

**Economic development by the Indiana University  
Pervasive Technology Institute, Pervasive Technology  
Labs, and the Research Technologies Division of  
University Information Technology Services during FY  
2013/2014**

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## **Executive Summary**

The Pervasive Technology Institute (PTI) continued focusing on technology transfer and economic growth during 2013-14. During this report period, researchers in PTI brought in over \$8 million in external funding.

The Pervasive Technology Institute is now at the end of 15 years of Lilly Endowment support, starting in 1999 with the initial Indiana Pervasive Computing Research Initiative (IPCRES) grant award from the Lilly Endowment. This grant award funded the creation of the Pervasive Technology Labs and also funded acceleration of hiring within the School of Informatics and Computing. In 2008 a second award funded the evolution of the Pervasive Technology Labs in to the Pervasive Technology Institute.

PTI has brought in a total of more than over \$136 million in grants and contracts. This exemplifies the quality of research being conducted by both the research and cyberinfrastructure centers on an on-going basis. During FY 13/14, PTI brought in over \$8M in external grants and contracts.

When PTI was formed in 2008, building on the foundation of PTL, one of the goals was to create an engine of innovation and creative activity centered on technology and software products. Creation of this hub has allowed Indiana University (IU) and the state of Indiana to grow and prosper and be recognized as leaders in research and development in this sector. As one example of national leadership, PTI has a critical role in the NSF-funded eXtreme Digital (XD) program, playing key leadership roles within the eXtreme Science and Engineering Discovery Environment project, as well as contributing leadership class resources; FutureGrid and Mason to the XD/XSEDE program. Since 1999 IU has received a total of \$25M in funding from the NSF for its involvement in the XD Program (XSEDE, FutureGrid, and the predecessor organization TeraGrid). Research of the caliber primes the pump and sets IU and the state on a path of national recognition and subsequent success.

PTI has played a strong role in economic development in the state. As of June 30 2014, PTI employs 42 FTE academic and professional staff funded by grants and contracts. Since the start of the IPCRES grant in 1999, PTI and its predecessors have added 2,094 full time job-years to the Indiana economy through grants and contracts, or the equivalent of 149.60 full time jobs over the past 14 years. (Where a job year is one full time job funded for one year). This impact is calculated using an economic model that accounts for direct and indirect effects of external funding on jobs creation both within IU and the state. High quality jobs created in the Indiana economy were a direct outcome of this funding.

PTI efforts have resulted in the creation of two patents to date, helped create and aid businesses started in and operating in Indiana, and achieved a clear place for Indiana University as a national leader in the development, deployment, and support of new computer science, cyberinfrastructure, and information technology developments.

PTI accomplishments during the reporting period:

*Inventions, patents, licenses and strategic partnerships*

- IU, through PTI, is for the first time in possession of a patent for new information technology developments. Dr. Andrew Lumsdaine received a patent on sparse matrix technology – US patent number US20070198621 A1. This technology will be licensed by Indiana University Research and Technology Corporation (IURTC).
- During FY 2014, The Pervasive Technology Institute submitted 17 invention disclosures to IURTC, primarily focused on software development. We continue to partner with the Apache Software Foundation to release open source software used in workflows on advanced national computational resources. This partnership allows us to leverage community development, thus allowing IU to encourage broader participation and sharing of best practices, a new and sustaining approach to producing software.

*Status of Companies created with investment of PTI Capital Investment Fund*

- Chartlogic (<http://www.chartlogic.com/>) continues to operate as a viable business, with IU continuing to be a shareholder from the original PTI Capital Fund investment. This company creating new tools and systems for management of electronic medical records.

*Direct aid to Development of Indiana businesses*

The Pervasive Technology Institute has played an important role in attracting and partnering with companies in Indiana. Here are some key companies now operating in Indiana, some employing state graduates as a direct result of PTI:

- PTI and the School of Informatics and Computing played a strong and direct role in attracting Cigital, Inc. to open an office in Bloomington IN. Cigital (<http://www.cigital.com/>) is a market leader in cybersecurity, with the Bloomington office staffed with 19 employees. The IU relationship with Cigital was cultivated by the former PTL Science Director Dennis Gannon. Cigital's CTO received a Ph.D. at IU and launched his business in the state. (The press release announcing Cigital's office in Bloomington is online at <http://www.cigital.com/press-release/cigital-hosts-open-house-event-to-launch-new-bloomington-office/>.) The local Bloomington office employees are roughly half IU graduates, the majority holding Bachelor's degrees or higher. Most are individuals who came to IU from outside the US and are staying here after completing their studies. Cigital expects to continue hiring staff.
- ChalkLabs, LLC is a small company based in Bloomington, IN started by former students of IU Professor Katy Borner, who received funding through the original IPCRES grant to IU via a PTL fellowship award. This company creates report-generating software and reports. There are now a total of nine employees of this company, surviving the process of being an early startup for over four years, the company is stabilizing. There are a total of seven employees of Chalklabs . Two of the founders are former students and staff of Katy Borner, SOIC faculty member and a PTI affiliate. They are Indiana residents, one of whom has a MS degree from IU in informatics, the other a Ph.D. candidate and a faculty member from SOIC.

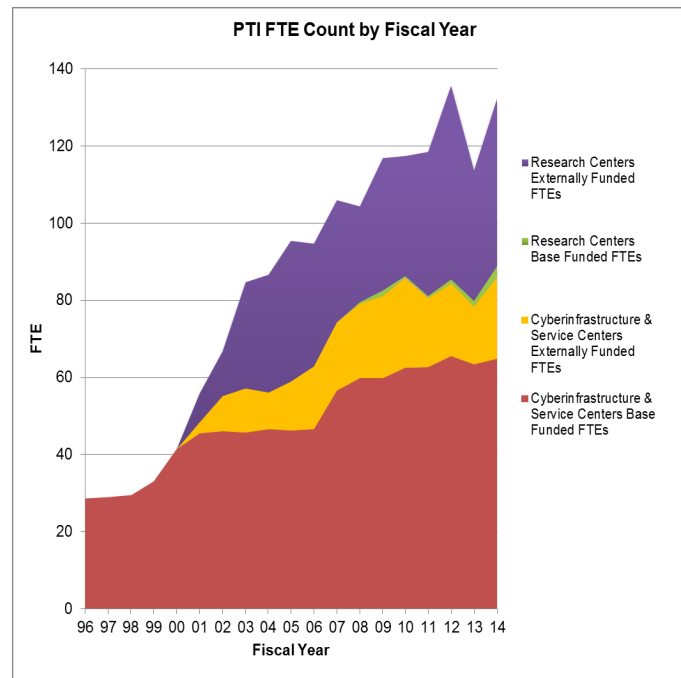
*Pervasive Technology Institute summary of economic development activities FY  
2013/2014*

- Precise Path Robotics (<http://www.precisepath.com/>) is the outcome of a collaboration between Scott Jones and PTL/PTI staff. Precise Path Robotics (<http://www.precisepath.com/>) engineers build and sell robotic lawn mowers. These lawnmowers use software that evolved from PTL contributions to the IndyRobotics entry in the DARPA autonomous vehicle contest. Precise Path Robotics has more than 16 employees in Indiana and seems to be on a path to becoming a vibrant Indiana-based business. The staff of Precise Path Robotics are primarily Indiana residents.
- Our partnership with Cummins Engine Company continues to be strong and important to their technology development related to piston engine design, running simulations on IU's Big Red II supercomputer.
- Work has been conducted on IU's Big Red II supercomputer to test an experimental version of the Convergent Science, Inc. CFD application. This testing takes advantage of the GPU accelerators in Big Red II to allow the company to expedite production of the CFD.

*Job Creation*

- PTI has aided south-central Indiana by winning grant awards that bring money into the area and create jobs.
- As of June 30, 2014, there were 42 staff members employed in PTI whose positions are funded by grant and contract external funding. As demonstrated by the graph below, employment continues to increase overall in the research and cyberinfrastructure PTI centers.
- Another view of job creation can be had through use of the economic models that include direct and indirect expenditures of grant monies within Indiana. An economic model recommended by the Indiana Business Research Center, used carefully and conservatively, suggests that \$136 million in grants awarded to or enabled by PTI and its collaborators have facilitated the creation of 2,094 full time job-years of employment in the state of Indiana.

*Pervasive Technology Institute summary of economic development activities FY  
2013/2014*



**Figure 1: PTL/PTI Staffing Graph 1996 - 2014.**

*Conclusion*

The Pervasive Technology Labs (PTL), Pervasive Technology Institute (PTI), and their collaborators, aided by and working with IURTC and the Indiana government, have contributed substantially and meaningfully to economic growth and job creation in Indiana. The Indiana economy is now rebounding from the 2008 economic downturn. IU's Pervasive Technology Institute contributed to sustaining and growing jobs in the state during the past decade, a time when jobs were disappearing in the state and nation. IU is committed to building a 21<sup>st</sup> century workforce through its education and research mission. This commitment will enable the state and nation to prosper and innovate with a well-educated workforce well into the future.

*Acknowledgments*

Indiana University thanks the Lilly Endowment for its foresight, its belief in the value of information technology and informatics innovations created by Indiana University, and its dedication to IU and Indiana. This dedication is tangibly evident in the generous award of two grants to Indiana University to create the Pervasive Technology Labs and support PTL's evolution into the Pervasive Technology Institute. We also thank the faculty, staff, and students of the Pervasive Technology Institute who work with insight and diligence to ensure that their innovations matter in practice, particularly to the residents of the State of Indiana.