CHALLENGES IN ASSESSING THE ECONOMIC IMPACT OF UNIVERSITIES
SOME REFLECTIONS ON INDICATORS, DATA AND PATHWAYS TO MEASURE INNOVATION

Malgorzata Krasowska
Ural University
Yekaterinburg, Russia
23.11.2016
WHAT YOU WILL HEAR ABOUT TODAY:

01 University missions nowadays
02 Indicators used in university rankings
03 In search of economic impact indicators
04 Pathways to economic impact
05 Technology transfer and commercialization
06 What publication and patent based indicators tell us
07 Examples and inspirations
BROAD MISSIONS OF A UNIVERSITY: KEY ACTIVITIES

1. EDUCATION AND TRAINING
2. BASIC AND APPLIED RESEARCH
3. FACULTY SERVICES AND CONSULTANCY
4. TECHNOLOGY TRANSFER AND COMMERCIALIZATION
RANKINGS AND DEVELOPMENTS OF NEW INDICATORS

- Data and number of indicators experience a rapid growth
NEW DEVELOPMENTS IN RANKINGS: A CLOSER LOOK AT INNOVATION AND ECONOMIC IMPACT

The Top 25 Global Innovators: Government

BROUGHT TO YOU BY
Reuters News
Thomson Reuters IP & Science

REUTERS
TOP 75
ASIA’S MOST INNOVATIVE UNIVERSITIES 2016
KEY INDICATORS IN UNIVERSITY RANKINGS

- Quality of education (alumni successes, awards, recognitions)
- Quality of faculty (reputation, awards, medals)
- Research Output (publications, citations, comparison)
- Employer reputation
- Student-to-faculty ratio
- International faculty and students ratios

- Patents and all things related
- Industry income
- Industry partners
- Commercialization
- Graduates in industry leadership roles
- Spin-offs
- New infrastructures
PATENTS BASED INDICATORS

What can be measured:

- Patent volume (filed to and registered with WIPO)
- Patent success (the ratio # applications/accepted patents)
- Global patents (for US, Europe, Japan PO)
- Patent citations (by other patents)
- Patent citation impact, Percent of patents cited
- Patent to article citation impact; Industry article citation impact
- Percent of industry collaborative articles
Measuring economic impact ...

„Universities are being viewed as economic engines that convert public funding into knowledge, scholarship and products with an economic impact as a by-product of this engine’s activity”

E. Stephan, How economics shapes science
Harvard University Press, 2012
BROAD MISSIONS OF UNIVERSITIES LEAD TO DIVERSE IMPACTS

<table>
<thead>
<tr>
<th>CONDUCTED BY THE ACADEMIC SECTOR</th>
<th>IMPACT ON INDUSTRY, GOVERNMENT, ETC.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education &amp; Training</strong></td>
<td><strong>Trained workforce, professional</strong></td>
</tr>
<tr>
<td></td>
<td><strong>future academics</strong></td>
</tr>
<tr>
<td><strong>Students</strong></td>
<td><strong>Faculty</strong></td>
</tr>
<tr>
<td><strong>Skills and Knowledge</strong></td>
<td><strong>Expertise</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Policy development, process</strong></td>
</tr>
<tr>
<td></td>
<td><strong>improvement, public engagement</strong></td>
</tr>
<tr>
<td><strong>Services (consultancy)</strong></td>
<td><strong>Journal articles, books, patents,</strong></td>
</tr>
<tr>
<td><strong>Faculty</strong></td>
<td><strong>legislation, etc.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Acquired Knowledge</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Spin-offs &amp; Products</strong></td>
</tr>
<tr>
<td><strong>Basic &amp; Applied Research</strong></td>
<td><strong>Licenses, Products, etc.</strong></td>
</tr>
<tr>
<td><strong>Faculty Researchers</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tech Transfer &amp; Commercialization</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Staff</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Thomson Reuters

MEASURING ECONOMIC IMPACT AND INNOVATION: SOME KNOWN TRUTHS

— INDICATORS to measure economic impact are available but they are not well developed for systematic institutional comparisons

— TIME is an issue: it can take decades from initial investment to a visible and measurable economic impact

— DATA: third parties can collect data and measure economic impact independently of the university involved in research and investment

— PATENT applications’ high quantity ≠ high economic impact

— INDUSTRY dependent: data varies depending on the industrial sector involved

— INSTITUTIONS may have impact on companies they do not collaborate with
POTENTIAL INDICATORS OF ECONOMIC IMPACT

Education and training activities:
• Graduate employment rates
• Average graduate salaries (after x number of years)
• Value and size of professional training programs
• Number of courses accredited / recognized by professional bodies
• Entrepreneurship courses (enrollment, industry engagement)
• Value of industry-funded scholarships
• Values of other contributions from industry
• Alumni in executive roles in industry or professional societies etc
POTENTIAL INDICATORS OF ECONOMIC IMPACT

Basic and applied research:

- Value of research contracts from industry
- Number of research contracts from industry
- Number of publications with acknowledgements of industry funding
- Number and proportion of papers co-authored with industry
- Volume of citation of such publications
- Patent applications
- Proportion of patent applications that were granted
Technology transfer and commercialization:
- Number of staff in TTO
- Number of disclosures, IP licenses
- Value of IP income
- Number of active patents
- Venture capital investment in spin-off companies
- Number of spin-off companies
- Value of sale of shares of spin-offs
- Proportion of spin-off companies still in operation after 5 years
- Revenue of spin-off companies after 5 years
Consultancy services by faculty and secondary impact in practice

- Number of contracts or engagements
- Value of this revenue
- Number of faculty on advisory boards, management boards
- Co-authorship, citation or news mention in various sources (acts of parliament, changes of statutes, changes in regulations, standards, legislation, policy recommendations)
- Authorship of new datasets or other resources that facilitate improvements to business processes
THE PATHWAYS TO ECONOMIC IMPACT

INPUTS at universities are very diverse:

- Public sector scholarships
- Industry/commercial research contracts
- Investments/endowment
- Tuition fees, scholarships
- Commercialization of research
- Infrastructure and facilities
- Intellectual capacity
- Knowledge base
THE PATHWAYS TO ECONOMIC IMPACT: A SIMPLE CYCLE?

- FURTHER
- NEW
- RESEARCH

INPUTS

OUTCOMES (IMPACT)

ACTIVITIES

OUTPUTS
THE PATHWAYS OF R&D IMPACTS

**INPUTS**
- Public sector scholarships
- Industry/commercial
- Investment/endowment
- Tuition fees, scholarships
- Commercialization
- Infrastructure & facilities
- Intellectual capacity
- Knowledge base

**ACTIVITIES**
- Education & Training
- Services (consultancy)
- Basic & applied Research
- Tech transfer & commercialization

**OUTPUTS**
- Graduates
- Policy, standards
- Journals, books, other
- Patents, licensable
- Tech transfer & spin outs
- Trained people

**OUTCOMES**
- Skilled employment
- Social change
- Economic benefits
- Health & Environments
- Legislation & policy
- Research advancement

*Source: Thomson Reuters IP & S*
INPUTS at University can be very diverse:

- Public sector scholarships
- Industry/Commercial Research Contracts
- Investments/endowment
- Tuition fees, scholarships
- Commercialization of research
- Infrastructure and facilities
- Intellectual capacity
- Knowledge base
Office of Research Commercialization (ORC)

Mission and Units

ORC is dedicated to transforming research at Rutgers into products, services and partnerships for the public good, generating value for the University and enhancing economic development in the State of New Jersey.

- Rutgers Translational Sciences
- Intellectual Property and Licensing
- New Ventures

The Office of Technology Commercialization is responsible for the protection and efficient transfer of university discoveries to the marketplace for the benefit of society.
TRANSLATING BASIC RESEARCH TO PRACTICAL APPLICATION

Cumulative Profit / Loss

Research And Development → Commercial Evaluation → Intellectual Property → Proof-of-Concept → Product Launch → Success as a New Product/Service → Success as a Business

Technology Transfer → Commercialization → Valley of Death

Impact

Time

ACADEMIC RESEARCH

INDUSTRY MARKET
SOURCES OF MAJOR CHALLENGES IN INDUSTRY-UNIVERSITY COLLABORATION

- Are academia and industry worlds’ apart?

- How to build these cross-sector partnership?

- Have you considered enumerating mutual benefits?
## WHAT PUBLICATION BASED INDICATORS CAN TELL US

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Articles co-authored with industry</td>
<td>Output / Outcome</td>
<td>The volume articles that contain one or more co-authors from a commercial entity. This indicator shows the volume of research activity that is conducted in collaboration with industry and it is an indicator of potential future economic impact.</td>
</tr>
<tr>
<td>Citations affiliated with industry per article</td>
<td>Outcome</td>
<td>Article to article citations are an established indicator of influence and research impact. By limiting the citing items only to those items that are affiliated with industry it becomes an indicator of the influence and impact that basic research conducted in an academic setting has had on commercial research.</td>
</tr>
<tr>
<td>% Articles acknowledging funding from industry</td>
<td>Input</td>
<td>An indication of commercial sector investment. Although the articles themselves are a research output, the funding acknowledgment is an indication of research funding and is therefore an input measure.</td>
</tr>
<tr>
<td>Patent citations per article</td>
<td>Outcome</td>
<td>Similar to “Patent citations per patent” this indicator measures the average number of times an article has been cited by patents. This unique indicator is an indication that basic research conducted in an academic setting (as measured by articles) has had influence and impact upon commercial Research &amp; Development (as measured by patents).</td>
</tr>
</tbody>
</table>
### WHAT PATENT-BASED INDICATORS CAN TELL US

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patents</td>
<td>Output</td>
<td>The number of basic patents filed by the organization is an indication of research output with potential for commercial value.</td>
</tr>
<tr>
<td>Granted patents per application</td>
<td>Outcome</td>
<td>The proportion of patent applications that are granted shows the success rate in the patent filing process and indicates the significance of the inventions.</td>
</tr>
<tr>
<td>Patent global diversity</td>
<td>Outcome</td>
<td>The proportion of patents that have been filed in a second major country is a measure of the globally diversity of the patent portfolio. Filing a patent is an expensive and laborious process and filing in multiple countries is an indication that the invention is non-trivial and has commercial value.</td>
</tr>
<tr>
<td>Patent citations per patent</td>
<td>Outcome</td>
<td>This indicator measures the average number of times a patent family has been cited by other patents. As part of the patent inspection process the patent examiner will cite significant prior art. The number of times a patent has been cited is an indication that it has had impact on further R&amp;D.</td>
</tr>
<tr>
<td>% patents cited one or more times</td>
<td>Outcome</td>
<td>This indicator is the proportion of papers that have been cited by other patents one or more times. It is a complementary indicator to the “Patent citations per patent” indicator</td>
</tr>
</tbody>
</table>
## Top US Universities Results

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Number of patents</th>
<th>Granted patents per application</th>
<th>Patent global diversity</th>
<th>Patent citations per patent</th>
<th>% patents cited one or more times</th>
<th>Patent citations per article</th>
<th>% Articles co-authored with industry</th>
<th>Citations affiliated with industry per article</th>
<th>% Articles containing acknowledgement of funding from industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of California System</td>
<td>2,796</td>
<td>49.3%</td>
<td>29.1%</td>
<td>2.34</td>
<td>53.6%</td>
<td>0.069</td>
<td>2.70%</td>
<td>0.465</td>
<td>10.1%</td>
</tr>
<tr>
<td>United States Navy</td>
<td>1,720</td>
<td>90.2%</td>
<td>5.5%</td>
<td>1.21</td>
<td>45.3%</td>
<td>0.039</td>
<td>1.28%</td>
<td>0.162</td>
<td>1.3%</td>
</tr>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>1,357</td>
<td>58.1%</td>
<td>21.4%</td>
<td>2.86</td>
<td>63.2%</td>
<td>0.161</td>
<td>4.20%</td>
<td>0.752</td>
<td>8.1%</td>
</tr>
<tr>
<td>University of Texas System</td>
<td>1,144</td>
<td>51.3%</td>
<td>28.3%</td>
<td>1.93</td>
<td>57.3%</td>
<td>0.087</td>
<td>2.90%</td>
<td>0.441</td>
<td>12.9%</td>
</tr>
<tr>
<td>Stanford University</td>
<td>1,032</td>
<td>66.5%</td>
<td>23.2%</td>
<td>2.56</td>
<td>59.6%</td>
<td>0.096</td>
<td>3.83%</td>
<td>0.595</td>
<td>12.6%</td>
</tr>
<tr>
<td>United States Department of Energy</td>
<td>890</td>
<td>75.7%</td>
<td>14.6%</td>
<td>1.52</td>
<td>46.9%</td>
<td>0.057</td>
<td>2.59%</td>
<td>0.301</td>
<td>2.4%</td>
</tr>
<tr>
<td>State University of New York System</td>
<td>891</td>
<td>55.7%</td>
<td>21.4%</td>
<td>1.51</td>
<td>46.9%</td>
<td>0.037</td>
<td>1.94%</td>
<td>0.288</td>
<td>12.0%</td>
</tr>
<tr>
<td>State University System of Florida</td>
<td>825</td>
<td>50.7%</td>
<td>21.3%</td>
<td>1.64</td>
<td>49.5%</td>
<td>0.045</td>
<td>1.73%</td>
<td>0.230</td>
<td>6.9%</td>
</tr>
<tr>
<td>United States Army</td>
<td>791</td>
<td>88.0%</td>
<td>5.7%</td>
<td>1.28</td>
<td>46.0%</td>
<td>0.053</td>
<td>2.00%</td>
<td>0.194</td>
<td>2.4%</td>
</tr>
<tr>
<td>California Institute of Technology</td>
<td>766</td>
<td>71.1%</td>
<td>24.3%</td>
<td>2.96</td>
<td>62.1%</td>
<td>0.066</td>
<td>1.86%</td>
<td>0.269</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
"It is clear that university leadership matters in technology transfer, both in setting the approach and tone within universities but also in the national push for development. Different leaders define different missions for their universities, reflecting different institutional capabilities. This will make simple comparisons between universities that are based on single outputs, (for example, number of spin-out companies formed) difficult, meaningless and negatively misleading.

University vice-chancellors in the UK are fully committed to delivering on the Government’s economic priorities, but we will each contribute differently.’

Professor Trevor McMillan, Vice-Chancellor of Keele University

http://www.hefce.ac.uk/media/HEFCE,2014/Content/Pubs/Independentresearch/2016/University,KE,framework,Good,practice,in,technology,transfer/2016_ketech.pdf
Detecting sub-sea hydro-carbons: MTEM Ltd:

— In 2001 researchers in University of Edinburgh’s School of GeoSciences developed a new electromagnetic method to detect sub-sea and underground hydrocarbons.

— In November 2004 MTEM Ltd was launched from the University of Edinburgh with £7.4 million of funding from three equal investors: HitecVision, Energy Ventures, and Scottish Equity Partners.

— After completing the first commercial marine survey in the North Sea, Petroleum Geo-Services (PGS) bought MTEM Ltd. for $275m.

— PGS then established a Strategic Alliance with the University leading to £1.1m in research funding.
The Stellenbosch University Satellite is the first miniaturized satellite designed and manufactured in South Africa. It was launched aboard a Delta II rocket from the Vandenberg Air Force Base on 23 February 1999. Sunsat was built by post-graduate engineering students at the University of Stellenbosch. Its AMSAT designation was SO-35 (Sunsat Oscar 35).
LAUNCHING SOUTH AFRICA’S MICRO-SATELLITE RESEARCH INDUSTRY WITH SUNSAT

INPUTS

- Public sector scholarships & grants
- Industry/commercial research contracts
- #1 - Industry and University funds graduate students and faculty research with the establishment of the SUNSAT program in early 90s
- Infrastructure & facilities
- Intellectual capacity
- Knowledge base

ACTIVITY

- Education and training
- #2 - 100 + Eng students trained (consultancy)
- Basic & applied Research
- #3 - University conducts research
- #4 - Peer reviewed literature published in 90’s
- #5 – Sun Space and Information Systems spun-out to develop commercial satellites in 2000

OUTPUTS

- Graduates
- Journals, books, other publications
- Patents, licensable tech
- Tech transfer & spin outs

OUTCOMES

- #6 – Skilled engineers in workforce
- Employment
- Social change
- Economic benefits
- Health & Environmental benefits
- Legislation & policy
- Research advancement
THE PATH TO A BLOCKBUSTER DRUG: NORTHWESTERN UNIVERSITY, IL, USA
THE PATH TO A BLOCKBUSTER DRUG

**INPUTS**
- Public sector scholarships & grants
- Industry/commercial research contracts
- Investment/endowment
- Tuition fees, scholarships
- Commercialization
- Infrastructure & facilities
- Intellectual capacity
- Knowledge base

**ACTIVITIES**
- Education & Training
- Services (consultancy)
- Basic & applied Research
- Tech transfer & commercialization

**OUTPUTS**
- Graduates
- Policy, standards
- Journals, books, other
- Patents, licensable
- Tech transfer & spin outs
- Trained people

**OUTCOMES**
- Skilled employment
- Social change
- Economic benefits
- Health & Environmental benefits
- Legislation & policy
- Research advancement

1. Government funds research
2. University conducts research
3. Peer reviewed literature published in 80’s
4. Industry funds & collaborates on testing candidate compounds
5. New drug launched in 2005
6. Compounds are patented in 90’s

Source: Thomson Reuters

Clarivate Analytics
Formerly the IP & Science business of Thomson Reuters
SELECT CRITERIA FOR INDICATORS OF ECONOMIC IMPACT

— *Is the indicator size-independent?* Due to the variations in the size of universities in terms of faculty, students, research activities or support for commercialization, it is important that indicators reflect the performance of the university in a size-independent way.

— *Is the indicator direct, or indirect?* Indicators should be used that reflect both the direct economic impact, as well as the indirect benefits universities may have on local, regional and national economies.

— *Is the indicator sufficiently timely to tell us something about the university’s recent impact?* The influence of universities on downstream economic activity may take significant time to accrue and therefore it is important to consider how timely each indicator may be.

— *Is a meaningful and relevant baseline available for this indicator?* Interpretation of indicators and their subsequent value in rankings are enhanced by relating a discrete value to a relevant baseline. Common baselines include location-based or global averages, disciplinary averages, or institutional classification averages (e.g. Carnegie Classification of Institutions of Higher Education).
## ASSESSMENT OF PUBLICATION-BASED INDICATORS

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SIZE-DEPENDENCY</th>
<th>DIRECTNESS</th>
<th>TIMELINESS</th>
<th>BASELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Articles co-authored with industry</td>
<td>Normalized to total number of articles</td>
<td>Indirect</td>
<td>Current – same as existing publication-based indicators</td>
<td>Possible</td>
</tr>
<tr>
<td>% Citations affiliated with industry per article</td>
<td>Normalized to total number of citations</td>
<td>Indirect</td>
<td>Moderate to slow – requires time for article to be incorporated into industry research</td>
<td>Possible</td>
</tr>
<tr>
<td>% Articles containing acknowledgement of funding from industry</td>
<td>Normalized to total number of articles</td>
<td>Indirect</td>
<td>Current – same as existing publication-based indicators</td>
<td>Possible</td>
</tr>
<tr>
<td>Patent citations per article</td>
<td>Normalized to total number of articles</td>
<td>Indirect</td>
<td>Slow – requires time for article to be incorporated into industry research and patent application process</td>
<td>Possible</td>
</tr>
</tbody>
</table>
### ASSESSMENT OF PATENT-BASED INDICATORS

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SIZE-DEPENDENCY</th>
<th>DIRECTNESS</th>
<th>TIMELINESS</th>
<th>BASELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patents</td>
<td>Size-dependent</td>
<td>Indirect</td>
<td>Moderate – it takes time to prepare patent application</td>
<td>Possible</td>
</tr>
<tr>
<td>Granted patents per application</td>
<td>Normalized to the number of patents applied</td>
<td>Indirect</td>
<td>Moderate – the patent evaluation process takes years at most authorities</td>
<td>Possible</td>
</tr>
<tr>
<td>Patent global diversity</td>
<td>Normalized to the number of patents</td>
<td>Indirect</td>
<td>Moderate to slow – patent filings in multiple jurisdiction may take years</td>
<td>Possible</td>
</tr>
<tr>
<td>Patent citations per patent</td>
<td>Normalized to number of patents</td>
<td>Indirect</td>
<td>Moderate to slow – patents take some time to accrue patent citations</td>
<td>Possible</td>
</tr>
<tr>
<td>% patents cited one or more times</td>
<td>Normalized to number of patents</td>
<td>Indirect</td>
<td>Moderate to slow – patents take some time to accrue patent citations</td>
<td>Possible</td>
</tr>
</tbody>
</table>
WHERE IS DATA COMING FROM?

— Data on scholarly publications and citations were sourced from Clarivate Analytics (formerly IP & S Thomson Reuters) InCites™, which is the gold standard for bibliometric evaluation and built on Web of Science citation index.

http://researchanalytics.thomsonreuters.com/incites/

— Patent data were sourced from Derwent World Patents Index (DWPI), which is the world’s largest and most authoritative database of patents. The Patent Citation Index was also used which is a complementary database of patent citations.

"There are many common preconceptions around challenges in accessing university intellectual property. Our experience in working with industry paints a different picture and, hopefully, this paper will reassure the technology community that we take on board feedback and common ground can be found."

UK University Technology Transfer: Behind the Headlines
Claire Brady, Head of Technology Transfer at Edinburgh Research and Innovation, the Commercialization office for the University of Edinburgh
HAVE YOU HEARD OF UT AUSTIN 8 STEPS OF COMMERCEALIZATION?

**Invention Disclosure**
The discoveries and inventions are formally disclosed by the inventors via a confidential invention disclosure form.

**Assessment**
Evaluates the disclosed invention and develops a preliminary commercialization strategy.

**Research**
Observations and experiments during research activities often lead to discoveries and inventions that may have commercial applicability.

**Patenting**
If the invention appears suitable for patenting, OTC engages outside counsel to pursue patent protection for the invention. Patents protect numerous inventions, but copyright and trademarks are used as well.

**Revenue and Commercialization**
Involves advanced development, commercialization, marketing and distribution; terms of compensation can include fixed fees, milestone fees, royalties and equity.

**Prospecting**
OTC proactively approaches companies, entrepreneurs and investors who have been identified as potentially suitable partners to bring the technology to market.

**Licensing**
OTC prepares a legal agreement that is signed by the university and the commercialization partner and reflects the negotiated business terms.

**Negotiation**
With the interested licensee, works out terms and timeline, which may include the continued involvement of the inventors.
OTHER EXAMPLES OF UNIVERSITY COLLABORATION WITH COMMERCIAL ENTITIES

Nanyang Technological University (NTU), Singapore

1955: Funded and Nanyang University (1955-1979)
1981: Nanyang Technological Institute established
1991: Established as Nanyang Technological University
      Focus: engineering and business till 2001
2001: New schools added (i.e. Biological Sciences, Humanities, Social Sciences, Physical and Mathematical Sciences, Medicine, Art, Design & Media)
One of the world’s biggest engineering college

Research-intensive and interdisciplinary

http://www.slideshare.net/StateOfInnovation/2016-innovation-forum-presenter-slides from Prof. Michael Khor’s presentation on NTU (30-59)
NTU’S ALLIANCES WITH FOREIGN UNIVERSITIES

http://www.slideshare.net/StateOfInnovation/2016-innovation-forum-presenter-slides om Prof. Michael Khor’s presentation on NTU (30-59)
NTU’S MAJOR INTERNATIONAL INDUSTRY PARTNERS

http://www.slideshare.net/StateOfInnovation/2016-innovation-forum-presenter-slides om Prof. Michael Khor’s presentation on NTU (30-59)
THANK YOU !!!

Clarivate Analytics
Formerly the IP & Science business of Thomson Reuters