Indiana's Life Sciences Industry: 2002-2010

Tracking Progress and Charting the Course for Continued Success

Walter H. Plosila, Ph.D.
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Executive Summary

Introduction

This report represents an assessment of where Indiana stands nationally in the life sciences industry as of December 2010. The report also documents progress Indiana has made in this dynamic industry since the original report identifying Indiana's life sciences strengths, opportunities, and challenges, was issued in February 2002 (***Life Sciences: A 21st Century Economic Driver for Central Indiana***, **Battelle**). Further, this report suggests a set of challenges Indiana faces in the coming decade. Dr. Walter H. Plosila authored the original 2002 Report as well as the current edition.

In order to assess the progress made to date and in support of BioCrossroads' ongoing goals to create a comprehensive source of information on Indiana's life sciences sector, BioCrossroads partnered with the Indiana Business Resource Center at the Kelley School of Business, Indiana University (IBRC). Data was gathered on agricultural feedstock and chemicals; medical devices and equipment; drugs and pharmaceuticals; research, testing and medical laboratories; and health information technology (HIT) sub-sectors. Where appropriate, the IBRC data took a deeper look into the medical devices and equipment subsector to highlight Indiana's outsized share of that growing industry. IBRC used data sources including secondary data from publicly available sources and conducted a survey of Indiana life sciences companies. This data has been supplemented with additional data and information collected from BIO and Battelle.[i]

Although Battelle's 2002 Report identified a strong and growing information technology industry in Indiana with signs of potential strength and applicability to life sciences, HIT is not one of the four primary life sciences industries tracked by BIO and Battelle. Therefore, HIT data are not represented in all sections of analysis. Indiana has been recognized nationally as a leader in HIT and BioCrossroads has taken proactive steps to define the industry and organize its assets around this emerging sector. Where possible, the HIT data collected through BioCrossroads' work with IBRC is incorporated into this report's analysis.

This report covers the three key anchors for a thriving life sciences industry: talent, capital and technology. To fully explore these critical components, the report starts with a summary of findings and conclusions from the 2002 Report and is then organized into four parts to fully assess Indiana's progress to date and identify future challenges.

- Part I of the report provides an overview of the Indiana life sciences landscape and explores industry and higher education assets statewide. Data are presented on jobs, growth in jobs, industry concentration and specialization, wages, characteristics of key industry segments, geographical coverage, and occupational and other workforce information.
- Part II provides a summary of accomplishments and progress in the life sciences since 2002 organized around five common groupings: (l) Innovation & Entrepreneurship; (2) Capital Availability; (3) Talent Pool; (4) Business-Higher Education Partnerships; and (5) Maturing Life Sciences Clusters.
- Part III covers prospects for the state's future in the life sciences and summarizes the result of a recent survey of the Indiana life sciences industry, including industry identification of success factors in Indiana, current challenges and issues facing the industry in the future.
- Part IV provides an overview of challenges that Indiana must address if this growing sector is to sustain and achieve its economic potential.

Summary of Findings from the 2002 Report

The 2002 Report asked if Indiana could raise the level of its life sciences core competencies to be a national and global leader in key areas of life sciences. To answer that question, the report suggested several specific challenges which would need to be addressed. These included:

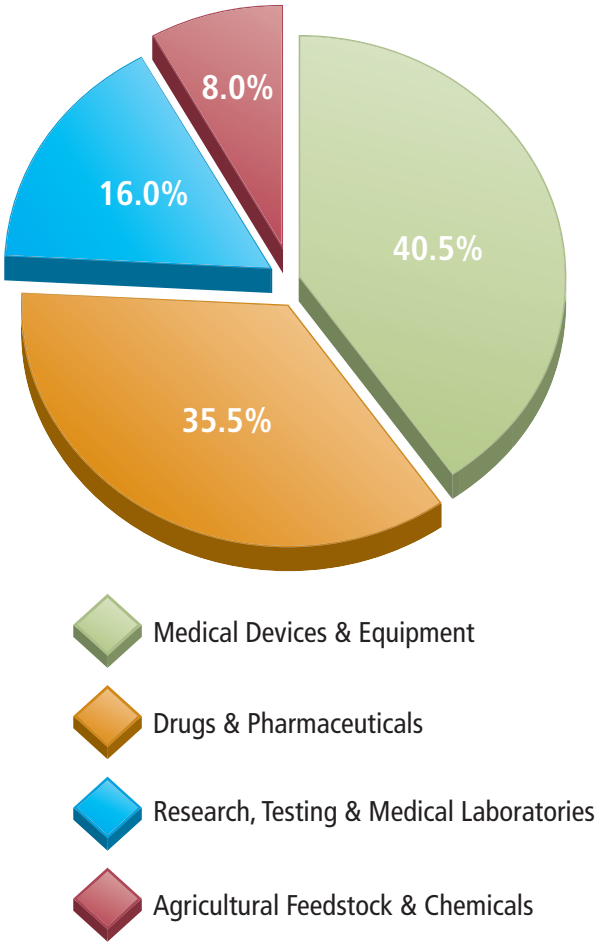
- Creating stronger industry-university-government partnerships;
- Ensuring continued, focused investments in key areas of life sciences research;
- Generating a climate more supportive of entrepreneurship and new business start-up companies;
- Ensuring venture capital at all stages;
- Addressing the lack of specialized facilities and need for technology parks;
- Educating, retaining and attracting a skilled life sciences workforce;
- Raising the recognition of the region and state's position.

This review has found considerable progress in addressing each of these seven challenges. The results are documented in this report and are found in the growing maturity of Indiana's life sciences landscape. Indiana has seen growth and maturity in the life sciences sector in terms of the number and variety of jobs, firms, investment and in a critical mass of research, development, patents, and technologies.

Key Factors Enabling Future Progress Beyond 2010

Altogether more than 50,000 workers across 825 establishments were found in the primary life sciences industries in Indiana in 2009. Each of the primary sectors of life sciences, as defined by BIO and Battelle, is represented in the state. Medical devices and equipment stands as the largest sector, with nearly 20,300 employees, followed by drugs and pharmaceuticals, with nearly 17,800 employees. Agricultural feedstock and chemicals employ more than 4,000 workers. Research, testing and medical laboratories employ nearly 8,000 people. The life sciences offer Indiana the opportunity to pursue a true high tech corridor cluster reaching many parts of the state.

Composition of Indiana's Life Sciences Industry



The following key factors found in Indiana's life sciences industry give the state its competitive advantage and enable organizations like BioCrossroads to leverage the foundational strengths of the cluster for future growth:

Highly Specialized

Indiana is much more specialized than the rest of the nation in three of the four segments of the life sciences: drugs and pharmaceuticals, medical devices and equipment, and agricultural feedstock and chemicals – one of only five states in the U.S. so specialized. For perspective, a location quotient ("LQ") greater than 1.20 denotes employment specialization significantly above the national average. Indiana has specialized and concentrated employment in the life sciences; it has a location quotient of 1.72, the third highest state in the United States, behind only New Jersey and Massachusetts.

Economic Specialization of Life Sciences Industries in Indiana: 2009 LQ

- **2.79 for Drugs & Pharmaceuticals**
- **2.22 for Medical Devices & Equipment**
- **2.07 for Agricultural Feedstock & Chemicals**
- **0.66 for Research, Testing & Medical Laboratories**

Highly Compensated

Indiana life sciences workers, on average, have a wage differential which pays them more than twice the average private sector job in the state – nearly $81,000 compared to $38,100 – a differential of $42,900.

Strong Research Universities

Total academic life sciences research from all sources in Indiana stands at more than $511 million, representing more than 53.6% of total university research in Indiana in 2008 (most recent year for available data). Indiana University and Purdue University combined offer a powerful research engine, having together spent $2.75 billion in life sciences-related R&D in the period 2004 to 2008. The National Institutes of Health (NIH) – the gold standard to measure the competitiveness of Indiana's research universities and private research institutes – finds a total growth rate of NIH funds from all sources in Indiana of 25% compared to a national increase of 11% between 2008 and 2009, when Federal stimulus funds are included.

Skilled Workforce

Indiana is a major generator of life sciences graduates. More than 3,200 Indiana students graduated with a life sciences-related post-secondary degree in 2008. Two-thirds were bachelor-level degrees, and of those, approximately 1,600 were B.S. degrees in biological sciences.

Positive Business Climate

A large number of new life sciences firms have formed since 2004 in Indiana. A total of 220 life sciences start-up companies occurred in this time period, or an average of 44 per year. This is a dramatic turnaround in a state whose numbers for overall entrepreneurial activity generally rank very low among the 50 states.[ii]

Strong Philanthropic Support

Over the past decade, Indiana life sciences research universities and related institutes have received over $600 million in major philanthropic grants, for building research capabilities of relevant and strategic importance to the sector, from leading local foundations including the Lilly Endowment Inc., the Eli Lilly and Company Foundation, the Regenstrief Foundation and the Richard M. Fairbanks Foundation.

Strong Public-Private Partnerships

Since 2002, Indiana has been a leader in developing novel public-private partnerships to establish privately managed venture capital funds. To date, BioCrossroads has raised more than one-quarter billion dollars for life sciences opportunities. Also through BioCrossroads, Indiana has launched eight new sustainable enterprises to advance signature life sciences strengths, and elevated Indiana's national visibility in the areas of biotechnology, medical devices and HIT.

Access to Capital

Indiana has held steady in terms of private venture capital invested in life sciences enterprises within Indiana. Over this six-year period, $277 million was invested in Indiana life sciences firms, ranking Indiana 26th nationally in terms of life sciences-related venture capital financing.

Cluster Maturity

The Hoosier state has shown considerable progress over the last decade by forming a strong set of life sciences cluster industries, anchored by drugs and pharmaceuticals; medical devices and equipment; and agricultural feedstock and chemicals. And the fourth segment – research, testing and medical laboratories – is showing emerging potential. Battelle's 2002 Report laid out the challenges facing Indiana in building a stronger set of life sciences cluster industries and posited a set of success factors to be addressed to accomplish that objective. This review shows a strong quantitative success story – in terms of industry concentration, specialization, export growth, patents, and business start-ups/expansion/acquisition that indicates Indiana has moved a considerable distance toward meeting those 2002 challenges.

Through the efforts of BioCrossroads, and in collaboration with many other groups from philanthropy to universities and industry leaders, many of the factors for success have been and continue to be addressed. Indiana has labored to improve access to a venture capital industry focused on life sciences, address education and workforce issues to ensure an adequate future workforce, find ways to increase the stability of a strong existing cluster – orthopedics – through a newly created consortium, and identify the next set of business opportunities that build on Indiana's existing strengths including health information technology, contract manufacturing, and pharmaceutical distribution and logistics.

Indiana has been identified as one of the nation's innovation cluster success stories. In 2002, there was a lack of recognition both in and outside of Indiana of the strength and scale of life sciences. Today, life sciences is seen as a way to further diversify Indiana's economy from durable traditional manufacturing of the industrial age to a broader, technology-driven set of key industries of the future. Indiana has gained significant ground in terms of hard numbers as to jobs, firms, exports, and other wealth generation data. Indiana has continued to grow its life sciences industries in spite of the severe national and global recession of the last several years. Indiana is very close to becoming one of two states in the U.S. (the other being California) to have both a specialized and large employment base in three of the four subsectors of the life sciences: drugs and pharmaceuticals, medical devices and equipment, and agricultural feedstock and chemicals. Should this happen, Indiana can adopt the motto of the Life Sciences Super Cluster State.

This has all been accomplished because the life sciences industry has seen Indiana as a place to invest and grow. And the investment numbers demonstrate this has been happening continuously throughout the past decade.

Indiana's life sciences cluster maturity can be examined and assessed in four different ways:

1. Patents

The number of life sciences-related patents issued within a state provides an indicator of the relative strength and innovation of that industry. From 2004 to 2009 more than 1,900 life sciences-related patents were issued to Indiana assignees. And 2009 was the most active year since 2004, with 378 patents awarded. Indiana stands out in its share of biotechnology patents with 6.1% of all U.S. biotechnology patents for the time period 2004 to 2009.

2. Attracting and Expanding Life Sciences Firms and Jobs

From 2005 to 2010, the Indiana Economic Development Corporation (IEDC) reports Indiana obtained an estimated 14,500 life sciences job commitments and nearly $1.8 billion of projected capital investment from life sciences companies.

Table 1

Indiana Life Sciences Attraction/Expansion Projects: 2005-2010

Source: IEDC

Subsector	5-year Total Job Commitments	5-year Total Investments (millions)
Agricultural Feedstock and Chemicals	682	$345.3
Pharmaceutical Distribution	4,557	$224.4
Healthcare Services	553	$15.3
Medical Devices and Equipment	4,343	$433.0
Drugs and Pharmaceuticals	1,924	$403.3
Research, Testing and Medical Laboratories	2,451	$338.1
Total	14,510	$1,759.4

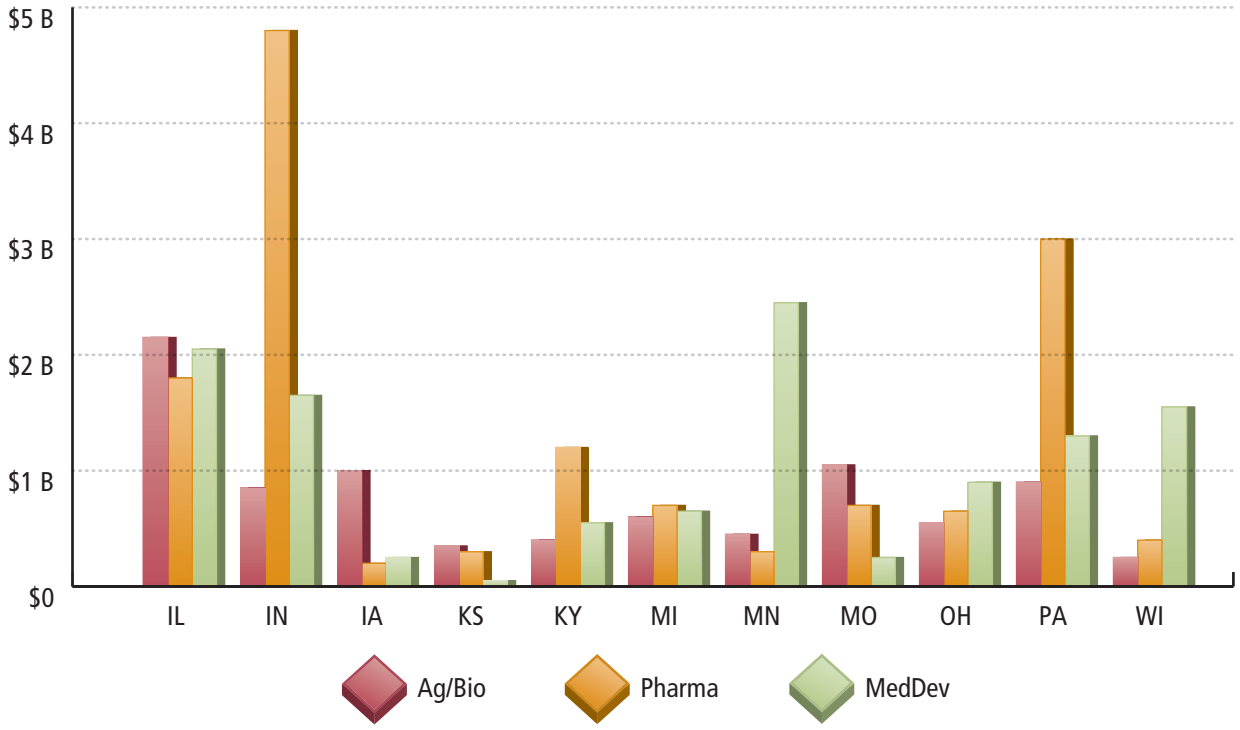
3. Growing Competitiveness in Life Sciences Exports

The life sciences industry is indeed a global business with global competition. Overall, the total value of Indiana's life sciences exports nearly tripled between 2002 and 2009 from $2.5 billion to $7.4 billion, ranking Indiana third highest among all the states, behind only California and Texas.

Figure 1

2009 Exports by Sector

Source: IBRC



4. Success in Identifying and Building New Life Sciences Niches for Economic Growth and Innovation Excellence

Indiana has identified, organized, and grown several relatively unique market niches for its life sciences clusters, in each case built around existing strengths. These niches include health information technology, biopharmaceutical contract services, orthopedics, and pharmaceutical distribution and logistics. These four distinctive markets build on Indiana's existing industry expertise and skilled workforce, the research capabilities of its universities and the caliber and types of graduates from its higher education institutions. They also take advantage of multiple cross-cluster strengths in new and different ways.

Economic Impact of Indiana's Life Sciences Industry

Indiana's more than 50,000 life sciences jobs give rise to another 105,000 jobs – for a total of 155,000 jobs, with an overall economic impact of $44 billion on the Indiana economy. This is an important and significant way to help address Indiana's future economic prosperity, offering good, well paying jobs directly but then having an overall multiplier effect on Indiana's economy of 2.7 indirect jobs for every direct job created in the life sciences industry. Meaningful concentrations of these jobs are broadly distributed throughout the state.

Table 2

Economic Impact Indicators (2009)

Source: IBRC using IMPLAN

Sector	Direct	Ripple Effect	Total	Multiplier
Employment				
Total	50,002	105,500	155,502	3.7
Ag/Biotech	4,002	24,000	28,002	7.0
Pharma	17,760	46,500	64,260	3.6
Med Devices	20,264	28,800	49,064	2.4
Research Labs	7,976	6,200	14,176	1.8
Output (millions)				
Total	$26,833	$16,840	$43,673	1.7
Ag/Biotech	$7,180	$4,700	$11,880	1.7
Pharma	$12,286	$7,300	$19,586	1.6
Med Devices	$6,244	$4,100	$10,344	1.7
Research Labs	$1,123	$740	$1,863	1.7

Key Components to a Growing Life Sciences Industry

BioCrossroads and other organizations supporting the growth of Indiana's life sciences industry have made considerable progress during the past decade to position Indiana as a leader in this growing global industry. However, if Indiana is to maintain and further grow its life sciences cluster industries, it will need to:

- Recognize major changes await the U.S. life sciences industry in the coming decade and ensure that Indiana seizes opportunity without losing its strong base;
- Find additional ways to assist the Warsaw-based orthopedics sector through successful implementation of collaborative approaches and mechanisms;
- Address the imbalance in degreed vs. high school-only education of the life sciences workforce in face of increasingly higher skills required of the life sciences industries of the future;
- Address ways to fill the ever-widening seed/early stage capital funding gap to further grow Indiana's life sciences industries of the future;
- Lead the charge in forging new and stronger strategic partnerships of the Indiana life sciences industry, medical centers and universities to form comprehensive discovery-to-product-development approaches and mechanisms;
- State and local government should manage limited resources wisely but, where possible, encourage incentives to the private sector to help address gaps that could impede the growth of the state's life sciences industry; and
- Advocate for national policies and investments which both protect Indiana's existing life sciences clusters and further its competitiveness in face of increased global competition.

These seven areas address the three key components necessary to sustain a growing life sciences industry: talent, capital and technology. The full report describes the sector and Indiana's role in it, addresses progress made since 2002, identifies current and future challenges and provides a rationale for each of these seven areas of challenge and opportunity.

Conclusion

Battelle's 2002 Report laid out the challenges facing Indiana in building a stronger set of life sciences cluster industries and posited a set of success factors to be addressed to accomplish that objective. This review shows a strong quantitative success story – in terms of industry concentration, specialization, investment, export growth, patents, business start-ups/expansion/acquisition and other measures. Cumulatively this shows the considerable distance Indiana has moved both to address these challenges and emerge as a national center in the life sciences.

Many of the factors for success have been and continue to be addressed – improving access to a venture capital industry focused on life sciences; addressing education and workforce issues to ensure an adequate future workforce; finding ways to address strong existing clusters – e.g. orthopedics – through a newly created consortium; and identifying the next set of opportunities, building on Indiana's existing strengths in emerging areas such as health information technology, contract manufacturing, and pharmaceutical distribution and logistics.

Indiana has demonstrated how to build a set of stronger clusters through creation of an ongoing catalytic organization – BioCrossroads – and sticking to a game plan over a multi-year time period. Most importantly, this has been accomplished because the life sciences industry has seen Indiana as a place to invest and grow. Partnering industry, academe, government and the philanthropy sector has helped to achieve Indiana's successes. Such partnerships will need to continue and expand in the future to meet the next set of challenges for Indiana.

Summary of Findings & Conclusions:

2002 Indiana Life Sciences Strategic Framework Report (Battelle)

The 2002 Battelle Report identified life sciences as a major opportunity to grow and further diversify Indiana's economic base, from durable manufacturing to more value-added technology sectors including the life sciences. This report was an outgrowth of Battelle's original report to the Central Indiana Corporate Partnership (CICP) identifying the clusters in which Central Indiana could further grow its economy, including life sciences, information technology, advanced manufacturing, and logistics. Outlined below is a summary of what the 2002 Report suggested as ways for Indiana (specifically Central Indiana) to move forward in the life sciences. While the data used in the 2002 Report was for the 15-county Central Indiana region, and the data for this 2011 Report are statewide, it is still useful to highlight directions proposed in 2002. The recommendations for growth were similar for both Central Indiana and the state as a whole, given the high proportion Central Indiana life sciences represented of the state's entire life sciences industry. The expanded data footprint of this report is also indicative of BioCrossroads' evolution since 2002 from a primarily Central Indiana-focused initiative to the comprehensive statewide life sciences initiative that it is today.

The 2002 Report found that life sciences represented a key core activity for future economic growth in Indiana. Central Indiana in 2002 demonstrated a strong and improving position in the life sciences, as exemplified by:

- The region had a broad presence of life sciences industries found across the Bloomington-Indianapolis-West Lafayette corridor, with particularly high concentration in pharmaceutical and medical device industries.
- The life sciences industry in Central Indiana generated substantially higher average earnings than typically found in Central Indiana.
- The region had a growing and diverse research base, standing as one of only 23 regions with more than $200 million in funded research expenditures. Life sciences research was the largest area of research for the region comprising more than 50% of all university research dollars.
- The region had opportunities in many of the high potential emerging life sciences areas based on its strengths in bioinformatics, genomics/proteomics, bioengineering and plant and animal sciences.

The 2002 Report identified life sciences as a deserving area of focus and a key underlying driver of an increasingly technology-driven economic future for several reasons:

- The life sciences were a major, cross-cutting sector of the economy involving a range of manufacturing, service and research activities. Many industries were involved in the life sciences from drugs, medical devices, health services, research and testing and agricultural-related industries and other key supplier and component manufacturing industries.
- The life sciences represent a mix of high growth industries that could be an important economic driver for communities, but also industries that are more stable over the ups and downs of business cycles.
- The life sciences offer employment opportunities well beyond Ph.D.s and medical doctors, with the highest share of employment found in production and technician positions.
- A key for life sciences success is the presence of strong research drivers. Indiana could provide the substantial research depth needed to support the life sciences, because of a concentration in private, public, and non-profit research organizations.
- Life sciences were also becoming a focal point for the convergence of technologies because advanced manufacturing is essential for the development of innovative products such as artificial joints, non-invasive surgery techniques and information technology critical for mining the wealth of genomic data being generated for drug discovery and diagnosis. These strengths in advanced manufacturing and information technology were present and growing in Indiana, augmenting the opportunities in the life sciences.

The 2002 Report identified a number of emerging market opportunities in which Indiana's life sciences research and industry base was positioned to potentially benefit. Among those areas identified in 2002 were:

- **Bioinformatics and Health Informatics**
- **Proteomics**
- **Outsourced drug discovery**
- **Wound care**
- **Orthopedic products**
- **Micro-Electro-Mechanical Systems (MEMS)**
- **Home Healthcare**

The 2002 Report noted that Indiana was well positioned in many of these exciting new areas of life sciences, particularly new drug discovery involving genomics, proteomics and bioinformatics, bioengineering involving tissue engineering and medical devices, and plant and animal sciences. As will be seen, Indiana has recognized and is now building strong industry niches in the areas of health informatics (health information technology) and outsourced drug discovery (contract research organizations) and has global leadership in orthopedic products.

The 2002 Report asked if Indiana could raise the level of its life sciences core competencies to be a national and global leader in key areas of life sciences. To answer that question, the 2002 Report suggested in the years ahead the region and state would need to address seven specific challenges. These included:

- Creating stronger industry-university-government partnerships that bring the key participants together to address life sciences development.
- Ensuring continued, focused investments in key areas of life sciences research to have the region and state be among the national leaders.
- Generating a climate more supportive of entrepreneurship and new business start-up companies that leverage the life sciences research base and industry anchors found in the region and state.

- Ensuring venture capital at all stages from pre-seed to later rounds of investment is available to support the growth of life sciences companies.
- Addressing the lack of specialized facilities and need for technology parks to create more of a sense of critical mass and identity for the life sciences cluster.
- Educating, retaining and attracting a skilled life sciences workforce to Indiana, across the range of skills needed.
- Raising the recognition of the region and state's position and commitment to developing its life sciences cluster.

The 2002 Report ended with this statement:

So Central Indiana stands at a crossroads. It has the assets to be a major player in the sizable, broad-based and growth-oriented field of the life sciences, but time is of the essence. The competition is not standing still and Central Indiana cannot afford to sit on the sidelines and not pursue investments. A coherent, comprehensive, integrated action agenda needs to be implemented to ensure success.[iii]

The remainder of this report will identify the progress Indiana has made and the results accomplished implementing this life sciences action agenda since 2002.

I. Indiana Life Sciences Landscape:

Industry & Higher Education Overview

Life Sciences Stands as a Major, Cross-cutting Sector of the Nation and Indiana's Economy

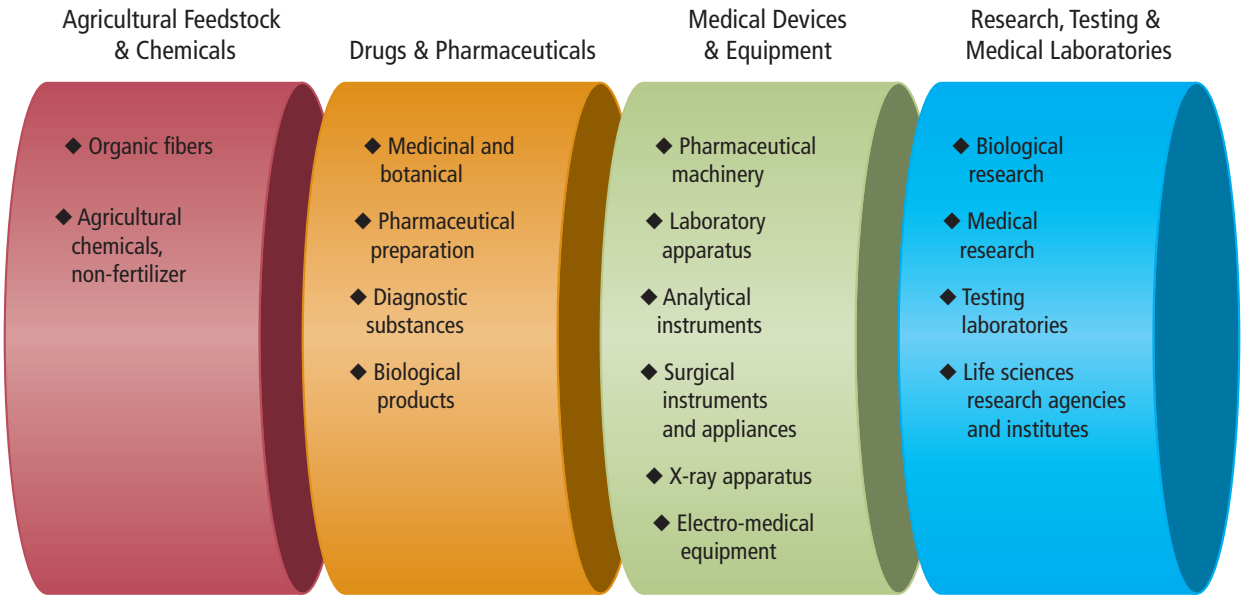
Life sciences represent a major slice of Indiana's and the nation's economy, reaching into a significant and vast array of industries from drugs to medical devices to clinical care to agriculture sciences to research and testing. What is common across these industries is the application of biological knowledge and processes.

The life sciences not only cut across different markets, but also range across manufacturing, services and research activities. U.S. employment in the life sciences is growing, and reached 1.42 million jobs in 2008 (the last year for which national data are available), up from 1.3 million jobs in 2006, a growth rate of 1.4%, and while overall private sector employment nationally declined by 0.7%. When economic multiplier effects are taken into account, more than eight million jobs nationally are driven by the life sciences industry with every life sciences job generating another 5.8 jobs in the remainder of the economy.[iv]

Figure 2

Definition of the Four Life Sciences Subsectors

Source: BIO/Battelle



Indiana's Life Sciences Industry Includes All Major Segments

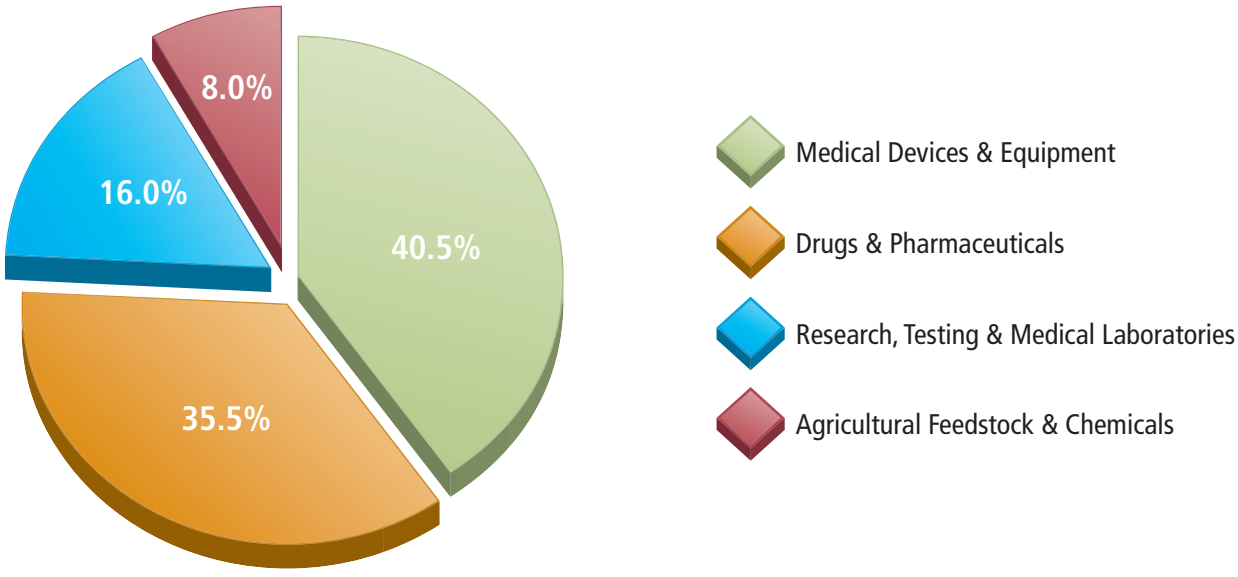
Altogether more than 50,000 workers across 825 establishments were found in the primary life sciences industries across Indiana in 2009. Each of the primary sectors of life sciences is represented in the state, with at least 44 establishments and more than 4,000 workers (agricultural feedstock and chemicals). Medical devices and equipment stands as the largest sector, with nearly 20,300 employees, followed by drugs and pharmaceuticals, with nearly 17,800 employees. Research, testing and medical laboratories employ nearly 8,000 persons. There are important synergies and links among and between these industry segments, with Indiana having national strengths in three of the four industry segments.

Indiana's life sciences firms have increased their employment by 17.9% from 2006 to 2009, and the number of life sciences establishments in Indiana has grown by 46.4% since 2006. Wages for these firms in this same time period have increased by 33.2%. Strong growth in medical devices, which has outpaced national growth, has powered Indiana's continued advancement in the life sciences from 2006 to 2009.

Figure 3

Composition of Indiana's Life Sciences Industry

Source: IBRC using data from the Bureau of Labor Statistics



An example of Indiana's life sciences stature is that 33% of the global orthopedics industry is based in Warsaw, a town of 12,500. Warsaw, with nearly 6,800 jobs in the medical devices/ orthopedics sector, is almost 56 times more specialized in jobs than the rest of the nation. It ranks 12th in the country among all regions in terms of employment for this industry.

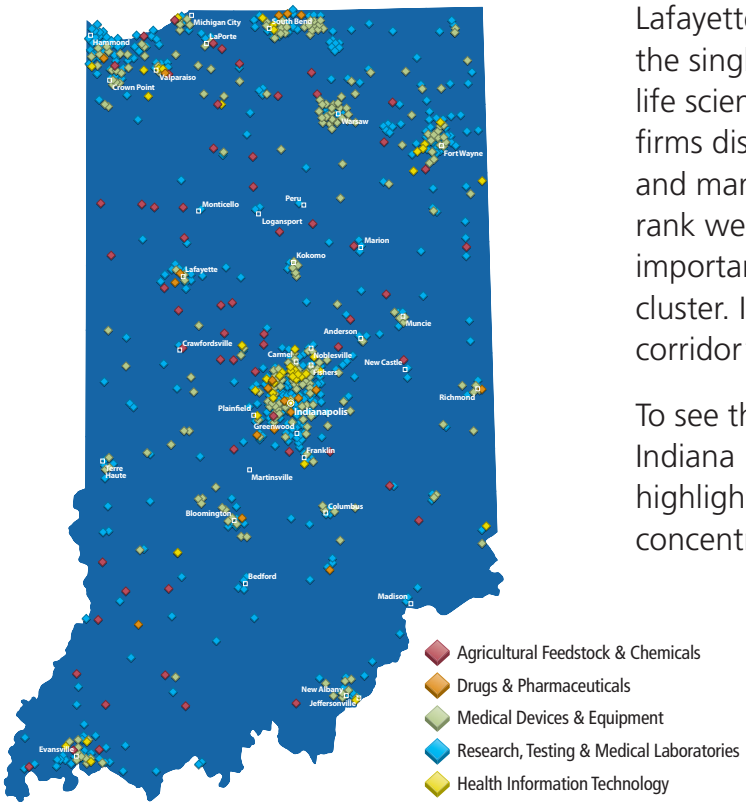
A more recent article (June 4, 2009) in The Economist magazine stated:

Though every state wants to be a hub for life sciences, Indiana is really one… Life sciences accounted for 23% of all (Indiana) job growth from 2001 to 2007.

Life Sciences Firms are Located Across Indiana

Map 1

Indiana Life Sciences Companies



Source: IBRC/BioCrossroads

A map of Indiana shows that while the Lafayette/Bloomington/Indianapolis area is the single largest location in the state for life sciences activity, there are life sciences firms distributed throughout the state, and many of Indiana's metropolitan areas rank well nationally and are home to many important segments of the life sciences cluster. Indeed, Indiana's "life sciences corridor" reaches many parts of the state.

To see the true dimensions of this Indiana "life sciences corridor" we will highlight some of these major life sciences concentrations around Indiana:

- **Bloomington MSA** – Home to Indiana University and the Cook Group, Bloomington is one of only two MSAs in the U.S. with a specialized employment concentration in all four life sciences sectors and is more than seven times more specialized in the life sciences than the rest of the U.S. Bloomington ranks first in the country among all small MSAs in the medical devices and equipment category and ranks third in drugs and pharmaceuticals employment.
- **Columbus MSA** – Columbus ranks 13th in the small MSA drugs and pharmaceuticals subsector.
- **Indianapolis MSA** – Ranks second in the U.S. for employment concentration in drugs and pharmaceuticals, fourth in the agricultural feedstock and chemicals subsector, and 15th in the medical devices and equipment category. Indianapolis is more than 2.65 times as specialized in life sciences employment as the rest of the country.
- **Lafayette MSA** – Ranks 13th in the agricultural feedstock and chemicals subsector for small MSAs (total private employment less than 75,000) and ranks tenth in drugs and pharmaceuticals employment concentration. Lafayette is almost two and a half times more specialized in life sciences employment than the rest of the U.S.
- **Michigan City/La Porte MSA** – In the medical devices and equipment subsector, the area ranks 12th in employment concentration.
- **Muncie MSA** – Muncie ranks third in the small MSA category for its research, testing, and medical laboratories industry sector.
- **South Bend/Mishawaka MSA** – The area ranks 14th among medium sized MSAs in the research, testing, and medical laboratories employment concentration.
- **Warsaw** – Regarded as the "Orthopedics Capital of the World" and Indiana's most concentrated life sciences region. When compared with the larger MSAs analyzed nationally, the Warsaw Micropolitan Area (population 12,500) would rank as the 12th largest regional employer in medical devices and equipment in the U.S. with a total workforce of 6,800 in that category.[v] ***Warsaw is almost 56 times more concentrated in life sciences jobs than anywhere else in the U.S.***

In addition to these regions, life sciences employment shows up also in such communities as Elkhart-Goshen (469 jobs), Evansville (1,848 jobs), and Fort Wayne (919 jobs).

Indiana Life Sciences Firms' Job Growth

Indiana has added more than 8,800 new jobs in the life sciences since 2002, three-fourths of which were added since 2006 during a severe national recession. During the eight-year period, covering 2002 through 2009, 8,800 new jobs were added within Indiana's life sciences industries – a growth rate of over 21% – at a time when Indiana lost over 147,000 private sector jobs, or 6% of its private sector workforce. The growth of life sciences employment was found in three of the four key industry segments, with all gaining employment, except drugs and pharmaceuticals. Of the 8,800 jobs added, 5,600 were in medical devices and equipment, a 38% increase. Agricultural feedstock and chemicals gained more than 1,900 jobs – a 95% increase, and research, testing, and medical laboratories gained more than 2,800 jobs – a 57% increase – since 2002. From 2002 to 2009, drugs and pharmaceuticals actually lost over 1,600 jobs or 8.5% of its employment, with 1,300 of these job losses since 2006. Of the 8,800 life sciences jobs added to Indiana's economy since 2002, 6,600 jobs have been added within the last three years (since 2006), suggesting Indiana's life sciences industry remains extremely competitive, despite the worst national recession since the Great Depression.

Table 3

Census of Employment and Wages - Change & Percent Change, 2002-2009

Source: IBRC using U.S. Bureau of Labor Statistics data

	Jobs		Establishments	
Indiana	% Change	# Change	% Change	# Change
Total	-4.5%	-127,222	5.5%	8,400
Total Private	-6.0%	-147,529	5.3%	7,686
Total Life Sciences	21.4%	8,807	59.1%	307
Agricultural Feedstock & Chemicals*	95.3%	1,953	361.5%	47
Drugs & Pharmaceuticals	-8.5%	-1,641	25.7%	9
Medical Devices & Equipment	38.3%	5,612	4.6%	13
Research, Testing & Medical Labs	56.6%	2,883	31.9%	61

**The 2009 total employment for Agricultural Feedstock and Chemicals includes published employment for NAICS Code 325320 - Pesticide and Other Agricultural Chemical Manufacturing. In 2002, the employment for this NAICS code was not disclosed by the Bureau of Labor Statistics and therefore the 2002 employment figure is understated and impacts the growth rate for the period tracked.*

Indiana is Much More Specialized Than the Rest of the U.S. in the Life Sciences Sector

A key to capturing growth is insuring that a state's industry has a competitive advantage relative to other states and the nation. The specialization of industry in a state compared to its national level can be measured by employment concentration. Location quotients (LQs) are a standard measure of the specialization of a particular industry in a state relative to the nation. An LQ greater than 1.0 for a particular industry indicates that the state has a greater relative specialization, whereas an LQ less than 1.0 signifies a relative underrepresentation. An LQ greater than 1.20 denotes employment specialization significantly above the national average.

Indiana is much more specialized than the rest of the nation in three of the four segments of the life sciences: drugs and pharmaceuticals, medical devices and equipment, and agricultural feedstock and chemicals – one of only five states in the U.S. which is so specialized. Indiana has specialized and concentrated employment in the life sciences; it has a location quotient of 1.72, the third highest state in the United States, behind only New Jersey and Massachusetts. Indiana has a superior specialization in the drug and pharmaceutical industry standing nearly three times above the national average. In addition, the state is 2.2 times more specialized in medical devices and 2.1 times more specialized in agricultural feedstock and chemicals. While other states and regions talk about becoming more specialized in at least one of the four industry segments of life sciences, Indiana is already more than twice as specialized in three of the four industry segments. Indiana is one of only five states in the U.S. and its territories which are specialized in three of the four life sciences industry segments – along with California, Massachusetts, New Jersey and North Carolina. **Unfortunately, while these other states are well recognized powerhouses in the life sciences, Indiana's strengths are under recognized nationally and globally.**

Economic Specialization of Life Sciences Industries in Indiana: 2009 LQ

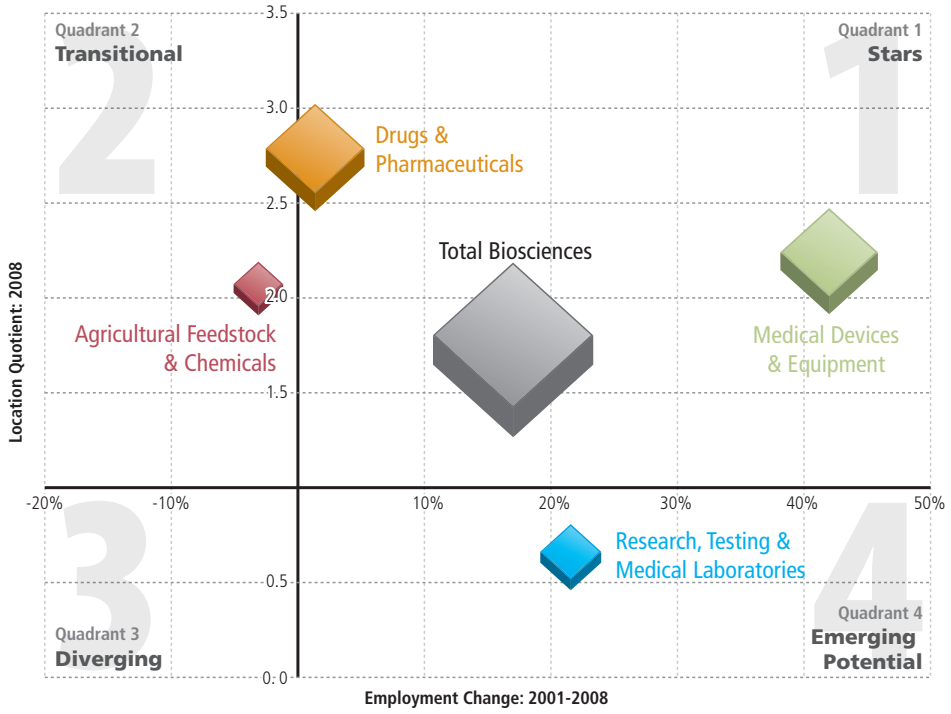
- **2.79 for Drugs & Pharmaceuticals**
- **2.22 for Medical Devices & Equipment**
- **2.07 for Agricultural Feedstock & Chemicals**
- **0.66 for Research, Testing & Medical Laboratories**

Figure 4 uses a somewhat different data set, measuring the time period from 2001 to 2008 rather than 2002 to 2009, as used in previous pages. It shows how Indiana's life sciences industry segments compare not only on specialization but also relative to employment growth in Indiana as compared to the nation. Figure 4 classifies industry segments into four quadrants: stars, transitional, divergent and emerging potential. Two of the four industry segments of Indiana's life sciences industry are stars as is Indiana's overall life sciences industry as a whole; the fourth segment – research, testing and medical laboratories – is shown as emerging potential. While already strong, there is every reason for Indiana to continue to pursue further growth in its life sciences research and testing firms, many of which represent the cutting edge work coming out of academic and medical center research as well as potential strategic partners for larger existing firms in drugs and pharmaceuticals and medical devices and equipment.

Figure 4

Indiana has specialized and growing employment in two life sciences subsectors.

Source: Battelle analysis of Bureau of Labor Statistics, QCEW data from the Minnesota IMPLAN Group.



Indiana's Life Sciences Industry Offers Good, High Paying Jobs

Indiana life sciences workers, on average, are paid more than twice the average private sector job in the state – nearly $81,000 compared to $38,100. Each industry segment of Indiana's life sciences sector pays considerably above the state's average private wages, with drugs and pharmaceuticals and agricultural feedstock and chemicals paying the best average wages. Medical devices and equipment employers' average salaries are lower but still significantly higher than average private sector wages – some 56% higher. Life sciences firms offer the kinds of employment opportunities educators and parents find appealing as careers for their students and children.

Table 4

Indiana Average Annual Wages per Employee, 2009

Source: IBRC data

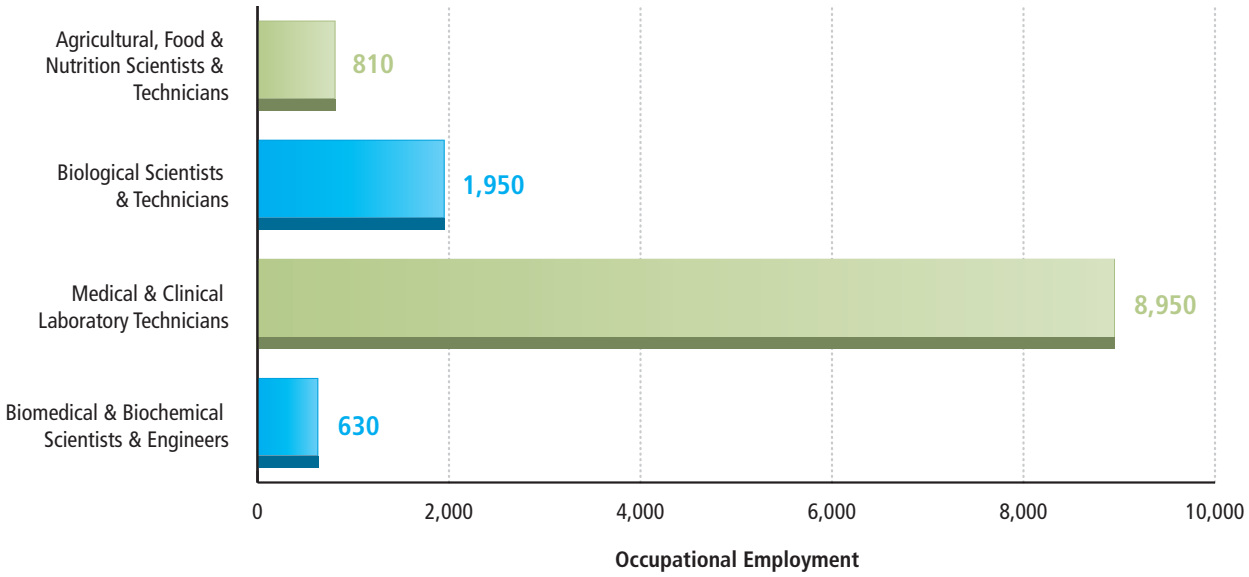
Drugs and Pharmaceuticals	**$ 114,066**
Agricultural Feedstock and Chemicals	**$ 85,695**
All Life Sciences	**$ 80,936**
Management of Companies and Enterprises	$ 72,152
Health Information Technology	**$ 70,990**
Orthopedics Devices	**$ 68,791**
Medical Devices and Equipment	**$ 59,706**
Research, Testing and Medical Laboratories	**$ 59,483**
Professional, Scientific, and Technical Services	$ 53,504
Manufacturing	$ 52,358
Finance and Insurance	$ 52,188
Construction	$ 47,060
Healthcare and Social Services	$ 40,022
Transportation & Warehousing	$ 38,821
Total Private	$ 38,138
Educational Services	$ 36,654
Real Estate and Rental and Leasing	$ 32,897
Retail Trade	$ 22,887
Accommodation and Food Services	$ 12,926

There are a broad range of jobs found in the life sciences industries, especially in production and technician positions. The life sciences support a wide range of occupations, not only Ph.D.s and medical doctors, but in fact, the largest occupations are those found in production and manufacturing for drugs and pharmaceuticals, agricultural feedstock and chemicals and medical devices and equipment. Leading occupations include assemblers, operators, inspectors, and maintenance and repair workers. Figure 5 below shows the large concentration of individuals with life sciences occupations as being technicians.

Figure 5

Indiana Life Sciences-related Occupational Employment, 2009

Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics (OES) survey data, 2009



Importance of Research Drivers

Academic, Medical and Research Landscape Overview

The life sciences sector stands out from other technology sectors such as information technology hardware and advanced manufacturing, in the close relationship between basic research and product development. Major new products and innovations in the life sciences are frequently derived and developed from earlier basic research discoveries, where in other technology sectors the links are less direct. Life sciences firms undertake substantially higher levels of R&D.

The past 25 years of developments in the life sciences industry throughout the U.S. shows a concentration as well as emergence of life sciences firms around university centers and non-profit research institutions. Major university and non-profit research institutions are not only the key to basic research discoveries that generate product leads for life sciences companies, but more importantly, they create an environment in which life sciences companies can flourish, because they offer a strong talent pool of graduates. University and non-profit centers are trying to increase their role in bridging the gap between basic and applied research by better managing their intellectual property, developing or sponsoring incubators and research parks for both new and established firms to locate closer to their universities and centers, and by increasing use of state sponsored matching grant programs to encourage industry/university collaboration.

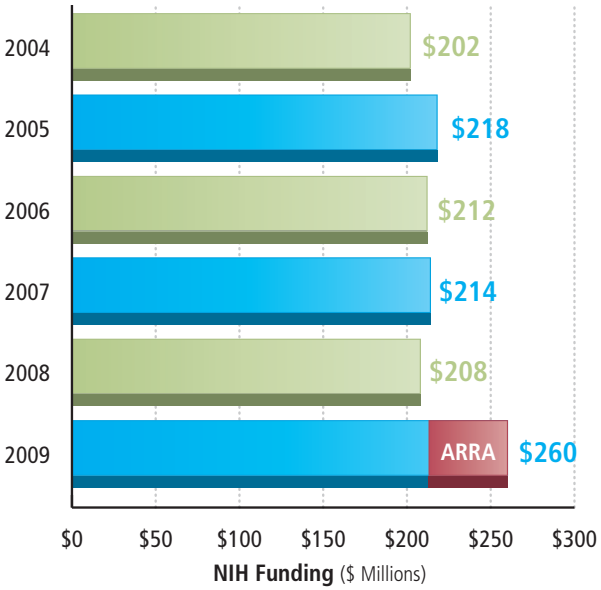
Total academic life sciences research in Indiana stands at more than $511 million, which represents 53.6% of all university research in Indiana in 2008. This was a spending increase of more than $100 million over 2007 funding levels, although academic R&D spending for the life sciences as a proportion of all spending is much lower than the nation – at 53.65% compared to a national percentage of 61.3%. And Indiana, on a per capita basis, spends nearly $24 less than the U.S. average on life sciences academic R&D.

Indiana University and Purdue University together offer a powerful research engine, with $2.75 billion in life sciences-related R&D expenditures during the period 2004 to 2008. In addition, the University of Notre Dame and Ball State University spent nearly $129 million in life sciences-related R&D in the same time period.

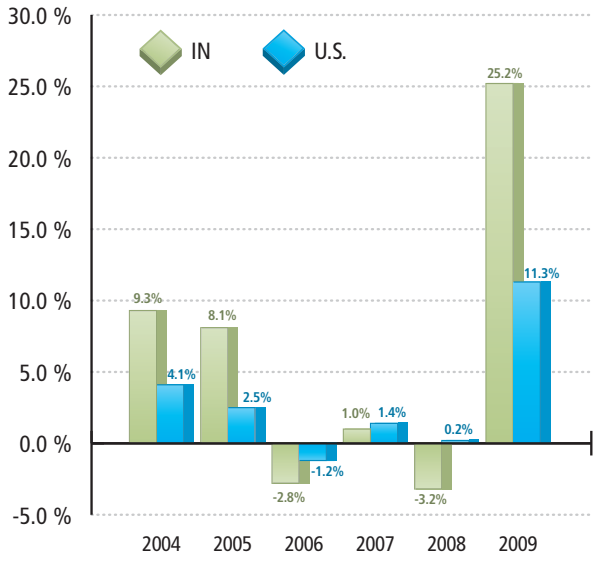
The National Institutes of Health (NIH) funding is considered the gold standard to measure the competitiveness of Indiana's research universities and private research institutes. We find a total growth rate of NIH funds from all sources in Indiana of 25% compared to a national increase of 11% between 2008 and 2009, as reflected in Figure 6. In fact, for fiscal year 2009, Indiana ranked 24th in terms of overall NIH funding received. However, Indiana ranked 36th overall in per capita NIH funding. Indiana's $40 in funding per person is well below the national average of $84. The challenge is whether Indiana can establish and maintain a growing share of NIH funds. Or will the state revert to the trend witnessed from 2005 to 2008 of steady to declining market share? Another way to gauge Indiana's competitiveness for research dollars is through the National Science Foundation's (NSF) academic R&D expenditures survey that collects information on R&D expenditures by academic field and includes all federal, state and private sources of funding. For fiscal year 2009, Indiana ranked 20th overall for life sciences-related research funding as measured by NSF.

Figure 6

NIH Awards in Indiana, 2004-2009



Change in NIH Awards in Indiana & the U.S., 2004-2009



Source: National Institute of Health (NIH), Office of Extramural Research, Award Trends, Dollars Awarded by State, 2003-2009

Indiana has Many University Research Strengths in Non-Life Sciences Areas Important to Life Sciences (Convergence of Technologies)

Life sciences is unique in its inherent diversity, combining activity and expertise from biology, agriculture, medical sciences, public health, organic chemistry, engineering, and computer science, among other fields. The 2002 Report noted that Indiana's universities had considerable strengths in engineering, computer science, information technology, and advanced manufacturing. Many of the "tools" and technologies of these industries are increasingly important to the work of life sciences firms from imaging and modeling to computer simulations and bio-nano applications, among others.

While Indiana universities' share of academic R&D expenditures for life sciences are lower than the nation per capita, this may be due in part to the many strengths of these same universities in securing and spending federal dollars from the National Science Foundation, Department of Defense, and other agencies in other convergent R&D areas. Without benefit of an in-depth core competency analysis of those academic strengths, technology platforms, and product niches, we cannot precisely estimate the trade-offs of additional medical research versus Indiana's capacity in engineering and other fields. It is very likely that these "tool" research capabilities enable Indiana medical devices, orthopedics, and health information technology firms to gain benefits from these non-biological academic strengths.

Private industry research is also a main driver found in Indiana. Being home to many of the world's leading life sciences research companies, Indiana goes well beyond just the base of its academic research. Eli Lilly and Company alone spent more than $4 billion in research and development in 2009, and while Lilly has worldwide R&D facilities, its strongest concentration is found in Indiana. Indiana is also home to other firms with significant R&D operations and investments including: Baxter Biopharma Solutions, Beckman Coulter, Biomet, Boston Scientific, Bristol Meyers Squibb, Cook Group, Covance, DePuy, Dow AgroSciences, Hologic, Indiana University Health, Mead Johnson, Medco, Roche Diagnostics, UCB Group, WellPoint, and Zimmer, among others.

Indiana Life Sciences Talent Pool

Having sufficient external federal funding and industry-sponsored research enables universities to attract key investigators with expertise that may be of interest to Indiana-based firms. And, it gives graduate and undergraduate students exposure to cutting edge research, improving the talent pool from which Indiana's signature industry can select new hires.

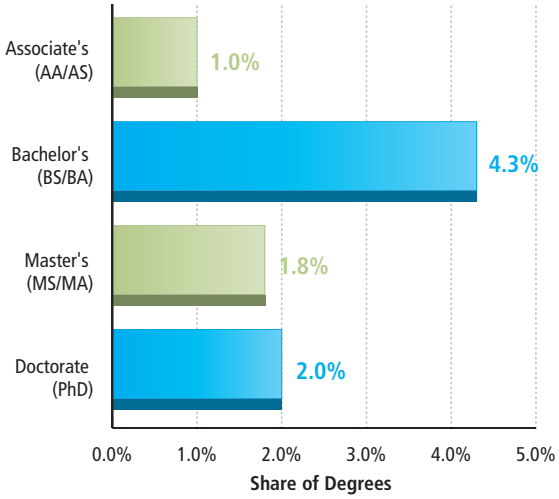
Indiana is a major generator of life sciences graduates. More than 3,200 Indiana students graduated with a life sciences-related postsecondary degree in 2008. Two-thirds of these were bachelor-level degrees and of those approximately 1,600 were degrees in biological sciences. Associate's degrees were heavily concentrated in "other" fields such as nursing and clinical/medical laboratory science. Indiana stands out in the number of life sciences bachelor's degrees awarded. In 2008, Indiana accounted for 4.3% of all these degrees awarded nationally, even though it has 2.1% of the nation's population. While Indiana's share of these and "other life sciences fields" graduates is also significant, there is currently not a statewide or national mechanism available to track activity, including job-placements, post-graduation.

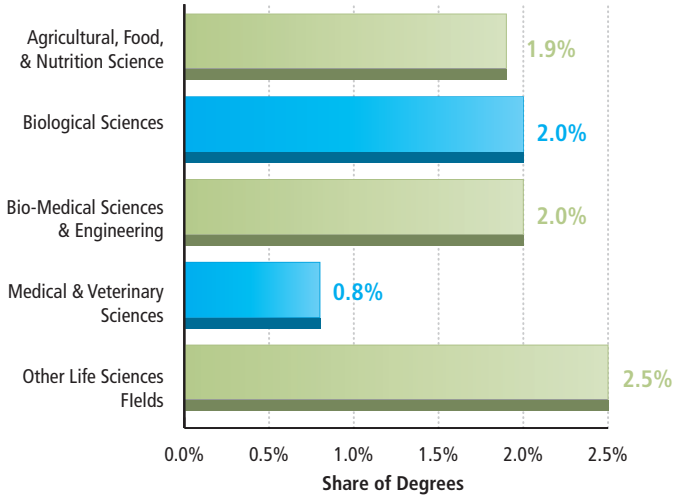
Figure 7

Indiana Share of U.S. Life Sciences-related Degrees by Award Level, AY 2008

Indiana Share of U.S. Life Sciences-related Degrees by Academic Discipline, AY 2008

Source: National Institute of Education Statistics, Integrated Postsecondary Education Data System (IPEDS), 2008





II. Summary of Indiana Accomplishments and Progress in the Life Sciences – 2002-2010

Key Challenges

The 2002 Report identified seven key challenges for Indiana to move forward in the life sciences, including:

- Creating **stronger industry-university-government partnerships** that bring the community together to address life sciences development;
- Ensuring continued, **focused investments** in key areas of life sciences research to have Indiana be among the national leaders;
- Generating a **climate more supportive of new business start-up companies** that leverage the life sciences research base and industry anchors found in the region;
- Ensuring **venture capital is available** to support the growth of life sciences companies;
- Addressing the lack of **specialized facilities** and need for technology parks to create more of a sense of critical mass and identity for the life sciences cluster;
- Educating, retaining and attracting **skilled life sciences workforce** to Indiana, across the range of skills needed;
- **Raising the recognition** of Indiana's position and commitment to developing its life sciences cluster.

Key Success Factors for Life Sciences Cluster Development from Leading Regions and States

The 2002 Report also reviewed best practice lessons learned from the leading life sciences regions across the nation, and identified six key success factors:

- Engaged universities with active leadership across research, technology commercialization, and industry partnerships;
- Extensive networking across sectors and with industry;
- Available capital covering all stages of the business life cycle;
- Discretionary federal or other R&D funding support, both exploratory and focused;
- Workforce and talent pool on which to build and sustain efforts;
- Patience, a long-term perspective, and commitment and a proactive business climate.

Comparative Analysis: Assessing Challenges and Success Factors with Progress Made in Indiana's Life Sciences 2002-2010

In the sections of this report that follow, we have placed the 2002 key challenges and success factors into five groupings: (l) Innovation & Entrepreneurship; (2) Capital Availability; (3) Talent Pool; (4) Business-Higher Education Partnerships; and (5) Maturing Life Sciences Clusters. In each group we have focused on providing both quantitative data that demonstrates performance or outcomes for Indiana using the most recent data and appropriate measures available, along with qualitative information to chart the degree to which Indiana has addressed each challenge and taken account success factors of other states and regions in growing its life sciences-driven economy over the past nine years. Finally, an overall assessment is given of progress for each grouping.

Group One: Innovation & Entrepreneurship

Challenge: Generating a climate more supportive of new business start-up companies that leverage the life sciences research base and industry anchors found in the region.

Challenge: Addressing the lack of specialized facilities and need for technology parks to create more of a sense of critical mass and identity for the life sciences cluster.

Success Factor: Extensive networking across sectors and with industry. They are driven and led by industry, although government and academia may strongly participate.

Assessment: Strong track record demonstrated with focus, encouragement, and linkage of resources to build a stronger life sciences base in Indiana.

A number of efforts have been undertaken since 2002 to help increase the formation and growth of new life sciences firms in Indiana. Because of this, related efforts such as strong networks among large firms and new enterprises, availability of early stage and seed capital, and programs such as the state's 21st Century Research and Technology Fund all contributed. While outlined in the next section, venture raising initiatives have led to formation of several funds and these funding sources have leveraged other dollars so as to assist in the formation of 15 university-related or university-based firms, working in many different areas from chronic pain and memory loss to epidemic infections and cancer. In addition, there are a number of efforts, led by BioCrossroads, to connect Indiana's life sciences research institutions, corporations, philanthropic organizations, and state and local governments to build new firms and enterprises, whether it's through specialized facilities including life sciences focused incubators, management and technical assistance, mentoring, workforce development, and other measures. Examples include BioCrossroadsLINX, a non-profit organization focused on advancing Indiana's strengths in drug development and manufacturing; OrthoWorx, a Warsaw-based non-profit to advance and support growth and innovation within Northern Indiana's orthopedics device sector;

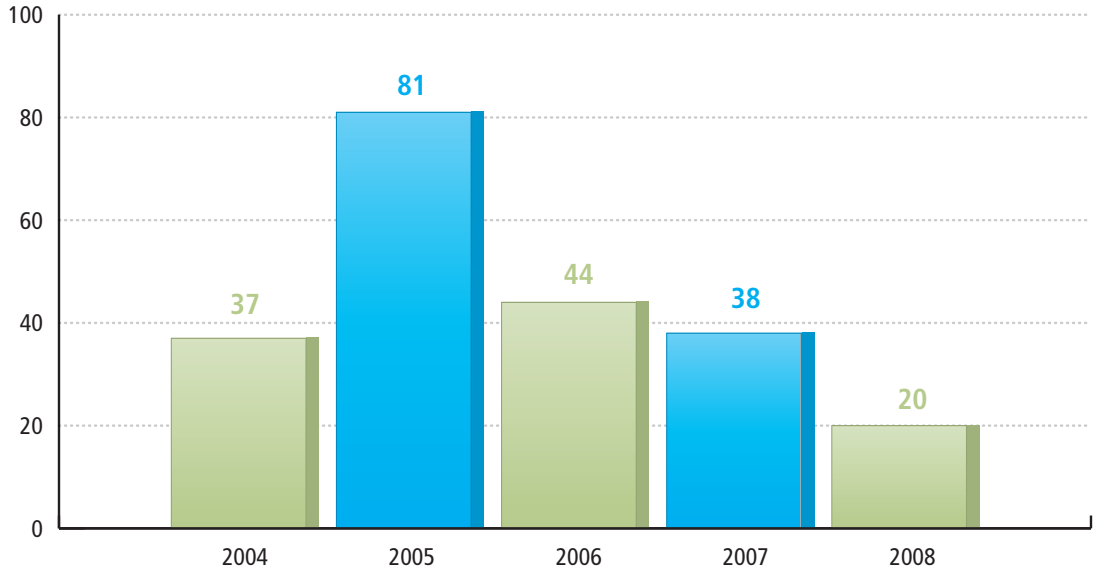
the Indiana Health Information Exchange (IHIE), a non-profit that operates the nation's largest health information exchange; and Datalys Center for Sports Injury Research & Prevention, a national non-profit providing research and surveillance services to sports and health organizations, based in Indiana.

The impact of these efforts is shown in the table below that charts the growth in life sciences start-up firms across Indiana in the 2004 to 2008 time period. A total of 220 life sciences start-up companies occurred in this time period, or an average of 44 per year. This is a dramatic turnaround in a state whose numbers for entrepreneurial activity (see Kauffman Innovation Index) rank very low among the 50 states. Unfortunately, we do not have corresponding data on the survival rate of these enterprises. Even so, this is a very impressive number of new life sciences firms per year across Indiana.

Figure 8

Indiana Life Sciences Start-up Companies

Source: IBRC using data analysis from National Establishment Times Series (NETS) Database

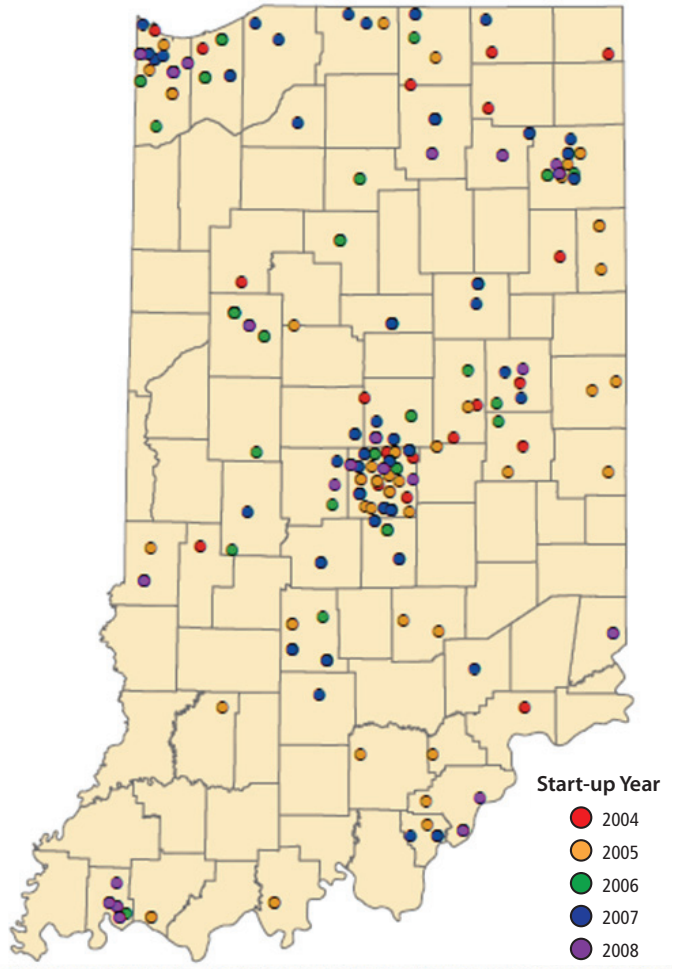


Equally important is the distribution of these new life sciences start-up companies throughout the State of Indiana. Map 2 below shows geographically where these new companies have formed in the 2004 to 2008 time period. Their distribution, while closely following where industry segments are already concentrated, does show a broader pattern of distribution to smaller towns and more rural areas.

Map 2

Life Sciences New Company Formations by Year

Source: IBRC, National Establishment Time-Series Database, December 22, 2010



Since 2002, Indiana has seen a growing number of research incubators and research parks appearing around the state, each focused on helping commercialize research into new and existing firms. Purdue University now has four incubator facilities at locations throughout Indiana – in Merrillville, New Albany, West Lafayette, and Indianapolis. The University's Discovery Park, initiated in 2001, has grown into a $400 million research and learning complex with 11 centers, including ones in life sciences and nanotechnology. It was named the country's outstanding research park in 2004. Indiana University's incubator, the Emerging Technology Center, is in downtown Indianapolis and its second incubator is in Bloomington. Innovation Park at the University of Notre Dame opened in the fall of 2010. These parks and incubators help address the lack of specialized facilities to spur life sciences entrepreneurship for the life sciences cluster identified in the 2002 Report as a challenge to be addressed.

Group Two: Capital Availability

Challenge: Ensuring venture capital is available to support the growth of life sciences companies.

Success Factor: Available capital covering all stages of the business life cycle.

Assessment: Two fund of funds and seed/early stage funds are helping address gaps facing Indiana.

In 2002, Indiana, like many other Midwest states, faced a considerable challenge in securing private venture capital which is vital to small, young life sciences firms through their first months and years, through the "Valley of Death" and the extensive ongoing financial support necessary prior to getting a product to the marketplace. Since that time, Indiana has been a leader in developing novel public-private partnerships to establish privately managed venture capital funds that balance fiduciary responsibility of their investors with a need to address insufficient private investment available for in-state life sciences firms.

These initiatives have included:

INext Fund

In December 2009, capping a difficult year that saw venture capital funding decline nationally by over 50%, BioCrossroads announced the formation of a major new life sciences venture capital fund. Organized through BioCrossroads, and managed by the Credit Suisse Customized Fund Investment Group, the $58 million INext Fund is a capital pool that invests in venture capital firms strategically focused on life sciences. Three of the top life sciences venture capital firms in the United States – 5AM Ventures, OrbiMed Advisors, and SV Life Sciences – received funding from the INext Fund.

Indiana Future Fund

The INext Fund is a successor to the original Indiana Future Fund, a $73 million fund of funds launched in 2003 to stimulate Indiana's venture capital sector as a ready source of early investment for our most promising life sciences companies. Thus far, the Indiana Future Fund program has directly invested over $40 million, and brought in an additional $170 million from national venture capital investors into more than 24 Indiana life sciences start-up firms.

Indiana Seed Fund

Eleven companies have received investment capital from the $6 million BioCrossroads Indiana Seed Fund investment portfolio. ImmuneWorks, a biotech firm developing a therapy for lung disease, signed a joint development agreement in February 2010 with LungRx, a wholly-owned subsidiary of United Therapeutics. Respiratory monitoring device developer SonarMed received FDA 510(k) clearance to start product commercialization and completed a Series A round of funding. Also in 2010, more than half of the life sciences start-up companies that had previously received an investment from the Indiana Seed Fund also received funding under the Federal Therapeutic Discovery Project Credit with more than $1.5 million credits approved by the IRS.

Indiana Enterprise Fund

The Indiana Enterprise Fund is a strategic investment fund capitalized by BioCrossroads' corporate stakeholders and focused especially on emerging health information technology enterprises.

Additional Venture Funds

Not only is it important to access Indiana-based venture funds, but it is also important to attract other venture funds to do business in the state. Other life sciences-focused venture funds that have established a presence in Indiana since 2002 include Burrill & Co., Pappas Ventures, Clarian Health Ventures, HALO Angels, Heron Capital, Spring Mill Ventures, Pearl Street Venture Fund, Main Street Venture Fund, StepStone Advisors, Triathlon Medical Ventures, Indiana University's Innovate Indiana Fund and Purdue University's Trask Innovation Fund. Because venture firms increasingly "syndicate" their investments, having multiple funds with operations in Indiana is important to enable firms to start up and grow in the state.

Successful Venture-Funded Companies

- Suros Systems, funded by angel and venture investors in 2000, was acquired by Hologic, Inc. in 2006 for over $250 million.
- Marcadia Biotech, founded in 2006, was sold to Roche Group in 2010 for $537 million.
- Endocyte, a pharmaceutical company based in West Lafayette, sold shares to the public in February 2011 and is listed on the NASDAQ.

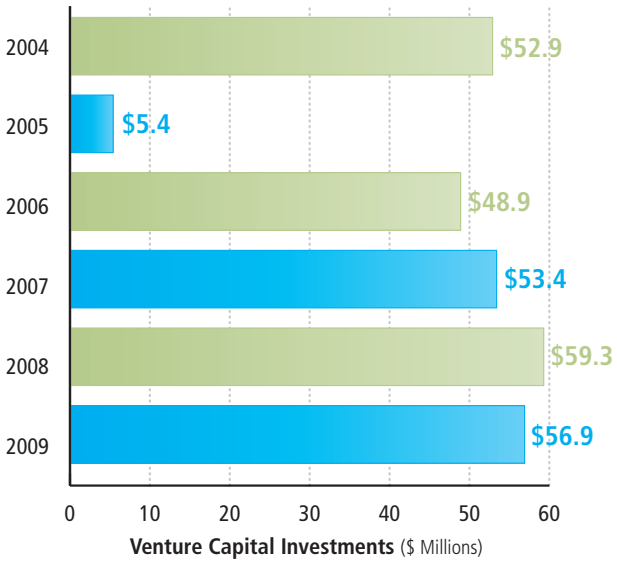
Even with these considerable in-state efforts since 2002, there remain capital gaps not being sufficiently addressed by the private sector, particularly in the early stages of company development, including proof of concept/reduction to practice. Indiana has basically held steady in terms of private venture capital invested in life sciences enterprises since 2004. In 2008, $59 million was invested in Indiana life sciences firms. The number fell to $57 million in 2009, although this drop-off in venture investments was not as severe as the national drop-off over the same recessing period. Over the 2004 to 2009 period, $277 million was invested in Indiana life sciences firms, ranking Indiana 26th nationally in life sciences-related venture capital invested.

Among Midwest states, Indiana's life sciences venture capital investment number is in the middle, still considerably behind the leading states of Minnesota and Ohio.

Figure 9 illustrates this progress:

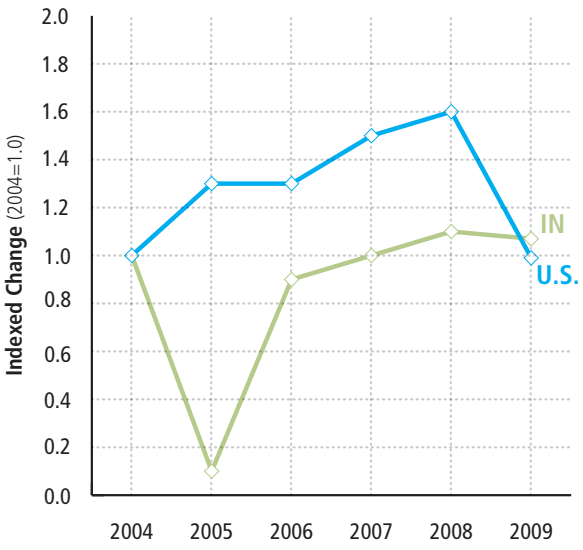
Figure 9

Life Sciences-related Venture Capital Investments in Indiana, 2004-2009



Life Sciences-related Venture Capital Investments in Indiana & the U.S., 2004-2009

Source: Thomson Reuters' VentureXpert Database, 2004-2009, as of January 2010



Group Three: Talent Pool

Challenge: Educating, retaining and attracting skilled life sciences workforce to Indiana, across the range of skills needed.

Success Factor: Workforce and talent pool on which to build and sustain efforts.

Assessment: Being addressed at all levels from K-12 to post graduate but life sciences industry minimum education requirements today appear to understate a future need for more advanced post high school certificate and degree programs.

BioCrossroads and its partners in higher education, the philanthropic community, industry, K-12 education, and others have been actively addressing the education and workforce needs of the life sciences industry over the past several years. BioCrossroads is working to improve K-12 Science and Math education and formed the Indiana Science Technology Engineering and Mathematics (I-STEM) Network in 2006. BioCrossroads has worked with the State of Indiana, educators and industry to advance science education reform and helped districts to broaden advanced placement (AP) courses throughout the state. Coordinated by the University of Notre Dame, the Indiana AP Bridge Project focuses on access to math and science advanced placement courses for students and support to AP teachers of math and science.

Ivy Tech Community College, Indiana's statewide community college with 23 campuses and nearly 200,000 students annually, now offers a number of applied science programs to meet the growing needs of life sciences firms, including associate's degree programs in biotechnology, chemical technology, and kinesiology. Other examples of Ivy Tech health-related programs include technician programs in health information technology, medical laboratory technology, and central service technician.

I-STEM Network is a statewide consortium of 14 higher education institutions dedicated to measurably improving K-12 student achievement in the STEM disciplines by focusing on professional development for K-12 teachers. The Network is the outcome of a task force created in 2004 by BioCrossroads, with financial support from philanthropic sources. Purdue University acts as the managing partner of this Network, with funding from the State of Indiana, Eli Lilly and Company, Lumina Foundation, Indiana Department of Education, and Lilly Endowment Inc. The focus is on middle school algebra professional development and science education reform. To date more than 6,000 teachers working with over 150,000 K-12 students have participated in I-STEM professional development programs.

Currently Indiana's life sciences workers are highly concentrated in medical and clinical laboratory technical jobs, and account for 73% of total life sciences occupational employment – a greater share than for the country as a whole. There are fewer individuals in Indiana working as technicians in agriculture and food nutrition, as biological scientists and technicians, or as biomedical and biochemical scientists and engineers.

The recently completed BioCrossroads survey of Indiana life sciences firms found the Indiana life sciences industry considers an "experienced" workforce as the single most important factor to their success. An "educated" workforce was the third most important factor to the respondents. A company's share of Indiana jobs having as a minimum educational requirement, a bachelor's degree, was highest for health information technology firms at 56%; research, testing and medical laboratories at 50%; but was less than 40% for drugs and pharmaceuticals and agricultural feedstock and chemicals. The minimum educational requirement for an associate's degree was very low across all industry segments – below 10% except for medical devices (13%). Minimum educational requirements of a high school degree were highest for medical devices at 54%; it was 41% for drugs and pharmaceuticals and then 14-24% for the remainder of the industry subsectors. Interestingly, when asked in the same survey about training needs of its workforce, the most common response was industry specific technical training for those with associate's or bachelor's degrees.

This analysis suggests that Indiana's life sciences industry is bifurcated between a large percentage of its workers with only a high school degree and, on the other extreme, a significant number of positions and industries where a bachelor's degree is the minimum education requirement. There appears to be much less industry interest or recognition of an associate's degree as the minimum requirement, even though most of the occupational employment in the industry today is for technicians (with a high school degree). It may well be that in the years ahead, given global competition, the minimum education requirements will likely increase to associate's degree for many of these technician jobs and Indiana must be accordingly prepared to respond to changing industry education and training requirements for its workforce.

Table 5

Of all your company's Indiana positions, what share of the total have the following minimum education requirements?

Source: IBRC/BioCrossroads Survey, October 2010

	High School	Associate's Degree	Bachelor's Degree	Master's Degree	Ph.D.
Ag/Biotech	17%	3%	37%	18%	26%
HIT	24%	5%	56%	13%	2%
Medical Devices	54%	13%	26%	4%	4%
Pharmaceuticals	41%	8%	38%	7%	6%
Research, Testing, and Labs	14%	9%	50%	11%	16%

Group Four: Business-Higher Education Partnerships

Challenge: Creating stronger industry-university-government partnerships that bring the community together to address life sciences development.

Challenge: Ensuring continued, focused investments in key areas of life sciences research to have Indiana be among the national leaders.

Success Factor: Engaged universities with active leadership across research, technology commercialization, and industry partnerships.

Assessment: Progress has been made to further engage universities. Lilly Endowment has made major investments in these partnership efforts to propel Indiana forward.

Progress in Academic Research

- Since 2002, Indiana's life sciences industry has had increasing access to major research centers and anchors at the state's university and medical centers, many of which have been recently established and/or undertaken additional initiatives to support Indiana's life sciences. Leading medical, engineering, materials and information technology programs at these centers provide industry with a knowledgeable talent pool from which to hire graduates and provide access to expertise on the cutting edge of such fields as nanotechnology, health information technology, and medical research. The state's research institutions including Indiana University, the Indiana University School of Medicine, Purdue University, and the University of Notre Dame, collaborate through such multi-institutional initiatives as the Indiana Innovation Alliance and the new Indiana Clinical and Translational Sciences Institute (CTSI). Outlined below are some of the developments since 2002 at each of these institutions that address a number of the original 2002 Report challenges:

- **IU School of Medicine:** The nation's second largest medical school, it has further built its reputation because of its successful designation by NIH as a Clinical and Translational Sciences Institute for Translational Research. This new center now serves as a further bridge to industry and physicians. Over $60 million was raised by universities, industry, and philanthropic sources for this collaborative venture to supplement the Federal NIH investment. Lilly and WellPoint are working with the CTSI in the development of new public/private initiatives in disease modeling and health economics. IU's School of Medicine has other federally designated centers of excellence in such fields as cancer (at the NCI-designated IU Simon Cancer Center), kidney disease, Alzheimer's disease, and alcohol research. The school hosts or is affiliated with 35 research institutes and centers including the Regenstrief Institute, an international leader in medical informatics. The school is a key player in the state's economic development initiatives and promotes research and develops business and academic collaborations. It has added more than 762,000 square feet of research space at its Indianapolis and regional campuses since 2000.

- **Purdue University:** The University has strong ties to the life sciences community of Indiana. Its assets are in biomedical engineering, pharmacy, nanotechnology, agriculture, analytical chemistry, instrumentation, supply chain management and veterinary medicine. Purdue's School of Pharmacy is the second largest in the U.S. and has nationally recognized engineering and technology programs. A new $25 million Hall of Biomedical Engineering has allowed the University to expand its department of biomedical engineering into a full-fledged graduate school and also offer a comprehensive undergraduate program in biomedical engineering. Purdue is also home to the Alfred Mann Institute for Biomedical Development, established to better commercialize innovative biomedical technologies.

- **University of Notre Dame:** Notre Dame's efforts in the life sciences include leading edge work in infection and vector-borne diseases, cell and cancer biology, physiology, ecology and evolution. Among its facilities are a Cancer Institute, Global Health Institute, Center for Transgene Research, the Midwest Institute for Nanotechnology Development (MIND), and Centers for Biophysics & Biocomplexity and Rare Disease Research.

State of Indiana Government

- Since 2005, the following tax policies supporting the life sciences sector have been enacted or strengthened in Indiana:
  - Research and Development Tax Credit
  - Venture Capital Investment Tax Credit
  - Research and Development Sales Tax Exemption
  - Patent Income Exemption
- Indiana does not permit transferability or refundability of the R&D tax credit for small firms without profits as do an increasing number of other states. Indiana does have an angel tax credit but it is not targeted to life sciences. Indiana does not offer tax credits to individuals who invest in life sciences early stage venture funds.
- Recent changes to the following programs administered by the IEDC have benefited the life sciences sector:
  - The 21st Century Research and Technology Fund was changed to focus on small, high-growth companies that are commercializing products.

The Small Business Innovation Research Initiative was developed to help small companies access federal SBIR funding. If small companies receive this federal funding, then the IEDC provides matching funds.

Creation of New Intermediary Non-Profits to Build Partnerships

BioCrossroads and its partners have created a number of new non-profit, intermediary organizations to help address and build partnerships among and between industry, education, and government. Examples of these initiatives include:

- **BioCrossroadsLINX** (www.biocrossroadslinx.com) BioCrossroadsLINX was established in 2007 as a strategic initiative to understand and implement the best ways to grow Indiana's drug development strengths through external partnerships, building relevant university research and workforce development programs.
- **Datalys Center for Sports Injury Research and Prevention** (www.datalyscenter.org) A national, non-profit organization, Datalys Center conducts research – and provides research and surveillance expertise – to support the sports injury information needs of organizations and individuals focused on improving the health and safety of the growing number of Americans who are physically active and/or participate in sports. Datalys Center builds upon Indianapolis' sports-centric life sciences assets and, through partnerships with organizations such as the National Collegiate Athletic Association and the American College of Sports Medicine, has developed a best in class sports injury research platform.
- **Fairbanks Institute for Healthy Communities** (www.fairbanksinstitute.org) The Fairbanks Institute for Healthy Communities is a non-profit organization working to improve community health. Through the Indiana Health Study, which has two disease platforms – coronary artery disease and type II diabetes – and key partnerships, the Fairbanks Institute is creating INbank™, a novel research resource available to academic, government and commercial researchers to take advantage of Central Indiana's demographically diverse population. INbank™ will enable research that can lead to more effective personalized medicines and better health for generations to come.

These entities will help position Indiana and its life sciences partners to build stronger capacity and help propel Indiana into a leadership position among the states. They build on existing research and industry strengths and also play an important contributory role in such efforts as to position Indiana in HIT.

Other examples of collaborative vehicles and initiatives put into place by or with substantial assistance from BioCrossroads since 2002 include:

- **OrthoWorx** (www.OrthoWorxindiana.com) OrthoWorx is a Warsaw-based, industry, community and education initiative established to advance and support growth and innovation within the region's uniquely concentrated, globally significant orthopedics device sector. Founded in 2009, the initiative engages and enhances the broader community interests that both serve and depend upon the sector's continued growth by targeting an integrated set of educational, workforce, cultural, communication, branding, logistical and entrepreneurial efforts.

  The organization was created out of a comprehensive Lilly Endowment-funded study conducted by BioCrossroads in 2009. The report, "Warsaw, Indiana: The Orthopedics Capital of the World – An overview, analysis and blueprint for future industry and community growth", explores the sector's current assets and challenges and sets forth a series of action-oriented recommendations designed to secure and advance the community's current position as home to nearly a third of the world's orthopedics device industry.
- **Clinical and Translational Sciences Institute (CTSI)** Established in 2008, a $25 million Clinical and Translational Science Award (CTSA) was granted to the Indiana University School of Medicine, Purdue University and the University of Notre Dame to fund collaborative university-industry translational research (see discussion below under investments in universities and community colleges).
- **Indiana Health Information Exchange** Founded in 2004, IHIE now operates as the nation's largest information exchange with communities throughout Indiana. With successful securing of Federal stimulus funds the Exchange and its partners have been able to significantly expand its collaborative efforts in recent years to build a statewide comprehensive health information technology effort (see discussion below under health information technology).

Investments in Universities & Community Colleges

The State of Indiana provides financial support to Indiana's public universities through funding of annual operations and direct appropriations for research facilities and equipment. In addition, the state can provide bonding authority to the individual university for borrowing funds to build research facilities. From 2002 to 2010, the state provided $366 million in direct funding or bonding authority to universities for research-related facilities and infrastructure.

Lilly Endowment Inc. has served as a catalyst – accelerating Indiana universities', community colleges' and other educational initiatives' life sciences research and educational capabilities. Endowment grants have been instrumental in helping the following organizations build a foundation for life sciences education and community enhancement, and their continued commitment has fostered growth and collaboration.

Table 6

Lilly Endowment Inc. – Selected Educational and Community Development Grant Support (2000-2010)

Grant	Description	Recipient	Amount (millions)
INGEN	Create programs to enhance education, bioethics, genomics, medical informatics, bioinformatics, and training for working scientists at the Indiana University School of Medicine	IU Foundation	$155.0
Discovery Park	Build a research and education complex focused on cross-disciplinary research and innovation	Purdue Research Foundation	$51.0
METACyt	Support life sciences research at Indiana University with a focus on analytical technology development and molecular biology	IU Foundation	$53.0
Ivy Tech Community College	Development of biotechnology curriculum for Bloomington, Evansville, Indianapolis and West Lafayette campuses	Ivy Tech Foundation	$2.5

Grant	Description	Recipient	Amount (millions)
Initiative to Recruit and Retain Intellectual Capital for Indiana Higher Education Institutions	Initiative to encourage Indiana's universities and colleges to consider how they can attract or keep more of the brightest and most talented minds in Indiana	IU Foundation	$10.0
Riley Hospital for Children / Earl Herr Chair	Capital campaign grants for education, training, fellowships and research	James Whitcomb Riley Memorial Foundation	$10.0 $1.0
Pharmacy Schools	Promote pharmacy education, outreach and research Establish a school of pharmacy	Butler University Purdue Research Foundation Manchester College	$25.0 $25.0 $35.0
Wishard Hospital	Rawls scholarships providing full-tuition grants for minority students to study at Indiana University School of Medicine	Wishard Memorial Foundation	$2.0
Indiana Physician Scientist Initiative	Recruit and train physician-researchers and invest in translational programs	IU Foundation (IU School of Medicine)	$60.0
OrthoWorx	Establish a Warsaw-based, industry, community and education initiative to advance and support growth and innovation within the region's orthopedics device sector	Kosciusko County Community Foundation	$7.0
CLEAR Health Information	Support creation of the Center for Law, Ethics and Applied Research in Health Information at Indiana University	IU Foundation	$4.0
I-STEM Resource Network	Establish and support a statewide consortium of higher education institutions working to improve K-12 student achievement	CICP Foundation	$5.0
BioCrossroads Initiative	Support for charitable, educational and scientific activities of the BioCrossroads initiative of the Central Indiana Corporate Partnership	CICP Foundation	$17.2
Total			$462.7

Other foundations have also played a major role in developing Indiana's life sciences assets, including the Regenstrief Foundation which has provided approximately $100 million in funding in support of the life sciences, including developing a leading medical informatics program at the Regenstrief Institute at Indiana University and the Richard M. Fairbanks Foundation, Inc. (RMF), which has granted over $50 million in support of life sciences-related organizations including the Fairbanks Institute for Healthy Communities, Indiana University's School of Public Health, the Indiana University School of Medicine, the Indiana Clinical and Translational Sciences Institute and the Indiana Health Information Exchange. RMF has also provided $3.75 million to BioCrossroads through the CICP Foundation since 2007.

Group Five: Maturing Indiana's Life Sciences Clusters

Challenge: Raising the recognition of Indiana's position and commitment to developing its life sciences cluster.

Success Factor: Patience, a long-term perspective, and commitment and a proactive business climate.

Assessment: Indiana's life sciences cluster is becoming fully mature, showing dynamic growth and increased connectivity, positioning the state for increased global recognition. Indiana is within range of becoming one of two states in the U.S. with both a large industry presence and specialization in three of four industry segments.

National Recognition

BioCrossroads, since its formation in 2002, has helped build awareness by helping market Indiana's life sciences industry. It serves as the spokesperson for the industry and as an advocate for its needs and interests. It is quoted frequently in national and international publications as well as within Indiana media. Its website, www.biocrossroads.com, receives considerable traffic and helps focus attention on Indiana. In addition, separate BioCrossroads originated websites for Indiana's contract drug development service providers, orthopedics industry cluster and health information technology sector, have elevated Indiana's visibility in these sectors.

Several think tanks and publications have cited Indiana and BioCrossroads as success stories in life sciences market development. In the past year, Indiana and/or BioCrossroads have been featured in publications such as Time and The Economist. In addition, BioCrossroads' leadership has presented at the Brookings Institute and the Aspen Institute on regional innovation initiatives.

Since 2002, Indiana has shown considerable progress in the life sciences by organizing a very strong life sciences cluster anchored by the three segments: drugs and pharmaceuticals, medical devices and equipment and agricultural feedstock and chemicals. And the fourth segment – research, testing and medical laboratories – is showing emerging potential. Indiana is one of five states with economic specialization in three industry segments – in prestigious company with such states as California, Massachusetts, New Jersey and North Carolina.

However, Indiana – while specialized – has not reached sufficient employment concentration levels to stand out nationally with at least 5% of the total U.S. employment in either the medical devices and equipment or the agricultural feedstock and chemicals industry segments. It is only specialized and concentrated in one segment – drugs and pharmaceuticals. Actually, Indiana does not have to add very many more jobs to be among the top states in employment concentration for both the medical devices and equipment, and agricultural feedstock and chemicals subsectors as well. ***Assuming no overall increase in employment and using 2008 national data, as of that year Indiana would have needed an***

additional 907 jobs in medical devices and 606 jobs in agricultural feedstock and chemicals to rank as one of only two states with both specialization and employment concentration in three industry segments. In 2008 only California among the 50 states had specialization and concentration in three of four industry segments and no state was specialized and concentrated in all four segments. Four states – Illinois, Massachusetts, New Jersey and Pennsylvania are large and specialized in two of the industry segments.

Indiana today has one segment where it does qualify as large and specialized – drugs and pharmaceuticals – but employment peaked for this industry and this industry segment is moving downward in size, not just in Indiana but nationally as well. However, Indiana would have to lose 2,500-3,000 additional jobs in drugs and pharmaceuticals to lose its 5% threshold for concentration (assuming there were no other losses across the country in the industry).

What are the advantages of becoming recognized as both specialized and concentrated in more than one industry segment? For one reason, it's the reality of why a region desires clusters – it ensures a better chance of self perpetuation because firms can share expertise, take advantage of specialized workforce and education programs, have access to skilled and expert service providers that know their industry, etc. Having a critical mass attracts similar industries to a state or region. Having strength enables one to build on top of its stature, as Massachusetts and California, in particular, have demonstrated over the past several decades. Finally, a cluster builds entrepreneurship – some workers may build their own firm based on their knowledge and expertise in the industry. While clusters can change because industries change, Indiana has a strong basis in life sciences due to its depth and emerging strengths across four subsectors.

Life Sciences Cluster Maturity

Several sets of pertinent statistics demonstrate the maturing of Indiana's life sciences cluster since 2002:

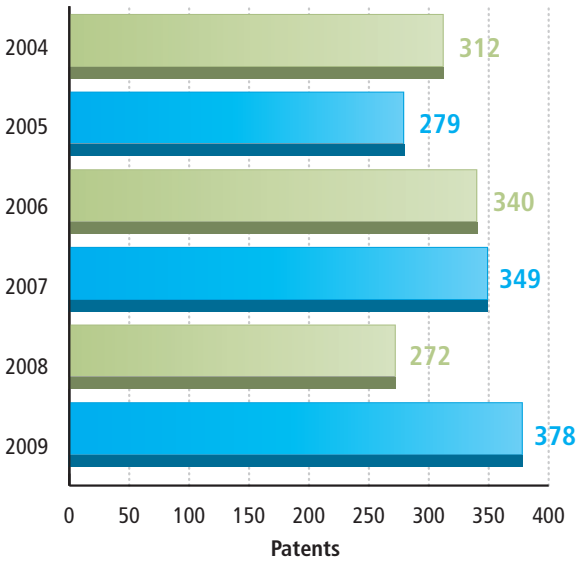
Figure 10

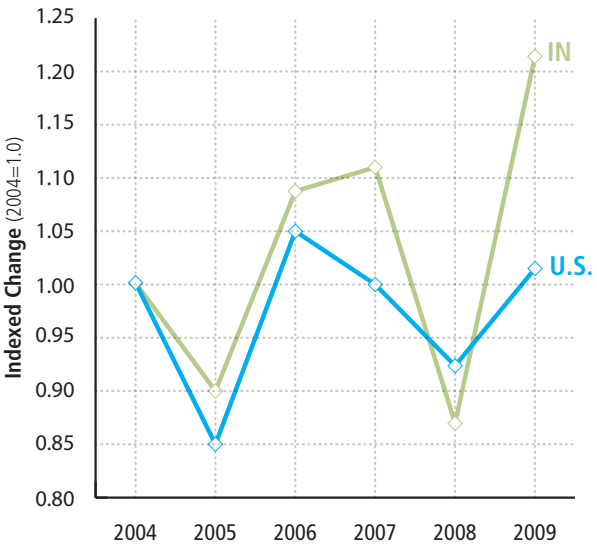
Cluster Maturity: Innovation of the Indiana Life Sciences Industries Measured by Patents/FDA Filings

Life Sciences-related Patents in Indiana, 2004-2009

Trends in Life Sciences-related Patents in Indiana and U.S., 2004-2009

Source: Thomson Reuters' Delphion Patent Database, 2004-2009





The number of life sciences-related patents issued firms in a state is an indicator of the relative strength and innovation of that industry. From 2004 to 2009, more than 1,900 life sciences-related patents were issued to Indiana assignees – and 2009 was the most active year with 378 patents awarded. Indiana's growth in patent activity has generally remained just above that of the U.S. average, with the exception of a precipitous fall in 2008 and a rapid increase in 2009 above U.S. levels of growth. Indiana's patent activity is well diversified across life sciences categories. Drugs and pharmaceuticals received the largest number of patents and comprise 3% of all U.S. patents in that category. Indiana stands out in its share of biotechnology patents with 6.1% of all U.S. biotechnology patents for the time period of 2004 to 2009. In addition, from 1995 to 2010, Indiana ranked 8th in the U.S. in the number of 510(k) applications made to the U.S. Food and Drug Administration with 1,821, and 11th in the number of PMA applications with 405.

Cluster Maturity: Attracting and Expanding Life Sciences Firms and Jobs in Indiana

Since 2005, the Indiana Economic Development Corporation (IEDC) reports that Indiana has successfully secured an estimated 14,500 life sciences job commitments and nearly $1.8 billion of projected capital investment from life sciences companies.

Table 7

Indiana Life Sciences Attraction/Expansion Projects: 2005-2010

Source: IEDC

Subsector	5-year Total Job Commitments	5-year Total Investments (millions)
Agricultural Feedstock and Chemicals	682	$345.3
Pharmaceutical Distribution	4,557	$224.4
Healthcare Services	553	$15.3
Medical Devices and Equipment	4,343	$433.0
Drugs and Pharmaceuticals	1,924	$403.3
Research, Testing and Medical Laboratories	2,451	$338.1
Total	14,510	$1,759.4

Among these attractions and expansions were:

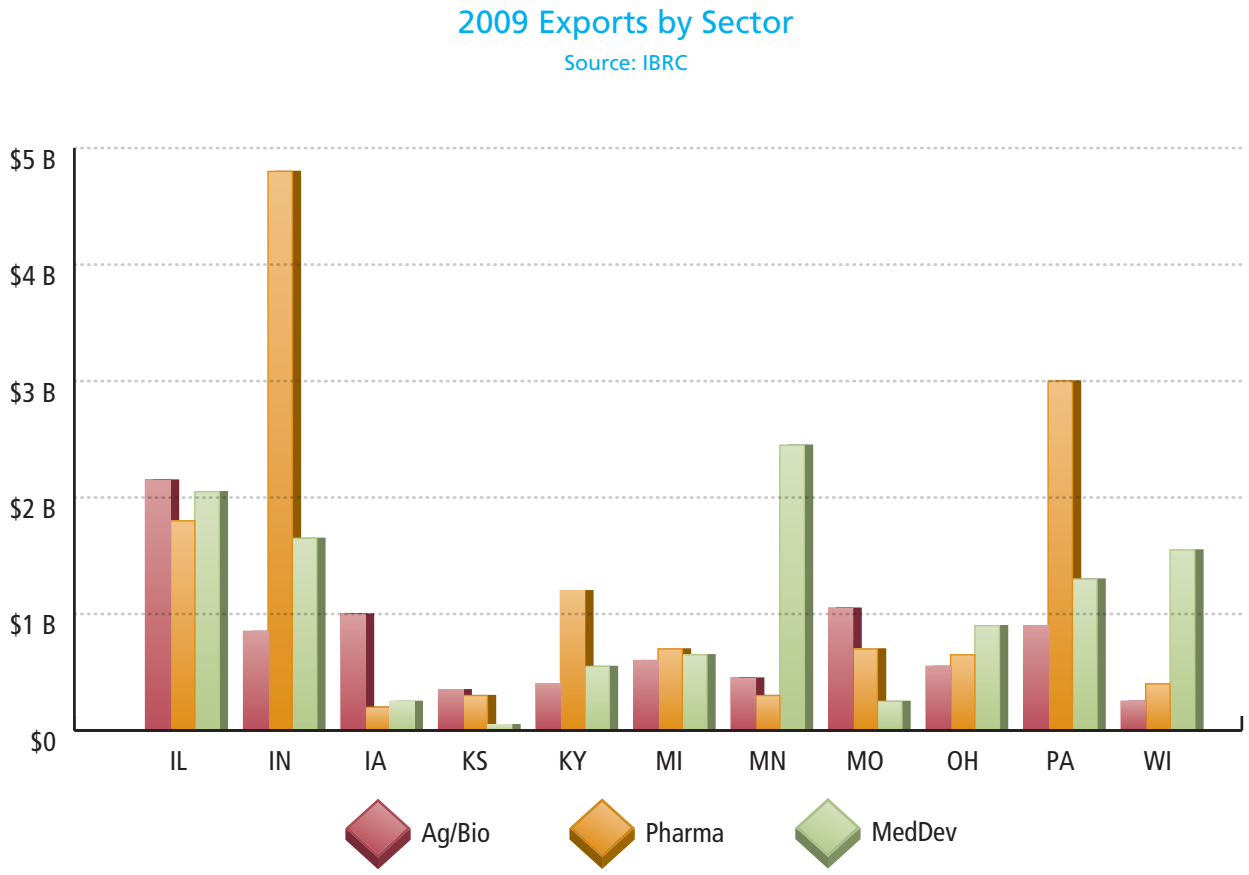
- Dow AgroSciences' expansion of its research labs, which will result in a $345 million investment and the hiring of 580 additional employees over the next five years.
- Medco Health Solutions has located the world's largest automated pharmacy, its Personalized Medicine Center and Oncology Therapeutic Resource Center in Indiana. When fully operational, Medco will employ over 1,500 workers, including 250 pharmacists with an investment of more than $150 million.
- Beckman Coulter expanded its presence in Indiana from 100 employees to 600 employees between 2006 and 2010 and has invested over $25 million.

Such attraction of life sciences investment demonstrates the further growth and dynamic nature of the ever-growing Indiana life sciences cluster.

Cluster Maturity: Growing Competitiveness in Life Sciences Exports

Another way to look at the growing strength of Indiana's life sciences cluster is to look at its place in the global economy. Increasing the ability of American states to compete is dependent on the ability of its indigenous industry to compete. Life sciences industries are indeed global businesses with global competition. Figure 11 below shows how Indiana's exports for three of these four industry subsectors (research, testing and medical laboratories is not included) are faring in exports relative to their Midwest competitors such as Minnesota, Michigan, Illinois, and Pennsylvania (which has two large and specialized industry subsectors). Indiana outperforms all these states in drugs and pharmaceuticals and holds its own with Pennsylvania in medical devices and equipment sector, even though the latter has a larger employment base. Overall, the total value of Indiana's life sciences exports nearly tripled between 2002 and 2009 from $2.5 billion to $7.4 billion, ranking Indiana third highest among all the states, behind only California and Texas.

Figure 11



Cluster Maturity: Identifying and Building New Life Sciences Niches for Economic Growth and Innovation Excellence

It was noted earlier that the 2002 Report identified emerging areas of technology where Indiana stands out. This section highlights where Indiana has demonstrated success in several relatively unique market niches for its life sciences clusters, built around existing strengths. These niches include health information technology, biopharmaceutical contract services, orthopedics, and pharmaceutical distribution and logistics. These four distinctive markets build on Indiana's existing industry expertise, the research capabilities of its

universities, the caliber and types of graduates from its higher education institutions, and takes advantage of multiple cross-cluster strengths in new and different ways. Demonstrated successes in these emerging niche opportunities has enabled Indiana to further grow its life sciences cluster and prospects are strong for further growth in them.

Leveraging Existing Strengths
The National Leader in Health Information Technology (HIT)

Battelle's original work for Central Indiana Corporate Partnership (CICP) and its follow-on life sciences case statement identified and highlighted the growing convergence of information technology and life sciences, arguing that the tools increasingly used in the life sciences laboratories were the tools of software and hardware from the information technology industry. It was also noted that for Indiana to succeed in the life sciences, it needed not just a strong life sciences industry and research base, but also a strong information technology industry and research base. The 2002 Report identified a strong and growing information technology industry in the state, not as value-driven as desired, but with signs of potential strength. These reports also acknowledged Indiana's research strengths in bioinformatics, computer, systems and software engineering at its research universities, including Indiana University and Purdue University.

Leaders in Indiana have seized on the opportunities offered, given Indiana's strengths in both information technology and life sciences, to build an ambitious effort to become one of the major global centers in health information technology, with a number of successes already achieved.

BioCrossroads has been committed to the advancement of Indiana's signature research and commercial capabilities surrounding HIT and HIT exchange, serving as a convener, founder and leading initial investor in the Indiana Health Information Exchange (IHIE), in 2004. This non-profit corporation is advancing a national, revenue-based model for the secure sharing of clinical information among healthcare patients, providers and other healthcare entities.

Today Indiana has five HIEs operating throughout the state; more than 6.3 million messages exchanged every month; 12,000 physicians already participating; and more than 12 million patient records in the network.

To fully develop the state's competitive edge in health information technology, education and training programs are also growing and two research-related entities have been established that ensure discovery along with education and training to help create jobs in new enterprises in software and health information services. In addition, a new venture fund to focus on this industry niche has also been established – the Indiana Enterprise Fund. In short, an entire comprehensive set of talent, technology and capital efforts have formed around health information technology to help grow this relatively new industry segment in Indiana and further propel Indiana into national and global leadership.

In addition, Ivy Tech and Indiana University (IU) have added new courses, degrees and curriculum in health information technology. The IU School of Informatics now offers an undergraduate degree in health information administration, a master's degree in health information, and the Information Doctoral Program in health informatics. The Regenstrief Institute has become an internationally recognized informatics and healthcare research group with one of the largest and most comprehensive medical informatics laboratories in the world, giving Indiana a unique research asset. Its sister organization, the Regenstrief Center for Healthcare Engineering, located at Purdue University, is an interdisciplinary research center applying concepts from engineering, science, and management to the healthcare system.

And in 2009, BioCrossroads spearheaded a collaborative effort, bringing together the State of Indiana, Indiana's five independent health information exchanges and four state organizations. Coordinated by BioCrossroads, the consortium submitted an application to receive significant federal stimulus funding for a statewide health information technology program that will be used to further enhance the quality, reach and connectivity of the State of Indiana's HIT delivery system. As a result, to date, Indiana has received more than $50 million in federal stimulus funds to advance Indiana's leadership in HIT. Similarly, BioCrossroads collaborated with the IHIE on a grant application from the Beacon Community Cooperative Agreement Program, and was successful in receiving $16 million, one of only 17 highly competitive grants awarded under the ARRA.

Leveraging From Existing Strengths
Orthopedics – Medical Devices

Warsaw is home to a robust, respected and globally competitive orthopedics device cluster; one of the most concentrated medical device centers globally. Three of the world's five leading orthopedics device firms began in Warsaw and remain there today. These original equipment manufacturers are supported by dozens of Warsaw-based suppliers and contract manufacturers that collectively earn more than $11 billion in annual revenues, representing better than a 50% market share in the U.S. and more than a 33% market share globally. The region contains headquartered firms, many of their suppliers, and a highly skilled workforce. Market information suggests that with the growing population of senior citizens, knee, hip and other replacements are seeing increased demand. Warsaw needs to encourage more collaboration among and between its orthopedics cluster stakeholders, assist the industry in moving its skilled workforce into more advanced technologies, and promote the recognition within the region, state, nation and world of its strong orthopedics base which is increasingly R&D driven. Zimmer alone has 800 researchers working in town, and Warsaw companies have generated publications and patents far in excess of what would be expected. The average patenting rate in the U.S. is five per 10,000 people; in Indiana it is 13 and in Warsaw it is 32.

A recent BioCrossroads report identified several challenges facing Indiana's orthopedic industry including: (l) increased federal regulatory and compliance reviews of the medical device industry; (2) rising cost pressures; (3) significant education and training shortfalls; (4) attracting and retaining senior engineering and management talent; (5) the absence of a full array of locally accessible industry support services; (6) travel, shipping, and other logistical transportation infrastructure; and (7) an increasing need, particularly among smaller firms, to have access to innovative research, new technologies, and the capital required for commercialization.[vii]

Until recently, the region lacked any form of leadership organization to focus on the future of this important Indiana industry to help address these challenges. In 2009, Lilly Endowment provided a $7 million grant to the Kosciusko County Community Foundation to support the establishment of OrthoWorx. This new organization was created to advance and support the continued vitality, growth and innovation within the orthopedics industry cluster in the region and state.

Leveraging From Existing Strengths
Biopharmaceutical Development – Contract Services

Because of the existing drug and pharmaceutical cluster strengths of Indiana, BioCrossroads and others have been able to identify, coming out of a new business model by Eli Lilly, another opportunity to further build and strengthen Indiana's life sciences cluster. Eli Lilly has moved from being a FIPCo – that is a pharmaceutical firm which owns its entire value chain from a research idea to a pill used by a patient, to a new model called FIPNet, or a fully integrated pharmaceutical network. There is still integration but the pieces are linked internally and externally through Lilly partnerships, alliances and other relationships to other entities without outright ownership of everything.

Two examples of how this has already evolved in Indiana demonstrate how FIPNet models may help further strengthen and build Indiana's life sciences cluster in terms of jobs, firms, sales and other measures. Eli Lilly sold a large research site in Greenfield in 2008 to Covance, one of the largest contract research organizations in the U.S. As part of the arrangement, Lilly entered into a long term relationship with Covance for work they perform at the Greenfield site. A similar strategy was adopted by Lilly when they sold their Tippecanoe Laboratories in Lafayette in 2009 to Evonik Industries. While these two sales have given Lilly more flexibility by being able to tap the specialized capabilities of these two partners to provide services, it also now means these two former Lilly facilities can do business with other firms as well as Lilly, giving them room to grow and adding more net employment to Indiana's life sciences base. While these two transactions reduced Lilly's headcount by more than 1,000 in Indiana, the two new firms more than made up for this loss in becoming new employers in Indiana.

The buyers of Lilly's two facilities are called contract service providers (CSP). Contract service providers are emerging as another industry niche or segment which is expanding Indiana's life sciences cluster. Today there are nearly 9,000 workers and 50 firms working in the CSP sector in Indiana alone. And Indiana is one of the few areas in the U.S. with a concentration of firms that excel in specialized and sophisticated drug development services such as contract research (CROs), contract manufacturing (CMOs) and logistics. What was a new trend in 2007 has now become an industry standard with the emergence of fully integrated pharmaceutical networks.

Leveraging From Existing Strengths
Pharmaceutical Distribution & Logistics

Indiana has also identified and pursued another distinctive industry niche – pharmaceutical distribution and logistics – which builds on the state's central location and cluster strengths in both logistics and life sciences. Beginning in 2006 with WellPoint's expansion of its specialty pharmacy distribution division, NextRX, at the Indianapolis Airport, this distinctive niche of the life sciences has grown to 4,500 jobs and the total capital investment in Indiana at the end of 2010 was $224 million. Another significant addition to Central Indiana's pharmaceutical distribution landscape came in late 2007 when Medco Health Solutions announced that it would build the world's largest automated pharmacy in Whitestown. Medco is also adding a Personalized Medicine Research Center at their facility, and they are developing an Oncology Therapeutic Research Center at the same facility. In 2007, Arcadia Resources decided to move its headquarters to Indianapolis from Southfield, Michigan, and locate a pharmaceutical distribution facility on the north side of the city. In 2010, Express Scripts announced the acquisition of WellPoint's specialty pharmacy unit – NextRX and its plan to expand the facility.

One of the factors contributing to Indiana's emergence as a pharmaceutical distribution and logistics center is its workforce. Between Purdue University and Butler University there are 300 Pharmaceutical Doctorate candidates graduating annually, but Indiana has been a net exporter of many of these graduates. The Lilly Endowment recently awarded $35 million to another Indiana institution, Manchester College, to establish the state's third school of pharmacy which will further increase this supply of talent. Today, approximately 1,000 Registered Pharmacists work in the state's life sciences sector. Ivy Tech Community College now offers a pharmacy technician degree and a logistics/warehousing technician degree. In addition, Indianapolis is home to FedEx's second largest cargo hub and several cold chain storage facilities. And, as the Crossroads of America, Indiana is recognized nationally as a major logistics hub due to its spoke and wheel highway system.

Indiana Life Sciences Industry Economic Impact

Overall Economic Impact of Life Sciences

While Indiana's life sciences industry directly employs more than 50,000, this number does not account for the full impact this high-value growth sector has on Indiana. Indiana's life sciences firms have interdependent relationships with suppliers of other goods and services. The life sciences sector both supports and depends on other regional and national firms and enterprises to supply everything from legal services and insurance support to travel services and logistics support, as examples. As a result, the overall impact on the state of the life sciences industry is much greater than just its direct impact. State employment multipliers are used to measure the additional regional impact of adding life sciences jobs. Multipliers quantify the broad ripple effects of one industry on other segments. IBRC calculated state and national employment impact factors for each major life sciences subsector. The multipliers represent the total change in number of jobs in all industries (direct, indirect and induced effects) that result from a change in one job in the corresponding industry sector. They found that the 50,000 direct life sciences jobs impact another 105,000 jobs in the broader Indiana economy, or a total of 155,000 jobs. These jobs translate into an overall economic impact on Indiana's economy of $44 billion. For every one job directly created in the life sciences industry in Indiana another 2.7 jobs are created elsewhere in the state's economy.

Table 8

Economic Impact Indicators (2009)

Source: IBRC using IMPLAN

Sector	Direct	Ripple Effect	Total	Multiplier
Employment				
Total	50,002	105,500	155,502	3.7
Ag/Biotech	4,002	24,000	28,002	7.0
Pharma	17,760	46,500	64,260	3.6
Med Devices	20,264	28,800	49,064	2.4
Research Labs	7,976	6,200	14,176	1.8
Output (millions)				
Total	$26,833	$16,840	$43,673	1.7
Ag/Biotech	$7,180	$4,700	$11,880	1.7
Pharma	$12,286	$7,300	$19,586	1.6
Med Devices	$6,244	$4,100	$10,344	1.7
Research Labs	$1,123	$740	$1,863	1.7

III. Prospects for Indiana's Life Sciences Future

Industry Views from Survey Results

BioCrossroads recently completed a survey of Indiana's life sciences companies' operations, prospects and views on their industries in Indiana. A 29-question survey covered topics such as company operations and activity in Indiana; its workforce characteristics and needs; strategic collaborations; and current challenges and expectations for the industry in Indiana. Invitations to complete the survey were sent to life sciences companies in all sectors, a total of 105 firms. Sixty companies responded – a response rate of 57%. These 60 companies represent 23,000 life sciences employees in the state, with 37% of respondents from the medical devices and equipment sector; 22% from health information technology; 20% from drugs and pharmaceuticals; 13% from research, testing and medical laboratories; and 8% from agricultural feedstock and chemicals.

The survey revealed that Indiana life sciences companies engage in a wide variety of functions, from R&D to sales and marketing, manufacturing, logistics, design and engineering. 74% of the firms have added employees over the past five years and 82% expect growth in 2011. They generally find Indiana an attractive place in which to do business and grow. It is important to note that respondents were asked to choose only the single most important factor for each category and the data below are indicative of relative importance as compared to the choices allowed. More specific responses to key questions are outlined below:

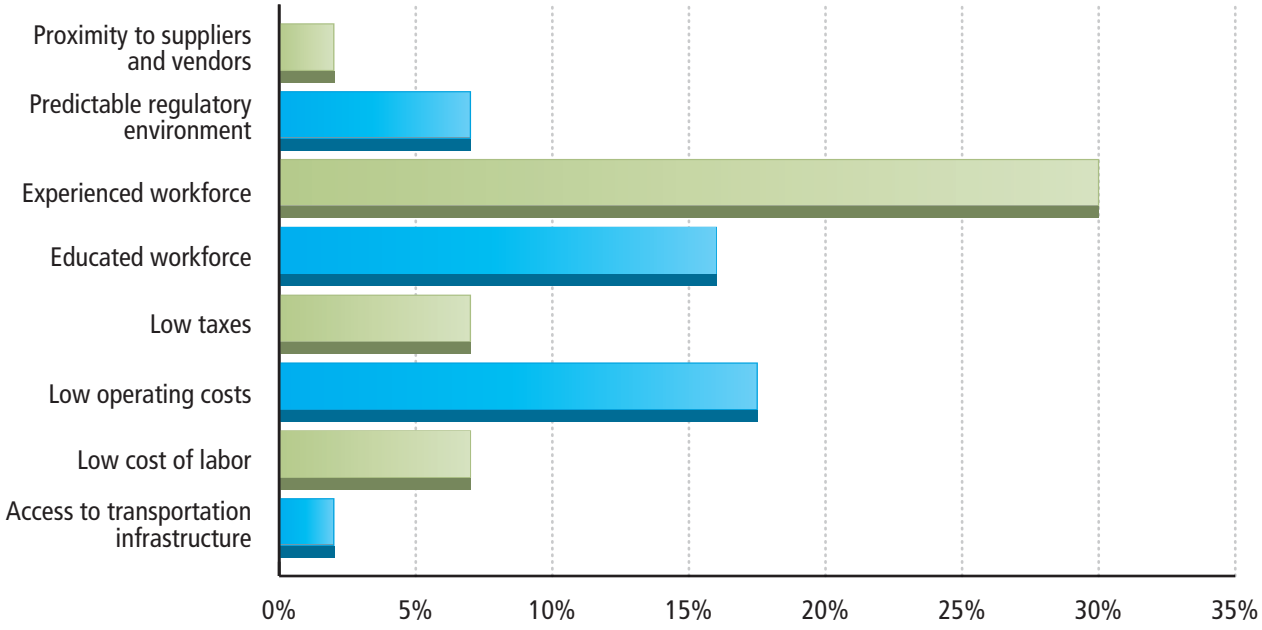
Factors for Success in Indiana

Companies emphasize that the most important factor for success in Indiana is the workforce. An experienced workforce was the number one factor for 30% of the companies, followed by educated workforce at 16% (the third most important on the list). Low operating costs was the second most important factor at 17%.

Figure 12

Factors Important to Success - All Companies

Source: IBRC/BioCrossroads Survey, October 2010



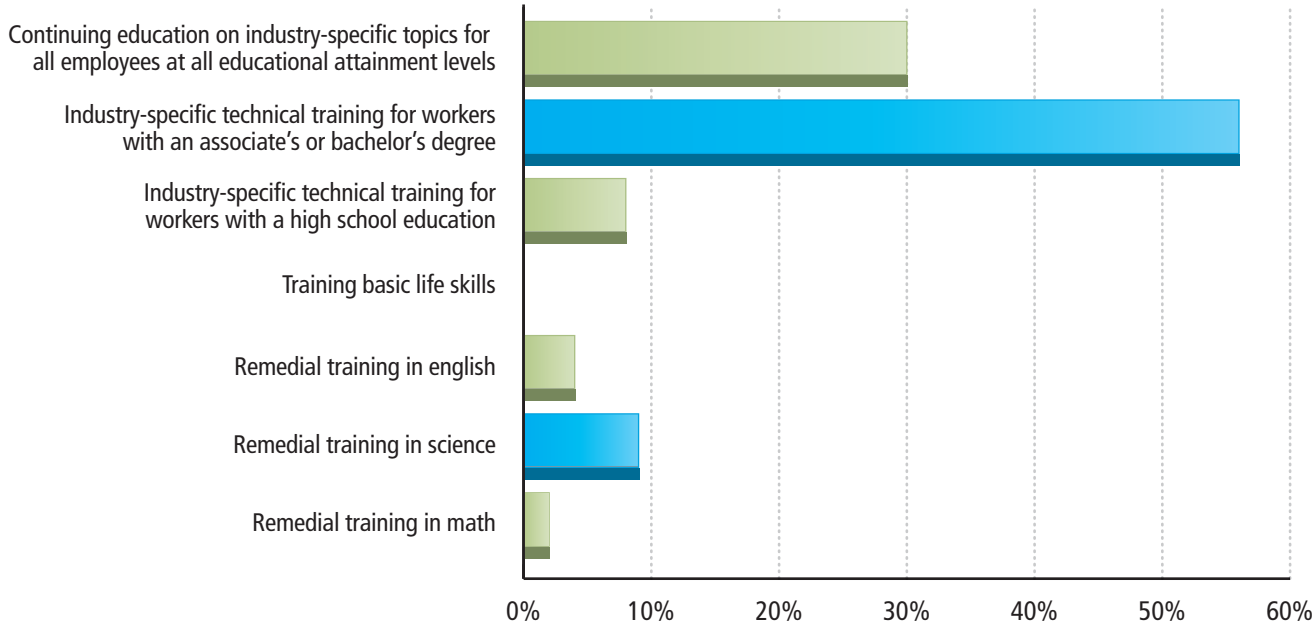
Training Needs

Because workforce is such a dominant factor for a company's success, it is also useful to look at the industry's training needs as well. The need for industry-specific technical training for current workers with associate's or bachelor's degrees received the greatest response at over 50%.

Figure 13

Greatest Training Needs - All Companies

Source: IBRC/BioCrossroads Survey, October 2010



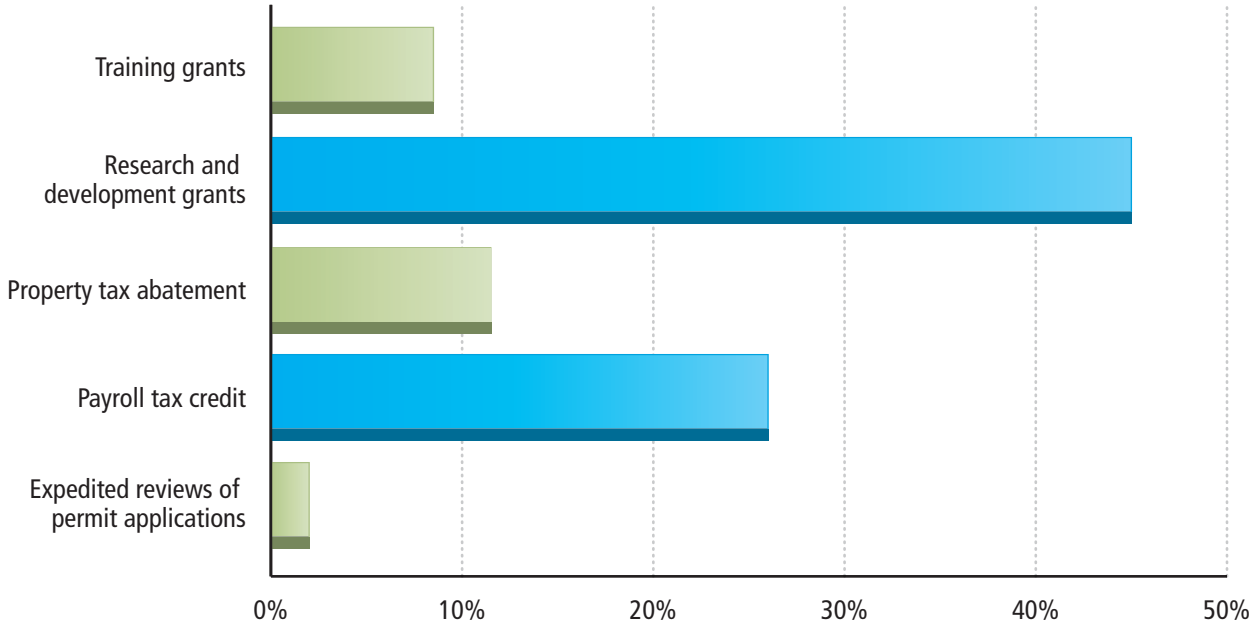
State and Local Incentives for Life Sciences Companies

Life sciences companies responded that the most valuable state and local government incentive is providing research and development grants (which Indiana does provide) and payroll tax credits.

Figure 14

Most Valuable State and Local Incentives - All Companies

Source: IBRC/BioCrossroads Survey, October 2010

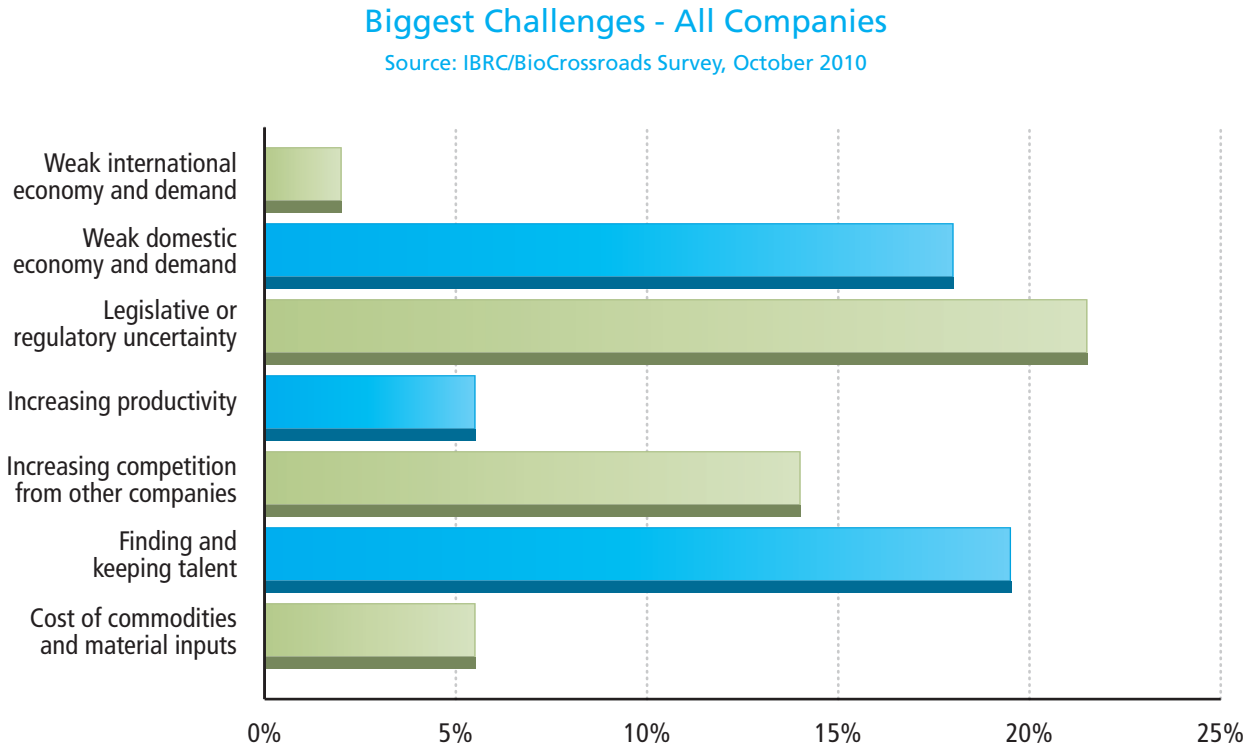


Challenges for the Future

Companies indicated that the top three challenges facing them were: (l) legislative or regulatory uncertainty; (2) finding and keeping talent; and (3) weak domestic economy and demand.

The talent answer is consistent with answers to previous questions. Uncertainty created by governmental regulations or possible legislation seems to be a particularly important matter these days. Implementation of the new healthcare reform legislation on regulatory approvals and reviews by FDA, the uncertainty of long term taxation, and the continued indecision regarding taxation of foreign earnings by life sciences firms are all concerns that they face. While there was not much apprehension about the international economy and demand, respondents are concerned about the state of the U.S. economy and what it might mean for their U.S. domestic business.

Figure 15



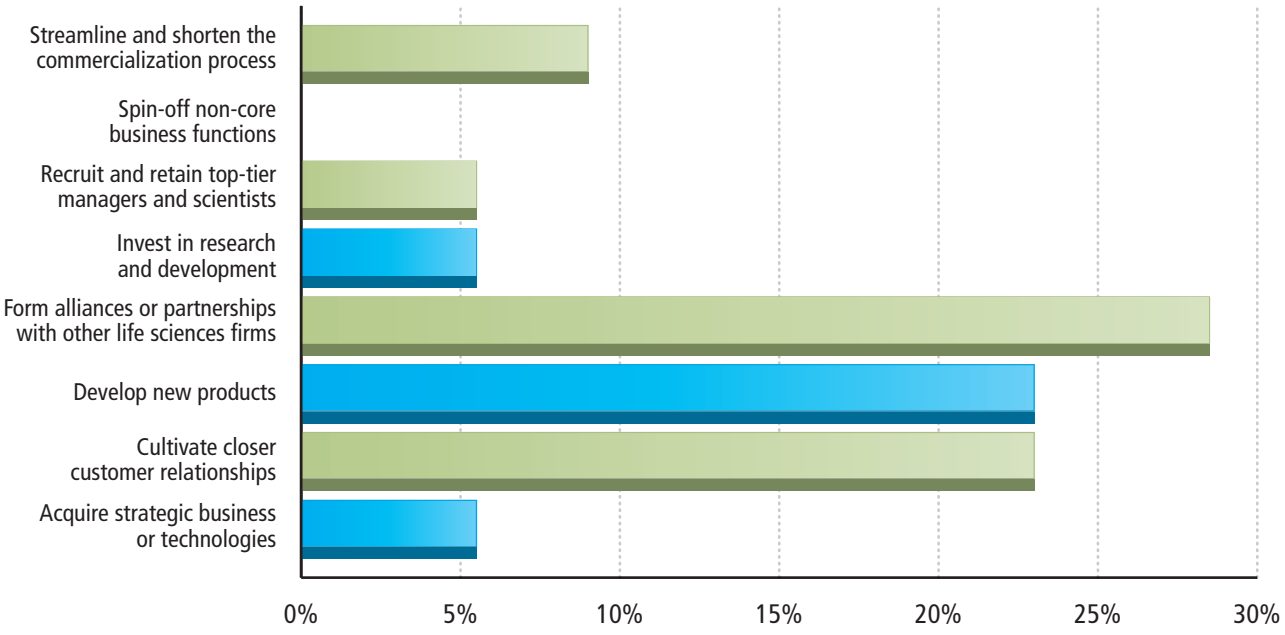
Company Strategies for the Future

Indiana life sciences companies see building alliances and partnerships with other life sciences firms as the key to their future success. The efforts by BioCrossroads to encourage collaboration fits very well with industry strategies. Since Indiana's life sciences industry cluster has been strengthened over the last decade due to an expansion of jobs, establishments, and exports, even more opportunities for firms to partner are on the horizon.

Figure 16

Most Important Strategy - All Companies

Source: IBRC/BioCrossroads Survey, October 2010



IV: Challenges Ahead for Indiana's Life Sciences Industries

Goals

A key goal for Indiana over the coming years is to accelerate Indiana's job growth so that it becomes one of two states with both large and specialized employment in three industry segments, thus identifying Indiana as a Life Sciences Super Cluster State, along with California. The amount of additional employment Indiana needs in medical devices and agricultural feedstock and chemicals to reach the threshold of 5% of employment in each of these industries is not very far from current employment levels.

Challenges

BioCrossroads and other organizations supporting the growth of the life sciences sector in Indiana have made considerable progress during the past decade by better positioning the state in this growing global industry. Based on what has already been accomplished, what the life sciences industry has identified as challenges for the future, and an examination of global and national trends, seven challenges lie ahead for Indiana's life sciences cluster and the desire to maintain and further grow its presence. It will need to continue to address the key components to a growing life sciences industry: talent, capital and technology.

- **Recognize that Major Changes Await U.S. Life Sciences Industry in the Coming Decade and Ensure Indiana Seizes Its Opportunity Without Losing Its Base.**

  Problem: The life sciences industry of today will not be the industry of tomorrow. Healthcare reform, regulatory and reimbursement changes and other factors could impede the introduction of new medical products and reduce operating margins and employment opportunities for the industry. The drugs and pharmaceuticals industry is already seeing a shift from large, vertically-integrated organizations to smaller, focused companies utilizing a network of drug development service providers. Similarly, the device industry faces increasing regulatory challenges, and in many instances, they are developing and introducing new products abroad rather than in the U.S. Consequently, it is critical that Indiana's life sciences industry be positioned both to respond and to take advantage of these market changes. One hopeful sign is that over the last eight years, more than 40 new life sciences firms a year are being established in Indiana, some of which may turn into the large companies of tomorrow. In addition, Indiana has already taken advantage of changes in the industry to position the state as a leader in both contract drug development and pharmaceutical distribution and logistics. Indiana must be prepared to continue to seize such as yet unknown opportunities in the future.

  Challenge: ***Indiana must*** *work to anticipate and identify the major changes that await U.S. life sciences industry in the coming decade and look to* ***seize opportunity to guard against losing its base***.

  Rationale: Indiana must adjust to potentially radical changes in the global life sciences business over the coming decade and be prepared to address potential impacts on both its current base and the potential to grow and develop new industry segments. Much as BioCrossroads and its partners have done in the case of health information technology, similar comprehensive efforts to push research, develop new firms and industry segments, and ensure sufficient workforce availability will need to be undertaken not just for new market opportunities but to realign and rebuild existing industry segments.

- **Ensure Maintenance of Warsaw's Status as the World-class Orthopedics Center.**

  Problem: Warsaw, a small town in North Central Indiana, has become a world center in orthopedics. And three of the five largest orthopedics manufacturers and many of their suppliers are located there as well. In the fast changing world of medical devices, the orthopedics industry faces many challenges. Warsaw's relatively isolated location affects logistics, transportation, and other operating costs. The new federal healthcare reform law raises fees on orthopedic and other device firms and proposes a new regulatory scheme regarding how new devices can be introduced. Regulatory uncertainty at the U.S. Food and Drug Administration makes it more unpredictable when and if new products can be introduced.

  Challenge: ***Find additional ways to assist the Warsaw-based orthopedics industry through successful implementation of collaborative approaches and mechanisms****. The creation of OrthoWorx can promote, market, and feature Indiana's unique world class strengths around Warsaw-based orthopedics firms.*

  Rationale: The establishment of OrthoWorx as a regional initiative to support the growth of this cluster in Northern Indiana is a solid first step in this ongoing effort. OrthoWorx has identified a number of issues that will be addressed to ensure that the Warsaw-based cluster is better able to compete in the global market, and has developed a comprehensive strategic vision to address these issues.

- **Link Industry and Educators to Plan for Increased Skill Needs of the Future Indiana Life Sciences Workforce.**

  Problem: Much of the current occupation base of Indiana life sciences firms seems dependent on high school graduates. As manufacturing development and production becomes more advanced, a post-high school education will increasingly become a minimum requirement for all life sciences industry subsectors. Educators must be prepared to address employer needs as the industry evolves. This requires increased direct communications between educators and employers, and calls for employers to increase their planning to address changes in technology and skills and better prepare for them.

  Challenge: ***Address the imbalance of higher institution degrees vs. high school only education in the life sciences workforce****. As technology and science advances, companies will require more skilled and educated workers. A partnership between industry and academia to address current and future education needs is necessary for Indiana to continue the growth of the life sciences.*

  Rationale: Lifelong learning will be increasingly necessary for the incumbent workforce in life sciences in order for Indiana's companies to compete with countries who have much lower wage and operational costs. Using and applying technology to more complex problems and working in a multi-disciplinary environment can overcome wage level differentials provided the creative innovative impulses of life sciences entrepreneurs remain strong. Building better communication channels between educators and industry can ensure Indiana workers are up to date and on the cutting edge of product innovation and production.

- **Address Critical Seed/Early Stage Capital Gaps To Build the Next Generation of Indiana Life Sciences Entrepreneurs.**

  Problem: Indiana faces a problem found throughout the U.S. – a shortage of seed and early stage funds to help get new start-up companies through their early years – the "Valley of Death". In the past eight years a number of efforts have enabled the state to stay even with the rest of the U.S. in venture capital investments. However, just like the rest of the country, Indiana is faced with a venture industry that is more cautious and is now looking at larger, later stage deals.

  Challenge: ***Indiana must continue to address ways to fill this seed/early stage capital funding gap if it wants to further grow its life sciences industries of the future***. *Approaches to do so range from use of pooled funds from major institutional players in the state (philanthropic endowment, insurance, larger firm & public pension funds, etc.) to increasing the support to Indiana entrepreneurs to seek and successfully secure Federal Small Business Innovation Research (SBIR) fund awards.*

  Rationale: A vital component of growing the job base in the state is the availability of sufficient capital sources at all stages of the life cycle of firms. Indiana has addressed these gaps over the past decade and will have to continue to develop its unique solutions, given that the national venture capital industry continues to "fly over" most of the country except the two coasts. Without this earliest stage funding, Indiana is not going to excel in its identified market niches such as health information technology or maintain and grow in areas such as research and testing, where many of the growing breakthrough companies begin.

- **Achieve Higher Levels of Strategic Collaboration Between Industry and Universities Through Indiana Leadership.**

  Problem: The nature of the scientific research is increasingly requiring more multi-disciplinary research teams to develop new drugs, treat and prevent diseases, and address complex health issues. Federal and patient advocacy funding sources, recognizing this, are increasingly making larger research awards which require medical centers and universities to assemble deep but broad multi-disciplinary teams. And with the growth in the number of institutions and investigators competing for funds from the National Institutes of Health and other funders, it is increasingly competitive. Successful applicants must do "seed" research work before they apply but sources of funding for this "seed" work are increasingly hard to find. Finally, industry is recognizing it cannot simply rely on incremental internal product development to grow and survive but must partner on major discovery with universities and other firms through centers, alliances, and other forms of partnership. Fortunately Indiana's life sciences firms are strong proponents of forming such alliances and partnerships, according to the recent industry survey.

  Challenge: ***Forge new and stronger strategic partnerships of the Indiana life sciences industry and Indiana medical centers and universities to form comprehensive discovery to product development approaches and mechanisms***.

  Rationale: Achieving a designated NIH-awarded Clinical and Translational Sciences Institute, as Indiana has done, is an important initial step but because of its stronger academic and industry research base than most states and its smaller population base, Indiana has the opportunity to develop and demonstrate such partnerships on a much larger scale than elsewhere. Forming strategic consortia in unique market niches, continuing and expanding the Indiana 21st Century Research and Technology Fund to seed such partnerships, and developing fully fledged clinical trial platforms to go with discovery research – are areas Indiana should explore. Companies are more likely to expand operations and activities where their academic R&D collaborations bear fruit. A better assessment of the core competencies of Indiana's research organizations and better aligning these with industry around common technology platforms and product niches could increase in-state collaborations.

- **Manage Public Resources and Promote a Positive Life Sciences State Business Climate.**

  Problem: Indiana's business climate/operating costs is the second most important factor contributing to the success of its life sciences companies, according to the BioCrossroads' survey of Indiana companies. The most important element cited an experienced workforce.

  Challenge: ***Indiana state and local government should continue to manage limited resources wisely. However, the state should also maintain incentives to the private sector that promote growth of its life sciences industry****. Recommendations include ensuring that the 21st Century Research and Technology Fund has the resources to help address gaps in seed and early stage capital through its grant programs, adjusting Indiana's tax policies to spur more angel investments and formation of more venture capital funds, and highlighting the state's relatively low tax burden versus other states attempting to attract Indiana life sciences companies to their states. It is important that Indiana's economic development agencies and its tax, regulatory and other business climate policies and tools be continually aligned for life sciences industry growth.*

  Rationale: In a time of limited public funding sources and budget austerity it is difficult for state and local governments to offer additional incentives both to existing companies and those looking to relocate here. As Indiana has proven in recent years, a lean government can reduce increased tax burdens on the life sciences industry. Many other states face a problem because they are not giving the same attention to running lean governments and instead offer cash and tax incentives to attract and grow their life sciences industry from outside their states. Indiana must remain vigilant to these efforts by other states to recruit away Indiana's life sciences industry by narrowly targeting incentives to encourage private sector gap filling and demonstrating to life sciences firms the comparative tax burdens of Indiana relative to other states.

- **Reassert U.S. Leadership in Medical Innovation.**

  Problem: While the U.S. has long been recognized as the worldwide leader in medical innovation, recent developments suggest we are losing our global edge. It is time to join the forces of the public and private sectors to help rebuild and remobilize U.S. medical innovation leadership. Such leadership includes securing sufficient ongoing investments in medical research, addressing regulatory, tax, and patent law issues, addressing our ability to build a talent pool; providing more attention to translational research; and addressing shortfalls in private investment.

  Challenge: ***Advocate for national policies and investments which both protect Indiana's existing clusters of the life sciences and further its competitiveness in face of increased global competition****. Among those matters of particular concern are: the need for greater consistency and predictability in review and approval of new medical products by the FDA; R&D and other federal tax incentives for industry; addressing ways to increase private funds for seed and early stage venture capital; ongoing stable funding to NIH and increased support for industry-university partnerships in funding streams; encouraging NIH to permit some of its funds to be used for technology transfer/commercialization including proof of concept/reduction to practice funding; and building the U.S. pipeline in STEM for the future.*

  Rationale: American medical innovation global leadership is of rather recent vintage since the 1980's – and due to the partnership of government, industry, and universities. Other countries in the world, primarily interested in the economic potential from medical innovation, are attempting to replicate and eventually surpass the American innovation engine.

Conclusion

Battelle's 2002 Report laid out the challenges facing Indiana in building a stronger set of life sciences cluster industries and posited a set of success factors to be addressed to accomplish that objective. This review shows a strong quantitative success story – in terms of industry concentration, specialization, export growth, patents, and business start-ups/expansion/acquisition that indicates Indiana has moved a considerable distance toward meeting those 2002 challenges. Through the efforts of BioCrossroads, and in collaboration with many other groups from philanthropy to universities and other higher education institutions, and industry leaders, many of the factors for success have been and continue to be addressed: building stronger access to venture capital focused on life sciences; addressing education and workforce issues to ensure an adequate future workforce; finding ways to address a strong existing cluster – orthopedics – through a newly created consortium; and identifying the next set of business opportunities presented building on Indiana's existing strengths – in health information technology; contract manufacturing, and pharmaceutical distribution and logistics. Indiana demonstrates vividly how to build a set of stronger clusters through creation of an ongoing catalytic organization – BioCrossroads – and sticking to a game plan over a multi-year time period.

Indiana has been identified as one of the nation's innovation cluster success stories. From a lack of recognition both in and outside of Indiana in 2002, life sciences is now seen as a way to further diversify Indiana's economy from durable traditional manufacturing of the industrial age to a broader, technology-driven set of key industries of the future. Indiana has gained significant ground in terms of hard numbers as to jobs, firms, exports, and other wealth generation data. Indiana has continued to grow its life sciences industries in spite of the severe national and global recession of the last several years. Indiana is very close to becoming one of two states in the U.S. (the other being California) to having both specialized and large employment base in three of the four subsectors of the life sciences: drugs and pharmaceuticals, medical devices and equipment, and agricultural feedstock and chemicals. Should this happen, Indiana can adopt the motto of the Life Sciences Super Cluster State evidencing the achievement and progress the state has made setting itself apart from the rest of the country.

Walter H. Plosila, Ph.D.

Walt Plosila has extensive experience in the public and private as well as non-profit sectors. He has directly worked for three Governors (Kansas, Pennsylvania and North Carolina) and consulted over his career with over 40 states. His contributions include early involvement in the formation of Maryland's biotechnology industry in the mid-80's; design of Pennsylvania's Ben Franklin Partnership Programs; Ohio's Third Frontier Initiative; and life sciences strategies in such states as Arizona, Colorado, Indiana, Iowa, and Missouri; and in such regions as Pittsburgh and St. Louis. Most recently he served as Vice President, Technology Partnership Practice, for Battelle, where he worked with universities, regional business organizations, foundations and states in the development and design of technology-based economic development strategies and their implementation. He is currently Senior Advisor to the Practice.

Previously, Plosila served as Executive Director of the North Carolina Alliance for Competitive Technologies; President of the non-profit Suburban Maryland Technology Council (now Technology Council of Maryland); Deputy Secretary of the Pennsylvania Department of Commerce and Director of the Pennsylvania Governor's Office of Policy and Planning.

Plosila has a Ph.D. from the University of Pittsburgh, from which he also received a Distinguished Alumnus Award; an M.A. from Pennsylvania State University; and a B.A. from Beloit College (Wisconsin).

He is past chair of the National Science Foundation's Industrial Innovation Committee. He is a speaker on technology innovation throughout the U.S. and abroad.

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[i] Battelle/BIO, State Bioscience Initiatives 2010, May 2010.

[ii] ITIF/Kauffman Foundation, The 2010 State New Economy Index, November, 2010.

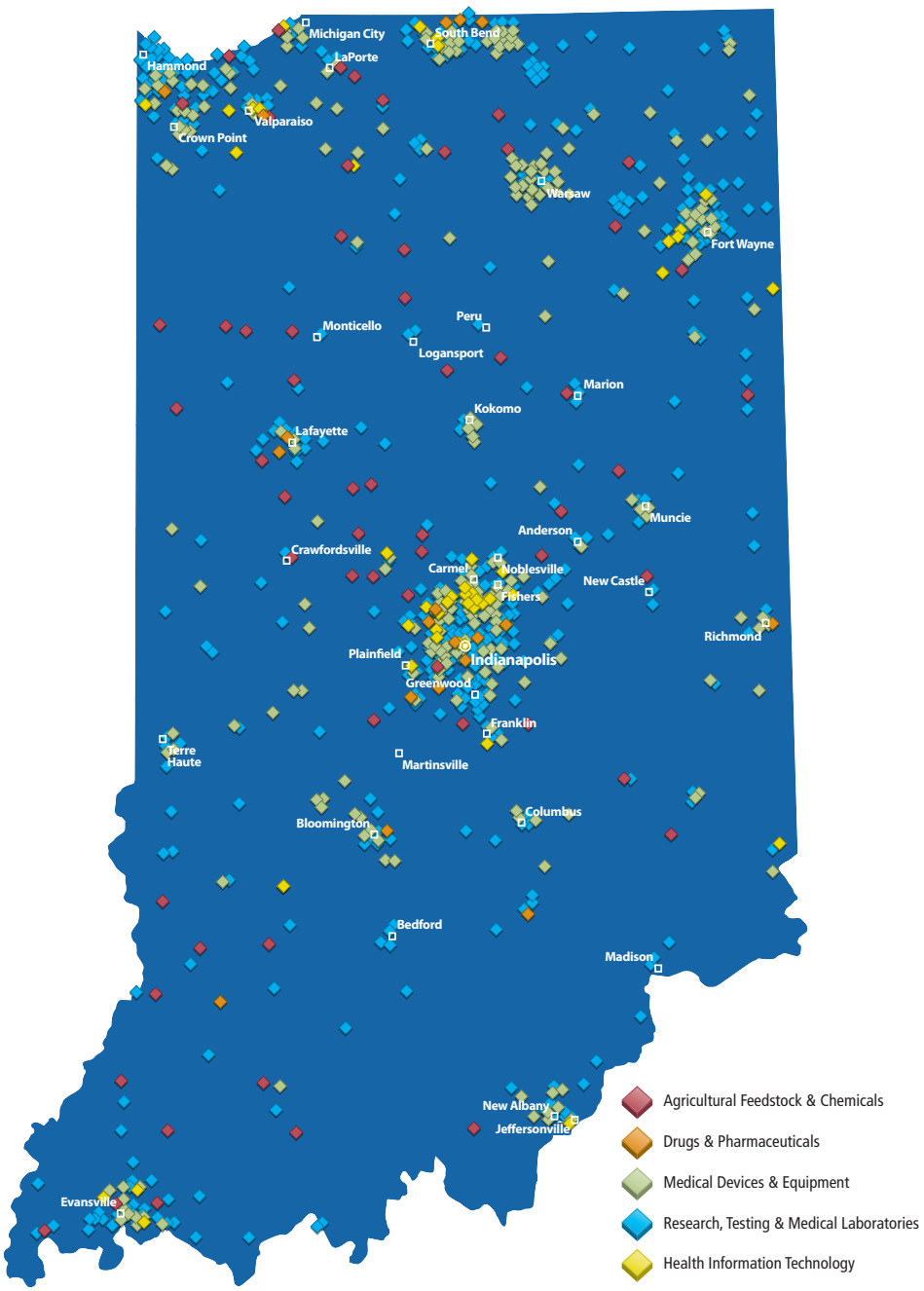
[iii] Battelle, Life Sciences: A 21st Century Economic Driver for Central Indiana, February, 2002.

[iv] Battelle/BIO, State Bioscience Initiatives 2010, May, 2010.

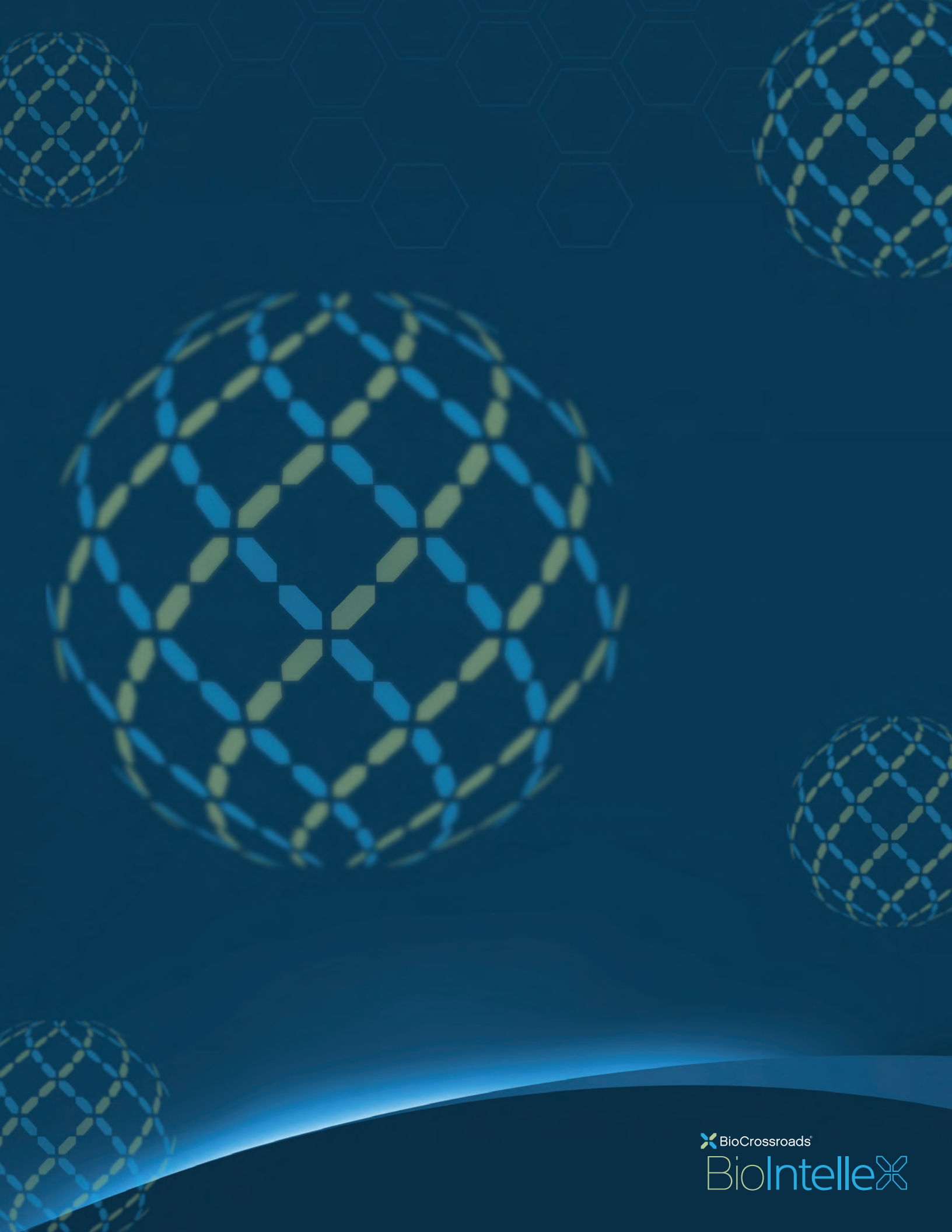
[v] BioCrossroads, Warsaw, Indiana: The Orthopedics Capital of the World, September, 2009.

[vi] The omission arises because Warsaw is not located in one of the 361 Federally-designated MSAs. The BIO/Battelle report only analyzes data for the top 361 MSA, which does not include Warsaw. Rather, it is in what is called a "micro" area.

Life Sciences Firms are Located Across Indiana



Source: IBRC/BioCrossroads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