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## **Enterprise development and global competitiveness through the development of higher education**

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**Abstract:** The purpose of this study was to delineate and identify the common criteria for higher education institution classification and evaluation as a research university, and to analyse the relationship between higher education, innovation and the country's competitiveness. Criteria to classify research universities derive from classification in the USA, China, Europe and Thailand. Criteria to evaluate research universities based on international rankings: Shanghai Jiao Tong University global ranking and Times Higher Education QS World Universities Ranking. To test the relationship with competitiveness, the global competitive index was used. The results were as follows: firstly, common criteria that have been used to classify research universities consisted of three dimensions: funding, programmes and staff. Secondly, common criteria that have been used to evaluate research universities consisted of three dimensions: publications, citations and research awards. Finally, the relationship between higher education, innovation and global competitiveness appeared to be highly interrelated. The results provide useful information to higher education policy-makers in the context of higher education management and the development of a national research university.

**Keywords:** higher education; national research university; enterprise development; global competitiveness.

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## 1 Introduction

The acceleration of globalisation and the emergence of the knowledge-based economy have led to dramatic changes. In many countries, higher education has had to adapt in terms of character and function to meet society's complex demands and expectations (Burbules and Torres, 2000; Deem and Brehony, 2005; Mok and Welch, 2003; Vaira, 2004). The need for a nation's universities to become 'world-class universities' has been something that is seen to be both challenging and desirable. Horta (2009) demonstrated that the obvious feature of the top 500 'world-class universities' is that all of these universities are recognised worldwide as 'research universities'. Liu and Cheng (2005) and Deem et al. (2008) also stated many governments have realised that the research university is fundamental to enhance competitiveness and sustainability. Furthermore,

research literature such as Bils and Klenow (2000), Hanushek and Kimko (2000), Krueger and Lindahl (2000), Cohen and Soto (2001) consistently finds that investment in knowledge and skills for human capital leads to improved productivity and key bursts in promising national economies.

In addition, the World Bank (2002) added that within the higher education system, the research university also plays an important role in training professionals, high level specialists, scientists and researchers consistent with economic demand and brings forth new knowledge components, contributing to the national innovation system. Lee et al. (2007) also stated that organisational flexibility, long-term enterprise development and a country's competitiveness depend primarily on graduates and university education. Given the significance of higher education and innovation on enterprise development and global competitiveness, three research questions have been addressed:

- 1 What common criteria can be employed to classify 'research universities'?
- 2 What common criteria can reflect the quality and recognition of 'research universities'?
- 3 What are the relationships between higher education quality, innovation and global competitiveness?

## **2 Background**

### *2.1 The existing ways to classify research universities*

In many locations, such as in the USA, China, Europe and Thailand, government policy has encouraged higher education institutions (HEIs) to become research universities (Deem et al., 2008; Horta, 2009; Liu and Liu, 2005; Office of the Higher Education Commission, Thailand<sup>1</sup>). However, HEIs have diversity and complexity, e.g. population structure, government policy, financial policy, and the HEIs requirements and environment, such as university development and identification, location, related community, instruction programmes, learner's background, etc. (Birnbaum, 1983; Hedin et al., 2005; Huisman, 1995; Liu, 2007; Shin, 2009; Teichler, 2007a,b; van Vught, 2008). Hence, with such diversity and complexity in higher education, how does the Commission of Higher Education (CHE) recognise which universities are to be classified as research universities?

Classification has become an important tool to identify which universities can be classified as a research university. Examples of such classification include Carnegie Classification, USA; Amano and Chen (2004) Classification, Japan; Liu and Liu (2005) Classification, China; Bartelse and van Vught (2009) Classification, Europe and Phusavat (2008) Classification, Thailand. McCormick and Zhao (2005) and McCormick (2007) stated that classification has been very useful to stakeholders (e.g. students, HEIs, businesses and industries, researchers and policy-makers), as it provides useful information about the similarities and differences between universities based on agreed criteria. For example, the CHE used useful classification information as follows: firstly, they enable an understanding of the characteristics of educational groups (e.g. research university, master's university, baccalaureate colleges, etc.). Secondly, they can design development guidelines that suit the individual educational institutes which can lead to

enhancing higher education standardisation and economic competitiveness at an international level. Moreover, McCormick (2008) added that ‘classification’ is more likely to be used to identify the similarities between institutes rather than ranking the institutes. This could be a reason why classification does not reflect the quality of higher education but is simply used to identify the HEIs criteria or parameters which have been developed in agreement with the objectives of classification.

Higher education classification has been popular worldwide, especially the Carnegie Classification of Institutions of Higher Education<sup>2</sup>, a well-established classification system widely used by US universities and colleges. It was first developed in 1973 by classifying the educational institutes into five major categories (C): C1, doctoral-granting institutions; C2, comprehensive universities and colleges; C3, liberal art colleges; C4, two-year colleges and institutes; and C5, professional schools and other specialised institutions. As a proxy for research activity, the doctoral-granting institution was divided into four sub-categories: research I, research II, doctoral I and doctoral II. The higher educational institute’s role on research has been highly valued. In the US higher education system, research activity varies from institute to institute, which attracted considerable attention in developing HEIs into research universities (McCormick, 2008).

The Carnegie Classification of Institutions of Higher Education has been revised many times, in 1976, 1987, 1994, 2000, 2005 and most recently in 2010, while the core classification has remained the same. The notable changes included:

- 1 Variation in the labels used, definitions and technical parts.
- 2 The number of research universities increased by 25% as a result of the 1994 classification (Evangelauf, 1994).
- 3 After 1994, the Roman numbers were omitted from research university I and II, doctoral university I and II, aiming to avoid latent mistakes pertaining to differences in the institutes’ quality.
- 4 The position of the institutes was analysed in 1976, 1987 and 1994 and summarised as an indicator of prestige, which is a key driver of the institutions’ direction and decision-making on their policies (Aldersley, 1995). The HEIs have attempted to upgrade themselves and move towards the status of research university.
- 5 In 2000, research university I was integrated into the doctoral university I, while research university II was integrated into the doctoral university II.

In 2005, the classification system was overhauled comprehensively. The overall picture of change included, firstly, changing from a single classification into a set of multiple parallel classifications based on three major questions: ‘What is taught?’, ‘Who are the students?’ and ‘What is the setting?’ With these questions, the following five categories were added (C1, undergraduate instructional programme; C2, graduate instructional programme; C3, enrolment profile; C4, undergraduate profile and C5, size and setting), and the substantially revised original classification now called basic classification includes six categories (C1, associate’s colleges; C2, doctorate-granting universities; C3, master’s colleges and universities; C4, baccalaureate colleges; C5, special focus institutions and C6, tribal colleges). Secondly, a web-based tool was developed where users are able to combine the classification schemes and generate subsets in which they are interested. Finally, the elective classification or so-called ‘community engagement’ was developed, subject to the voluntary participation of the

institutes. In this case, data were obtained from institutions directly, in contrast to the empirical data used in previous classifications. Broadly speaking, the 'elective classification' facilitates the institutional classification in terms of mission and action, which were grouped into three categories:

- 1 curricular engagement
- 2 outreach and partnership
- 3 curriculum engagement and outreach and partnership (McCormick and Zhao, 2005).

More recently, in 2010 the classification system update retains the same structure when compared with the classification in 2005.

Furthermore, the Carnegie Classification of Institutions of Higher Education became an exemplar tool for classification development by researchers in many countries. For example, the Japanese Classification is composed of five major categories: C1, research university; C2, doctorate-granting university I; C3, doctorate-granting university II; C4, master's degree-granting university and C5, colleges (Amano and Chen, 2004). Similarly, the Chinese Classification included five major categories: C1, research university; C2, doctorate university; C3, master' university; C4, baccalaureate college and C5, associated colleges (Liu and Liu, 2005). Thailand's Classification system contains five areas in classifying each university's position, including university characteristics, teaching, research, student body and management (Phusavat, 2008). The European Classification is composed of five main categories with 14 dimensions: C1, education (four dimensions: degree level, subject mix, orientation of programmes and involvement in lifelong learning); C2, research and innovation (two dimensions: research intensiveness and innovation intensiveness); C3, international orientation (two dimensions: teaching and research); C4, size and setting (four dimensions: size, mode of delivery, public/private character and legal status) and C5, community engagement (two dimensions: cultural engagement and regional engagement) (Bartelse and van Vught, 2009).

## *2.2 The existing methods for evaluation research universities*

The 1990s is known as the 'decade of quality', when the term 'quality' became commonly used in industry, commerce and the government sector. In the context of higher education, quality is widely used and plays an important role in the higher education system. In many countries, universities have been classified as research universities; e.g. the Ivy League universities have been classified as research universities in the USA, G13 (Group of Thirteen) in Canada, the Russell Group in the UK, the League of European Research University in European continent, G08 (Group of Eight) in Australia, China's Research Universities I in mainland China and other research universities worldwide. Most people perceived these universities as being leading research universities with important components, e.g. top-quality academic staff and students, adequate funding for research and development (R&D), facilities for academic work and other qualities. Nonetheless, the universities have been questioned about the quality among the stakeholders (i.e. students, instructors, institutional executives, policy-makers, industrial operators and the public). One frequently asked question was 'how can the quality of a university as a research university be evaluated?'

The review of literature revealed that quality assurance in higher education by means of independent evaluation can ensure quality. Bogue (1998) proposed several evaluation approaches. Firstly, peer review evaluation (e.g. educational institutes *per se*, external professionals or an external body). This approach included educational accreditation and university ranking/rating. Secondly, total quality management has also been employed for educational evaluation. Thirdly, the assessment of outcomes is a way of quality assurance that emphasises the accomplishment of the curriculum. Finally, quality assurance includes an accountability indicator and performance indicators.

However, Salmi and Saroyan (2007) revealed that for the evaluation of research activities, ranking as a quality measure could be used to compare the quality of research activity at national and international levels. The phenomenon of ranking university has grown rapidly worldwide. National ranking has emerged since the 1980s, while international ranking has happened more recently (Högskoleverket, 2009). Bowden (2000) and McCormick (2008) stated that 'ranking' is a rating tool based on the criteria that are established. The process of ranking consists of sequences as follows: collecting data, selecting the category and quality of variables, standardising and weighting the indicators from selected variables, and calculation and comparison (Högskoleverket, 2009). In addition, Usher and Savino (2006) and Cunningham (2008) included criticism about biases in the ranking systems. However, the ranking systems have been commonly used domestically and internationally, and are used for continuous development and the improvement of weak areas.

The ranking system provides many advantages including a mechanism to indicate which university should be classified as a leading research university, especially in research activities. It also comprises a ranking system, providing the students, the government, higher educational leaders, employers and policy-makers with useful information supporting their decision-making. For example, students make good use of information to support their decisions in choosing which educational institute to attend, the government applies the information to formulate the educational policy and budgeting, the higher educational leaders apply the information to enhance their institutional management, the employers use the information for recruitment purposes and the policy-maker uses the information for policy planning. Furthermore, the ranking system is a tool facilitating quality improvement. For example, it is important to protect the students and stakeholders from low quality provision and encourages the institutes to move towards the leader, encouraging the academic community to improve quality, and influence competition and productivity. Finally, the ranking system brings about transparency and serves as an effective instrument for public accountability (Salmi and Saroyan, 2007; Usher and Savino, 2007). With the evident advantages of the ranking system, institutes worldwide, especially research universities, are making an effort to improve their quality based on established criteria and are eager to become world-class universities. Therefore, in this paper, the authors focus on the international ranking systems that are well known including the Shanghai Jiao Tong University global ranking (SJTU) and the Times Higher Education QS World Universities Ranking (THE-QS) as tools for the evaluation of research activities.

### 2.2.1 Shanghai Jiao Tong University global ranking

SJTU was initiated in 2003. Its primary aim was to develop the Academic Ranking of World Universities (ARWU). Liu (2006) stated that the ARWU was posted on the

internet in 2003. There were more than 2,000,000 visitors accessing the site, averaging 2,000 visitors daily. Liu and Cheng (2005) added that over 2,000 educational institutes were taken into account, and over 1,000 institutes had been ranked. However, only 500 institutes were presented on the internet. The International Ranking System by SJTU occurs every year with the intent to focus only on the quality of research. The Jiao Tong Group said it is hardly possible to rank other qualities such as teaching and learning for reasons that there are great differences among universities and many more differences at the national level. In addition, there were technical problems in collecting data at the international level. Moreover, they did not desire to use subjective measures of opinion from informative sources about the universities. They needed objective measurable indicators and comparisons that could be made at an international level, where the data could be checked. Consequently, the International Ranking System by SJTU employed four criteria with several research performance indicators including

- 1 alumni and staff winning the Nobel Prize and Fields Medals
- 2 highly cited researchers
- 3 published papers in Nature and Sciences, articles in Science Citation Index-expanded (SCIE) and Social Science Citation Index (SSCI)
- 4 academic performance with respect to the size of an institution.

The criteria and weight for each indicator are shown in Table 1.

**Table 1** Comparison of the methodologies of international ranking systems

		<i>SJTU</i>		<i>THE-QS</i>	
Universities analysed	1,000+		500+		
Universities ranked	500		200		
<i>Criteria</i>	<i>Indicator</i>	<i>Weight</i>	<i>Indicator</i>	<i>Weight</i>	
Quality of education	Alumni of institution winning Nobel Prize and Fields Medals	10%	Staff–student ratio (proxy for ‘teaching quality’)	20%	
Internationalisation	–	–	International students	5%	
			International staff	5%	
Research output	Papers indexed in Nature and Science	20%	–	–	
	Papers indexed in SCIE and SSCI	20%			
Prestige	Staff of an institution winning Nobel Prize and Fields Medals	20%	Academics peer review	40%	
			Reputation: employers	10%	
Impact	Highly cited researchers in 21 broad subject categories	20%	Research citation per head of academic faculty	20%	
Per capita performance	Per capita academic performance of an institution	10%	–	–	
Total		100%		100%	

*Source:* Adapted from SJTU<sup>3</sup> (2009) and THE-QS<sup>4</sup> (2009).

### 2.2.2 *Times Higher Education QS World Universities Ranking*

THE-QS was first proposed in 2004, with the aim to compare the achievement of universities which are attempting to achieve world-class university standards. THE-QS described four pillars: research quality, teaching quality, student employability and international outlook. These pillars have brought forth six indicators derived from various sources, such as the Higher Educational Statistics Agency, the Higher Educational Funding Council, the Quality Assurance Agency, the Office for Standards in Education and Individual University Survey (Stella and Woodhouse, 2006). Research quality was measured by two indicators: an academic ‘peer review’ and the number of research citations per head of academic faculty. Teaching quality was measured in terms of student–teacher ratio. Student employability and the international outlook were measured by two indicators, international teacher and researcher ratio, and the proportion of international students. The criteria and weight for each indicator are shown in Table 1.

### 2.3 *The existing ways to measure competitiveness*

The global competition report (GCR) proposed by the World Economic Forum (WEF) has been widely accepted for over three decades as a ranking tool for measuring global competitiveness (Schwab, 2009). It is agreed that the GCR reflects the country’s overall economic environment and allows us to acknowledge the existing competition in each country, based on the indicators of economic prosperity, and enables individual countries to understand the advantages and disadvantages of competition in each respective country. Consequently, the GCR has become a crucial instrument for policy-makers and business leaders worldwide to formulate appropriate policy and institutional reform and eventually lead to global competitiveness enhancement.

The GCR included 12 pillars of competitiveness:

- 1 institutions
- 2 infrastructure
- 3 macroeconomic stability
- 4 health and primary education
- 5 higher education and training
- 6 goods market efficiency
- 7 labour market efficiency
- 8 financial market sophistication
- 9 technological readiness
- 10 market size
- 11 business sophistication
- 12 innovation

which were divided into three different areas: basic requirements (pillars 1–4), efficiency enhancement (pillars 5–10), and innovation and sophistication factors (pillars 11 and 12) (Schwab, 2009).

Recently, the WEF has completed a report outlining the ranking of countries for economic competitiveness at the international level. The latest volume of the report, year 2009–2010, described the objective of the national competitiveness assessment that measures the level of prosperity. This depends on how each country employs its resources and how productive it has been. The Global Competitiveness Index (GCI) was used to evaluate the competition capacity. There were 133 countries which were selected from five regions: Europe, Latin America and the Caribbean, Asia and the Pacific, Middle East and North Africa, and sub-Saharan Africa. The information used for ranking included two major parts: quantitative and qualitative data. Quantitative data were derived from international organisations, such as the International Monetary Fund, the World Bank and United Nations agencies. The qualitative data were derived from the exclusive opinion survey which consisted of more than 13,000 samples from 133 countries. Of the overall samples, 12,614 samples (95% responds per country) returned the completed questionnaires. Most items met the GCI structure and a seven-point scale was used (1 = mostly severe and 7 = mostly positive) (Schwab, 2009).

The ranking results showed that the top ten countries with the highest scores for competitiveness were Switzerland (5.60), the USA (5.59), Singapore (5.55), Sweden (5.51), Denmark (5.46), Finland (5.43), Germany (5.37), Japan (5.37), Canada (5.33) and the Netherlands (5.32). Comparison with the GCR 2008–2009 revealed that the top ten countries were the same countries, but their respective ranks had changed (See detail in [www.weforum.org/reports](http://www.weforum.org/reports).)<sup>5</sup> In addition, the GCR demonstrated that the innovation factor was particularly important to competitiveness, as it appeared in the top ten countries with the highest overall GCI. The top ten countries were in the development stage of innovation-driven economics. To bring forward their innovation development, it is necessary for countries to be supported in different ways, especially pillar 5, higher education and training (World Bank, 2002).

#### *2.4 The relationship between higher education, innovation and competitiveness*

Schwab (2009) stated the two key pillars as an essential foundation for sustaining a country's long-term competitiveness in the globalised markets and trades. Firstly, the 5th pillar, 'higher education and training', is crucial for efficiency-driven economics. It included

- 1 secondary enrolment
- 2 tertiary enrolment
- 3 quality of the educational system
- 4 quality of maths and science education
- 5 quality of management schools
- 6 internet access in schools
- 7 local availability of research and training services
- 8 extent of staff training.

Secondly, the 12th pillar, ‘innovation’, is essential for driving the economy. It included

- 1 capacity for innovation
- 2 quality of scientific research institutions
- 3 company spending on R&D
- 4 university–industry collaboration in R&D
- 5 government procurement of advanced tech products
- 6 availability of scientists and engineers
- 7 utility patents (see detail in [www.weforum.org/reports](http://www.weforum.org/reports)).

For higher education and training, Schultz (1961), Lucas (1988), Becker (1993), Kremer (1993), Motwani and Kumar (1997) and Hedin et al. (2005) have shown that higher education and training is important for countries to add to the value chain beyond simple production processes and products. In particular, the current economic situation has leveraged competitiveness in manpower. Many industries need well-trained workers who have the potential to adapt themselves to the ever-changing environment (Burke et al., 2009). This is consistent with Ramoniene and Lanskoronskis (2011), who stated higher education increases the efficiency of each individual worker, making the economy more productivity and produces healthy workforces which are vital to a country’s competitiveness and productivity. From their viewpoints, HEIs have a direct effect on the quality of workforces because they educate and prepare people for the labour market.

Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992) stated standards of living can be expanded only with innovation in the long run. Innovation is particularly important for economies as they approach the frontiers of knowledge and the possibility of integrating and adapting exogenous technologies tends to disappear (Distanont et al., 2011; Memiyanty et al., 2010). Furthermore, Ramoniene and Lanskoronskis (2011) stated that the innovation pillar is also affected by a country’s higher education system because innovation is less likely without high quality scientific research institutions, a highly skilled workforce, including scientists and engineers, sufficient R&D investment by private companies and the protection of intellectual property.

### **3 Objectives**

This study has three major objectives:

- 1 to analyse common criteria used in higher education classification as research university
- 2 to delineate common criteria used in the international ranking: SJTU and THE-QS for evaluating the research-focused university quality
- 3 to test the relationship between higher education, innovation and competitiveness.

#### **4 Methodology**

To achieve the objectives mentioned above, several steps are required. The first step is to review and examine of higher education classification which included the USA higher education classification version 1994, 2000 and 2005 by the Carnegie Foundation for the Advancement of Teaching (CFAT), the Chinese higher education classification by Liu and Liu (2005), the European higher education classification by Bartelse and van Vught (2009) and Thailand higher education classification by Phusavat (2008). The second step is to review and examine the international ranking: SJTU and THE-QS version 2009. The third step is to analyse common criteria used to classify and evaluate the HEI's quality as research universities. The fourth step is to delineate the relationship between higher education, innovation and competitiveness which was sub-divided as follows:

- 1 compare the index tendency for pillar 5 (higher education), pillar12 (innovation) and overall GCI
- 2 analyse the advantages and disadvantages among four variables which pillar 5 (higher education) and pillar 12 (innovation) were selected for analysis to reflect the research university explicitly; consisting of the quality of the educational system (5.03), quality of maths and science education (5.04), quality of scientific research institution (12.02) and university–industry collaboration in R&D (12.04)
- 3 the relationship test was performed using Pearson's correlation coefficient.

The last step, detailed discussion and the implementation of common criteria for research activity-focused HEIs classification development and linkage to quality assurance to ensure national competitiveness.

#### **5 Results**

In this section, the results were presented in three issues as follows: firstly, the outcomes of higher education classification review indicate that all higher education classifications included research universities. The common criteria used for higher education classification based on research activities revealed that the USA higher education classification by CFAT, the Chinese higher education classification by SJTU and Thailand higher education classification by Phusavat (2008) did not take the criteria reflecting the quality and recognition of university into consideration. The criteria included three dimensions:

- 1 research funding, e.g. the amount of government research funding, supporting funds per person in one academic year, etc.
- 2 the instructional programmes and curriculums, e.g. universities focus on engineering or technology orientation; focus on doctoral degrees, ratio between doctoral and baccalaureate degrees, etc.
- 3 number of instructors or research staff, e.g. science and engineering (S&E) research staffs, doctoral conferrals in humanities fields, etc.

- 4 in the light of Chinese HEI classification by Liu and Liu (2005) and European HEI classification by Bartelse and van Vught (2009), the additional criteria provided to reflect quality and recognition was publication and citation, e.g. number of SCIE and SSCI articles per capita, number of peer-reviewed publications per full-time equivalent (FTE) academic staff, etc.

Further, detail and criteria are shown in Table 2.

Secondly, reviewing the international ranking SJTU and THE-QS demonstrated that ranking was used to evaluate the HEIs quality, especially in research activities. Ranking has been developed for many times based on the defined and suitable criteria. However, ranking has been criticised for bias; continuous improvement has been conducted consistently with situation. The common criteria for the international ranking: SJTU and THE-QS in the context of research activity evaluation consisted of three dimensions

- 1 publications
- 2 citations
- 3 research award, prestige and patents issued,

consistent with Bowden (2000), Dill and Soo (2004), van Dyke (2005), and Williams and van Dyke (2005) as illustrated in Table 3.

Finally, analysis result of relationship between higher education, innovation and competitiveness was described below.

**Table 2** Classification criteria for HEIs as research university in the USA, China, Europe and Thailand

<i>Classification</i>	<i>Categories (C)/Sub-categories (SC)</i>		<i>Classification criteria</i>
Carnegie Classification (edition 1994)	C1	Research university I	Institutions typically offered a full range of baccalaureate programmes, awarded 50 or more doctoral degrees, and received annually \$40 million or more in federal support
	C2	Research university II	Institutions typically offered a full range of baccalaureate programmes, received between \$15 million and \$40 million per year in federal support
Carnegie Classification (edition 2000)	C1	Doctoral/research universities—extensive	Institutions typically offered a wide variety of baccalaureate degrees and award 50 or more doctoral degrees per year across at least 15 academic disciplines
	C2	Doctoral/research universities—intensive	Institutions typically offer a wide variety of baccalaureate degrees and award at least 10 doctoral degrees per year across at least 3 academic disciplines or at least 20 doctoral degrees per year overall
Carnegie Classification (edition 2005, 2010)	C2	SC1: research universities (very high) SC2: research universities (high) SC3: doctoral/research universities	<ul style="list-style-type: none"> <li>• R&amp;D expenditures in S&amp;E</li> <li>• R&amp;D expenditures in non-S&amp;E fields</li> <li>• S&amp;E research staff</li> <li>• Doctoral conferrals in humanities fields, in social science fields, in science, technology, engineering and mathematics field, and in other fields (e.g. business, education, public policy, social work)</li> </ul>

**Table 2** Classification criteria for HEIs as research university in the USA, China, Europe and Thailand (continued)

<i>Classification</i>	<i>Categories (C)/Sub-categories (SC)</i>	<i>Classification criteria</i>
Chinese (SJTU)	C1 Universities with engineering or technology orientation	Over one-third of all graduate students enrol in engineering field
	C2 Universities with medical orientation	Over one-third of all graduate students enrol in medical fields
Chinese (Liu and Liu, 2005)	C1 SC1: research university I	<ul style="list-style-type: none"> <li>• Number of doctoral degree more than 193</li> <li>• Ratio between doctoral and baccalaureate degrees more than 0.09 for SC1 and 0.06–0.09 for SC2</li> </ul>
	SC2: research university II	<ul style="list-style-type: none"> <li>• Amount of government research funding more than 44 million Yuan</li> <li>• Number of SCIE and SSCI articles per capita at least 0.7</li> </ul>
European (Bartelse and van Vught, 2009)	C2 SC1: research intensiveness	<ul style="list-style-type: none"> <li>• Number of peer-reviewed publications per FTE academic staff</li> <li>• The Institute for Scientific Information-based citation indicator, normalised per field, also known as the ‘crown indicator’</li> </ul>
	SC2: innovation intensiveness	<ul style="list-style-type: none"> <li>• Number of start-up firms</li> <li>• Number of patent applications field</li> <li>• Annual licensing income</li> <li>• Revenues from privately funded research contracts as percentage of total research revenues</li> </ul>
Thailand (Phusavat, 2008)	C4 Research area	<ul style="list-style-type: none"> <li>• Research budget: SC1 <math>\leq 0.5\%</math>, SC2 = 0.50–0.99%, SC3 = 1.00–1.49%, SC4 = 1.50–1.99% and SC5 <math>\geq 2\%</math></li> <li>• Supporting funds per person in one academic year: SC1 <math>\leq 5,000</math> baht, SC2 = 5,000–10,000 baht and SC3 <math>\geq 10,000</math> baht</li> </ul>

**Table 3** Criteria used in the ranking of research activities

<i>Criteria</i>	<i>Common of indicator</i>
Publications	Publications in science-oriented indices
	Publications in Science and Nature
	Publications in social science-oriented indices
	Publications in other indices
Citations	Bibliometrics (counting of publications and citations)
	Highly cited publications
	Citations in engineering publications
	Citations in social science-oriented indices
	Research citation per head of academic faculty

**Table 3** Criteria used in the ranking of research activities (continued)

<i>Criteria</i>	<i>Common of indicator</i>
Research awards, prestige and patents issued	National research awards
	International research awards
	Number of patents issued
	Alumni of institution winning Nobel Prize and Fields Medals
	Academics peer review
	Reputation: employer

### 5.1 Index tendency comparisons and relationship between pillar 5, 12 and overall GCI

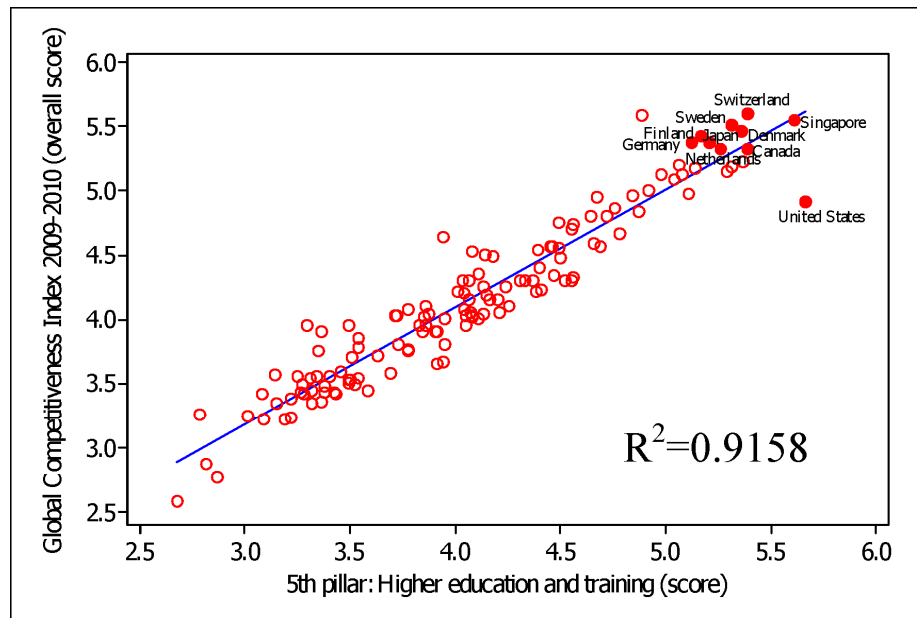
Table 4 shows the directional tendency comparison for overall GCI and pillar 5 (higher education and training), and pillar 12 (innovation). It indicated the same direction with overall GCI for pillars 5 and 12. Eight of the top ten countries with high overall GCI reported a high index for pillar 5 (5.49–5.97), except for only two of the top ten countries, Germany and Japan, whose scores were ranked 22 and 23, respectively. However, Germany and Japan showed scores higher than average score of 4.08, at 5.06 and 5.07, respectively. Figure 1 implied that, between overall GCI and the 5th pillar scores, there was a very high linear relationship ( $r = 0.957$ ,  $p < 0.01$ ). Next, among the top ten countries with a high overall GCI, eight of them showed a high level of innovation (12th pillar), with scores between 5.04 and 5.77, except for Canada and the Netherlands whose scores were ranked at 12 and 13, respectively. However, both Canada and the Netherlands showed high innovation scores of 4.80 and 4.79, respectively, which were scores higher than the average score (mean = 3.37) (See Table 4). Figure 4 demonstrated that the relationship between overall GCI and the 12th pillar was found to be a highly positive one ( $r = 0.880$ ,  $p < 0.01$ ). Similarly, Figure 7 showed a high relationship between scores of the 5th and 12th pillar ( $r = 0.894$ ,  $p < 0.01$ ).

**Table 4** Ranking comparisons of 5th pillar, 12th pillar and overall GCI 2009–2010

<i>Country/economy</i>	<i>Overall GCI (2008–2009)</i>		<i>Overall GCI (2009–2010)</i>		<i>5th pillar (higher education and training index 2009–2010)</i>		<i>12th pillar (innovation index 2009–2010)</i>	
	<i>Rank</i>	<i>Score</i>	<i>Rank</i>	<i>Score</i>	<i>Rank</i>	<i>Score</i>	<i>Rank</i>	<i>Score</i>
Switzerland	2	5.60	1	5.60	6	5.60	2	5.56
USA	1	5.59	2	5.59	7	5.57	1	5.77
Singapore	5	5.55	3	5.55	5	5.62	8	5.09
Sweden	4	5.51	4	5.51	3	5.76	5	5.39
Denmark	3	5.46	5	5.46	2	5.90	10	5.04
Finland	6	5.43	6	5.43	1	5.97	3	5.53
Germany	7	5.37	7	5.37	22	5.07	7	5.11
Japan	9	5.37	8	5.37	23	5.06	4	5.51
Canada	10	5.33	9	5.33	9	5.50	12	4.80
The Netherlands	8	5.32	10	5.32	10	5.49	13	4.79

Source: Adapted from Schwab (2009).

**Figure 1** Relationship between economic competitiveness and higher education and training (see online version for colours)



Note:  $r = 0.957$ ,  $p < 0.01$ .

## 5.2 Advantages and disadvantages in analysis of variables

According to the GCR 2009–2010, the advantage and disadvantage analysis was performed by comparing the overall GCI ranking and individual variables for the top ten countries. If individual variables ranged from 1 to 10, this indicated the advantageous variables; in turn, if they were greater than 10 (11, 12, 13, ..., 133), it indicated disadvantageous variables. Therefore, four individual variables were analysed, including the quality of the educational system (section 5.03), the quality of maths and science education (section 5.04), the quality of scientific research institutions (section 12.02) and university–industry collaboration in R&D (section 12.04). This revealed the quality of higher education, innovation and competitiveness relationship. In other words, the higher educational institutions emphasised the quality of the educational system, particularly in maths and science. Enhancing the university to become a research university by concentrating on R&D and industrial collaboration was an important mechanism for economic development. Tables 5 and 6 show the advantages and disadvantages comparison for four variables when comparing each variable ranking with the overall GCI ranking. This indicates that the top ten countries had advantages in four variables, while just a few countries had disadvantages. For example, Switzerland in section 5.03 has a ranking of 2, indicating Switzerland has an advantage in this variable. However, the countries with disadvantageous variables still had higher scores than the mean of 133 countries (section 5.03, mean = 3.8; section 5.04, mean = 4.0; section 12.02, mean = 3.9 and section 12.04 mean = 3.6). Most importantly, it was found that eight of the top ten countries had advantages on university–industry collaboration in R&D (section 12.04), reflecting the emphasis on R&D by their higher education institutes, and that industrial

collaboration was conducive to increasing their national competitiveness potential. Figure 2 shows the relationship between overall GCI and the quality of educational system (section 5.03) ( $r = 0.755$ ,  $p < 0.01$ ); Figure 3 shows the relationship between overall GCI and the quality of maths and science education (section 5.04) ( $r = 0.647$ ,  $p < 0.01$ ); Figure 5 shows the relationship between overall GCI and the quality of scientific research institutions (section 12.02) ( $r = 0.834$ ,  $p < 0.01$ ); Figure 6 shows the relationship between overall GCI and university–industry collaboration in R&D (section 12.04) ( $r = 0.852$ ,  $p < 0.01$ ). A strong linear relationship was found for overall pairs of relationships with positive coefficient values.

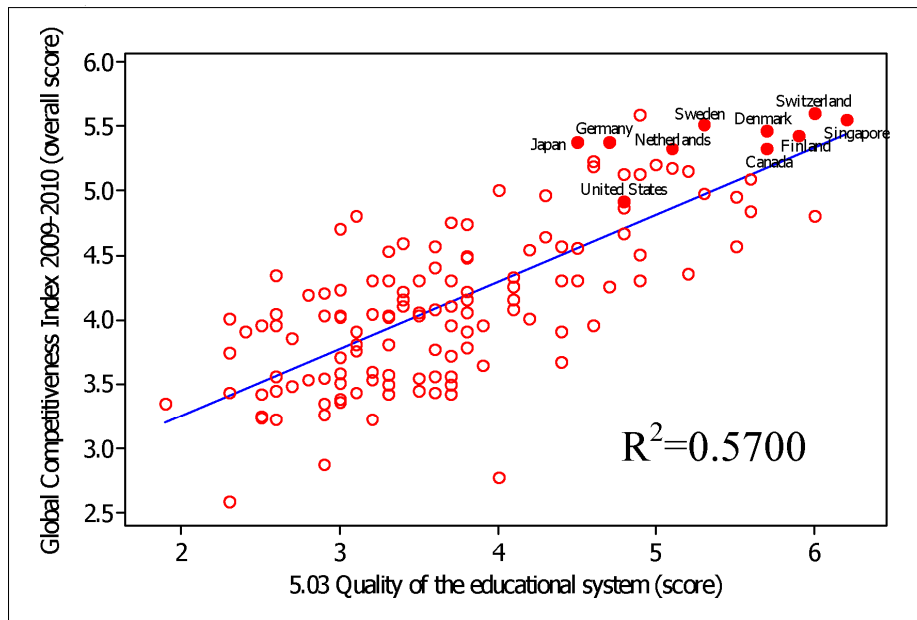
**Table 5** The advantages and disadvantages comparison of 5th pillar variables ranking with the overall GCI ranking

<i>Country</i>	<i>Section 5.03</i>			<i>Section 5.04</i>		
	<i>Rank</i>	<i>Score</i>	<i>Variable status</i>	<i>Rank</i>	<i>Score</i>	<i>Variable status</i>
Switzerland	2	6	Advantage	5	5.7	Advantage
USA	22	4.8	Disadvantage	48	4.5	Disadvantage
Singapore	1	6.2	Advantage	1	6.4	Advantage
Sweden	12	5.3	Disadvantage	36	4.8	Disadvantage
Denmark	6	5.7	Advantage	15	5.2	Disadvantage
Finland	4	5.9	Advantage	2	6.4	Advantage
Germany	27	4.7	Disadvantage	45	4.5	Disadvantage
Japan	31	4.5	Disadvantage	25	4.9	Disadvantage
Canada	5	5.7	Advantage	14	5.3	Advantage
The Netherlands	15	5.2	Disadvantage	16	5.2	Disadvantage

**Table 6** The advantages and disadvantages comparison of 12th pillar variables ranking with the overall GCI ranking

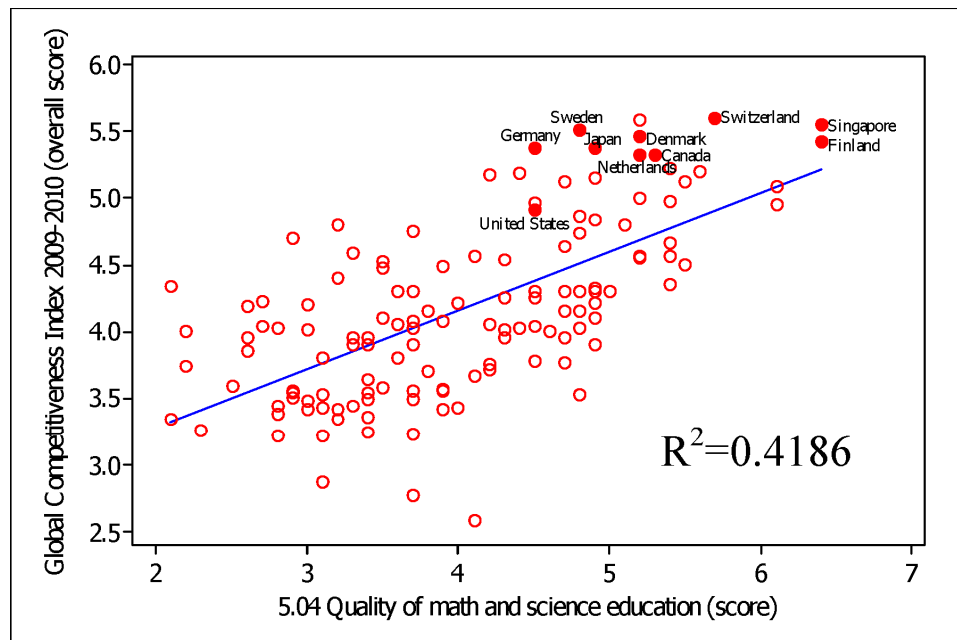
<i>Country</i>	<i>Section 12.02</i>			<i>Section 12.04</i>		
	<i>Rank</i>	<i>Score</i>	<i>Variable status</i>	<i>Rank</i>	<i>Score</i>	<i>Variable status</i>
Switzerland	1	6.2	Advantage	2	5.7	Advantage
USA	2	6.2	Advantage	1	5.9	Advantage
Singapore	12	5.6	Disadvantage	4	5.6	Advantage
Sweden	6	5.7	Advantage	5	5.6	Advantage
Denmark	9	5.7	Advantage	6	5.5	Advantage
Finland	13	5.6	Disadvantage	3	5.6	Advantage
Germany	5	5.8	Advantage	10	5.2	Advantage
Japan	15	5.3	Disadvantage	20	4.7	Disadvantage
Canada	11	5.7	Disadvantage	9	5.2	Advantage
The Netherlands	7	5.7	Advantage	11	5.2	Disadvantage

**Figure 2** The relationship between economic competitiveness and innovation (see online version for colours)



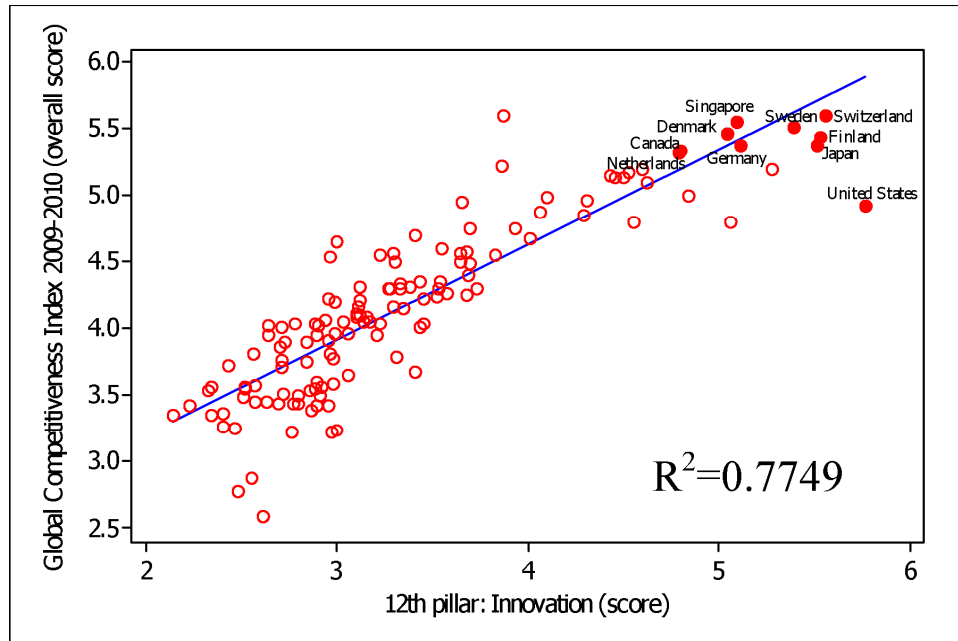
Note:  $r = 0.880, p < 0.01$ .

**Figure 3** The relationship between the quality of higher education and innovation (see online version for colours)



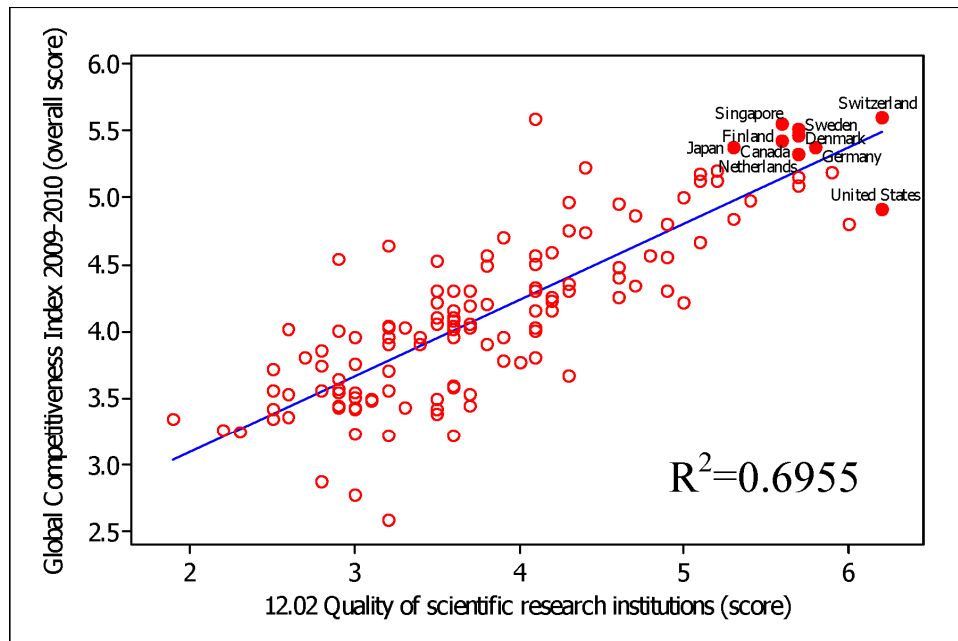
Note:  $r = 0.894, p < 0.01$ .

**Figure 4** The relationship between economic competitiveness and quality of the education system (see online version for colours)



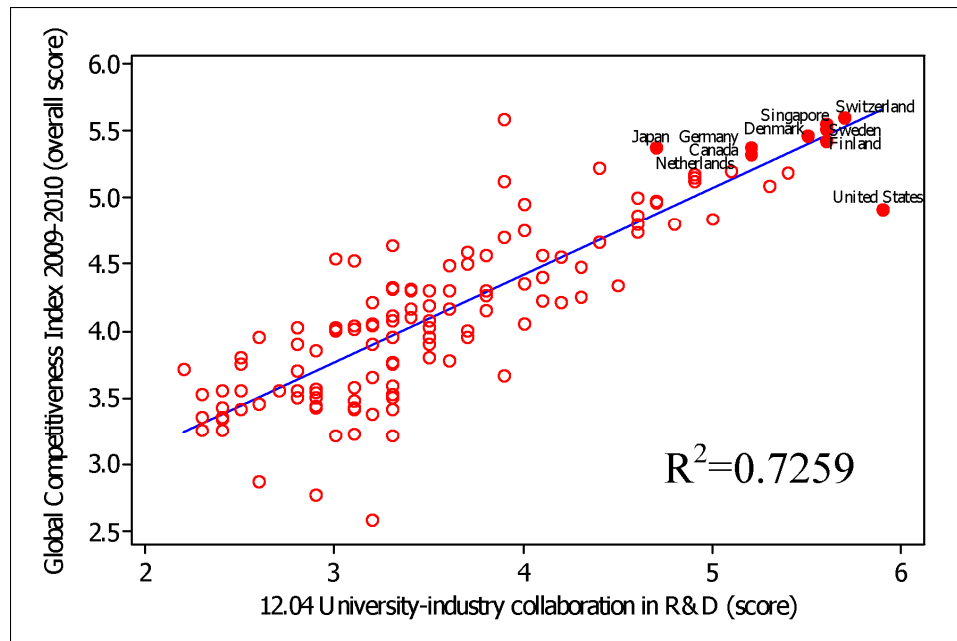
Note:  $r = 0.755, p < 0.01$ .

**Figure 5** The relationship between economic competitiveness and the quality of maths and science education (see online version for colours)



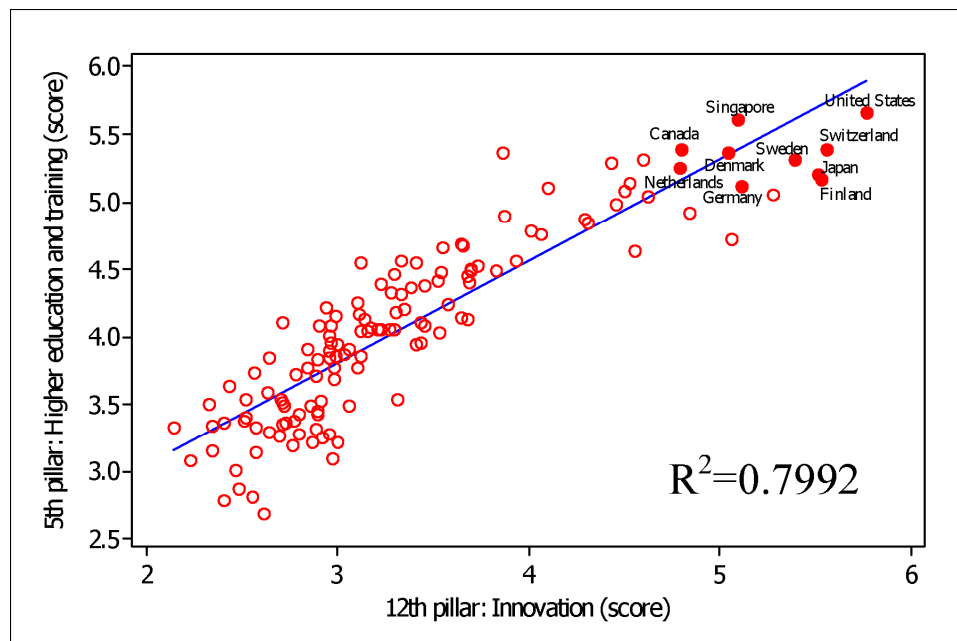
Note:  $r = 0.647, p < 0.01$ .

**Figure 6** The relationship between economic competitiveness and the quality of scientific research institutions (see online version for colours)



Note:  $r = 0.834, p < 0.01$ .

**Figure 7** The relationship between economic competitiveness and university–industry collaboration in R&D (see online version for colours)



Note:  $r = 0.852, p < 0.01$ .

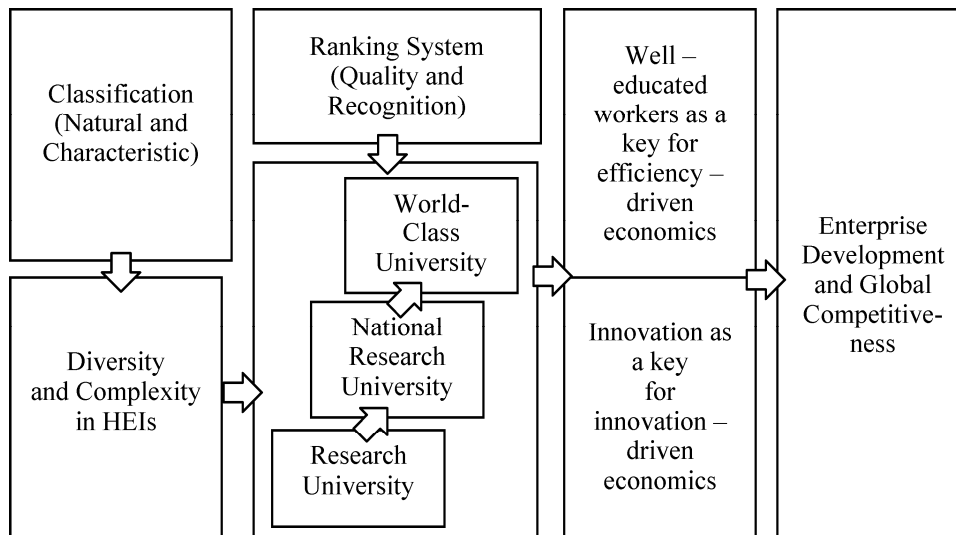
## 6 Discussion

In this paper, we demonstrated the significance of enhancing the HEIs into research universities and world-class universities because they serve as sources producing a large number of well-educated workers and the source of innovation, where both factors are necessary for the business sector to propel enterprise development in terms of global competitiveness as shown in Figure 8. This is consistent with Ramoniene and Lanskoronskis (2011), who identified the need for pools of well-educated workers who have the potential to adapt in harmony with the changing environment.

Of particular interest is the finding that quality higher educational institutions and higher education system are crucial factors to move up the value chain beyond simple production processes. This finding is very important because it products and serve as R&D sources that have positive impacts on competitiveness globally.

Finally, because of diversification and greater complexity in the higher educational system, classification and evaluation for research universities have become necessary as it enables higher education policy-makers to be effective in management, resource management and higher education development. For example, with a limited budget for many higher education systems, it is extremely important to determine how much research fund should be granted to a research university, how a research university should be administrated to produce the applicable researches leading to investment in advanced technology, create community income and promote export industries rather than to import to improve the national enterprise competitiveness.

**Figure 8** The role of the research university in enhancing global competitiveness



## 7 Conclusions and future studies

This study has taken an important step towards an integrated framework for the relationships between higher education quality, innovation and competitiveness. The relationships between higher education quality, innovation and competitiveness enhancement were tested and shown to be highly related. A way to increase competitiveness in terms of university quality in any country is to enhance a university to become a national research university and a world-class university. The research universities are producing well-educated workers and innovation which are both factors that are vital to boost a nation's competitiveness (Schwab, 2009). 'Classification' is an effective tool to identify which university is qualified and should be classified as a research university (Amano and Chen, 2004; Bartelse and van Vught, 2009; the Carnegie Classification (see footnote 2); Liu and Liu, 2005; Phusavat, 2008). Meanwhile, 'ranking' is a tool determining the quality of a research university whose research activities are emphasised (Salmi and Saroyan, 2007).

There are several possibilities for research extension. Firstly, future work should focus on developing a higher education classification model in Thailand based on common criteria or parameters reflecting research activities. More rigorous studies must be completed to substantiate antecedent and consequent relationships among all the variables.

Another interesting set of questions surrounds the classification methods with parameters. The criteria or parameters to be used in the higher education classification model should be supported by government policies to improve the quality of higher education and to promote enterprise development and global competitiveness. It underlines the theme of the current administration that sustaining enterprise development and the country's competitiveness depends on research and the quality of university education.

## References

- Aghion, P. and Howitt, P. (1992) 'A model of growth through creative destruction', *Econometrica*, Vol. 6, No. 2, pp.323–351.
- Aldersley, S.F. (1995) "'Upward drift" is alive and well: research/doctoral model still attractive to institutions', *Change*, Vol. 27, No. 5, pp.51–56.
- Amano, I. and Chen, W.Y. (2004) 'Classification of higher education institutions in Japan (in Chinese)', *Fudan Jiaoyu Luntan (Fudan Education Forum)*, Vol. 2, No. 5, pp.5–8.
- Bartelse, J. and van Vught, F. (2009) 'The European higher education classification: objective and concepts', in *Mapping the Higher Education Landscape: Towards a European Classification of Higher Education. Higher Education Dynamics*, Vol. 28, pp.57–69.
- Becker, G.S. (1993) *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Chicago: University of Chicago Press.
- Bils, M. and Klenow, P. (2000) 'Does schooling cause growth?', *American Economic Review*, Vol. 90, No. 5, pp.328–335.
- Birnbaum, R. (1983) *Maintaining Diversity in Higher Education*. San Francisco, CA: Jossey-Bass.
- Bogue, E.G. (1998) *Quality Assurance in Higher Education: The Evaluation of Systems and Design Ideals*. New Direction for Institutional Research. No.99, New York: John Wiley & Sons.

- Bowden, R. (2000) 'Fantasy higher education: university and college league tables', *Quality in Higher Education*, Vol. 6, No. 1, pp.41–60.
- Burbules, N.C. and Torres, C.A. (Eds.) (2000) *Globalization and Education: Critical Perspectives*. London: Routledge.
- Burke, G., Keating, J., Vickers, A., Fearnside, R. and Bateman, A. (2009) *Mapping Qualifications Frameworks across APEC Economies*. Centre for Postcompulsory Education and Lifelong Learning (CPELL), University of Melbourne and Victorian Registration and Qualifications Authority (VRQA).
- Cohen, D. and Soto, M. (2001) *Growth and Human Capital: Good Data, Good Results*. Technical Papers #179. Paris: OECD Development Centre.
- Cunningham, S. (2008) 'University and discipline cluster ranking systems and the humanities, arts and social sciences', *Higher Education in Europe*, Vol. 33, No. 2, pp.245–258.
- Deem, R. and Brehony, K.J. (2005) 'Management as ideology: the case of new managerialism in higher education', *Oxford Review of Education*, Vol. 31, No. 2, pp.213–231.
- Deem, R., Mok, K.H. and Lucas, L. (2008) 'Transforming higher education in whose image? Exploring the concept of the 'world-class' university in Europe and Asia', *Higher Education Policy*, Vol. 21, pp.83–97.
- Dill, D.D. and Soo, M. (2004) 'Is there a global definition of academic quality?: a cross-national analysis of university ranking systems', Paper presented at the *Public Policy for Academic Quality Research Program*.
- Distanont, A., Haapasalo, H., Rassameethes, B. and Lin, B. (2011) 'Developing new product through collaboration in high-tech enterprises', *Int. J. Management & Enterprise Development*, Vol. 10, No.1, pp.51–71.
- Evangelauf, J. (1994) 'A new "Carnegie Classification"', *The Chronicle of Higher Education*, 6 April, pp.A17–A25.
- Grossman, G. and Helpman, E. (1991) *Innovation and Growth in the World Economy*. Cambridge, MA: MIT Press.
- Hanushek, E. and Kimko, D. (2000) 'Schooling, labor-force, quality and the growth of nations', *American Economic Review*, Vol. 90, No. 5, pp.1184–1208.
- Hedin, S., Barnes, C. and Chen, J. (2005) 'AACSB 2003 accreditation standards: impact on continuous quality improvement', *Int. J. Services and Standards*, Vol. 1, No. 3, pp.358–378.
- Högskoleverket (2009) *Ranking of Universities and Higher Education Institutions for Students Information Purpose?* Stockholm: Swedish National Agency for higher Education.
- Horta, H. (2009) 'Global and national prominent universities: internationalization, competitiveness and the role of the state', *Higher Education*, Vol. 58, No. 3, pp.387–405.
- Huisman, J. (1995) *Differentiation, Diversity and Dependency in Higher Education*. Utrecht: Lemma.
- Kremer, M. (1993) 'The O-ring theory of economic development', *Quarterly Journal of Economics*, Vol. 108, No. 3, pp.551–575.
- Krueger, A. and Lindahl, M. (2000) *Education for Growth: Why and for Whom?* Working Paper #7591. Washington, DC: National Bureau of Economic Research.
- Lee, S., Lee, Z. and Lee, J. (2007) 'Knowledge transfer in work practice: adoption and use of integrated information systems', *Industrial Management and Data Systems*, Vol. 107, No. 4, pp.501–518.
- Liu, N.C. (2006) 'Academic Ranking of World Universities (ARWU)', Paper Presented at the *International Symposium on University Ranking*, Leiden, Netherlands, 16 February 2006.

- Liu, N.C. (2007) 'Research universities in China: differentiation, classification, and future world-class status', in *World Class Worldwide: Transforming Research Universities in Asia and Latin America*. The Johns Hopkins University Press, pp.54–69.
- Liu, N.C. and Cheng, Y. (2005) 'Academic Ranking of World Universities – methodologies and problems', *Higher Education in Europe*, Vol. 30, No. 2, p.14.
- Liu, S. and Liu, N.C. (2005) 'Classification of Chinese higher education institutions [in Chinese]', *Journal of Higher Education*, Vol. 26, No. 7, pp.40–44.
- Lucas, R.E. (1988) 'On the mechanics of economic development', *Journal of Monetary Economics*, Vol. 22, No. 1, pp.3–42.
- McCormick, A.C. (2007) *A New Set of Lenses for Looking at Colleges and Universities*. Available at: <http://www.carnegiefoundation.org/perspectives/new-set-lenses-looking-colleges-and-universities>, Accessed on 6 November 2010.
- McCormick, A.C. (2008) 'The complex interplay between classification and ranking of colleges and universities: Should the Berlin principles apply equally to classification?', *Higher Education in Europe*, Vol. 33, Nos. 2/3, pp.209–218.
- McCormick, A.C. and Zhao, C. (2005) 'Rethinking and reframing the Carnegie Classification', *Change*, Vol. 37, No. 5, pp.51–57.
- Memiyanty, H.A.R., Rozainun, H.A.A. and Lin, B. (2010) 'Perception on professional capabilities of accounting graduates', *Int. J. Management in Education*, Vol. 4, No. 1, pp.61–79.
- Mok, K.H. and Welch, A. (Eds.) (2003) *Globalization and Educational Restructuring in the Asia Pacific Region*. Basingstoke, Hampshire: Palgrave Macmillan.
- Motwani, J. and Kumar, A. (1997) 'The need for implementing total quality management in education', *Int. J. Education Management*, Vol. 11, No. 3, pp.131–135.
- Phusavat, K. (2008) 'University reforms: roles of classification in resource allocation and management', *Int. J. Management in Education*, Vol. 2, No. 3, pp.318–339.
- Ramoniene, L. and Lanskoronskis, M. (2011) 'Reflection of higher education aspects in the conception of national competitiveness', *Baltic Journal of Management*, Vol. 6, No. 1, pp.124–139.
- Romer, P. (1990) 'Endogenous technological change', *Journal of Political Economy*, Vol. 98, No. 5, pp.X71–S102.
- Salmi, J. and Saroyan, A. (2007) 'League tables as policy instruments: uses and misuses', *Higher Education Management and Policy*, Vol. 19, No. 2, pp.24–62.
- Schultz, T.W. (1961) 'Investment in human capital', *American Economic Review*, Vol. 1, No. 2, pp.1–17.
- Schwab, K. (2009) *The Competitiveness Report 2009–2010*. Geneva, Switzerland: World Economic Forum.
- Shin, J.C. (2009) 'Classifying higher education institutions in Korea: a performance-based approach', *Higher Education*, Vol. 57, No. 2, pp.247–266.
- Stella, A. and Woodhouse, D. (2006) *Ranking of Higher Education Institutions* (Vol. AUQA Occasional Publications Number 6). Melbourne: Australian Universities Quality Agency.
- Teichler, U. (2007a) 'The changing patterns of higher education systems in Europe and the future tasks of higher education research', in European Science Foundation (Ed.), *Higher Education Looking Forward: Relations Between Higher Education and Society*. Strasbourg: European Science Foundation, pp.79–103.
- Teichler, U. (2007b) *Higher Education Systems, Conceptual Frameworks, Comparative Perspectives, Empirical Findings*. Rotterdam: Sense.

- Usher, A. and Savino, M. (2006) *A World of Difference: A Global Survey of University League Tables*. Toronto, ON: Educational Policy Institute.
- Usher, A. and Savino, M. (2007) 'A global survey of university ranking and league tables', *Higher Education in Europe*, Vol. 32, No. 1, pp.5–15.
- Vaira, M. (2004) 'Globalization and higher education organization change: a framework for analysis', *Higher Education*, Vol. 48, No. 4, pp.483–510.
- van Dyke, N. (2005) 'Twenty years of university report cards', *Higher Education in Europe*, Vol. 30, No. 2, pp.103–125.
- van Vught, F.A. (2008) 'Mission diversity and reputation in higher education', *Higher Education Policy*, Vol. 21, No. 2, pp.151–174.
- Williams, R. and van Dyke, N. (2005) 'Measuring the international standing of universities with an application to Australian universities', *Higher Education*, Vol. 53, No. 6, pp.819–841.
- World Bank (2002) *Constructing Knowledge Societies: New Challenges for Tertiary Education*. Washington, DC: World Bank. Available at: <http://go/worldbank.org/N2QADMBNI0>, Accessed on 2 December 2008.

## Notes

- <sup>1</sup>[www.nru.mua.go.th/main/page\\_home.php](http://www.nru.mua.go.th/main/page_home.php), Accessed on 5 March 2011.
- <sup>2</sup>[www.carnegiefoundation.org/classification](http://www.carnegiefoundation.org/classification), Accessed on 3 March 2011.
- <sup>3</sup>[www.timeshighereducation.co.uk](http://www.timeshighereducation.co.uk), Accessed on 2 July 2010.
- <sup>4</sup>[www.arwu.org](http://www.arwu.org), Accessed on 3 July 2010.
- <sup>5</sup>[www.weforum.org/reports](http://www.weforum.org/reports), Accessed on 3 March 2011.