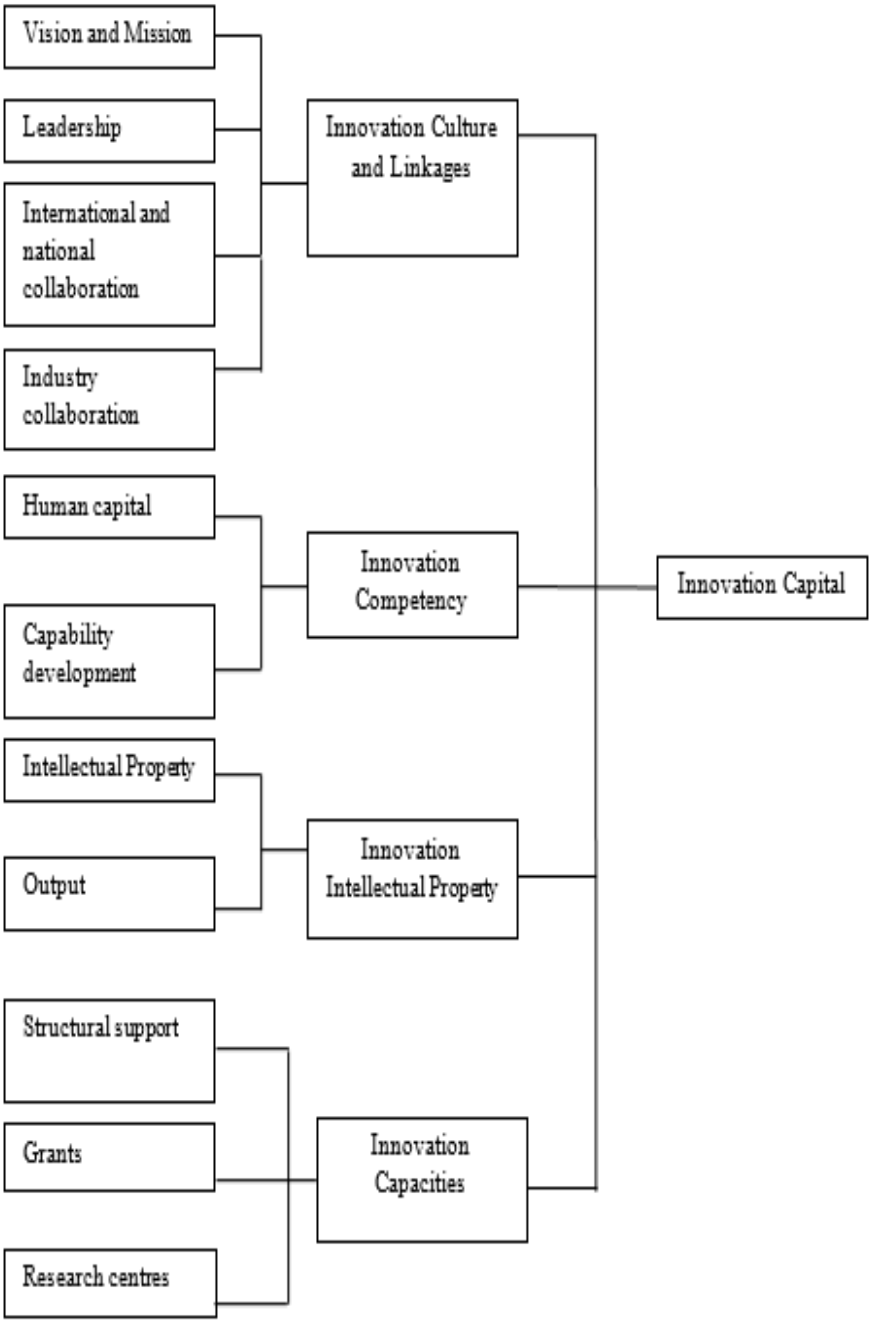

Figure 1: Proposed innovation capital model for public universities

LIMITATIONS OF THE STUDY

The current study has applied non-financial information to measure the innovation capital of the university. Thus, the future research should consider the use of financial information in measuring the innovation capital of the universities. Only 34.5% of the respondents are the senior academics ie. senior lecturers and associate professors. The questionnaires were distributed to only four public universities. It is proposed that future research embrace more participation from the senior level academics including the full professors and be extended to a wider sample of public universities.

It is proposed that future research should include more participation from the senior lecturers and professors from various public and private universities in Malaysia.

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