



Puerto Rico
Science, Technology
& Research Trust

Technology Transfer Initiative

Benchmarking R&D Summary

November 2015

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**Puerto Rico Science, Technology and Research Trust
Technology Transfer Initiative**

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Introduction

The Puerto Rico Science, Technology and Research Trust (Trust) Technology Transfer initiative is aimed at designing, creating and implementing an agile and effective structure to foster the commercialization of locally developed scientific inventions and discoveries.

Through this initiative the Trust seeks to establish a Technology Transfer Office (TTO) that serves as an umbrella entity to move innovations from academia to the private sector. The goal of this Technology Transfer initiative is the creation of new products and companies, expansion of employment, and fueling economic activity in Puerto Rico.

Benchmarking

Benchmarking academic institutions and their technology transfer performance and opportunities requires a detailed understanding of three areas:

- research & development performance,
- technology transfer metrics, and
- the use of best practices

This benchmarking document represents research & development performance. Technology transfer metrics and the use of best practices are presented separately.

1. Benchmarking Comparative R&D Performance in Academic Institutions

Research and development expenditures are reported annually by each institution to the U.S. National Science Foundation and reported by the NSF National Center for Science and Engineering Statistics in an annual Higher Education Research and Development Survey. Only those individual campuses reporting to NSF are included. The latest data available is FY2013 (July 2013 - June 2014). Summary tables are presented that aggregate information for:

- University of Puerto Rico System (UPR) campuses
 - Mayagüez, Medical Sciences, and Rio Piedras
- Ana G. Méndez University System (SUAGM) campuses
 - Metropolitana, Turabo, and del Este
- Ponce Health Science University (PHSU)
- University Central del Caribe (UCC)

Four areas are benchmarked:

- R&D Expenditures: Five-Year Trends, by Source, by Field
- R&D Staffing
- Clinical Trials
- Publication Citation

2. R&D Expenditures for Higher Education Institutions in Puerto Rico

Research and development at institutions of higher education provide researchers with the funds necessary to pursue new knowledge, address specific or broad issues, and make that new knowledge and those solutions available to their scientific colleagues, the private sector, and the public.

To facilitate this transfer of knowledge, publication in academic journals and presentation at academic conference are encouraged and key to making the results widely available. As the result of the U.S. Bayh-Dole Act (Pub.L. 96-517, 1980) universities and their researchers have been incentivized to also transfer the results of federally funded research to the private sector through a technology transfer process that involves the protection (e.g., patenting) and licensing of intellectual property. As a result, technology transfer offices were established in universities and a new profession emerged that links science to business, with the goals of developing new products and processes and benefitting the public at large.

Key indicators of technology transfer potential are the funding level, source of funds, and field of funded research. Each indicator is presented in the following tables.

2.1. Five-Year Trends

Puerto Rico's universities compete with all U.S. universities for federal funds to support research programs. In 2013, Puerto Rico's universities spent¹ \$140 million on research and development, a 23% increase over a five-year period. Expenditures from the one-time American Recovery and Reinvestment Act of 2009 (ARRA) have decreased through 2013.

The public University of Puerto Rico System (UPR) consistently achieved the highest ranking, producing about 75% of all R&D expenditures at Puerto Rico's universities. In addition, its expenditures increased from \$97.9 million in 2009 to \$105 million in 2013, a 7% increase. The most rapid increases in R&D expenditures were from the Ana G. Méndez University System (SUAGM), from \$1.7 million to \$16.3 million, and the Ponce Health Sciences University (PHSU), from \$7.1 million to \$12.3 million, while Universidad Central del Caribe (UCC) showed a slight decline.

¹ R&D data is measured by "expenditures", i.e., the funds actually spent on research.

Puerto Rico Higher Education R&D Expenditures (2009-2013), ranked by FY2013 expenditures
(Dollars in thousands)

Institution	2009	2010	2011	2012	2013
University of Puerto Rico System	97,953	99,022	134,473	114,728	105,014
Ana G. Méndez University System	1,729	9,880	10,843	17,905	16,309
Ponce Health Sciences University	7,085	8,934	10,502	11,586	12,243
University Central del Caribe	7,484	7,122	7,515	7,313	7,095

The total and individual campuses and their rank among U.S. institutions are represented below.

U.S. Higher Education R&D Expenditures (2009-2013), ranked by FY2013 expenditures

(Dollars in thousands)

Rank	Institution	2009	2010	2011	2012	2013
	All Puerto Rico institutions	114,251	124,958	163,333	151,532	140,661
206	U. PR, Medical Sciences Campus	41,668	39,134	64,017	45,649	43,374
232	U. PR, Rio Piedras	31,592	30,515	32,582	33,099	29,234
233	U. PR, Mayaguez	20,991	26,475	34,424	32,115	29,225
307	Ponce School of Medicine and Health Sciences	7,085	8,934	10,502	11,586	12,243
353	U. Metropolitana	597	1,888	2,387	9,472	7,835
358	U. Central del Caribe	7,484	7,122	7,515	7,313	7,095
362	U. del Turabo	423	6,620	7,098	6,953	6,916
539	U. PR, Cayey	1,735	927	1,474	1,916	1,726
556	U. del Este	709	1,372	1,358	1,480	1,558
566	U. PR, Humacao	1,967	1,971	1,976	1,949	1,455

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

2.2. By Source

The source of funds is an indicator of the university's ability to compete among its peers, its linkages to its region, to businesses, and other non-profits. In addition, the funds expended by the institution itself can reflect research priorities and the financial commitments needed to compete with peers.

Of the total (\$140.6 million), Puerto Rico's institutions receive the majority (2/3 or \$92.2 million) of their R&D funding from the federal government through competitive grant processes, as do most U.S. universities, both public and private. As expected the UPR's share (\$66 million) represented the highest level and 63% of its total expenditures. In addition, it led in all other categories. **Of note are funds sourced from business (\$3.3 million or 2%) and the deviation from overall U.S. university performance, which is a challenge for effective technology transfer in Puerto Rico.** During FY2013, U.S. institutions expended \$3.5 billion (or 5%) sourced from business of the total \$67 billion in R&D expenditures.

Puerto Rico Higher Education R&D Expenditures, by source of funds FY2013

(Dollars in thousands)

Institution	All R&D expenditures	Federal government	State and local government	Institution funds	Business	Nonprofit organizations	All other sources
University of Puerto Rico System	105,014	66,017	3,640	29,574	3,329	2,042	412
Ana G. Méndez University System	16,309	8,945	0	7,364	0	0	0
Ponce Health Sciences University	12,243	11,251	992	0	0	0	0
University Central del Caribe	7,095	5,946	230	919	0	0	0

The total and individual campuses and their rank among U.S. institutions are represented below.

U.S. Higher Education R&D Expenditures, by source of funds FY2013

(Dollars in thousands)

Rank	Institution	All R&D expenditures	Federal government	State and local government	Institution funds	Business	Nonprofit organizations	All other sources
	All Puerto Rico institutions	140,661	92,159	4,862	37,857	3,329	2,042	412
206	U. PR, Medical Sciences Campus	43,374	31,037	2,582	7,119	1,490	1,146	0
232	U. PR, Rio Piedras	29,234	17,946	99	10,629	0	296	264
233	U. PR, Mayaguez	29,225	14,414	959	11,265	1,839	600	148
307	Ponce School of Medicine and Health Sciences	12,243	11,251	992	0	0	0	0
353	U. Metropolitana	7,835	7,226	0	609	0	0	0
358	U. Central del Caribe	7,095	5,946	230	919	0	0	0
362	U. del Turabo	6,916	747	0	6,169	0	0	0
539	U. PR, Cayey	1,726	1,168	0	558	0	0	0
556	U. del Este	1,558	972	0	586	0	0	0
566	U. PR, Humacao	1,455	1,452	0	3	0	0	0

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

2.3. By Field

The discipline, or field, of research is important to better understand where new knowledge may impact further research as well as present opportunities to link with a private sector partner with the ability to develop the discovery for a particular market.

The profile of Puerto Rico's institutions is not only characterized by the funding levels of various federal agencies, but also shows similarity to the average funding percentages of U.S. universities in 6 of 9 fields, for example:

- Life sciences represent 56% of the U.S. total and 53% of Puerto Rico's total.
- Environmental sciences represent 5% of the U.S. total and 8% of Puerto Rico's total.

While three fields show differences:

- Math and computer sciences represent 4% of the U.S. total and 1% of Puerto Rico's total.
- Physical sciences represent 7% of the U.S. total and 15% of Puerto Rico's total.
- Engineering represents 16% of the U.S. total and 9% of Puerto Rico's total.

In planning for technology transfer, the fields of life sciences, physical sciences, engineering, and environmental sciences provide the foundation for discovery and commercialization opportunities.

Puerto Rico Higher Education R&D Expenditures, by control and R&D field FY2013

(Dollars in thousands)

Institution	All R&D expenditures	Environmental sciences	Life sciences	Math and computer sciences	Physical sciences	Psychology	Social sciences	Sciences, nec	Engineering	All non-S&E fields
University of Puerto Rico System	105,014	11,655	53,995	1,294	15,558	1,709	1,989	2,541	12,607	3,666
Ana G. Méndez University System	16,309	30	1,736	403	5,178	58	179	40	476	8,209
Ponce Health Sciences University	12,243	0	12,243	0	0	0	0	0	0	0
University Central del Caribe	7,095	0	7,095	0	0	0	0	0	0	0

The total and individual campuses are represented below.

U.S. Higher Education R&D Expenditures, by control and R&D field FY2013

(Dollars in thousands)

State, institutional control, and institution	All R&D expenditures	Environmental sciences	Life sciences	Math and computer sciences	Physical sciences	Psychology	Social sciences	Sciences, nec	Engineering	All non-S&E fields
Puerto Rico	140,661	11,685	75,069	1,697	20,736	1,767	2,168	2,581	13,083	11,875
Public	105,014	11,655	53,995	1,294	15,558	1,709	1,989	2,541	12,607	3,666
U. PR, Cayey	1,726	53	0	0	205	0	173	1,295	0	0
U. PR, Humacao	1,455	0	158	0	1,294	0	0	0	0	3
U. PR, Mayaguez	29,225	7,517	3,463	981	3,841	0	205	0	12,034	1,184
U. PR, Medical Sciences Campus	43,374	0	43,374	0	0	0	0	0	0	0
U. PR, Rio Piedras	29,234	4,085	7,000	313	10,218	1,709	1,611	1,246	573	2,479
Private	35,647	30	21,074	403	5,178	58	179	40	476	8,209
Ponce School of Medicine and Health Sciences	12,243	0	12,243	0	0	0	0	0	0	0
U. Central del Caribe	7,095	0	7,095	0	0	0	0	0	0	0
U. del Este	1,558	0	1,241	0	0	58	179	40	0	40
U. del Turabo	6,916	2	88	0	0	0	0	0	476	6,350
U. Metropolitana	7,835	28	407	403	5,178	0	0	0	0	1,819

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

3. R&D Staffing

Funded research is conducted by a principal investigator(s) and supported by other personnel needed to accomplish the research program’s objectives. These others are technically qualified staff in the field and experienced in research instrumentation or protocols, or they may be graduate students involved in the research project or post-doctoral students on a limited term appointment following their degree.

In Puerto Rico there were 2,258 university personnel involved in R&D during FY2013. As expected, UPR represents nearly 60% of the total, and over 80% of principal investigators. Of the total, **511 were principal investigators that represent a cadre of researchers that may have opportunities to participate in the technology transfer process. Further, the 48 postdocs represent an opportunity to engage in new entrepreneurial efforts.**

Effective technology transfer requires faculty researchers who have an understanding of related institutional policies and practices, the ability to recognize discoveries that might have commercial potential, and the desire to participate, and the confidence in working with technology transfer professionals.

Puerto Rico Higher Education R&D Headcount, by control FY2013

Institution	All personnel			
	Total	Principal investigators	Other personnel	Postdocs ^a
University of Puerto Rico System	1,336	420	916	45
Ana G. Méndez University System	609	29	580	0
Ponce Health Sciences University	193	27	166	1
University Central del Caribe	120	35	85	2

The total and individual campuses are represented below.

U.S. Higher Education R&D Headcount, by control FY2013

State, institutional control, and institution			All personnel			
			Total	Principal investigators	Other personnel	Postdocs ^a
Total			2,258	511	1,747	48
Puerto Rico	Public	U. PR, Cayey	68	8	60	1
		U. PR, Humacao	18	10	8	0
		U. PR, Mayaguez	375	279	96	4
		U. PR, Medical Sciences Campus	258	95	163	13
		U. PR, Rio Piedras	617	28	589	27
	Private	Ponce School of Medicine and Health Sciences	193	27	166	1
		U. Central del Caribe	120	35	85	2
		U. del Este	56	8	48	0
		U. del Turabo	99	12	87	0
		U. Metropolitana	454	9	445	0

* Postdocs are included in totals reported for all personnel. Postdocs are personnel with doctoral degrees generally awarded within the last 5 years and who are working for an institution under a limited-term appointment for training in research.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

4. Clinical Trials

Two campuses reported clinical trials in FY2013: UPR Medical Sciences Campus and the Ponce Health Sciences University. Clinical trial capability does not intersect with technology transfer, but it does reflect capabilities in research services, clinical monitoring, and project management.

U.S. Higher Education R&D Expenditures, by institutions reporting clinical trials FY2013

(Dollars in thousands)

State, institutional control, and institution			Total		Federal		Nonfederal	
			All R&D expenditures	Clinical trials	All R&D expenditures	Clinical trials	All R&D expenditures	Clinical trials
Puerto Rico	Public	U. PR, Medical Sciences Campus	43,374	3,652	31,037	3,593	12,337	59
	Private	Ponce School of Medicine and Health Sciences	12,243	675	11,251	0	992	675

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

5. Publication Citation Map

An additional indicator of technology transfer potential can be shown in research publication productivity and publication citations. The SCImago Journal & Country Rank is a portal that includes the journals and country scientific indicators developed from the information contained in the Scopus® database (Elsevier B.V.). These indicators can be used to assess and analyze scientific domains and visibility of the journals contained in the Scopus® database from 1996.

A review of publication co-citation references from 2011-2012 for Puerto Rico (attached)² shows distinct patterns of strong publication productivity/citation clusters:

- **Medicine: including biochemistry, genetics, and molecular biology**
- **Physics and Astronomy**
- **Agricultural and Biological Sciences**
- **Engineering and Materials Science**

The protection of intellectual property (IP) is fundamental in attracting private sector businesses, entrepreneurs and investors. Businesses (licensees) desire a competitive advantage through a license that transfers rights to exploit the IP. Without IP protection, discoveries and inventions may be publicly available through publication in journals, presentations at conferences, or other methods of public disclosure.

The goal of a technology transfer office is to work closely with researchers to facilitate timely disclosure of potential inventions. There are three keys to an effective relationship:

- Educate researchers about how to recognize a research discovery and when to disclose the findings to the technology transfer office.
- Synchronize the filing of IP protection/patents so as not to impede the researchers ability to publish.
- Build confidence in the researchers the technology transfer process will be robust, unbiased, and timely.

² SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved May 25, 2015, from <http://www.scimagojr.com>

Attachment

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