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Development of Research and Innovation Capacity Index of HEIs on Disaster Resilience Related Studies

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Abstract

Research capacity development is one of the most critical challenges facing HEIs in the Asian countries. Growing the number and quality of researchers is a strategic issue. For academia, developing research capacity can help enhance academic fulfilment as well as provide career advancement. The notion that excellent people are a resource to be treasured has led to increased attention being paid to how to attract, support and retain them, thereby building research capacity.

This paper is part of an Erasmus plus co-funded project called ASCENT, which focuses on building the research and innovation capacity (R&I) of Higher Education Institutions (HEI) on disaster resilience related studies. This paper particularly aims at reviewing the current context and gaps in the literature with regards to the indices used to assess the research capacity of the higher education institutions.

Qualitative systematic review approach was adopted at the initial stage, followed by three-round Focus Group Discussion with high-level academics from 14 countries in Asia and Europe. Twenty-one Key Performance Indicators (KPIs) of HEIs Research and Innovation Capacity were identified, which were grouped into three themes: Structure, System, and Policy; Skills and Training; and Staff.

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1. Introduction

Research is a powerhouse of knowledge creation. At a time when the world is transformed into what is widely dubbed as the knowledge society, the importance of knowledge creation has become ever more critical and ever more crucial, consequently placing universities at the centre of national development. Countries are striving to raise their global competitiveness through Research and Innovation (R&I) by revamping their higher education system.

Developing countries suffer from a lack of both financial and human resources in R&I [1, 2]. They need to improve their capacity to produce knowledge domestically and absorb the knowledge produced elsewhere. This can happen when human resources are trained in adequate numbers and an institutional framework to carry out R&I activities is created.

Among many communities in the EU and beyond, disasters pose significant concerns and challenges. With growing population and infrastructures, the world's exposure to hazards - of both natural and man-made origin - is increasing. According to UNDP [3], natural disaster events are scattered across the world and strike 75% of the world's area at least once in the last three decades. The geographical distribution of natural disasters has also been unequal, leaving some regions being more vulnerable to disaster than others. In the last three decades, EM-DAT [4] records of the natural disasters for the period of 30 years between 1984 and 2013 shows that Asia experiences the most disasters. The statistical data suggests that the three most destructive natural disasters - storms, earthquakes and flood, frequently occur in the developing countries. In addition to the loss of life, disasters greatly hamper the social- economic capacity of the affected communities.

A major contributory factor to disaster risk is capacity. This capacity needs to be deployed before the hazard visits a community in the form of pre-disaster planning. Effective mitigation and preparedness can greatly reduce the threat posed by hazards of all types. Likewise, capacity can also be deployed following a major disruptive event. The post-disaster response can impact the loss of life while timely reconstruction can minimise the broader economic and social damage that may otherwise result. Global funders and policymakers have increasingly considered as key priorities: the potential of networked models to enhance the impact and efficiency of investments in DR research capacity-building in Asia; the importance of ensuring stronger local ownership of initiatives; and, the importance of building sustainable research institutions. These key priorities are significantly important as strengthening the capacity of developing partner countries to do and use research is widely viewed as vital for meeting long-term innovation in creating disaster resilience societies. Consequently, identifying the R&I capacity development index is argued as one of the most critical exercises towards overcoming challenges facing HEIs in the partner countries, where growing the number and quality of researchers is considered to be a strategic issue.

The aim of the study is to develop a set of Key Performance Indicators for assessing the Research and Innovation (R&I) capacity of Higher Education Institutions (HEIs) in disaster resilience related subjects. The results of qualitative systematic literature review highlight the different dimensions and indicators of research and innovation capacity. It further discusses the use of FGD approach in the process of developing a set of key performance indicators (KPIs) as a tool to assess HEI's research and innovation capacity at the institutional, national and regional level.

2. Methodology

The development of the tools adopted a qualitative systematic literature review approach. At this stage, the exercise was focused on the identification of research and innovation capacity indices in the literature. Google Scholar was used as the source of publications, and "innovation capacity index" and "research capacity index" were used as the search keywords. The search results were limited to publication title only by adding "allintitle:" in the keywords and also limited to exclude patents and citation. Publications where full-text were not available or where full text was not in English were also excluded for further analysis.

At the next step, relevant publications was analysed for the objectives, context, and the R&I indices used in the study. Furthermore, using the content analysis technique, each of these publications were further examined to identify measures relevant to the R&I capacity framework. The measures included challenges and enablers of R&I capacity development with regards to policies, infrastructure facilities, and other contexts. Based on their similarities and relevance, the identified measures were linked to the R&I indices; further labelled as Key Performance Indicators

(KPIs). The measures and KPIs were compiled into a spreadsheet and are grouped into three groups of R&I capacity components: “Structure, System and Policy”, “Skills and Training”, and “Staff”.

The results of Key Performance Indicators identification from the literature discussed internally between authors. The aim was to remove indicators irrelevant to research capacity assessment. The draft version of the KPIs was later presented to participants of the three-round Focus Group Discussion (FGD) consisted of high-profile academics from 14 institutions from 7 countries across Europe and Asia. The FGD participants were members of the ASCENT project consortium, each of which has more than 10 years of experience as an academic in the higher education institutions. The participants were briefed about the objectives of the exercise and the KPIs tables were presented and discussed amongst participants, who were divided into three groups. The discussions took place in a round-table approach and each participant was given the opportunity to express their views. One facilitator was assigned to each group to provide clarification when required. The FGD participants were asked to identify irrelevant indicators and at the same time were asked to provide inputs and comments to the KPIs and measures on the list. Comments and inputs to list of the Key Performance Indicators were recorded from the FGD to reflect the context of the study. Finally, based on the collective inputs and comments from the FDG. The figure below shows the flow of the development process.

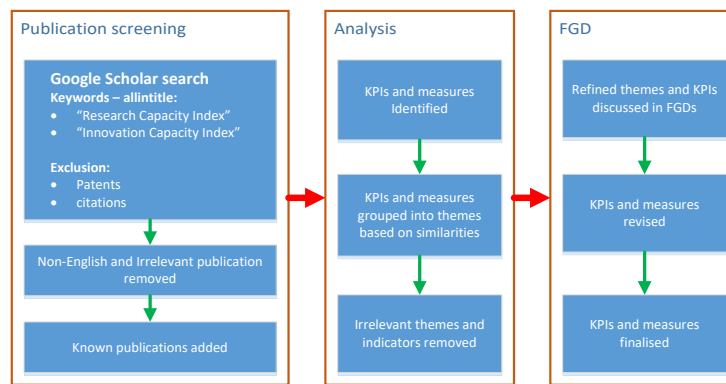


Figure 1 – KPIs and measures development process

3. Results

The keyword search in the Google Scholar results in 19 publications for the “innovation capacity index” keywords and 25 publications for the “research capacity index”. Consolidation of these results removed 10 publications duplicates, totalling 34 unique publications remained. This results in 34 publications considered for further screening (see Table 1).

Table 1 – Database Search Results.

Source	Keywords	No of Publications	Consolidated results
Google Scholar			
Filter:	Innovation capacity index	19	34
Exclude patents			
Exclude citations			
In title only (“Allintitle”)	Research capacity index	25	

The screening process of the publications revealed that most publications were either full-text not available in English nor the topics are relevant to this study. Consequently, a manual search of relevant publications in this area was performed to cover the gap. Four additional publications were accordingly included from personal bibliography

collection (Table 2). None of the results from “research capacity index” were usable (Table 3). Ultimately, 9 publications were included for further analysis.

Table 2 – Included publications

Search Keywords	Authors and Year	Themes	Study Scope
Innovation Capacity Index	Greenwood [5],	Innovative capacity index for effective open innovation	Global
	INSEAD [6],	Mapping innovation capacity	21 natural resources rich economies
	Lopez-Claros and Mata [7],	Factors, policies and institutions driving country innovation	Global
	Usman and Liu [8],	Framework to measure innovation capacity and efficiency	South Asian region
	Wonglimpiyarat [9]	Nations innovation capacity	Thailand
Personal Bibliographies	Block and Mills [1],	Assessing health policy and system research capacity	Global low and middle-income countries
	Cooke and Green [10]	Developing nursing and midwife research capacity	United Kingdom
	Jensen, Kralj [11],	Research capacity of higher education	Slovak
	University of Memphis [12]	Research capacity assessment	University of Memphis

Table 3 – Excluded publication for further analysis

Search Keywords	Authors and Year	Remarks
Innovation Capacity Index	De-bin [13], FAN and HE [14], Feng-wei [15], LAN and XIE [16], LIU and ZHANG [17], López-Claros [18], HE and Qin [19], Yan [20], ZHANG and PEI [21], ZHANG and ZHOU [22], ZHENG, ZHUANG [23], Wei and Zhijun [24], Tie-fan, Rong-fu [25]	Journal is in Chinese language
Research Capacity Index	Chen, Gong [26], Gezhi, Hang [27] Guan [28], Hong-wei and Yan [29], LU, HOU [30], Min [31], Ming [32]	Journal is in Chinese language
	Chunxia [33], Nan, Lixin [34],	Irrelevant article
	Nurhayati, Diatin [35]	Journal is in Indonesian Language

4. Discussion

The results of the desktop exercise show that there is a gap in the literature with regards to the framework for the assessment and identification of research capacity in the disaster resilience related subject. Search results suggest that publications on the innovation capacity index are dominated by articles on innovation issues with regards to technological advancement related to manufacturing and construction. Additionally, the majority of the publications are available in the Chinese language, limiting the benefit of the publications for the international academic community. Furthermore, as shown in Table 3, no publications with relevant indices are specific to the research capacity assessment. Whilst this study is limited to google scholar database result, it indicates the limited publications available in this area. Nevertheless, the manual selection of four known publications to the analysis helps identify indicators specific for the research capacity.

In its research capacity assessment report, the University of Memphis [12] adopted Birdsell’s model to assess the organizational capacity for research and identifies 24 assessment dimensions. The adopted model (Figure 2) recognizes that capacity is affected by the ability and motivation to perform. Nevertheless, it argues that the ability and motivation

need to have a culture which supports them. With regards to culture, Cooke and Green [10] indicate that an established culture of research in the relevant discipline and in the institution positively affect the research performance of an institution. On the contrary, lack of leadership, strategy or direction, and lack of ‘research mindednesses were also identified as the inhibiting culture to research capacity.

Quoting Bazeley [36] who suggests that motivation is a more critical element in staff development than the research skills, supported by personal characteristics including persistence, initiative, and concern for advancement [37], Cooke and Green [10] conclude that motivation to undertake research is a critical supporting element to developing research capacity. Complementing this view, Jensen, Kralj [11] highlight the challenges in low investment in the research and innovation that higher education institutions are facing can be overcome by increasing the level of funding for research, foster institutional alliances and networking, incentivise private investments in public research, provide adequate competitive infrastructure for research. They further stressed the importance to renewing the research infrastructure, networking and framework conditions in order to build the international competitiveness. Supporting the above argument on ICT, Lopez-Claros and Mata [7] also argue that access to and the quality of ICT infrastructure as one of the keys to improving the capacity of R&I. they describe the usage of ICT as indicators and supports towards innovation capacity which includes the quality of the infrastructure, government ICT usage, telephone and mobile cellular communication, and the use of internet, computers and TV.

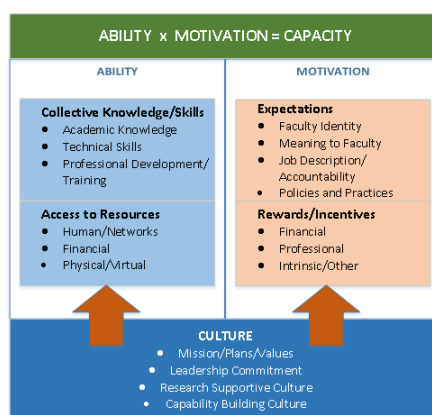


Figure 2 – Adaptation of the Birdsell, et al Box Model (University of Memphis, 2013)

With regards to the proposed Key Performance Indicators of R&I capacity, the Focus Group Discussion exercise emphasize the need to clearly define the terminologies used in the framework. For instance, as the indicators are meant for assessment of R&I capacity at the institutional, national, and regional level, there is a need to define the meaning of “region”, as the word region may be understood differently from different geographical context. Furthermore, even at the institutional level, there need to be stipulated whether they are meant for the faculty level, department, or university level. Similarly, the meaning of “infrastructure” needs to be defined as it is too broad a context which may be interpreted differently thus result in bias and error. To avoid further ambiguity, it was also suggested by the FGD participants that unless a particular measure is aimed for students in general, there needs to be a clear definition of students; i.e. whether it is undergraduate, postgraduate, or research students. Similar comments were given with regards to the need to make a clear definition of Higher Education Institutions (HEIs), particularly if it used to make a comparison between several institutions.

Furthermore, the FGD participants also suggested that, wherever possible, the responses to the identified measures of the KPIs are quantified as a binary or Likert scale in order to help improve the comparability of results between institutions and countries where the assessment will be performed. Some indicators, such as national literacy rate, GDP, etc., that can be assessed internally do not need to be addressed to external respondents. It was also suggested that the use of “%” as responses need to be avoided wherever possible in order to avoid subjective bias. This is in particular for responses where the percentage can be extracted in other ways, such as a number of teaching hours.

The final sets of KPIs are presented as a list related to three themes: “structure, system and policy”, “skills and training”, and “staff”. The KPIs consists of measures which can be grouped into Access to infrastructure, access to international research community, institutional incentives, publication quality, and quantity, R&I enabling environment, research capacity and intensity, research career development and staff renewal, research funding and grant, research partnership with external stakeholders, research infrastructure, research training and doctoral education, staff quality, and university innovation activities. Table 4 below shows the summary of the developed KPIs.

Table 4 – Summary of KPIs to Research and Innovation capacity

Themes	1. Structure, System, and Policy	2. Skills and Training	3. Staff
KPIs	1. Access to infrastructure 2. Access to international research community 3. Institutional incentives 4. R&I enabling environment 5. Research capacity and intensity 6. Research funding and grant 7. Research in Partnership with External Stakeholders 8. Research infrastructure 9. University Innovation Activities	10. Access to infrastructure 11. Access to international research community 12. Publication quality and intensity 13. Research capacity and intensity 14. Research funding and grant 15. Research in Partnership with External Stakeholders 16. Research training and Doctoral Education 17. University Innovation Activities	17. University Innovation Activities 18. Research capacity and intensity 19. Research career development and staff renewal 20. Research in Partnership with External Stakeholders 21. Staff quality

5. Conclusion

The desktop exercise on research and innovation (R&I) capacity suggest that there is a gap with regards to assessment tools for research and innovation capacity on the disaster resilience related subject. Publications on innovation capacity are dominated by articles in the Chinese language with regards to technological advancement related to manufacturing and construction. Also, no specific articles identified suggesting measures to assess research and innovation capacity for higher education institutions, particularly in the disaster resilience related subject.

This study accordingly fills the gap by proposing a set of Key Performance Indicators and measures to assess the R&I capacity of HEI in different geographical context at the institutional, national, and regional level. The proposed KPIs include measures that fall under three main themes: system, structure and policy; skills and training, and staff. The relevance of each measure to the institutional, national, and regional level. It is expected that the proposed tool will help HEIs’ in assessing their R&I capacity and identify their weaknesses and strength in order to improve their R&I competitiveness at the international level.

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7. References

1. Block, M.A.G. and A. Mills, *Assessing capacity for health policy and systems research in low and middle income countries**. Health Research Policy and Systems, 2003. 1(1): p. 1.
2. Gomo, E.M.P., et al., *Towards Sustainable Research Capacity Development and Research Ownership for Academic Institutes in Developing Countries: The Malawian Research Support Centre Model*. Journal of Research Administration, 2011. 42(1): p. 38-45,5-7.
3. UNDP, *A Global Report: Reducing Disaster Risk - A Challenge for Development*. 2004, UNDP.
4. EM-DAT, *Disaster Profile 1994-2013*, EM-DAT: The OFDA/ CRED International Disaster Database, Editor. 2013: Université catholique de Louvain – Brussels, Belgium.
5. Greenwood, D.G., *Collaborate to Innovate: Innovative Capacity Index for Effective Open Innovation*. 2010, University of Maryland University College: Ann Arbor. p. 75.
6. INSEAD, *Innovation Efficacy Index: Mapping Innovation Capacity in 21 Natural Resource Rich Economies*.
7. Lopez-Claros, A. and Y.N. Mata, *The Innovation Capacity Index: Factors, Policies, and Institutions Driving Country Innovation*, in *The Innovation for Development Report 2009–2010*. 2010, Springer. p. 3-65.
8. Usman, K. and Z. Liu, *Innovation Index Framework to Measure the Innovation Capacity and Efficiency of SAARC Countries*. European Journal of Social Sciences, 2015. 46(3): p. 325-338.
9. Wonglimpiyarat, J., *Innovation index and the innovative capacity of nations*. Futures, 2010. 42(3): p. 247-253.
10. Cooke, A. and B. Green, *Developing the research capacity of departments of nursing and midwifery based in higher education: A review of the literature*. Journal of Advanced Nursing, 2000. 32(1): p. 57-65.
11. Jensen, H.T., et al., *The Slovak Higher Education System and its Research Capacity*, in *EUA SECTORAL REPORT*. 2008, European University Association.
12. University of Memphis, *Research Capacity Assessment Taskforce Report*. 2013.
13. De-bin, Z., *The Index System of Shanghai S&T Innovation Capacity and Its Analysis & Evaluation*. Science & Technology and Economy, 2010. 5: p. 006.
14. FAN, X.-r. and B. HE, *Research on Technology Innovation Capacity Index of Chongqing, Sichuan and Shaanxi*. Journal of Northwest A&F University (Social Science Edition), 2008. 6: p. 008.
15. Feng-wei, X., *Research on Evaluation Index System of Technological Innovation Capacity of Equipment Manufacturing Industry Based on Collaboration*. Scientific Management Research, 2011. 5: p. 007.
16. LAN, X.-l. and N.-b. XIE, *Research on University Science & Technology Innovation Capacity Evaluation Index System Based on AHP/DEA*. Journal of Jiangxi Normal University (Philosophy and Social Sciences Edition), 2010. 1: p. 023.
17. LIU, Y. and M. ZHANG, *Construction of Evaluation Index System for the Independent Innovation Capacity of High-tech Industry in Western China [J]*. Science and Technology Management Research, 2010. 14: p. 023.
18. López-Claros, A., *Reading the Innovation Capacity Index 2009–2010 Country Profiles*, in *The Innovation for Development Report 2009–2010*. 2010, Springer. p. 241-377.
19. HE, Y.-q. and P. Qin, *A New Perspective to the Evaluation of Regional Innovation Capacity—Research on the Maturity of the Evaluation Index System for Regional Innovation Networks [J]*. Journal of Harbin Institute of Technology (Social Sciences Edition), 2005. 6: p. 20-21.
20. Yan, Z., *Research on Evaluation Index System of Innovative City and Innovation Capacity Structure of China's Key Cities*. Management Review, 2012. 6: p. 008.

21. ZHANG, G. and X. PEI, *Research on the Design of Evaluation Index System about the Independent Innovation Capacity of Equipment Manufacturing Enterprises in Shaanxi Province*. Journal of Xi'an Shiyou University (Social Science Edition), 2012. 4: p. 006.
22. ZHANG, M. and Z. ZHOU, *An Index System for Evaluating the Independent Innovation Capacity of High-tech Industry in China*. Science and Technology Management Research, 2010. 16: p. 014.
23. ZHENG, W., W. ZHUANG, and Z. JIAO, *Research on Evaluation Index System of University Science & Technology Innovation Capacity Based on Grey Relation*. Science and Technology Management Research, 2012. 2: p. 014.
24. Wei, C. and F. Zhijun, *Comparative Study on Measurement of Technology Innovation Capacity and Efficiency Based on Index Consistency*. Science & Technology Progress and Policy, 2010. 16: p. 031.
25. Tie-fan, L., L. Rong-fu, and Z. Yong, *A Study of Evaluation Principle, Index and Model Construction of High-Tech Innovation Capacity of Universities Anhui Province as the center*. Journal of Tongling University, 2013. 5: p. 028.
26. Chen, D.-C., et al., *The Research on Correlative Index between O_2 max and Partly Aerobic Capacity of Our Elite Female Basketball Players*. China Sport Science and Technology, 2002. 12: p. 008.
27. Gezhi, C., F. Hang, and L. Yang, *A Research on the Index System for Growth Capacity Evaluation of the Credit Guarantee Corporation*. Value Engineering, 2010. 14: p. 078.
28. Guan, G., *Research on Index System Construction and Evolution Mechanism of Enterprise Enformation Capacity*. Information Science, 2012. 9: p. 009.
29. Hong-wei, Q. and Y.X.-j.T. Yan, *Research on City Emergency Shelter Operation Capacity Evaluation Index System—Taking a Certain City Emergency Shelter during Wenchuan Earthquake for Example*. China Safety Science Journal, 2013. 6: p. 030.
30. LU, R., X.-g. HOU, and S.-h. ZHANG, *Establishment of the evaluation index system of coal-fired power plants out-dated capacity and case research*. Energy Conservation, 2011. 10: p. 011.
31. Min, O., *The Study on the Evaluation Index System of Higher Vocational Colleges' Research Capacity in the Niche Perspective*. Career Horizon, 2012. 11: p. 019.
32. Ming, Z., *Research on the Evaluation Index System of Initial Sustainable Development Capacity of Chinese Public Libraries*. Sci-Tech Information Development & Economy, 2010. 18: p. 013.
33. Chunxia, Y., *Research on Entrepreneurial Capacity Evaluation Index System of the Self-employed: Based on 603 Samples Analysis*. 2011.
34. Nan, S., M. Lixin, and F. Qiang. *Research progress on an index system of city water environmental carrying capacity*. in *Responsive Manufacturing-Green Manufacturing (ICRM 2010), 5th International Conference on*. 2010. IET.
35. Nurhayati, P., I. Diatin, and T. Suryanto, *Analisis Tingkat Kepuasan Peserta Lelang Dan Perceived Quality Tempat Pelelangan Ikan (TPI) di Pangkalan Pendaratan Ikan (PPI) Muara Angke, Jakarta*. Buletin Ekonomi Perikanan, 2007. 7(1).
36. Bazeley, P., *From vocational college to new university: The research profile and development needs of academic staff in a period of transition*. Higher education research and development, 1994. 13(2): p. 121-132.
37. Babu, A.R. and Y. Singh, *Determinants of research productivity*. Scientometrics, 1998. 43(3): p. 309-329.