# From Capacity to Presence:
# Enhancing the Usability of University Research in the Internet Age[1]

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Abstract

Creation of new knowledge by universities is typically assessed in terms of publications and citations in scholarly venues, and the same measures are used to assess capacity for future contributions. As the production and dissemination of knowledge becomes increasingly mediated by the Internet, the Internet presence of researchers is becoming a more valid and relevant measure of knowledge capacity than the conventionally used publication and citation data. This article proposes a methodology that includes the use of the scholar.google.com search engine to supplement the conventional indices for knowledge capacity in a policy-relevant field of knowledge. The methodology addresses presence as well as validation. The proposed approach is explicated through a study of Information and Communication Technology infrastructure reform relevant knowledge capacity in East, South East and South Asia. University research is viewed within the context of the larger body of knowledge available to users over the Internet and a greater usability of university research through a higher Internet presence is stressed.

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## From Capacity to Presence:

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### 1. Introduction

The importance of knowledge as a driver of development is unquestioned. Universities, research institutes and other knowledge organizations in developing countries are often called upon to play a role in development without a prior evaluation or understanding of the knowledge capabilities of these institutions. In this article we present a methodology to assess the capacity of knowledge producers at the individual, organizational, national or regional levels. This methodology takes into account the emergent centrality of the Internet as a medium to access, assess and retrieve information and know-how. The methodology may be used to improve and apply more effectively the methods currently used to assess knowledge capacity. Existing knowledge indices (Knowledge Assessment Methodology, World Bank, 2005; Rand S&T Indicator, Wagner et al. 2004; or ARCO Technology Index, Archibugi & Cocco, 2004) are too broad to be of utility to policy makers at a national or institutional level. The proposed method provides a sharper focus. As with all assessments of knowledge, this method is best used as a first screen and must be complemented by other means.

The capacity of countries to acquire and use knowledge for development is typically expressed in terms of the size and quality of the relevant knowledge base. Knowledge outputs are measured by the per capita number of R&D institutions, researchers, patents, journal articles and international co-authorships (Wagner, et al., 2004 and references therein). The three citation indices, the Science Citation

Index (SCI), the Social Science Citation Index (SSCI) and the Arts and Humanities Citation Index (A&HCI), compiled by isinet.com have become authoritative sources for assessing the extent and the quality of publications at all levels of analysis (Hicks,2004; Wagner et al., 2004).

The present work is the result of a knowledge networking initiative by LIRNE*asia*,[4] a regional research organization seeking to "improve the lives of the people of Asia by facilitating their use of information and communication technologies; by catalyzing the reform of the laws, policies and regulations to enable those uses; and by building Asia-based human capacity through research, training, consulting and advocacy." The objective was the compilation of a directory of Asia-based expertise in Information and Communication Technology (ICT) reform.

Our work with SSCI publications for the period 2000-2005 yielded only 119 names for 10 out of the 24 countries in South, South East and East Asia that were included in the study.[5] Scholar.google.com, a beta version of a new search engine launched by Google, increased the number of names to 377 and increased the country coverage to 17.[6] Our experience in this real-life setting showed us that a targeted Internet search engine can uncover more scholars from developing countries than the SSCI.

[4] www.lirneasia.net
[5] The focus of this study is South, East and South East Asia. The region includes China, Taiwan, Japan, North Korea, and South Korea (East Asia); Afghanistan, India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, and the Maldives (South Asia); and Brunei, Cambodia, East Timor, Hong Kong, Indonesia, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam (South East Asia).
[6] CiteSeer is a scientific literature digital library and search engine that focuses primarily on the literature in computer and information science. To our knowledge there is no archive for literature on policy aspects of Information and Communication Technology (ICT).

In a discussion of the concept of net presence in e-commerce, Rogers (2002) identifies two types of net economies and draws a parallel with the ‘economies’ of producing academic/scholarly works.

> [A]n organization’s Net presence derives from far more than site design and service delivery, and the maintenance of one’s frame around the rest of the Web. One way to think through new notions of Net presence is to understand two types of Internet economies, the ‘hit economy’ and the ‘link economy’.
>
> Whether by portal or search engine placement, preferred sites are granted a larger audience (more hits). The organizational strategy thus revolves around establishing robust portal and search engine presence. In all, the combination of crawler-digestible coding, key word information design and favoured placement is an organization’s modus operandus in the hit economy. Robust net presence is subsequently demonstrated on hit tables, which drives Web advertising, the seminal form of e-commerce.
>
> On the Web ‘granting a link’ (as a reference in science) and ‘receiving a link’ (as a citation in science) are akin to positioning oneself and being positioned by another, respectively. Cognisance of such positionings may lead to consideration of presence strategy. (Rogers, 2002)

Internet presence by itself does not give validity to a document or a researcher. In academia, research outputs are validated through peer review. What constitutes quality in academia has been subject to much debate (Boyer, 1990; Diamond & Adam, 2004 references therein). There now seems to be some consensus on the issue with the set of attributes identified by Diamond and Adam (2004) appearing in most faculty evaluation criteria in universities across USA and perhaps also in other countries.

Diamond and Adam (2004: p. 37) identified eight criteria for assessing the quality and relevance of a work of scholarship. Those dealing with the characteristics of scholarly work are:

(a) Requires a high level of discipline-related expertise
(b) The work and its results are appropriately documented and disseminated.
(c) Has significance beyond the individual context
(d) Breaks new ground or is innovative
(e) Is reviewed and judged to be meritorious and significant by a panel of peers

In this article, we propose that a citation by one or more other scholars would fulfill above criteria and 'validate' the presence of a researcher on scholar.google or a similar scholarly search engine. Although the citation-requirement is less rigorous than in Diamond and Adam, there is merit in casting a wide net at the outset to identify as many scholars as possible from developing countries. It is also noteworthy that while publications included in the SSCI undergo peer review, not all receive citations.

In order to make the assessment more comprehensive, we introduce a second criterion that we call 'connectivity'. Connectivity is not a new concept. In social network theory, (e.g., Monge and Contractor, 2004 and Adamic and Adar, 2001) connectivity is defined as the extent to which actors in a network are linked to one another by direct or indirect ties. In the present work we begin with the same definition but modify it with the attributes from Rogers' 'link economy' to propose that connectivity of an actor (researcher) can be described by the number and the nature of the links given (references) and links received (citations), direct or indirect.

In summary, we define an effective scholar/researcher[7] as an individual whose performance meets the following criteria:

- **Presence**: number of 'validated hits' on a search engine for scholarly works. Criterion is met by at least one validated hit.
- **Connectivity**:
    - Number and nature of links given
    - Number and nature of links received.

  Criterion would be defined by context.

These attributes, we believe, are more relevant to the emerging modes of production, dissemination and use of knowledge that are increasingly mediated by the Internet. We use the term researcher to identify any type of knowledge producer

[7] A differentiation of the terms scholar and researcher can be found in a document prepared by Higher Education Funding Commission of England (Relationship between teaching, research and other outputs of HEIs: final report, 1999. http://www.hefce.ac.uk/research/review/, accessed October 2005), In the HEFCE differentiation a scholar is one who has more breadth of knowledge than a researcher. In this article we do not differentiate between the two.

in a university, in a research institute, in a non-governmental organization or as an expert in a consulting firm.

In this article, we present data that demonstrate the feasibility of using Internet presence and connectivity to identify and assess capacity/expertise. The discussion of connectivity is preliminary in form.

Since the data were collected in the context of ICT infrastructure reform, we begin with a short introduction to the topic in Section 2, followed by a discussion on current measures of knowledge capacity in Section 3. Presence and connectivity attributes are discussed in Sections 4 and 5, respectively. In Section 6, we focus on the role of universities in the Asian knowledge base in ICT infrastructure reform using India and Korea as examples.

## 2. ICT Infrastructure Reforms in Asia

Infrastructure reforms are vital to economic development. Information-communication, energy and transportation are three of the key infrastructures. Building infrastructure or providing infrastructure services does not mean that the builders have to be inventors too. For example, it is common nowadays for mobile network operators to completely outsource the design and even the operation of their network infrastructure to equipment manufacturers or others. ‘Buy’ is often the most viable option in the ‘build or buy’ choice for inputs faced by infrastructure operators in developing countries. In the ‘buy’ scenario, the requisite technical know-how is the expertise to adapt existing technology to local use. Graduates of engineering programs in local universities or technical colleges constitute the necessary expertise (Gamage & Samarajiva, 2003).

The know-how required to implement the necessary institutional reforms is more specialized and cannot be purchased along with the equipment. This know-how includes knowledge of economics, law and public administration along with an understanding of information and communication technologies and the ability to formulate and implement policies that enable the least cost and most beneficial options in infrastructure development. Donor agencies such as World Bank may provide technical assistance for specific institutional reforms but even this must be complemented by local counterpart capacity.

There are several organizations in Asia devoted to aspects of research intended to contribute to ICT infrastructure reforms, generally focusing on particular countries/sub-regions or looking at ICT reforms as part of infrastructure reforms in general. What is lacking is a more coordinated effort to develop and nurture capacity in ICT infrastructure development across developing Asia. With this work we hope to identify some tools for assessing and using the capacity in Asia or elsewhere to contribute to ICT infrastructure development.

## 3. Measures of Knowledge Capacity

The Knowledge Index developed by the World Bank consists of 14 measures organized along five dimensions-- Performance Indicators, Economic Incentive and Institutional Regime, Education and Human Resources, Innovation System, and Information Infrastructure (World Bank, 2005). The ARCO Technology Index attempts to capture the capacity of countries to access and use technology for development. It presents eight measures along three dimensions--infrastructure, human resources, and technology products (Archibugi & Cocco, 2004), and is modeled on the United Nations Development Program's Technology Achievement Index (UNDP, 2001). The Rand Science and Technology Capacity Index captures knowledge at both basic and applied levels (Wagner et al., 2004). The Rand Index uses the three other dimensions—enabling conditions, resources and products-- to classify the eight measures.

Redistribution of various measures in an input-process-output framework could provide a better frame for comparison (Prakash, 2005). Upon redistribution of the measures on R&D institutions, researchers and expenditures as inputs; infrastructure, enabling conditions and some of the human resources measures as process determinants; and patents, journal articles and co-authorships as outputs (Table 1), it becomes apparent that all three indices essentially measure science and technology capacity, with some being more comprehensive than others. For example, although the three indices are labeled as Knowledge Index, Technology Index and Science and Technology Index, respectively, all three use patents and scientific and technical publications as output measures. The Rand Index is more comprehensive than the World Bank Index or the ARCO Index in terms of inputs and outputs while the World Bank Index is the most comprehensive in terms of process determinants.

**Table1. Measures of Knowledge Capacity**

| | **Knowledge Index (World Bank, 2005)** | **Technology Capacity Index (Arco, 2004)** | **Science & Technology Capacity Index (Rand, 2004)** |
|---|---|---|---|
| Inputs | • Researchers in R&D | - | • R&D expenditure<br>• R&D institutions<br>• Scientists and engineers |
| Process Determinants | • Annual GDP growth<br>• The human development index<br>• Degree of competition<br>• Regulatory quality<br>• Rule of Law<br>• Adult literacy rate<br>• Secondary enrolment rates<br>• Tertiary enrolment rates<br>• Telephones per 1,000 population<br>• Computers per 1,000 population<br>• Internet users per 10,000 population | • Internet penetration<br>• Telephone penetration<br>• Electricity consumption<br>• Mean years of schooling<br>• Literacy rate<br>• Tertiary science & engineering enrolment | • Per capita GDP<br>• Tertiary science and engineering enrolment |
| Outputs | • Patents<br>• Scientific and technical journal articles | • Patents<br>• Scientific articles | • Patents<br>• Scientific and technical journal articles<br>• International co-authorships |

In the present study, we focus on refining measures of knowledge outputs. Based on our experience in identifying and assessing a knowledge base in telecom infrastructure reforms we propose that the individual researcher is the appropriate unit of analysis and that measures for individual researchers should be aggregated to the institutional, regional or national levels as necessary. In contrast, the three indices discussed above use a country as the unit of analysis.

### 4. Presence

In the world of e-commerce and Internet search engines 'presence' is equated with the number of 'hits' on a search engine (Rogers, 2002). Internet search engines can be used by anyone with Internet access, even the most basic dial-up version. In contrast, proprietary databases such as SSCI are not easily available in most countries in Asia. The Citation Index Database is now owned by Thomson Scientific.[8] It indexes close to 14,000 international journals to provide a proprietary but authoritative basis for assessing knowledge products and producers worldwide. This database and the patent database of the US Patent and Trademark Office (USPTO) are commonly used to gauge the extent and the quality of the knowledge base at the individual, organizational, national or regional levels.

We searched the 2000-2005 Social Science Citation Database for any records containing the keyword 'telecom' or variants in the title or the abstract, and any of the 22 country names in the address field (e.g. telecom* and India). The database was accessed through the Web of Science in August 2005. We manually filtered out entries that are not directly relevant to ICT infrastructure reforms to get 79 'Asian' records (or records with at least one Asian author) and 119 'Asian' authors, where 'Asian' meant an author located in Asia. We used the address of the author as given in the address field of a publication. If two different publications gave two different locations we did additional searches to determine the current location of an author. The search yielded names of scholars from 10 countries (Bangladesh, Bhutan, China, India, Japan, Hong Kong, Pakistan, Singapore, South Korea and Taiwan) but 14 other countries (Afghanistan, Brunei Darussalam, Cambodia, East Timor, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Thailand and Vietnam) disappeared from the 'map of knowledge' according to SSCI.

Next, we used the term 'telecom' and its variants and each country name to retrieve scholarly documents relevant to telecom infrastructure reform from www.scholar.google.com.[9] We retrieved only the first 200 'hits' for each country and manually filtered the records to get a total of 719 records of which 226 had at least one 'Asia'-based author for a total of 348 authors. In terms of countries, scholar.google enabled us to restore six countries-- Nepal, Sri Lanka, Indonesia, Malaysia, the Philippines and Thailand--to the map.

All countries increased their presence with scholar.google. India increased its presence significantly from 5 to 92 records. South Korea increased its Internet presence only marginally compared to other countries (Figure 1).

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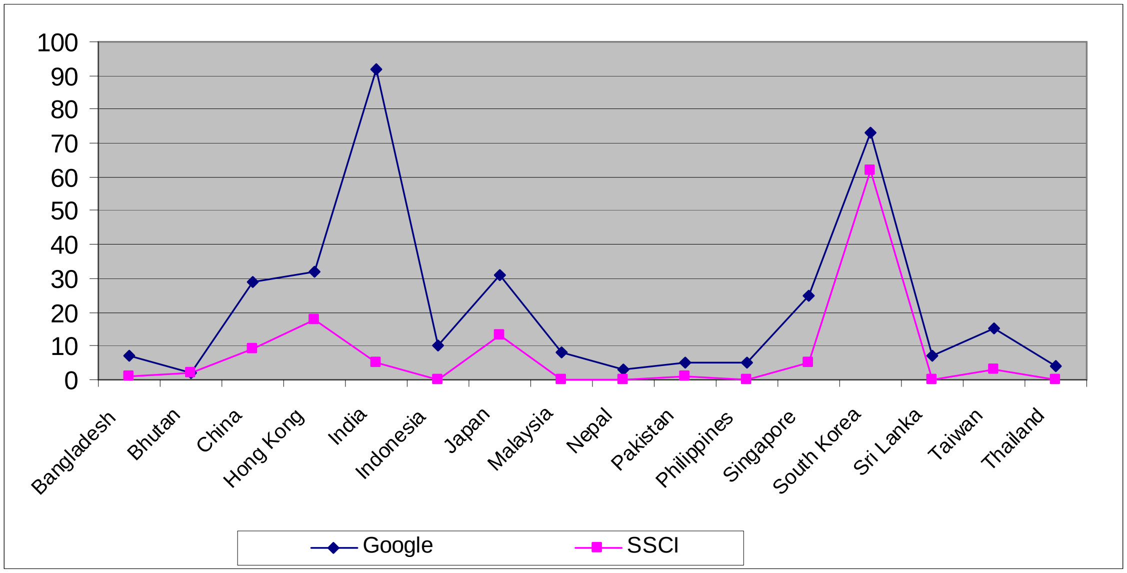
[8] A product developed by Eugene Garfield in 1994 and marketed originally through the Institute of Scientific Information.
[9]

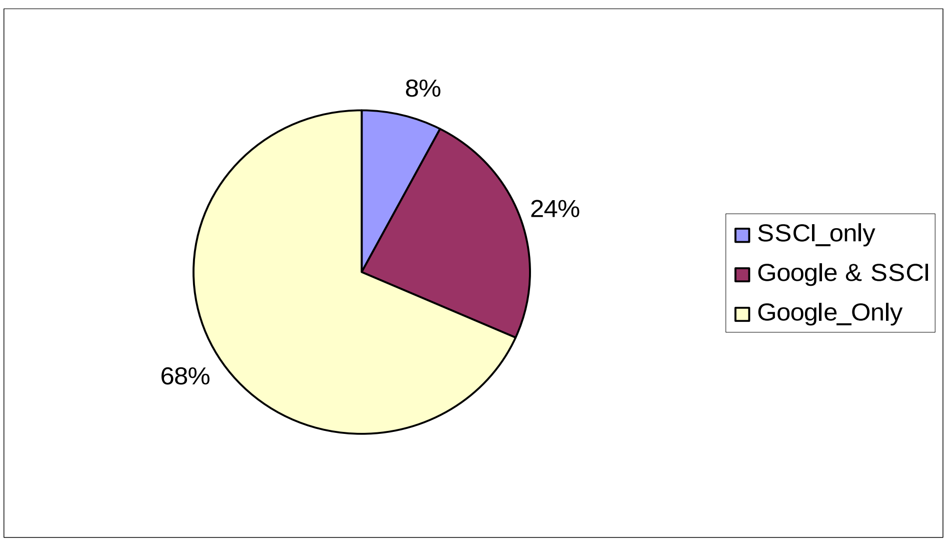
**Figure 1. Distribution of Scholarly Documents on Telecom Reform, by Country and Source (Google: www.scholar.google.com; SSCI, Social Science Citation Index, 2000-August 2005)**




The higher presence of researchers on the Internet search engine scholar.google relative to the SSCI reflects the fact that the criteria used by scholar.google to identify a publication as scholarly are simple and mechanical. A Web crawler used by google assesses ‘meta data’ about a document published on the web to determine the scholarly nature of document published on the net. Although google is not explicit about the specifics of meta data, it seems that the scholarly nature of the links to and from a document is used as an indicator of scholarly work.  SSCI on the other hand indexes only documents published by peer-reviewed journals and panels of experts to periodically review which journals should be indexed and which ones should be removed.

Given the mechanical nature of the selection of documents by scholar.google, Internet presence by itself should not be taken as an indicator of scholarly quality. Some of the records found on google are pre-prints, conference proceedings, abstracts and student papers that have not been validated through peer-review. However, Internet presence gives us a knowledge base that can be used as a starting point for further exploration of quality and relevance. While the SSCI search gave us only 119 names, the scholar.google search gave us 348 names. Because 90 names were found in both datasets, the two sources combined gave us 377 names of which 258 names (or 68% of the total) were represented only in scholar.google.

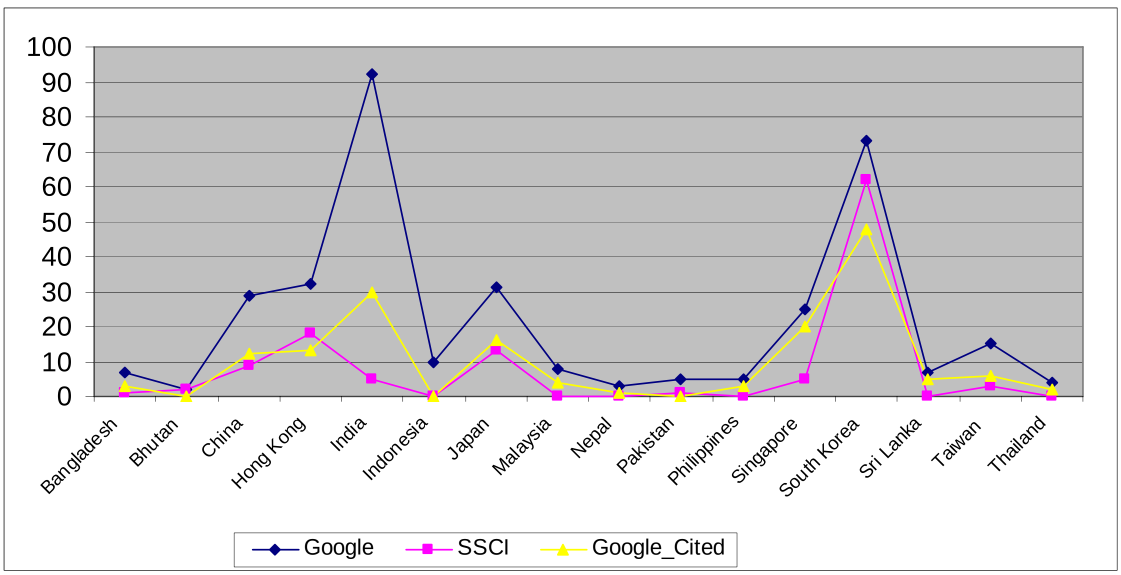
**Figure 2. Distribution of Scholarly Documents on Telecom Reform, by Source**




Scholar.google gives the number of citations for each record and if there are several versions of the same paper they are presented as one record with the citations aggregated and the source of each version noted.

If we limit the scope to records with citations, all countries reduce their presence with India more affected than others. The "Google Presence" of South Korea and Hong Kong on scholar.google dips below their 'SSCI presence', and Bhutan, Indonesia, and Pakistan lose their presence altogether (Figure 3). The case of South Korea and Hong Kong deserve special attention. Although their researchers have more validity in terms of SSCI publications that validity is not commensurately reflected on the Internet.

**Figure 3. Number of Scholarly Documents on Telecom Reform, by Country and Source (Google: www.scholar.google.com; Google_cites: Google records with citations; SSCI, Social Science Citation Index, 2000-August 2005)**




Restricting the records to those with citations reduced coverage to 13 countries (Row 2, Table 2) and researcher coverage to 224 individuals (Rows 1 and 2, Table 3), but the overall coverage is still superior to the 10 countries and 119 researchers afforded by SSCI (Row 3, Table 2 and Row 1, Table 3).

**Table 2. Number of Countries with Scholarly documents on Telecom Reform by Source**

| Source | Number of countries covered |
|---|---|
| scholar.google | 16 |
| scholar.google with citations | 13 |
| SSCI | 10 |

**Table 3. Number of Researchers in Telecom Reform by Method of Validation**

| | | |
|---|---|---|
| Researchers with publications in SSCI | 119 | 32% |
| Researchers with records in scholar.google that are cited by others with records in scholar.google | 105 | 28% |
| Researchers with records in scholar.google that have not been cited yet | 153 | 41% |
| **All** | **377** | **100%** |

Using the number of citations as a validation tool may unnecessarily restrict some documents. Some of the publications may not have received citations because they were posted recently or because they did not provide full texts online. Therefore it is advisable to maintain as many names in a roster or a database and evaluate individuals as necessary using complementary methods. From a usability point of view it is better have more names because citations only indicate academic relevance (See Section 6). In the future, as search engines become more powerful we should be able to combine validation criteria with connectivity criteria (Section 5) to add greater meaning to presence on the Internet.

## 5. Connectivity

Citers on scholar.google are likely to be scholars/researchers themselves. In fact, judging by URLs of the citations, more than 61% of all citations on scholar.google come from publications archived in university or academic publisher websites (Table 4).

**Table 4. Number and percent of Citations of Documents on Telecomcom Reform in Scholar.google by Type of Citer**

| Source | Number | Percentage |
|---|---|---|
| University websites | 526 | 30% |
| Publisher websites | 539 | 31% |
| Other, unidentified | 1020 | 39% |
| ALL | 2085 | 100% |

Many who read and use records from the Internet may never cite them because their purpose is not the creation of scholarly works but the application of the knowledge. Currently, we are unable to give credit to an article that is never cited by other scholars but read widely by practitioners. It is quite possible that search engines of the future will be able to go beyond the citation information offered by scholar.google.com and tell us how often a scholarly work is accessed on the Internet and whether it was accessed by persons associated with an educational site, a government site or another site, and even provide a network of connections for each researcher (Rogers 1996). At a future date search engines are likely to give a range of meta data (e.g., how many viewed the site or how many downloaded the document) in addition to the citation information currently provided.

If such meta data were available it would be possible to map the links from any one researcher to others who had cited the researcher's work or simply read the work or downloaded the work for reference. In the absence of a search engine that generates such meta data, a practical alternative would be to interview a representative sample of researchers in ICT infrastructure reform to identify how their work has been communicated to other stakeholders in the sector directly or indirectly.

**6. Role of Universities**

The International Association of Universities lists 2219 institutions from East, South East and South Asia in its Directory of Universities for 2004. Missing are a differentiation of these universities by mission and an assessment of the quality of these institutions.

The US University system is one of the best differentiated systems in the world. The most widely used differentiation is that used by the *Best Colleges and Universities Survey* of the *US News and World Report* (USNWR). The categories used by USNWR are Doctoral, Masters, Liberal Arts and Comprehensive institutions. The doctoral category comprises research-intensive universities while the other three types are more teaching-intensive. Research-intensive universities typically exceed certain threshold values for research expenditures and numbers of PhDs awarded. Faculty members in these institutions are expected to conduct research and contribute to knowledge. In teaching-intensive universities the focus is on undergraduate education and faculty research requirements are relatively less.

The only available differentiation for universities in Asia currently is in *Asia Week*'s survey of Best Universities in Asia. In 2000, the survey identified 151 universities for ranking.  These universities were then ranked according to peer reputation, faculty resources, student selectivity and research.

In our search for expertise in ICT reform we found it more effective to focus on productive individuals and to trace them back to their institutions than to begin with institutions since the knowledge base in ICT reform is spread across universities, industry, government agencies and non-profit organizations.

In Table 5 we summarize the distribution of researchers by type of organization for a subset of authors made up of authors from India and Korea who have received one or more citations on scholar.google. We identified the home institution of each researcher to derive the distribution shown below.

**Table 5. Distribution of Authors* by Type of Organization in India and South Korea**

| | India | South Korea |
|---|---|---|
| All Universities | 44% | 71% |
| *Research Universities* | *34%* | *28%* |
| *Other Universities* | *10%* | *43%* |
| Industry | 17% | 11% |
| Government | 7% | 0% |
| Non Profit | 31% | 19% |
| Total Number of Authors | 29 | 47 |

* Researchers with one or more citations in scholar.google in August 2005.

In India, the contribution of non-university actors is 55%. While it remains to be seen whether non-university actors are equally prominent in other areas of research in India, the data for telecom reform researchers are in line with the thinking that knowledge production is increasingly characterized by a proliferation of knowledge producers (Gibbon, 1984; Delanty, 2001 ). As Delanty (2001, p. 6) states:

> *Today knowledge has become more important and at the same time does not emanates from any one particular source. This restructuring in the mode of knowledge implies not the end of the university but its reconstitution. The great significance of the university today is that it can be the most important site of interconnectivity in what is now a knowledge society.*

The low presence of Indian researchers on SSCI compared to scholar.google could be partly due to the fact that in India there are more non-university actors in ICT infrastructure reform research.

In the case of South Korea, 71% of the authors are from the university sector which should partly explain why Korea has a stronger presence on SSCI than on scholar.google. In Korea the 'non-research' universities play an unexpectedly bigger role suggesting a problem in the *Asia Week* differentiation and pointing to the need for better differentiation of universities in the region.

How well universities in India and Korea, for example, do in serving as sites of "interconnectivity", as Delanty envisioned is question that deserves further study. There is a lively scholarly debate on the topic (Willinsky, 2005 and references, therein, for example) and attempts at maintaining open access depositories of scholarly works (Steele, 2005)

## 8. Conclusions

An organization becomes a university or a research institution not by designation but by performance. This is the same for individuals. Performance can vary widely across institutions and individuals. Only a small fraction of universities in Asia have sufficient capacity to contribute to development through knowledge generation. Even among the research universities in Asia some will be more productive than others in some fields and some teaching-intensive institutions may have surprisingly high knowledge generation capacity. Therefore, the use of measures such as counts of institutions or counts of researchers in capacity indices should be reconsidered. What is more appropriate is the aggregation of the performance of individual researchers.

Second, the current focus on performance as captured by instruments such as the Science Citation Index (SCI) or the Social Science Citation Index (SSCI) can miss activity in smaller developing countries and in policy or development-related fields. Publications in international journals do not come easily to those unconnected to international networks. There is also the fact that there is only a finite amount of space in international journals to accommodate scholarly works from across the world.

Third, Internet search engines are becoming ubiquitous and indispensable tools. An officer in in the Telecommunications Authority of the Maldives, for example, is now able to type in "telecom policy" in scholar.google.com and begin a well-informed initiative to contact experts from any country. It is inconceivable that citation indices will be used by persons in policy or regulatory fields in this manner. If universities and researchers wish to become better partners in development, they will have to do better in letting the world know about their expertise. The Internet is the most logical means to do that.

Fourth, surveys such as *Asia Week*'s Survey of Best Universities will continue to give some basic guidelines on the type and the quality of universities. However, raw institutional information is not sufficient in itself. Universities, let alone the more highly ranked ones, no longer have a monopoly on knowledge production. In terms of a knowledge base the focus should be on Internet presence and connectivity of individuals irrespective of affiliation or how they are portrayed by presence in established citation indices.

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