CONNECTING HIGHER EDUCATION AND INDUSTRY FOR ECONOMIC DEVELOPMENT

CSG Policy Webinar Series

PRESENTED BY CSG’s STATE PATHWAYS TO PROSPERITY INITIATIVE
Overview—Industry-University-Government Partnerships and Statewide Economic Development

Council of State Governments

Jeff Mason
Executive Director, Michigan University Research Corridor

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Director of Solution Services

26 February 2014
Agenda

• Global R&D Landscape and Economic Impact of R&D
• The Problem and the Payoff
• R&D Cluster Example: Research Triangle Park
• Analytical Reporting
• Statewide Research Networking Systems: Michigan Expertise Portal
• Q&A
Global R&D Landscape and Economic impact of R&D
The world as a whole spent over $1.55T in R&D in 2013.

In 2013 South Korea spent $63B, 3.6% of its GDP, on R&D, while France spent $52B, 2.3% of its GDP.

India’s investments in R&D were equivalent to the UK’s at $44B.

US R&D spending was up 4.1% over the prior year to $450B, while China’s spending rose 11.2% to $258B.
Global (PPP) Share of R&D Expenditures, 2006 and 2014

Source: Battelle, 2008 and 2014 Global R&D Funding Forecasts
The development of MP3 technologies illustrates the unexpected benefits of basic research. In 1965, a hand-sized storage and playback device that would hold 15,000 recorded songs was the stuff of science fiction. Even simple hand-held calculators were rare and expensive at that time. Research funded by the Department of Defense, the National Science Foundation, the National Institutes of Health, the Department of Energy, and the National Institute of Standards and Technology contributed to the breakthrough technologies of magnetic storage drives, lithium-ion batteries, and the liquid crystal display, which came together in the development of MP3 devices. The device itself is innovative, but it built upon a broad platform of component technologies, each derived from fundamental studies in physical science, mathematics, and engineering.
Some examples—government & university grants to basic and applied research into large firms

- **Google**—Sergey Brin and Larry Page’s basic research was supported by a National Science Foundation grant. Google now employes over 19,000 people globally and is considered one of the world’s most innovative and influential companies.

- **SAS Software**—Supported by a grant from the U.S. Department of Agriculture (USDA), SAS began as a research project at North Carolina State University to analyze agricultural data. The company is now the world’s largest privately held software company and the leader in business analytics software and services. SAS employs more than 11,000 people.

- **Cisco Systems; Pacific Biosciences; Hewlett-Packard; Sun Microsystems; Genentech; Medtronic; numerous small and mid-sized biotech, computer, nanotech, medical device and other firms**

- **MIT graduates** have started over 25,800 currently active companies with annual global sales of $2T. If these companies formed an independent nation, the revenues would make that nation the 17th-largest in the world.

The Problem and the Payoff
The Problem—How to Characterize and Understand Complex Relationships in Order to Maximize Mutual Benefits?

• Largest University in Oregon (30,000 students), urban campus, diverse student body
• Largest employer in Portland, Fortune 500 company, strong global R&D presence
• Hundreds of individual contacts between professors and Intel scientists, largely created on an ad-hoc basis—"a plate of spaghetti"
The Problem—How to Characterize and Understand Complex Relationships in Order to Maximize Mutual Benefits?

- Huge challenge—creating an “asset map” that fully characterized existing relationships, with ultimate goal of focusing and enhancing the relationships in key areas
- Took over 9 months of effort at both Portland State and Intel, but “worth all of the effort.
- The two institutions now have a well-defined reference framework to organize 4 major areas of interaction. Successful, but required exceptional commitment and tedious work.
Intel Vietnam Scholars

Intel Vietnam Scholars is a program sponsored by Intel Corporation that provides transfer engineering students from select Vietnamese universities the opportunity to complete a Bachelor of Science degree in Electrical or Mechanical Engineering, or Supply and Logistics Management at Portland State University. This program not only provides each student with an excellent education and international experience, but also prepares them for a career in Intel’s semiconductor assembly and test facility in Ho Chi Minh City when they return home. Since 2009 73 students have participated in the program, joining Portland State’s graduating classes of 2011, 2012 and 2014.

- Intel’s largest and newest assembly and test facility is in Ho Chi Minh City Vietnam
- Worked with Portland State to create custom BA program for Vietnamese students, who will become facility managers in Vietnam on their return.
- Joint Portland location allowed for students to gain direct experience working with some of Intel’s leading R&D researchers and management.

- Result: 75 managers in three graduating classes—last class in 2014
- Model for future university-industry programs.
R&D Cluster Example: Research Triangle Park, NC
In the 1950s, North Carolina was home to a deteriorating economic base rooted in tobacco, furniture manufacturing, small-scale farming and textiles, and had the second-lowest per capita income in the nation. The state’s economic future was highly uncertain.

Sources: Photo, Dorothea Lange, Library of Congress; text, www.rtp.org
The Research Triangle Park is home to more than 170 global companies, including IBM, GSK, Syngenta, RTI International, Credit Suisse, and Cisco, that foster a culture of scientific advancement and competitive excellence. RTP is located between three major universities: Duke University in Durham, North Carolina State University in Raleigh, and the University of North Carolina at Chapel Hill.

Source: www.rtp.org
Research Triangle Park—The Mission

“The Research Triangle is the marriage of North Carolina’s ideals for higher education and its hopes for material progress”

- High levels of integration between industry and university
- Multiple alliances
- Conferences, events
- Accelerator and incubator space
- Work with voluntary organizations
- 40% of 170 resident companies have fewer than 10 employees

Source: www.rtp.org
The Valley of Death

Source: altenergystocks.com (Osawa and Miyazaki, 2006)
SciVal Analytics
Institutional Collaboration Patterns
University of Michigan Global Co-Authorship Network

Collaboration by the University of Michigan

[Map showing worldwide collaboration with regions like North America, Europe, Middle East, Asia Pacific, South America, and Africa, with numbers indicating the number of collaborating institutions and co-authored publications]
Institutional Collaboration Patterns
Co-Authorship at Individual Institutions

China

- 222 collaborating institutions
- 2,540 co-authored publications

Tsinghua University

- 248 co-authors
- 202 co-authored publications

with the University of Michigan
Collaboration with Tsinghua University

Year range: 2009 to 2013

University of Michigan

189 co-authors with Tsinghua University

Total output of this Institution

<table>
<thead>
<tr>
<th>Publication</th>
<th>Authors</th>
<th>Citations</th>
<th>Citations per Publication</th>
<th>Field-Weighted Citation Impact</th>
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<td>483,957</td>
<td>9.0</td>
<td>1.98</td>
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</table>

Tsinghua University

248 co-authors with the University of Michigan

Total output of this Institution

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>49,096</td>
<td>31,755</td>
<td>183,333</td>
<td>3.7</td>
<td>1.12</td>
</tr>
</tbody>
</table>

Co-authored publications by Journal Category

- Physics and Astronomy (31.7%)
- Engineering (14.7%)
- Materials Science (5.3%)
- Chemistry (5.0%)
- Mathematics (5.3%)
- Computer Science (7.2%)
- Earth and Planetary Science (3.4%)
- Biochemistry, Genetics and Molecular Biology (4.1%)
- Chemical Engineering (4.4%)
- Environmental Science (5.0%)
- Other (11.0%)
Institutional Collaboration Patterns:
U of M Most Frequent Co-Authorship Relationships in Engineering

Collaboration by the University of Michigan

Source: Scopus data up to 16 Jan 2014

Institutions collaborating with the University of Michigan
Top 100 collaborating institutions, by number of publications co-authored with the University of Michigan

<table>
<thead>
<tr>
<th>Institution</th>
<th>Co-authored publications</th>
<th>Co-authors at the University of Michigan</th>
<th>Co-authors at the other institution</th>
<th>Citations</th>
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<tbody>
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<td>156 ▲</td>
<td>224 ▲</td>
<td>171 ▼</td>
<td>1,630</td>
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<td>Stanford University</td>
<td>112 ▲</td>
<td>184 ▲</td>
<td>197 ▲</td>
<td>1,073</td>
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<tr>
<td>University of Illinois at Urbana-Champaign</td>
<td>110 ▲</td>
<td>179 ▲</td>
<td>131 ▲</td>
<td>761</td>
</tr>
<tr>
<td>Ford Motor</td>
<td>107 ▼</td>
<td>88 ▼</td>
<td>90 ▼</td>
<td>372</td>
</tr>
<tr>
<td>University of Toronto</td>
<td>100 ▲</td>
<td>134 ▲</td>
<td>127 ▲</td>
<td>714</td>
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<tr>
<td>General Motors</td>
<td>99 ▼</td>
<td>100 ▼</td>
<td>84 ▼</td>
<td>234</td>
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<td>University of Wisconsin</td>
<td>93 ▲</td>
<td>165 ▲</td>
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<td>Harvard University</td>
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<tr>
<td>Michigan State University</td>
<td>90 ▲</td>
<td>143 ▲</td>
<td>163 ▼</td>
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<td>Argonne National Laboratory</td>
<td>89 ▲</td>
<td>155 ▲</td>
<td>157 ▼</td>
<td>849</td>
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<tr>
<td>The Ohio State University</td>
<td>89 ▲</td>
<td>169 ▲</td>
<td>108 ▼</td>
<td>1,024</td>
</tr>
</tbody>
</table>
University-Industry Collaborative Authorship

Cross Sector - Publications

All publications with at least one author from specific institution where institutions from different sectors collaborate

Data: Publications Subject: ALL Cross sector: Academic and Corporate

Chart Table File
The Ohio State University

22.8% International collaboration
- 34 publications (22.8%) were co-authored with Institutions in other countries
  - Citations per Publication: 3.2

12.8% National collaboration
- 16 publications (12.8%) were co-authored with other Institutions in the United States, but not with Institutions in other countries
  - Citations per Publication: 1.3

61.1% Institutional collaboration
- 91 publications (61.1%) were co-authored with others at The Ohio State University, but not with other Institutions
  - Citations per Publication: 2.5

3.4% Single authorship
- 5 publications (3.4%) were not co-authored but had a single author
  - Citations per Publication: 0.4

University of Michigan

20.1% International collaboration
- 51 publications (20.1%) were co-authored with Institutions in other countries
  - Citations per Publication: 2.4

32.7% National collaboration
- 83 publications (32.7%) were co-authored with other Institutions in the United States, but not with Institutions in other countries
  - Citations per Publication: 1.7

42.5% Institutional collaboration
- 108 publications (42.5%) were co-authored with others at The University of Michigan, but not with other Institutions
  - Citations per Publication: 1.7

4.7% Single authorship
- 12 publications (4.7%) were not co-authored but had a single author
  - Citations per Publication: 0.1

Academic-Corporate Collaboration

7.4% Academic-corporate collaboration
- 11 publications (7.4%) had one or more authors with both academic and corporate affiliation
  - Citations per Publication: 1.5

92.6% No academic-corporate collaboration
- 138 publications (92.6%) did not have authors with both academic and corporate affiliation

Academic-Corporate Collaboration

17.7% Academic-corporate collaboration
- 45 publications (17.7%) had one or more authors with both academic and corporate affiliation
  - Citations per Publication: 2.3

82.3% No academic-corporate collaboration
- 209 publications (82.3%) did not have authors with both academic and corporate affiliation
National/Global Context:
The United States National Map of Research Strengths

2013 Circle of Science Map for The United States
Example 5: National/Global Context:
National Maps of India, China, Germany and the UK

Other Nations

Strengths in IT, chemistry and engineering.

Comprehensive strengths, esp. in medicine and social sciences.
South Korea and Brazil all maintain targets for R&D spending alongside other policies designed to boost inputs into their national science system. China intends to increase its spending on R&D to 2.6% of GDP by 2020 from its value of less than 2% at present. South Korea 5% by 2022 and Brazil 2.5% by 2022. Many longer established scientific nations also maintain targets for R&D spending, such as the USA’s new target of over 3% of GDP and the EU’s similar Lisbon goal of 3% of member countries’ GDP.

It is difficult to predict the course of R&D spending over future years (for example, recent significant reductions in the 2011 science budget in Brazil have raised concerns about progress towards its 2022 target. However, by extrapolating current trends to forecast the way in which the global league table of spending might change if each country meets their current spending targets for R&D, we can suggest what the scientific world might look like within the next decade.

Figure 15 shows the effects of countries meeting or being on course to meet, their respective R&D targets. It can be seen that while the USA should maintain its current dominance of global R&D spending, China is set to leap above Japan in spending terms, and to chase the USA. Similarly, South Korea is highly likely to overtake the UK in coming years. Assuming these targets are met.
BIS report inputs: Quantitative

Data

- Scopus
- ScienceDirect usage
- OECD
- HESA
- WIPO
- AUTM
- HEFCE

Analyses

- 112 database tables, 2.3 Gigabytes
- 20MM+ articles, 200MM+ citations, 3B downloads
- 45MM indicator values
- Largest indicator: 6MM+ values
Monitor brain circulation—US map

- **Outflow**
  - Researchers: 3.8%
  - Relative Productivity: 1.11
  - Relative Seniority: 1.24

- **Returnees Outflow**
  - Researchers: 2.9%
  - Relative Productivity: 1.18
  - Relative Seniority: 1.28

- **Transitory (mainly non-USA)**
  - Researchers: 19%
  - Relative Productivity: 1.32
  - Relative Seniority: 1.15

- **Transitory (mainly USA)**
  - Researchers: 11.2%
  - Relative Productivity: 1.16
  - Relative Seniority: 1.09

- **Returnees Inflow**
  - Researchers: 2.6%
  - Relative Productivity: 1.95
  - Relative Seniority: 1.32

- **Inflow**
  - Researchers: 5%
  - Relative Productivity: 1.07
  - Relative Seniority: 1.18

- **USA only**
  - Researchers: 55.6%
  - Relative Productivity: 0.71
  - Relative Seniority: 0.87

- **Brain Outflow**
  - Researchers: 6.6%
  - Relative Productivity: 1.14
  - Relative Seniority: 1.26

- **Transitory Brain Mobility**
  - Researchers: 30.2%
  - Relative Productivity: 1.26
  - Relative Seniority: 1.13

- **Brain Inflow**
  - Researchers: 7.6%
  - Relative Productivity: 1.40
  - Relative Seniority: 1.23

Returnee Researcher = 2 or more years abroad
Transitory Researcher = 2 or more years abroad
Returnee and transitory researchers have higher relative productivity than those that stay only in Ohio.
The darker the state, the more researchers that move from that state to Ohio

Source: SciVal Custom Analytics (October 2012)
Michigan Corporate Relations Network (MCRN)
University Expertise and Resource Portal

Jeff Mason, University Research Corridor
What is the Michigan Corporate Relations Network (MCRN)?

What is the MCRN?

The Michigan Corporate Relations Network (MCRN) is a statewide university network designed to create partnerships that will connect Michigan's corporations to critical university assets to help promote innovative research and grow Michigan's economy.

Six major public universities in Michigan make up the network. They are:

- Michigan State University (MSU)
- Michigan Technological University (MTU)
- Wayne State University (WSU)
- Western Michigan University (WMU)
- University of Michigan-Ann Arbor (U-M)
- University of Michigan-Dearborn (UM-Dearborn)

http://michigancrn.org/
What is the Michigan Corporate Relations Network (MCRN)?

“Connecting Academia and Industry”

MCRN is the first statewide university-to-business engagement network in the United States. MCRN is dedicated to connecting businesses with a broad array of critical university assets.

How MCRN Means Business

• Best in class business engagement offices – creating “one-stop shops” for vital resources & expertise
• Small Company Innovation Program (SCIP) – making research affordable
• Michigan Information Transfer Source (MITS) – making key library resources accessible
• Small Company Internship Award program (SCIA) – making top student talent available
• MCRN Portal – centralized key data and faculty expertise

http://michigancrn.org/
What is the University Experts Portal?

The Michigan Corporate Relations Network (MCRN) Expertise and Resource Portal is an easy-to-use searchable website featuring available university researchers and related resources at facilities such as university research centers. The MCRN Expertise and Resource Portal is a single point of access website to serve businesses both within Michigan and around the globe. Combined with the business outreach services at each MCRN associated university, the portal provides a means for businesses to take advantage of the resources available at a single university, collaborations of universities, or the entire MCRN network of six universities.
Where does the data come from?
Where does the data come from?
Where does the data come from?
Where does the data come from?
How to use the University Expertise Portal

The MCRN University Expertise Portal enables you to search through topics of research and expertise at Michigan’s universities and create a request to our business engagement offices to connect you to the on-campus resources your business needs.

About MCRN  Portal FAQ  Tutorial

Search Help

My Experts Request List
You have 0 experts or facilities collected to contact
Click here to contact MCRN now and get in touch

COLLABORATORS

COMING SOON

Michigan Tech

MICHIGAN STATE UNIVERSITY
UNIVERSITY OF MICHIGAN
DEARBORN
WAYNE STATE

PURE MICHIGAN
Michigan’s URC

WESTERN MICHIGAN UNIVERSITY
The MCRN University Expertise Portal enables you to search through topics of research and expertise at Michigan’s universities and create a request to our business engagement offices to connect you to the on-campus resources your business needs.
How to use the University Expertise Portal

The University Expertise Portal is a way for businesses to connect to the expert resources available at Michigan’s universities.

### Basic Search Results

- **131 Experts**
- **2 Core Facilities**

### Search Results

<table>
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<tr>
<th>Rank</th>
<th>Select for contact</th>
<th>Name</th>
<th>Publications</th>
<th>Grants</th>
<th>Patents</th>
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How to use the University Expertise Portal

Basic Search Results
Download results

131 Experts 2 Core Facilities

Your Search
Search experts by Publications
in All Michigan Universities

Search Terms
corrosion
How to use the University Expertise Portal

High Temperature Corrosion Laboratory
Nuclear Engineering and Radiological Sciences

Profile
- corrosion
- high temperature
- chemical degradation
- constant
- containment
- temperature
- environment
- equipment
- machine
- hydrogen embrittlement

Facility Information
The High Temperature Corrosion Laboratory was established to provide a facility to conduct experimental research on corrosion, stress corrosion cracking (SCC), and hydrogen embrittlement experiments in high temperature aqueous and gas environments. In particular, simulated light water reactor environments. The HTCL consists of six refreshed autoclave systems (titanium, inconel, or stainless steel construction), five mounted in constant extension rate (CERT) machines and one in a constant load machine.

Location

Similar Core Facilities
- Irradiated Material Testing Laboratory
  - University of Michigan, Nuclear Engineering and Radiological Sciences
How to use the University Expertise Portal

My Experts Request List

What is this?
The list below contains the experts and facilities you selected to contact.

Review and select/deselect the entries in the list to contact. Once you've reviewed your entries, either generate an email now or save your changes and continue browsing.

Experts

<table>
<thead>
<tr>
<th>Experts</th>
<th>Publications</th>
</tr>
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<tbody>
<tr>
<td>Susil K. Putatunda</td>
<td>Wayne State University</td>
</tr>
<tr>
<td>Gary S Was</td>
<td>University of Michigan</td>
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</tbody>
</table>

Facilities

<table>
<thead>
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<th>Facilities</th>
<th>University of Michigan</th>
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</thead>
<tbody>
<tr>
<td>High Temperature Corrosion Laboratory</td>
<td></td>
</tr>
</tbody>
</table>

You have selected experts and facilities from 2 different institutions. You must select at least one institution in order to generate an email.

Resulting institutions to contact *

<table>
<thead>
<tr>
<th>University of Michigan</th>
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</thead>
<tbody>
<tr>
<td>Michigan State University</td>
</tr>
<tr>
<td>Wayne State University</td>
</tr>
<tr>
<td>Western Michigan University</td>
</tr>
</tbody>
</table>
How to use the University Expertise Portal

Resulting institutions to contact *

- University of Michigan
- Michigan State University
- Wayne State University
- Western Michigan University

Your contact data

Name *

Your organization *

Email address *

Telephone number *

Please describe the challenge you are seeking expertise to address in your business *

You will receive a response to your inquiry within 5 business days.

Update List and Close

Generate email to send
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- Western Michigan University (WMU)
- University of Michigan-Ann Arbor (U-M)
- University of Michigan-Dearborn (UM-Dearborn)
Resources

MCRN – http://michigancrn.org/

University Expertise Portal –
http://www.experts.scival.com/RegionalPortal/mcrn/

Questions – JeffMason@urcmich.org
j.horon@elsevier.com
Q&A

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Email D.Calto@elsevier.com