AN EVALUATION ON THE KEY DIMENSIONS TO ASSESS UNIVERSITIES' INNOVATION CAPABILITY

Zheng Chu, Lawson K and Wang Li
Department of Finance and Business Improvement ,University of Puthisastra

Abstract: Innovation capability is a key driver to assist organisations to compete in a complex and intellectual environment, especially knowledge-intensive industry. This paper aims to provide a critical evaluation of the effective key dimensions for universities' innovation capability assessment from student perspective.Online-survey with a questionnaire is used data collection. The result highlights the commonly used eight innovation dimensions, which arestrategy, innovation process, innovative organisation, linkages, learning, culture & climate, creativity, and communication. These dimensions havea positive relationship with innovation capability, especially for public universities, though innovation process, culture & climate, and communication do not have a positive relationship with innovation capability for private & other universities. The paper provides a fresh subject that conducts an innovation capability model for universities in response to the era of open innovation. Further discussion is conducted alongside future research recommendations.

Keywords: Innovation capability, university innovation, triple helix

1. Research Background

Understanding innovation competencies become important for organisations as a catalystfor economic growth in the current globalisation (Ko and Lu, 2010). This perspective is applied witha different method in many elements oforganisationssuch as process, product, or learning (ToivonenandTuominen, 2009). Innovation is claimed as the principle of firm's successful factor to compete in a complex and intellectual environment while managing knowledge is a most significant part of innovation, especially knowledge-intensive industry such as private service sector, education sector (Rajapathirana and Hui, 2018). The innovation capability works as a driver to assistorganisationsto be more innovative and competitive advantages and it interacts with many elements of the organisationsuch as strategy,structure, and system that can enhance innovation activities in organisations(Rajapathirana and Hui, 2018). Over the year the developing innovation system is considered in academic and policy to generate economic growth at national and regional level (Kerry and Danson, 2016).One prominent theoryis the triple helix model (Etzkowitz, 2003), explainsthe interaction betweenthe three actors ofuniversity, industry, and government). Thispromotestheinterchange of knowledge andproduction skills, normative control, and wealth creation(Kerry and Danson, 2016). Fromthe triple helix model, education is a delicatefoundationof intellectual abilities development andcreating idea patterns that impact the overall society's civilisation(Deem et al., 2008), and it can build more competitive advantages for the country (Phusavat et al., 2011). Education also plays the important role for the socioeconomicall over the world (Akram and Hilman, 2017)because higher education institutions (HEIs) can producemany skill resources to support the country with better knowledge (Blass and Hayword, 2014).

However, in recent times, HEIs are facing difficultiesin the global market in terms of competitiveness (Lynch and Baines, 2004; Sum and Jassop, 2013;De Haan, 2015), reputation (Edwards, 2007), government budget cuttings (Sum and Jassop, 2013), changing in a platform (Adcroft et al., 2010; Tierney and Lanford, 2016), government research funding (Marginson, 2007), and especially innovation (Saginova and Belyanski, 2008;

Vila et al., 2012; Blass and Hayward, 2014). These challenges drive and force HEIs to strongly focus their resourcesand capabilities enhancement todeal with the competitive environment (Akram and Hilman, 2017).In addition, it is often overlooked at the theoretical level on innovation shift from closed model to open paradigm that this shift is also a driver of the triple helix paradigm (Kerry and Danson, 2016). Open innovation is introduced by Chesbrough (2003) that give rapidly attention in the academic, this shift reflects global market with the increasingly acknowledging to get more the competitive advantage without limitation (Chesbrough, 2003; Tödtling et al, 2011; Lichtenthaler, 2011). The concept of open innovation involve both organitional-level dynamic evolution, and macro-level innovation system transformation (Yun, 2015;Yun et al., 2017; Yun and Liu, 2019).Within innovation trending, open innovations paradigm emerges with the triple helix model. University-industry-government interaction is risingwith increasing the knowledge infrastructure of innovations (Leydesdorff and Ivanova, 2016). The university actor gives significant role in the education sector with the transformation of the university along with innovation revolution trend, it is toward asan entrepreneurial university and social mechanisms that can operate differently in a competitive market.Under the open innovation paradigm, universitiesbecome an emerging coordination mechanism in a knowledge-structure economywithorganised knowledge production (Leydesdorff and Ivanova, 2016).And universities also provide a place where students are actively pursuit of knowledge and take charge, of their own learning and where students and their professors can engage in meaningful conversation (Khalifa, 2009). In this way, the student-as-customer and HEI-as-service provideris increasingly more important, as universities promote learning process, involvement, and communication to attract and retain students (Khalifa, 2009).

With the above background, it is clear that the innovation capability topic is important subject matter to study within university actor as study unit in new innovation era that needsthe involvement of student-as-customer. This paperaimsto provide a critical evaluation of the effective key innovation dimension for universities'innovation capability assessment from student perspective.Specifically, the research objectives are: 1) toindentfiythe dimension for innovation capability assessment from the different theoretical concepts and models; 2) to evaluate the relationship between innovation dimensions and innovation capability of universities; and 3) to discuss the innovation capability assessment model in the context of university innovation.

2. Literature Review

Current literature can be reviewed from the perspectives of triple helix, university innovation, and innovation capability.

2.1. Triple Helix Innovation

Over the year the developing innovation system is considered in academic and policy to generate economic growth at national and regional level (Kerry and Danson, 2016). The regional innovation system is developed with involvement the interaction from a different background that this interaction depicts the one prominent theory that Etzkowitz and Leydesdorff (2000) introduce it as the triple helix model (Etzkowitz, 2003), this model explains the interaction between three actors such as University (U), Industry or Business (I), and Government (G).Moreover,thetriple helix model keeps evolved in a different form since the statist regime to a laissez-faire triple helix regime and transform into the social structure of the triple helix (Etzkowitz, 2003). This evolution shows how the transformation of role and relationship between these three actors. At a statist

regime, government play major role that controlling over university and industry and spirals are rarely equal which innovation is working around other rotate of these spheres. Later it evolves to a laissez-faire triple helix regime which industry become the driving force with other two actors given the support structure and three of them are separate from each other at a fair spiral dimension. The interaction evolves to the new regime as the social structure of the triple helix, and institutional of university, industry, and government are working on their own functions and interaction roles to promote creativity toward the innovation structure (Etzkowitz, 2003), although another actor may interact such as civil society. Later, the civil society becomes interactive to these triple helix model and it slowly evolves from triple helix to quadruple/quintuple helixinnovation models that add another actor of "civil society" to existing three actors (Carayannis et al., 2018). In addition, university and industry are relatively separate institutional spheres, while the government put the contradictory direction to these two spheres through providing incentives and put pressure on universities to perform more than traditional approach and go beyond their boundary with wealth creation contribution (Etzkowitz and Leydesdorff, 1995). Later on, the linear model of demand and technology is no longer applicable while it replaces with evolution models of networks of non-linear dynamic; and this concept provides the co-evolutionary models of interaction (Nelson, 1994), or lock-in (David 1985; Arthur, 1989) which impact the social infrastructure in cycles of emerging techno-economic development (Etzkowitz and Leydesdorff, 1995). Last but not least, triple helix model mentions in technology studies with three sources of variation that (1) each industrial sector has different technology for their development (Pavitt, 1984); (2) each technology has a different form of innovation (Freeman and Perez 1988); (3) innovation system has different functions (Lundvall, 1988). A new innovation environment is created with the development of inter-disciplinary between institutional and national boundaries (Etzkowitz and Leydesdorff, 1995; Etzkowitz, 2003). This innovation gives new concepts in the triple helix which knowledge-producing institutions and promotes the significant role of university and government to the innovation process in more collaborative (Etzkowitz, 2003).

2. 2.University Innovation

While universities represent one of the three-basis element in innovation as mention in the triple helix and this model is continually studying and gain more researches with many scholars in a wider range of perspectives and geographical (Saad et al., 2017; Zhang et al., 2019).Moreover, universities transform into a recognised source of technology, as well as of human resources and knowledge that can build the capabilities to transfer technologies and they can increase their capacity to be more competitive under uncertain environment (Leih and Teece, 2016). This transformation makes universities become more technology-based and firm-concept that emerge as new identification "entrepreneurial university" (Etzkowitz, 2016).This transformation makes the entrepreneurial university become a key driver of triple helix in innovation with five key evolution stages of university technology transfer capabilities (Etzkowitz, 2016). The first stage, the entrepreneurial university is an academic institution that is under the control of neither government nor industry. This academic research is mainly focusing on the train the graduates and publication of research knowledge (Leih and Teece, 2016). The second stage, a liaison office is established with the purpose of transfer of technology development. Each individual liaison officer can manage their research department and interested firms; and they can arrange their consultation contracts on research or commercial activities that more beyond the first stage (Etzkowitz, 2016).The third stage, universitiesare working like technology transfer office that has the capability to manage the patent, license and other intellectual property on the market. They

also work on a different approach to add value to university technology development and more interact with firms' technology (Etzkowitz, 2016).The fourth steps, many universities are more actively on entrepreneur activities with the concept of firm-formation that this idea was informal emerged at Harvard and MIT in the late 19th century. This concept is known as "incubator" that is formal space located in an academic buildingfor a new start-up business and getting support from university and link with entrepreneur community and firms (Etzkowitz, 2016).As of now at stage five, universities transform with the integration between academic and commercial actor with new platform as university-industry research centres (Etzkowitz, 2016). With the impact of industrial revolution 4.0, universities also take a step to transformsuch as university-as-a-platform (Xing and Marwala, 2017).

2.3. Innovation Capability

Researches claim that managing innovation can be classified to the specific sector at industry or individual organisation; on this notion, the exist commonalities approach of innovation capability is needed as a fundamental that can support the environment to key success of organisations to generate new concept and ideas for further innovation development (Lawson and Samson, 2001).Innovation capability is continuously enhancing that any organisation need to aware (Assink, 2006). Teoh and Cai (2009) claim that innovation capability also can be distinguished as twotypessuch as incremental innovation capability refers to a continuous practice; despite radical innovation capability refer to ability use new technology to transform the existing product to completely new one as a disruptive innovation capability (Assink, 2006).Moreover, innovation capability is different from dynamic capability because this capability has a certain degree that links to strategic level while dynamic capability consists of three dimensions that allow organisations to innovation beyond their day-to-day activities and innovation capability has only one dimension (Wang and Ahmed, 2007; Björkdahl and Börjesson, 2011). However, innovation capability does not only connect to a strategic level, but other dimensions are also needed which mention in many research studies. Assink (2006) state that one dimension is not enough to assess and improve the organisations' innovation capability, it is required multiple dimensions that interact and support innovation capability. O'Connor (2008) explains that interdependency of innovation dimension is needed as a system working for innovation capability, this system knows as mutual interaction of complex dimension to extent that impact to innovation capability as the foundation to analyse the organisation innovation capability (Björkdahl and Börjesson, 2011). For example, Björkdahl and Holmén (2016) research show nine dimensions are used for assessing the innovation capability of organisations. Despite, many studies adopt the five dimensions for assessing innovation capability of Tidd and Bessant (2018)whileGoffin and Mitchell (2016) provide four innovation dimensions. The result of empirical review shows that the five selected default innovation dimensions such as strategy, processes, innovative organisation, linkages, learning (Tidd et al., 2005; Tidd and Bessant, 2018) are high-frequency usage for assessing innovation capability although it may not use for all studies. Moreover, there are other three dimensions also give an impression and high frequency for assessing innovation capabilities such as culture & climate, creativity, and communication (Cormican and O'Sullivan, 2004; BjörkdahlandBörjesson, 2012; Rao and Weintraub, 2013; Goffin and Mitchell, 2016; Frishammar et al., 2019).

2.3. Proposition and Hypothesis Development

Based from the literature, in this paper set eight innovation dimensions as the main theoretical framework for the innovation capability assessment for universities. The form of a proposition is developed with

eachinnovation dimensions set as independence variable (ID) for each hypothesis (H) to innovation capability as only dependence variable (DV) (Figure 1). The proposition 1 illustrates the relationship between innovation dimensions and innovation capability as a result of eight hypotheses for this study. And proposition 2 is developed with only one hypothesis to test the correlation of innovation dimensions impact to innovation capability.

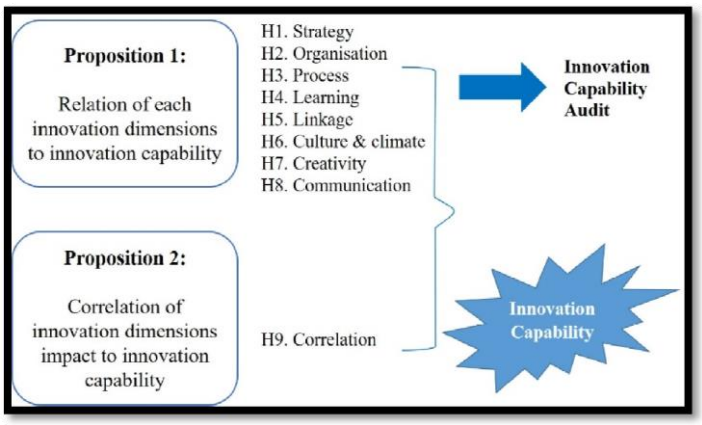

Figure 1: Proposition of This Study

2.3.1. H1: Innovation Strategy

Organisations strategic is important when assessing the innovation capability from a majority perspective (O'Connor, 2008). The clear vision of strategic can givea successful directionto implement the innovation activities, especially when all employees clearly understand the organisation strategy and seek the method to achieve (Lawson and Samson, 2001). It also needs management support and commitment to innovation strategy to push the innovation activities go on which management need to commit the strategy and allocate resources for innovation project (Danneels, 2011; Aagaard and Andersen, 2014).

2.3.2. H2: Innovation Process

Innovation process determines the activities that associate with organisation growth and survival, it has set into four stages of search, select, implement and capture (Tidd and Bessant, 2018).Fourth industrial revolution impacts the innovation process of the education sector that need to react in a new environment with a nonlinear model (Tohidi and Jabbari, 2012) such as generalise blended learning, online courses, and cultivated innovative talent (Xing and Marwala, 2017).

2.3.3. H3. Innovative Organisation

The working environment clearly determines how the optimal structure of organisation need to operate (Burns and Stalker, 1966). According to Tidd and Bessant (2018), the innovativeorganisation consists of elements such as shared vision, appropriate structure, key individuals, teamwork (Aagaard and Andersen, 2014), and innovation involvement.

2.3.4. H4: Linkages of Innovation

With open innovation and external collaboration, organisationscan gain benefits such as cost reduction of technology development, economies of scale, minimisethe risk of innovation development, a faster process and lunch new product faster, especially collaboration with a closed supplier (Schilling, 2017)and enhance knowledge and learning capability(Chesbrough, 2017).The universityin the triple helix model can expand their collaborations with government and industry as technology knowledge transfer, research support collaboration (Etzkowitz, 2016).

2.3.5. H5: Innovation Learning

There are two aspects of learning. first there is the new knowledge acquisition to increase the knowledge resource capacity; and second, there is the knowledge that captures from innovation process itself (Savolainen, 1999; Tidd and Bessant, 2018). Knowledge learning is heart of education sector, especially entrepreneurial university claim that capitalisation of knowledge (Rajapathirana and Hui, 2018) is their academic mission that can link between universities with either students or other users; and this learning can transfer university to be more competitive as an economic actor (Etzkowitz, 2016).

2.3.6. H6: Culture & Climate for Innovation

Culture influencesthe innovation productivity and capability of organisations (Cormican and O'Sullivan, 2004) because organizational culture can affect the development of organisation procedure, policy and practices (climate) (Schneider et al., 1996). This aspect can enhance innovative organisations with four shared values such as proactive, take risks, commitment, and accept change (Johannessen et al.,1999; Rao and Weintraub, 2013); especially openness of culture is needed to access the knowledge external environment that can enable the new knowledge and skills for innovation development (Cormican and O'Sullivan, 2004).

2.3.7. H7: Innovation Creativity

Innovation drives the creativity and universities take it to rapidly progressing in their learning development such as teacher's creative engagement with students (Kalin, 2016; Bloom and Dole, 2018). Education sector puts the effort for creative in learning innovation that learners can beyond the notional acquisition and this innovation creativity can bring the learner empowerment and it also can deal with employability longevity in the innovative economy (Bloom and Dole, 2018).

2.3.8. H8: Innovative Communication

External communicate from organisation to either supplier or customer is important to improve organisational innovation capability (Bacon et al., 1994; Poolton and Barclay, 1998) and it also can enhance the strategy implementation (Cina and Cummings, 2018). Internaly, communication improvement is needed for any functions to success including R&D (Maltz, 2000; Cormican and O'Sullivan, 2004)..

3. Methodology

This study aims to explore key dimension for universities' innovation capability assessment from student evaluation. It is a deductive study(Saunders et al., 2016) that the majority of business and management evaluation research has a subject matter on evaluating the effectiveness of an organisation strategy or process.Quantitative research is an appropriate research approach associated with positivism and support by realist and pragmatist (Saunders et al., 2016). For the research design, questionnaire survey is used for data collection). The study setting is conducted a field study (Sekaran and Bougie, 2016), which is selected for thereal-worldobservation to evaluate the effectiveness of key dimensions for universities'innovation capability which the evaluation of students from different regions. Collected data will use regression analysis for hypothesis testing.

3.1. Data Collection

The survey questionnaire (Appendix) are inspired and developed from innovation assessment statements of Tidd and Bessant (2018), Yam et al. (2004), Frishammar et al. (2019), Björkdahl and Börjesson (2012), Cormican and O'Sullivan (2004), Rao and Weintraub (2013), Goffin and Mitchell (2016), with each statement designed and customised to the university context. The questionnaire is structured with three important sets of variables.

3.1.1. Dependent Variables (DV)

Innovation capability is the only main dependent variable for questionnaires. This variable is depended on eight independent variables. There is also a direct question to the respondent on this variable that scales from 1 to 7 where the 1 meansnot sure and 7 means that it is extremely agreed within the university.

3.1.2. Independent Variables (ID)

There are mainly eight independent variables, strategy, process, organisation, linkage, learning, culture & climate, creativity, and communication. Each has six statements asking participants to scale from 1 (strongly disagree) to 7 (strongly agree) in the context of university. The question and statement of independent variables are core data for analysis and hypotheses testing.

3.1.3. Control Variables (CV)

This control variables have two sets of data such as student and university information. Datawas conducted with the duration of 4 months since January 2020, with target respondents who are university students from U.K (60%) and other countries (40%). With online survey, the study took randomly on the simple size with population selection that belongs to the member of the social community network group, from LinketdIn and Facebook. Altogether there are 105 effective respondentsfrom 24 countries and 78 universities.

3.2. Data Analysis

Collected data is imported into IBM SPSS 26 with variables set upinto different category and fields (Bell et al., 2019). Regression analysis is used to test significant level between one or more independent variables (innovation dimensions) with the dependent variable (innovation capability). Hypothesis is accepted ($p=<0.05$) or rejected depending on a significant level (Sekaran and Bougie, 2016). One-way ANOVA (F-

test) and coefficients (t-test) are used for the regression analysis of H1 to H8. In addition, Pearson correlations is used to test H9. Reliability analysis is used to make sure the input data are free from bias. NVivo12 is also used to analysean open questionsregarding student understanding and knowledge of their university innovation activities.

4. Data Analysis and Findings

The result of reliability data analysis shows that overall Cronbach's alpha is 0.981, and all 48 statementsof eight innovation dimensions statement showa Cronbach's alpha of 0.98,more than 0.70. It means that responses on data are free from bias, and it is reliable for analysis the data for testing the hypothesis of the study.

4.1. Proposition 1 analysis

H1: The positive relationship between innovation strategy and innovation capability

Table 1 and2 show that innovation strategy has a positive relationship with innovation capability because F and t-test significant level is lower than 0.05. It means this hypothesis is acceptable. Moreover, standardised coefficients beta is positive 0.860> 0 (Table 2) that mean the majority of respondents agree that innovation strategy exists with universities. It is consistent with the student's response from a survey with 64% agree and 20% do not agree with innovation strategy statements.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	76.888	1	76.888	292.099	.000[b]
	Residual	27.112	103	.263		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Strategy						

Table 1 :One-Way ANOVA on H1 Innovation Strategy

Coefficients[a]

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.804E-16	.050		.000	1.000
	Strategy	.860	.050	.860	17.091	.000
a. Dependent Variable: Innovation Capability						

Table 2: Regression Analysis on H1 Innovation Strategy

H2: The positive relationship between innovation process and innovation capability

The result showsthat there is a positive relationship between innovation process and innovation capability, since F and t-test significant level is lower than 0.05 (Table 3,4). Moreover, there is positive standardised coefficients beta with 0.913 (Table 2b),reflectingthe majority of respondents(58%) agreethat innovation process exists with their universities. Therefore, H2 is accepted.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86.645	1	86.645	514.244	.000[b]
	Residual	17.355	103	.168		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Process						

Table 3: One-Way ANOVA on H2 Innovation Process

Coefficients[a]

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.787E-17	.040		.000	1.000
	Process	.913	.040	.913	22.677	.000
a. Dependent Variable: Innovation Capability						

Table 4: Regression Analysis on H2 Innovation Process

H3: The positive relationship between innovative organisation and innovation capability

H3 is accepted with F and t-test significant level less than 0.05, meaningtheinnovativeorganisationhave positively impact on university innovation capability (Table 5, 6). Standardised coefficients beta is positive with 0.871 > 0 (Table 3b), showing the majority of students agree with the innovative organisationstatementsin their universities.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	78.814	1	78.814	322.323	.000[b]
	Residual	25.186	103	.245		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Organisation						

Table 5: One-Way ANOVA on H3innovative Organisation

Coefficientsa

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-6.636E-17	.048		.000	1.000
	Organisation	.871	.048	.871	17.953	.000
a. Dependent Variable: Innovation Capability						

Table 6: Regression Analysis on H3innovative Organisation

H4: The positive relationship between innovation linkage and innovation capability

The results from Table 7 and 8 illustrate that H4 is with F and t-test testing less than 0.05. There is a positive relationship between innovation linkage and innovation capability. Standardised coefficients beta is 0.902 (Table 4b), suggestingmost respondents agree that innovation linkage exist with their university; and 64% of students agree on overall innovation linkage statements.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	84.657	1	84.657	450.783	.000[b]
	Residual	19.343	103	.188		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Linkage						

Table 7: One-Way ANOVA on H4 Innovation Linkage

Coefficientsa

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.591E-16	.042		.000	1.000
	Linkage	.902	.042	.902	21.232	.000
a. Dependent Variable: Innovation Capability						

Table 8: Regression Analysis on H4 Innovation Linkage

H5: The positive relationship between learning innovation and innovation capability

Table 9 and 10 show that learning innovation has a positive relationship with innovation capability because F and ttest significant level is lower than 0.05. It means this hypothesis is acceptable. Moreover, standardised coefficients beta is positive 0. 878 > 0 (Table 9) that mean the majority of respondents agree that learning innovation exist with universities. It is consistent with the student's response from a survey with 63% agree and 19% do not agree with learning innovation statements.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	80.181	1	80.181	346.732	.000[b]
	Residual	23.819	103	.231		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Learning						

Table 9: One-Way ANOVA on H5 Innovation Learning

Coefficientsa

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.013E-16	.047		.000	1.000
	Learning	.878	.047	.878	18.621	.000
a. Dependent Variable: Innovation Capability						

Table 10: Regression Analysis on H5 Innovation Learning

H6: The positive relationship between Culture & climate for innovation and innovation capability

There is a positive relationship between culture & climate for innovation and innovation capability, and F and t-test significant level is lower than 0.05 (Table 11, 12). Moreover, there is positive standardised coefficients beta with 0. 893 (Table 12), reflecting thatthe majority of respondents(63%) agree that culture & climate for innovation exist with their universities. Therefore, H6 is accepted.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	82.934	1	82.934	405.508	.000[b]
	Residual	21.066	103	.205		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Culture & climate						

Table 11: One-Way ANOVA on H6 Innovation Culture & Climate

Coefficients[a]

Model		UnStandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-8.254E-17	.044		.000	1.000
	Culture & climate	.893	.044	.893	20.137	.000
a. Dependent Variable: Innovation Capability						

Table 12: Regression Analysis on H6 Innovation Culture & Climate

H7: The positive relationship between innovation creativity and innovation capability

H7 is accepted because F and t-test significant level is less than 0.05 that mean there is a relationship between innovationcreativity and innovation capability which innovation creativity can positively impact to university innovation capability (Table 13, 14). Standardised coefficients beta is positive with 0. 825> 0 (Table 14) as result of the majority of student agree (61%) with innovation creativity statements exist with their university.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	70.855	1	70.855	220.183	.000[b]
	Residual	33.145	103	.322		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Creativity						

Table 13: One-Way ANOVA on H7 Innovation Creativity

Coefficientsa				
Model	UnStandardised Coefficients	Standardised Coefficients	t	Sig.

		B	Std. Error	Beta		
1	(Constant)	-1.469E-16	.055		.000	1.000
	Creativity	.825	.056	.825	14.839	.000
a. Dependent Variable: Innovation Capability						

Table 14: Regression Analysis on H7 Innovation Creativity

H8: The positive relationship between innovativecommunication and innovation capability

Table 15 and 16 illustrate that H8 is accepted because a significant level of F and t-test testing is less than 0.05, indicating a positive relationship between innovative communication and innovation capability. Standardised coefficients beta is 0.832 (Table 16).68% students agree on overall innovative communication statements.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	71.911	1	71.911	230.820	.000[b]
	Residual	32.089	103	.312		
	Total	104.000	104			
a. Dependent Variable: Innovation Capability						
b. Predictors: (Constant), Communication						

Table 15: One-Way ANOVA on H8 Innovative Communication

Coefficientsa				
Model	UnStandardised Coefficients	Standardised Coefficients	t	Sig.

		B	Std. Error	Beta		
1	(Constant)	-2.012E-16	.054		.000	1.000
	Communication	.832	.055	.832	15.193	.000
a. Dependent Variable: Innovation Capability						

Table 16: Regression Analysis on H8 Innovative Communication

Consideringthe control variables with the location of universities and the type of universities, the result (Table 17) illustrates that each innovation dimensions has positive relation and impact to innovation capability inU.K, EU& others, despite relationship culture & climate and communication to innovation capability are not strongly insignificant as other innovation dimensions in EU& other locations with significant level 0.002 and 0.007 and coefficients beta 0.124 and 0.102, which is lower than other dimensions. Regarding the type of university, regression analysis shows that each innovation dimension has a positive relationship with innovation capability under public universities (n=75%); however, innovation process, culture & climate, and communication do not have a positive relationship with innovation capability of private& other universities (n=25%), since the t-test significant levels 0.257, 0.238, 0.053 are more than 0.05 (p>0.05).

	U.K		EU &Others		Public		Private &Others	
	Standardised Coefficients	Sig.	Standardised Coefficients	Sig.	Standardised Coefficients	Sig.	Standardised Coefficients	Sig.
	Beta		Beta		Beta		Beta	
Strategy	0.133	0.000	0.131	0.001	0.139	0.000	0.175	0.005
Process	0.145	0.000	0.198	0.000	0.167	0.000	0.094	0.257
Organisation	0.142	0.000	0.133	0.000	0.129	0.000	0.177	0.001
Linkage	0.181	0.000	0.164	0.000	0.168	0.000	0.166	0.003
Learning	0.123	0.000	0.130	0.000	0.125	0.000	0.201	0.011

Culture & climate	0.177	0.000	0.124	0.002	0.172	0.000	0.088	0.238
Creativity	0.138	0.000	0.144	0.000	0.123	0.000	0.135	0.013
Communication	0.101	0.000	0.102	0.007	0.108	0.000	0.108	0.053

Table 17: Consolidated Regression Analysis (T-Test) on Eight Innovation Dimensions and IC

4.2. Proposition 2 analysis

H9: The correlationsof innovation dimensions positive impact on innovation capability

Table 10 illustrates the correlation analysis. All eight innovation dimensions have significant relationship to each other (r >= 0.7). The strongest correlation is between strategy and innovation process dimension with r=0.873, compared to other dimensions. Others notable significant correlations are between organisation and process (r=0.849), between linkage and organisation (r=0.802), between learning and linkage (r=827), between culture & climate and learning (r=0.773), and between communication and creativity (r=0.797). However, the correlation between creativity and strategy show the lowest score (r=0.599) among all correlations. Innovation capability is effected strongly positively from all dimensions (r >0.8), especially from innovation process and linkage (r > 0.9).

Pearson Correlations								
	InnovationCapability	Strategy	Process	Organisation	Linkage	Learning	Culture&climate	Creativity
Strategy	.860**	1						
Process	.913**	.873**	1					
Organisation	.871**	.762**	.849**	1				
Linkage	.902**	.710**	.785**	.802**	1			
Learning	.878**	.698**	.759**	.697**	.827**	1		
Culture & climate	.893**	.741**	.764**	.698**	.760**	.773**	1	

Creativity	.825**	.599**	.649**	.647**	.694**	.699**	.762**	1
Communication	.832**	.632**	.691**	.613**	.718**	.725**	.739**	.797**
**. Correlation is significant at the 0.01 level (2-tailed).								

Table 18: Correlations between Innovation Dimensions

To summarise, all hypothesis areinitially accepted. However, in-depth analysis with control variables on type of university changes the result of three innovation dimensions such as innovation process, culture & climate for innovation, and innovative communication which significant level p>0.05 for a case of private and other universities, it means these three hypotheses are eventually rejected.

5. Discussion on the Key Dimensionsto Assess Universities' Innovation Capability

5.1. Innovation Strategy

H1 is accepted showing that innovation strategy can bring competitive, and universities take strategy to transform themselves with more entrepreneurial value to be more competitive (Leih and Teece, 2016; Akram and Hilman, 2017). For example, many public universities foster entrepreneurship with open enterprise centreswithan entrepreneurial university strategy (Etzkowitz, 2016). Moreover, 67% of students agree on innovation is part of a shared vision of how the university will continue to develop in strategy. Students keep commenting the university take innovation as a sustainable goal in their strategy.Theymention that "universities havea sustainable strategy group, Go-Green week, and innovation week". In addition, commitment and support of management areimportant for innovation strategy (Saleh and Wang, 1993; Danneels, 2011; Aagaard and Andersen, 2014); and articulation of innovation strategy is needed (Eisenhardt and Sull, 2001; Lawson and Samson, 2001; Björkdahl and Börjesson, 2012). The study also shows that university innovation strategy currently is not clearly communicated (50% responses). Students comment "not sure exactly, but innovation is in their slogan and gets a lot of lip service"; "It isn't communicated to the students, so I do not know of any!"This shows the lack of articulation on innovation strategy as a barrier of innovation that impacts the university innovation capability (Assink, 2006).

5.2. Innovation Process

The innovation process is recognised as a key mechanism for organisations to be competitive (Pisano and Verganti, 2008), and H2 is accepted. Findings show universities havea process in place to manage their new idea to development(Tohidi and Jabbari, 2012) and they also have a process to manage their innovation project (Moultrie et al., 2007) with more than 60% of students agree on this. For instance, students comment that universities use questionnaires as part of the innovation process to collect feedback from students (Khalifa, 2009)to improve modules. However, under the private & other universities category, innovation process does not have a positive effect on university innovation capability as a result of in-depth analysis (H3 is rejected with this condition). Organisations need to havea clear system to manage innovation project (Radnor and Noke, 2002; Moultrie et al., 2007) and have effective mechanisms to understand student needs (Tohidi and

Jabbari, 2012); however, more than 35% students from private universities cannot confirm.Privateorganisations as universities face challenge funding issueto implement innovation process or lack of innovation pipeline to manage the external ideas (Chesbrough, 2017). This situation reflects with the contrasting outcome between public and private university as students give more negative responsestothe innovation process of private university than public universities.

5.3. Innovative Organisation

Data analyses shows that innovative organisation has a positive impact on university innovation capability assessment, andH3 is accepted. Universities have a structure to support the innovation (Schilling, 2017) with 59% agree from student evaluation. For example, students mention that there are innovation departments such as RDI department (research, development and innovation) at their university as support structure from management (Al-Husseini and Elbeltagi, 2016). Moreover, the study also showsgood teamwork within the universities (O'Connor, 2008; Tidd and Bessant, 2018; Aagaar and Andersen, 2014) such as student government associations working with school administration; and reward structure (e.g. competition to win a prize) for innovation (Tidd and Bessant, 2018).Despite H3being accepted, Schilling (2017) claims that delegation is needed in an innovative organisation. In-depth analysis results reveal that public university may havecentralised decision structure with a traditional model which can slow the process of innovation (Schilling, 2017), in contrast to private university which has flexible and quick decision structure as a result of private organisationstending to be innovativewithorganic structures (Burns and Stalker, 1966; Lawson and Samson, 2001; Radnor and Noke, 2002), informal structures (Lawson and Samson, 2001; O'Connor, 2008), or virtual organisational structure (Davydova and Dorozhkin, 2016).

5.4. Linkage of Innovation

Networking becomesa crucial dimension for innovation with a new era of innovation "open innovation" (Chesbrough, 2003, 2017), and H4 is accepted. The external collaboration is important for R&D and new product development (Chesbrough, 2003; Chesbrough and Brunswicker, 2014), the response of survey shows more than 60% students agree that their universities work with an external partner (firms and other research centres/government) for further development and improvement. For example, universities link with employers to students for work placement; internships, and group visits in industries. The finding also reflects the collaboration of three actorsin the triple helix (Etzkowitz, 2003)and university-as-aplatform(Xing and Marwala, 2017) as university-industry research centres (Etzkowitz, 2016), especially public universityas the term research shows the high frequency in the word cloud on student comments. Moreover, 65% of students agree that university and students have close collaboration in exploring new concepts (Schilling, 2017; Chesbrough, 2003, 2017). For example, students comment that their university has collaboration hubs, whereas there arealso entrepreneurship programmes led by student clubs. Nevertheless, Verganti (2008) claims that customers may not know what they need, which makes organisation-customer collaboration not working. Survey result showsthe consent on this concept with a majority students at public university (25%)higher than private universities (18%). Public universitiesstuck with their internal networks, and that it is hardto adapt to new changes from the external connections(Birkinshaw et al., 2007). Private universities and other organisations take external collaboration for technology infrastructure and innovation performance enhancement (Verhaeghe and Kfir, 2002; Tidd and Bessant, 2018).

5.5. Learning Innovation

Findings indicate there is a positive relationship of innovation learning with innovation capability assessment in universities. The survey results show thatmost students agree that universities cultivate learning readiness and investing in learning and understanding technological capabilities. In-depth analysis shows that universities in EU & others region invest in learning technology more than universities in the UK, with the percentages of 83% and 63% respectively. For example, students in Germany mention that there are prototyping facilities for learning in their universities. It shows the rapidly progressing in the learning development of the universities (Kalin, 2016; Bloom and Dole, 2018). And 81% studentsagree this learning technology happens more in private universities rather than public universities. For instance, students comment that there are many online courses at private universitiesthat define the learning innovation beyond the traditional model (Bloom and Dole, 2018; Xing and Marwala, 2017).The transformation of universities as entrepreneurial university (Etzkowitz, 2016) provides more with technology transfer capabilities in a knowledge-structure economy (Leydesdorff and Ivanova, 2016).Moreover, Fry and Kolb (1979) state that organisations take the mistakes and learning from it as a learning curve for innovation development to improve their organisational capability and knowledge. This is because learning innovation can help problem-solving as a problem based and creative process (Lindfors and Hilmola, 2016) and capture more knowledge (Fry and Kolb, 1979). However, survey results show that only 51% of students agree their universities accepts and learns from their mistakes. This result is consistent across universities in UK, and EU&Others, both in public and private universities.

5.6. Culture & Climate for Innovation

Innovation culture emphasises the encourage proactivity (Björkdahl and Börjesson, 2012; Rao and Weintraub, 2013), and77% students agree that their universities havea culture to encouraged them to consider their future prospect and career opportunities. It is a quote from thesurvey “they always try to encourage students to think about their futures and how the industry their studying could change”.University also needsa climate that open to external ideas and new thinking (Frishammar et al., 2019); and 64% of the students agree with it. For example, universities encourage students to talk about their business ideas.Manyorganisations including education sector face the challenges of innovation culture such as nonopenness to the external environment (Oumlil and Juiz, 2016) and different culture modes (Hoffman and Schlosser, 2001). Indepth analyses show that culture & climate for innovation does not have positive affect the innovation capability for private & other universities, and thus H6 is rejected. Not-invented-here (NIH) and not-sold-here (NSH) syndrome (Hussinger and Wastyn, 2016; Frishammar et al, 2019) arecultural barriers of innovation. 58% responds from private universities in the survey show that their universities are not able to remove silo-thinking inside the universities as a non-sharing habit (Cormican and O’Sullivan, 2004).For example, universities have strong internal conservative culture (Brandli et al., 2015) and lack of environmental committee (Ávila et al., 2017), which can oppose to innovation culture & climate.

Innovation Creativity

Creativity drives the organisation success with innovative product and service (Rao and Weintraub, 2013), and H7 is accepted. 67% students agree that freedom of new opportunities is provided within the university workplace because the openness of the new opportunity cangive freedom of creativity for generating idea and

development (Rao and Weintraub, 2013; Dawson and Andriopoulos, 2017). It is quoted as "they opened the enterprise centre which encourages expanding innovation ideas and supporting them". Universities take this creativity to rapid progressing in their learning development (Kalin, 2016; Bloom and Dole, 2018). Moreover, Goffin and Mitchel (2016) also mention organisations may use attribute analysis for generating ideas for new ideas to get new product/service, and 62% students agree with it. Bloom and Dole (2018) claim that creativity in the education sector could deal with employability longevity in the innovative economy. However, in-depth analysis shows that only 43% students at private universities state their universities are more systematic in term of creativity to solve the problem.

5.7. Innovative Communication

Communicationis the keytosuccessful product innovation (Cormican and O'Sullivan, 2004). Therefore, innovative communication has a positive impact on innovation capability assessment of universities. Yam et al. (2004) claim that organisationsneedto collect customers' feedback for further improvement. The survey result shows most of the students (76%) agree on it. For example, universities use questionnaires to improve modules and universities hold meetings after events with students to ask for feedback.Cormican and O'Sullivan (2004) mention that organisation need gatekeepers in position to communicate with the external environment continuously, which consistent with the results showing that 71% of student agree on this concept, and it applies to their universities. For instance, universities have either student union or s associations for communication between students and universities. However, innovative communication may not suitable for assessing the innovation capability of private universities, and H8 is rejected with small margin at significant P-value = 0.053.

5.8. Innovation Dimensions Interactions

H9 is accepted sinceall eight innovation dimensions havea significant positive relationship witheachother,and the interaction has impact on universities' innovation capability. The dimensions strategy, processes, innovative organisation, linkages, learning(Tidd et al., 2005) were selected, alongsidetheorganisation innovation capability assessed as "how well do we manage innovation?". These five dimensions remain the same to the latest version of Tidd and Bessant's (2018) innovation audit model. They are correlated with each other at $0.698 < r < 0.873$ and the impact correlation with innovation capability at

$0.860 < r < 0.913$. It means it is significant to assess more than one innovation dimensions to evaluate the organisations'innovation capability. Cormican and O'Sullivan's (2004) model has five innovation dimensions, including culture & climate for innovation, innovative communication. There is lack of innovation process that has the strongest positive correlation with strategy dimension r=0.873. Other theoretical models also justify the interaction of innovation dimensions. For example, a good design modelof innovation showsthe correlation betweeninnovation strategy and innovation process that it is the strongest correlation dimensions (Moultrie et al.,2007).Organisational structure provides an interactive environment to support innovation culture that builds a climate for innovation implementation (Dawson and Andriopoulos, 2017).Cina and Cummings (2018) claim that public sector organisations are working to climate with open innovation communication (remove the traditional silo culture) that can enhance strategy implementation. Effective communication is the determinant of innovation culture (Roffeei et al., 2018).

The hypothesis result of this study is also supported byeducation concepts. Innovation process in education sector affects the blended learning from the impact of industrial revolution 4.0 (Xing and Marwala, 2017). Innovative organisation triangle or more correlation with innovation dimensions as an example of the transformational leadership model can enhance process and product innovation, and promote the innovation strategies (Al-Husseini and Elbeltagi, 2016). To enhance learning in the education sector, there are combinations of thinking and teaching culture, creativity, innovation process, and collaboration.With education diversity, the innovative climate can adjust the communication quality and team performance, and it is triangle correlation between climate, communication, and innovative organisation (Valls et al., 2016). Rrecent studies byBjörkdahl and Börjesson (2012), Rao and Weintraub (2013); Goffin and Mitchell (2016), and Frishammar et al. (2019) provide the variety and different innovation dimensions to assess the organisation innovation capability. For example, a structured process can promote innovation processes and capabilities, this innovation dimensions assessment has innovation process and learning for innovation dimension with correlation r =0.759 impact to organizational innovation capability (Björkdahl and Holmén, 2016). These studies significantly contribute to previous models, providing clarity and more edge for innovation dimension selection.

6.

7. Conclusion

This paper aims to provide a critical evaluation of the effective key innovation dimension for universities' innovation capability assessment from student perspective.Throughliterature review and empirical studies analysis, it identifies and selects eight innovation dimensions, strategy, innovation process, innovative organisation, linkages, learning, culture & climate, creativity, and communication. The result of the analysis shows that all hypothesis have positive impact on university innovation capability. However, in-depth analysis with control variable shows that three innovation dimensions, innovation process, culture & climate for innovation, and innovative communication have significant level $p>0.05$ for a case of private & other universities. It means that eight innovation dimension has a strong and positive relationship with innovation capability, especially for public universities, though innovation process, culture & climate, and communication do not have a positive relationship with innovation capability for private & other universities category. The paper also critically discussedthe hypotheses in compare, contrast, and critique with current literature.It justify the rejection of three innovation dimensions for private & other universities such as innovation process is rejected because of the funding issue, lack of innovation pipeline; culture & climate is rejected with cultural barriers of innovation (NIH, NSH, non-openness, and different culture modes), and innovative communication reject-with small margin of P-value at = 0.053 close to 0.05 with a small sample size of private universities. Moreover, each eight innovation dimensions are positively correlated to each other and give a significant impact on innovation capability assessment, which is strongly justified with many studies. The critical evaluation of this study justifies the selected eight innovation dimension is applicable for the university to assess their innovation capability from student evaluation, especially public universities.

There areseveral areas that need to address with recommendations. First, this study provides an open new chapter for researchers as it is fresh and brand-new topic that working on innovation capability model for universities that majority of study are working on private firms, However, the combination between innovation assessment model and triple helix model where these paradigms are new just emerged in last few decades.

These theoretical concepts are still evolving that may affect the existing theory may not justify and applicable for either current or future practices. It is recommended that future study continue working on the topic with updated theoretical concepts and testing with all three triple helix anchors for feasible and practical outcomes. Second, assessing university innovation capability with student evaluation is a new concept that response to an era of open innovation that it is innovation paradigm evolution “open innovation 2.0” (European Commission, 2016; Chesbrough, 2017). However, this study conducted with a small sample size, and the result may not reflect and sufficient to generalisedinnovation capability model under student evaluation for universities. Therefore, future studies need to conduct with larger sample size, for further validation.

8.

9. **References**

Aagaard, A., & Andersen, T. (2014). How can HR practices support front-end innovation and increase the innovativeness of companies? European Journal of International Management, 8(5), 488-505.

Adcroft, A., Teckman, J., &Willis, R. (2010). Is higher education in the UK becoming more competitive?International Journal of Public Sector Management, 23(6), 578-588.

Akram, K., &Hilman, H. (2017). Is dynamic capability view relevant to the higher education institutions for innovation capability? Developing Country Studies, 7(9),1-9.

Al-Husseini, S., &Elbeltagi, I. (2016). Transformational leadership and innovation: A comparison study between Iraq's public and private higher education. Studies in Higher Education, 41(1), 159-181.

Arthur, W.B. (1989). Competing technologies, increasing returns, and lock-in by historical events.The economic journal, 99(394), 116-131.

Assink, M. (2006). Inhibitors of disruptive innovation capability: a conceptual model. European journal of innovation management, 9(2), 215-233.

Ávila, L. V., Leal Filho, W., Brandli, L., Macgregor, C. J., Molthan-Hill, P., Özuyar, P. G., & Moreira, R. M. (2017). Barriers to innovation and sustainability at universities around the world,Journal of cleaner production, 164, 1268-

1278.https://doi.org/10.1016/j.jclepro.2017.07.025 viii. Bacon, G., Beckman, S., Mowery, D., & Wilson, E. (1994). Managing product definition in high-technology industries: A pilot study.California Management Review, 36(3), 32-56.

Birkinshaw, J., Bessant, J., &Delbridge, R. (2007). Finding, forming, and performing: Creating networks for discontinuous innovation.California Management Review, 49(3), 67-84.

Björkdahl, J., &Börjesson, S. (2012). Assessing firm capabilities for innovation.International Journal of Knowledge Management Studies, 5(1-2),171-184.

Björkdahl, J., &Holmén, M. (2016). Innovation audits by means of formulating problems.R&D Management, 46(5), 842-856.

Blass, E., & Hayward, P. (2014). Innovation in higher education; will there be a role for the academe/university in 2025? European Journal of Futures Research, 2(1), 1-9.

Bloom, L. A., & Dole, S. (2018). Creativity in education: A global concern.Global Education Review,5(1),1-4.

Brandli, L.L., Leal Filho, W., Frandoloso M.A.L., Korf E.P.,&Daris D. (2015). The environmental sustainability of Brazilian universities: Barriers and pre-conditions. In W.LealFilho, U.Azeiteiro, S.Caeiro, F.Alves (Eds),Integrating sustainability thinking in science and engineering curricula (pp. 63-74). Springer. https://doi.org/10.1007/978-3-

319-09474-8_5

Burns, T., & Stalker, G. (1966) The management of innovation(2nd ed.).Tavistock.

Carayannis, E. G., Grigoroudis, E., Campbell, D. F., Meissner, D., &Stamati, D. (2018). The ecosystem as helix: An exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models. R&D Management, 48(1), 148-162.

Chesbrough, H. (2003). The Era of Open Innovation.MIT Sloan Management Review, 44(3), 35-41.

Chesbrough, H. (2017). The future of open innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants.Research technology management, 60(1),35-38.

Chesbrough, H., &Brunswicker, S. (2014). A fad or a phenomenon? The adoption of open innovation practices in large firms.Research-Technology Management, 57(2),16-25.

Cormican, K., & O'Sullivan, D. (2004). Auditing best practice for effective product innovation management',Technovation, 24(10), 819-829.

Danneels, E. (2011). Trying to become a different type of company: Dynamic capability at Smith Corona.Strategic Management Journal, 32(1), 1-31.

David, P. A. (1985). Clio and the Economics of QWERTY.The American Economic Review, 75(2), 332-337.

Davydova, N. N., &Dorozhkin, E. M. (2016). Management of a network interaction of educational organisations oriented to innovation development. Indian Journal of Science and Technology, 9(29), 36-

42.https://doi.org/10.17485/ijst/2016/v9i29/88729 xxiv. Deem, R., Mok, K. H., & Lucas, L. (2008). Transforming higher education in whose image? Exploring the concept of the world-class university in Europe and Asia.Higher Education Policy, 21(1), 83-97.

Edwards, J. (2007). Challenges and opportunities for the internationalization of higher education in the coming decade: Planned and opportunistic initiatives in American institutions. Journal of Studies in International Education,11(3-4), 373-381.

Eisenhardt, K. M., &Sull, D. N. (2001). Strategy as simple rules. Harvard Business Review, 79(1), 106-119.

Etzkowitz, H. (2003). Innovation in innovation: The triple helix of university-industry-government relations.Social Science Information, 42(3), 293-337.

Etzkowitz, H. (2016). The entrepreneurial university: Vision and metrics.Industry and Higher Education, 30(2), 8397.

Etzkowitz, H., &Leydesdorff, L. (1995). The Triple Helix-university-industry-government relations: A laboratory for knowledge based economic development.EASST Review, 14(1), 14-19.

Etzkowitz, H., &Leydesdorff, L. (2000). The dynamics of innovation: From national systems and Mode 2 to a triple helix of university-industry-government relations. Research Policy, 29(2), 109-123.

Frishammar, J., Richtnér, A., Brattström, A., Magnusson, M., &Björk, J. (2019). Opportunities and challenges in the new innovation landscape: Implications for innovation auditing and innovation management. European

Management Journal, 37(2), 151-164.https://doi.org/10.1016/j.emj.2018.05.002 xxxii. Fry, R.,& Kolb, D. (1979). Experiential learning theory and learning experiences in liberal arts education.New Directions for Experiential Learning, 6,79-92.

Goffin, K., & Mitchell, R. (2016). Innovation management: Effective strategy and implementation (3rd ed.). Macmillan International Higher Education.

De Haan, H.H. (2015). Competitive advantage, what does it really mean in the context of public higher education institutions? International Journal of Educational Management, 29(1), 44-61.https://doi.org/10.1108/IJEM-07-

2013-0115

Hoffman, W.H., & Schlosser, R. (2001). Success factors of strategic alliances in small and medium-sized enterprises-

An empirical survey. Long Range Planning, 34(3), 357-381.https://doi.org/10.1016/S0024-6301(01)00041-3

Hussinger, K., &Wastyn, A. (2016). In search for the not-invented-here syndrome: The role of knowledge sources and firm success.R&D Management, 46(3),945-957.

Johannessen, J. A., Olsen, B., &Olaisen, J. (1999). Aspects of innovation theory based on knowledgemanagement.International Journal of Information Management, 19(2),121-139.

. Kalin, N. M. (2016). We're all creatives now: Democratized creativity and education.Journal of the Canadian Association for Curriculum Studies, 13(2),32-44.

Kerry, C., &Danson, M. (2016). Open innovation, Triple Helix and regional innovation systems: Exploring CATAPULT

Centres in the UK.Industry and Higher Education, 30(1),67-78. https://doi.org/10.5367/ihe.2016.0292 xl. Khalifa, A.S. (2009). Student-as-aspirant: Strategic implications for business education.European Business Review. 21(2), 172-190.

Ko, H., & Lu, H. (2010). Measuring innovation competencies for integrated services in the communications industry. Journal of Service Management, 21(2), 162-190.

Lawson, B., &Samson, D. (2001). Developing innovation capability in organisations: A dynamic capabilities approach. International Journal of Innovation Management, 5(3), 377-400.

Leih, S., &Teece, D. (2016). Campus leadership and the entrepreneurial university: A dynamic capabilities perspective. Academy of Management Perspectives, 30(2), 182-210.https://doi.org/10.5465/amp.2015.0022

Leydesdorff, L., &Ivanova, I. (2016). Open innovation and triple helix models of innovation: Can synergy in innovation systems be measured? Journal of Open Innovation: Technology, Market, and Complexity, 2(1), 1-

12.https://doi.org/10.1186/s40852-016-0039-7 xlv. Lichtenthaler, U. (2011). Open innovation: Past research, current debates, and future directions.Academy of Management Perspectives, 25(1), 75-93.

Lindfors, E., &Hilmola, A. (2016). Innovation learning in comprehensive education? International Journal of Technology and Design Education, 26(3),373-389.

Lundvall, B. (1988). Innovation as an interactive process: From user producer interaction to national systems of Innovation. In G.Dosi, C.Freeman, R. Nelson,& L. Soete(Eds.), Technical change and economic theory(pp. 349369).Anthem Press.

Lynch, R., & Baines, P. (2004). Strategy development in UK higher education: Towards resource-based competitive advantages.Journal of Higher Education Policy and Management, 26(2), 171-187.

Marginson, S., & Van der Wende, M. (2007). To rank or to be ranked: The impact of global rankings in higher education. Journal of Studies in International Education, 11(3-4), 306-329.

Moultrie, J., Clarkson, P. J., &Probert, D. (2007). Development of a design audit tool for SMEs.,Journal of Product Innovation Management, 24(4), 335-368.

Nelson, R.R. (1994). The co-evolution of technology, industrial structure, and supporting institutions. Industrial and Corporate Change, 3(1), 47-63. lii. O'Connor, G.C. (2008). Major innovation as a dynamic capability: A systems approach. Journal of Product Innovation Management, 25(4), 313-330.

liii. Oumlil, R., & Juiz, C. (2016). An up-to-date survey in barriers to open innovation. Journal of Technology Management

&Innovation, 11(3), 137-152.https://doi.org/10.4067/S0718-27242016000300016 liv. Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. Research Policy, 13(6), 343-373.

Phusavat, K., Comepa, N., Sitko-Lutek, A., &Ooi, K. (2011). Interrelationships between intellectual capital and performance: Empirical examination.Industrial Management & Data Systems, 111(6), 810-829.

Pisano, G.P., &Verganti, R. (2008). Which kind of collaboration is right for you.Harvard Business Review, 86(12), 7886.

Poolton, J., &Barclay, I. (1998). New product development from past research to future applications. Industrial Marketing Management, 27(3), 197-212.

Radnor, Z. J., &Noke, H. (2002). Innovation compass: A self–audit tool for the new product development process. Creativity and Innovation Management, 11(2),122-132.

Rajapathirana, R. J., &Hui, Y. (2018). Relationship between innovation capability, innovation type, and firm performance. Journal of Innovation & Knowledge, 3(1), 44-55.

Rao, J., &Weintraub, J. R. (2013). How innovative is your company's culture?MIT Sloan Management Review, 54(3),28-37.

Roffeei, S. H. M., Yusop, F. D., &Kamarulzaman, Y. (2018). Determinants of innovation culture amongst higher education students,Turkish Online Journal of Educational Technology-TOJET, 17(1), 37-50.