# Growing the New Michigan – Global Engineering Village

BUSINESS LEADERS FOR MICHIGAN

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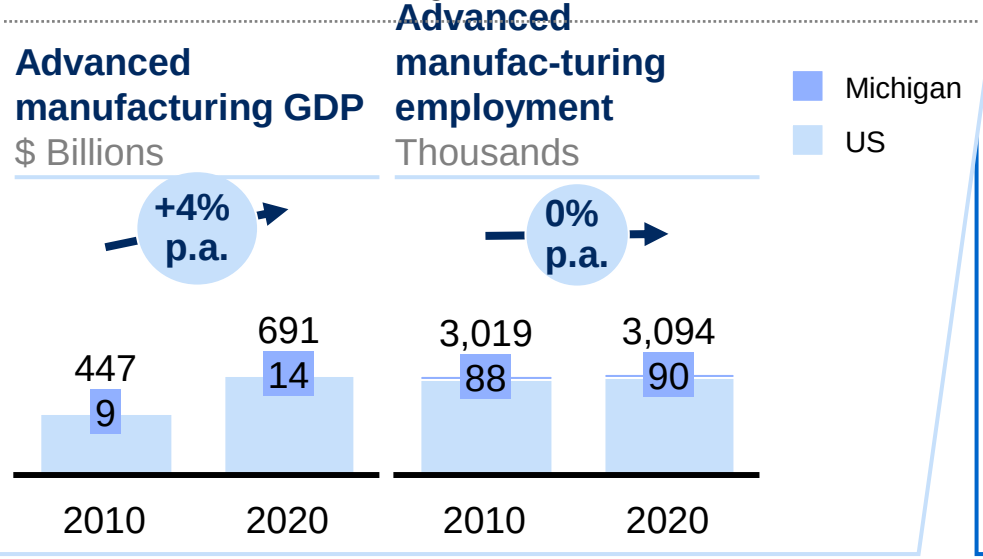
Developed by McKinsey & Company with support from Business Leaders for Michigan staff

McKinsey&Company

# Michigan can leverage its strong position in manufacturing to become a thriving Global Engineering Village

## The asset

- One of the leading states in manufacturing output
  - Manufacturing contribution to GDP remains strong despite overall slowdown in GDP growth
- Leading research hub for manufacturing activities
- Strong human capital and robust talent pipeline
  - No. 2 state in the nation in engineers per capita
  - No. 9 state in the nation in STEM graduates
- However, Michigan lags behind in the State Science and Technology (STI) Index, with an overall score of 50.74 and 2010 ranking of 26




## Potential ways to leverage the asset

- Enable sustainable growth by expanding towards engineering services from pure manufacturing of goods
  - Create a globally recognized brand "Engineered in Michigan"
- Leverage currently under-utilized assets to take advantage of global demand for "advanced" engineering services
  - Aspire to be Top Ten in location of engineering headquarters
- Expand engineering education curriculum focusing on cutting edge and multi-disciplinary engineering approach
  - Aspire to be Top Five in number of STEM graduates
- Build up R&D capabilities, risk capital and entrepreneurial infrastructure to be on par with high ranking states
  - Aspire to be Top Ten in new engineering start-ups (e.g., STI score of 80 or above)

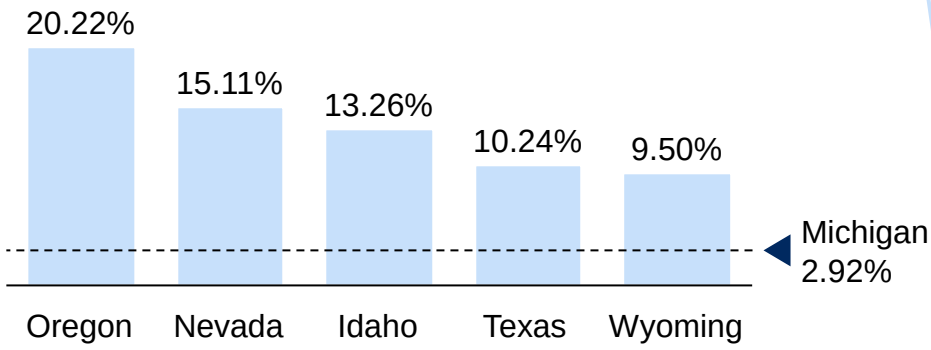
SOURCE: Milken science & technology report, MI department of treasury, McKinsey Global Institute analysis, Engineering Soceity of Detroit, Moody's

# 2020 Goal: Michigan should be a Top Five state in engineering services

## Today, top US states outperform Michigan in growing engineering services

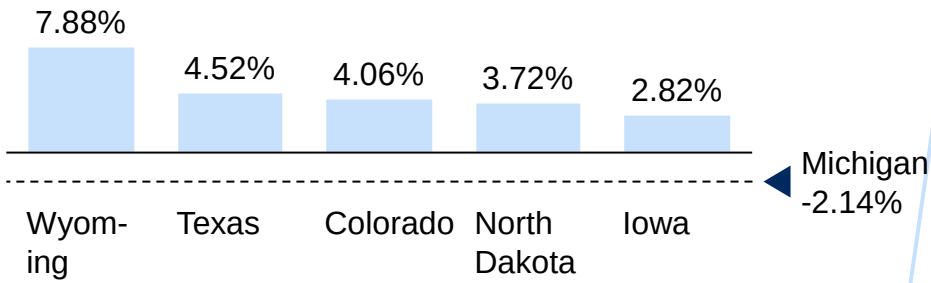
### Projected GDP growth in engineering service (US Top 5)

2010 - 2020




### Projected employment growth in engineering service (US Top 5)

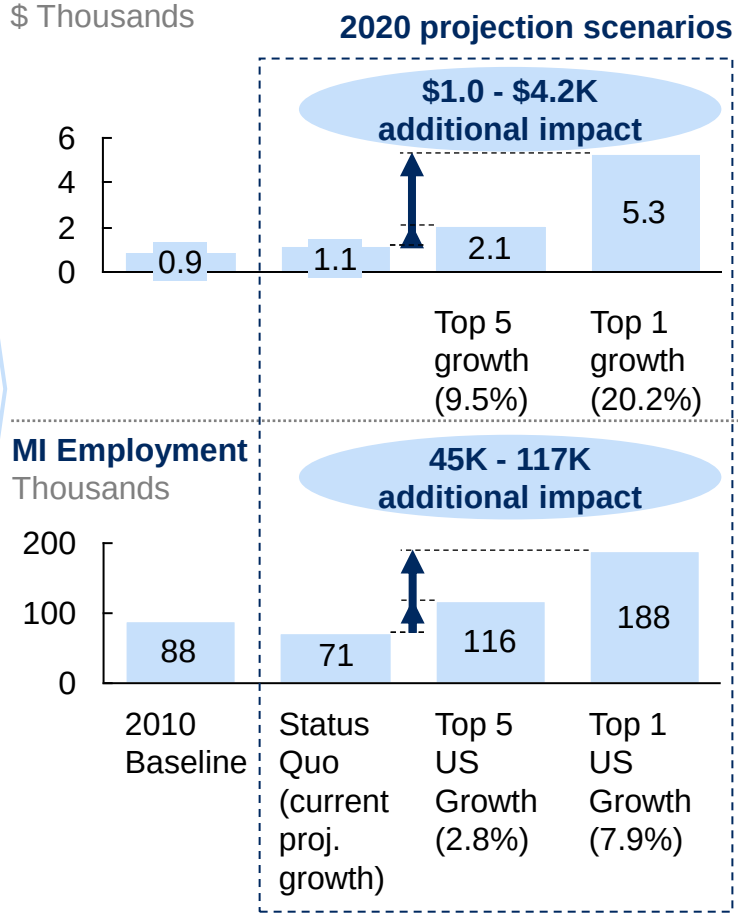
2010 - 2020




## Michigan should aspire to reach top US state growth in engineering services

### MI GDP per capita

$ Thousands




Source: AEG analysis, MGI analysis

# Key considerations for a Global Engineering Village

## A Opportunity & aspiration

- Opportunities in the new economy exist in expanding from pure manufactured products towards engineering services, where value added growth is
- Engineering service is an emerging sector that will grow at 3-5% p.a.
- Michigan should aspire to increase its current share (2-5%) of this sector by focusing on 3 areas
  - Process design for advanced manufacturing processes
  - End-to-end engineering solution for complex machinery and tools, a $63B industry, for advanced and regulated industries
  - Engineering services on disruptive technologies in high-end manufacturing
- Brand the sector as “Engineered in Michigan”

## B Feasibility & case for action

- Strong existing intellectual property (IP) base (8 patents per 10,000 employees), underutilized engineering resources and an education infrastructure (University of Michigan is ranked No. 7 in engineering) to address the opportunities above
- Michigan will need to be globally competitive on cost and knowledge dimensions and needs strong ties to target customer segments

## C Potential Enablers

- Collaboration between higher education, private and public sector to develop cutting edge education paths across relevant skill levels
- Establishing awareness and targeted brand building/communication with target investors and customers
- Removing barriers: business incubation/building and potential regulation
- Increased bandwidth and a more streamlined immigration process

SOURCE: MI department of treasury, McKinsey Global Institute analysis, Moody’s

# A General trend of expanding services provides Michigan an opportunity in advanced manufacturing and engineering services

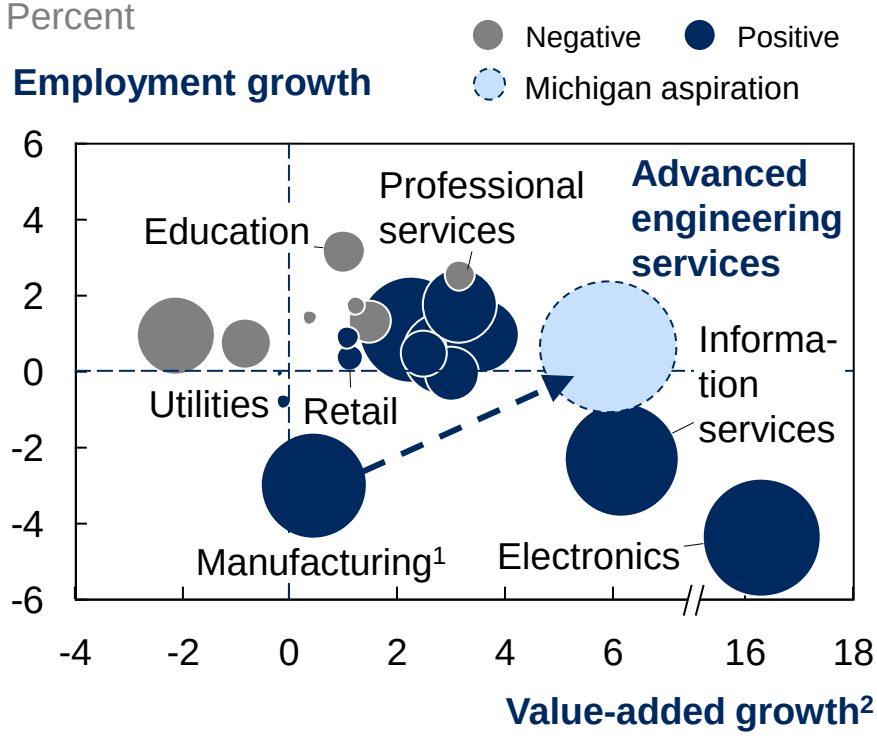
## Manufacturing in industries such as aerospace and military & defense presents a strong and growing opportunity

- Advanced and regulated industries, such as Aerospace, military/defense, will continue to grow due to their strategic importance to scientific discovery and national defense
  - Tier 1 aircraft supplier market estimated to grow at 3.5-5% p.a., projected to reach $100-200B by 2028
- These industries will continue to be profitable because of their strategic importance and level of sophistication, which build barrier of entry
- Historically these industries are less volatile due to their strategic importance
- Average operating margin in Tier 1 has been higher, and held steady in recent years, suggesting players have resisted pressure from industry dynamics (highest margin is at 15%)

## Engineering service for advanced manufac-turing has the potential for value-added growth

**Compound annual growth rate, 2000-08**

Percent




1 Manufacturing sector excluding Computers/electronics and Other transportation equipment sectors
2 Valued-added growth is the contribution of each sector to total GDP growth

SOURCE: McKinsey Global Institute growth and renewal project, McKinsey Aerospace report, team analysis

# A Michigan should aspire to provide high-end engineering and services for advanced industries on products and manufacturing technologies

**Global engineer-ing village**

| Opportunities | Aspiration |
|---|---|
| 1 **Process design** for manufacturing in advanced and regulated industries | ▪ **Operational excellence** in auto manufacturing can be applied to other advanced manufacturing sectors to increase productivity and efficiency<br>▪ Advanced and regulated industries present a great opportunity because of high barriers to entry |
| 2 High-end engineering of **complex machinery and tools** for advanced and regulated industries | ▪ Opportunity to create an **engineering center for advanced machinery and tools,** providing end-to-end engineering solutions including R&D, differentiated through IP and core expertise (e.g., customized high-end machinery & tools for regulated industries)<br>▪ Machinery and tools used in advanced and regulated manufacturing industries can only be provided by highly advanced suppliers with deep technological expertise<br>▪ **Precision manufacturing** applications, such as medical device and high tech instruments manufacturing, can leverage R&D and operational insights from auto industry |
| 3 Engineering services on application of **cutting edge technologies in high-end manufacturing** | ▪ Rising demand for **cutting edge IT solutions** driven by increased globalization of advanced manufacturing technologies may present "on-shoring" opportunity for **higher skill engineering**<br>▪ Create a brand identity for the sector: **"Engineered in Michigan"**<br>▪ Expertise in **state-of-the-art multi-disciplinary technology applications** (e.g., nanotechnology, mechatronics, and electro-mechanics) could be leveraged to create a global pocket of excellence |

Initial focus

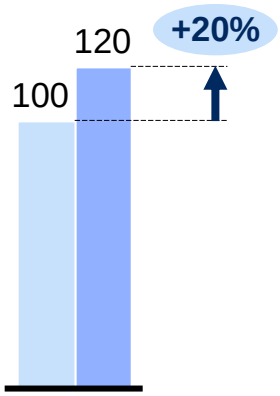
# 1 Engineering services in process design

## A Opportunity and aspiration

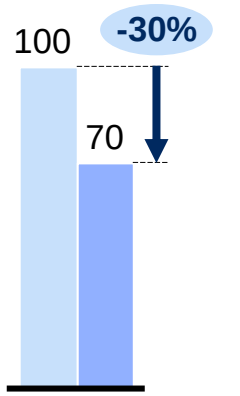
### Best-in-class automotive could drive significant benefit for aerospace[1]

Before
After

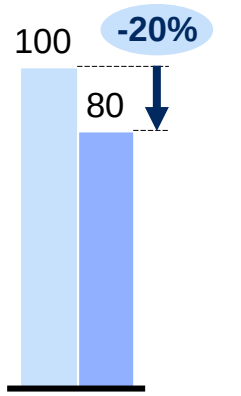
**Real-time Performance management**
Labor productivity




**Assembly line cycle time reduction**
Production cycle time




**Production planning techniques**
Total cost

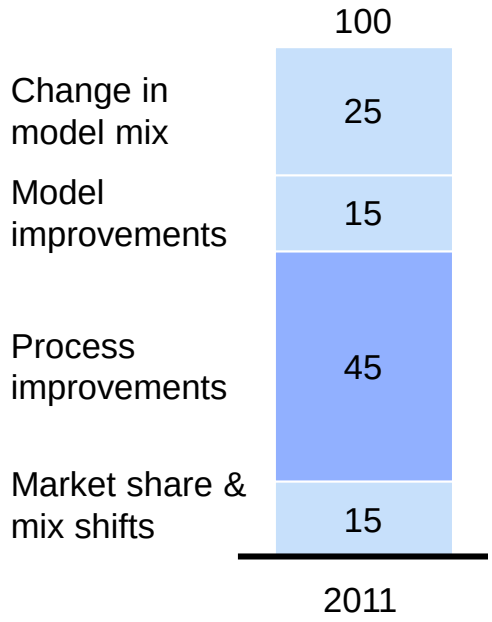



- **Process design is critical to manufacturing in advanced and regulated industries**
- **Application of best practices in auto can significantly reduce cost and drive efficiency**

## B Feasibility for Michigan

### Contributions to productivity growth in auto industry

Index, 100 = 15 year growth in value added per hour




- **Process improvements has been the greatest contributor of productivity in the auto sector**
- **Michigan's auto industry has developed deep expertise driving productivity increase through process design**

1 The various practices complement each other; the sizing estimates should not be considered additive

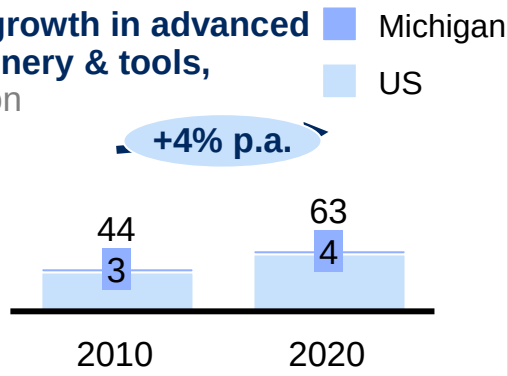
SOURCE: US Bureau of Economic Analysis; McKinsey Global Institute analysis

# 2 High end engineering of advanced machinery & tools

## A Opportunity and aspiration

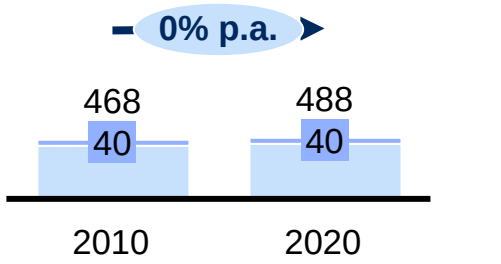
### GDP contribution

**GDP growth in advanced machinery & tools,**
$ Billion




### Employment potential

**Employment growth in advanced machinery & tools,**
Thousands

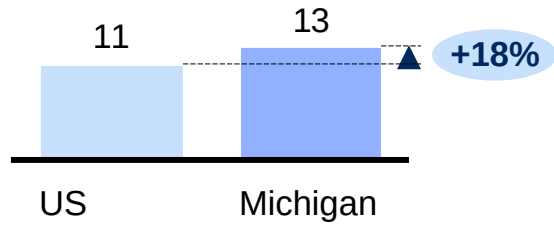



- Overall engineering of advanced machinery & tools manufacturing is a growing opportunity
- Focus on this opportunity will help leverage underutilized infrastructure and skill base

## B Feasibility for Michigan

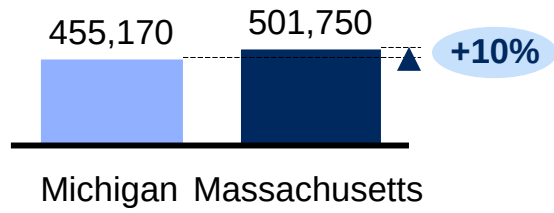
### Talent availability

**Proportion of STEM graduates**
Percent of total, 2009




### Talent utilization

**STEM employment**
2009




- Michigan universities have a strong pipeline of engineering talent base
- Access to skilled human capital in STEM provides Michigan the ability to provide high-end engineering services cost competitively

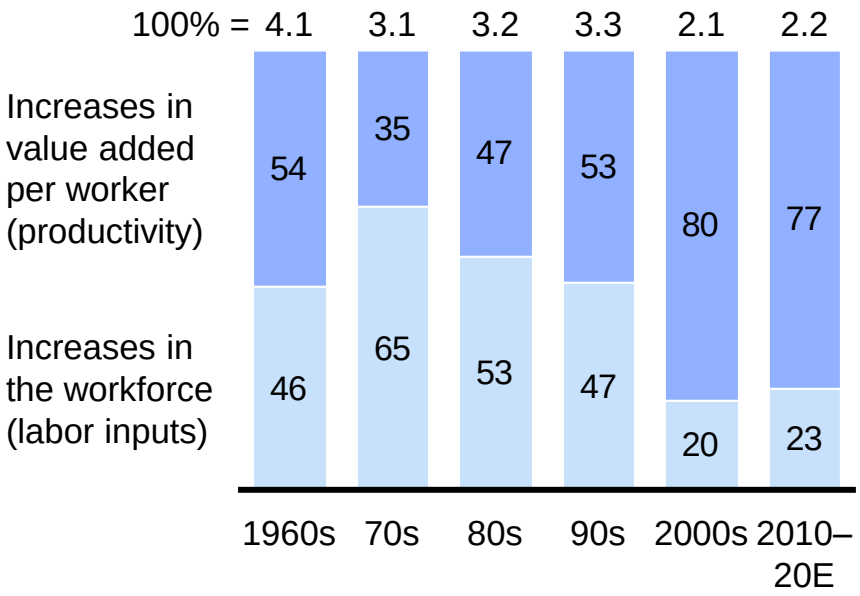
SOURCE: US Bureau of Economic Analysis, Michigan Porter analysis, McKinsey Global Institute analysis

# 3 Engineering services in multi-disciplinary technologies

## A Opportunity and aspiration

### Contributions to growth in real US GDP, overall economy

Share of compound annual growth rate, 1960–2008, %



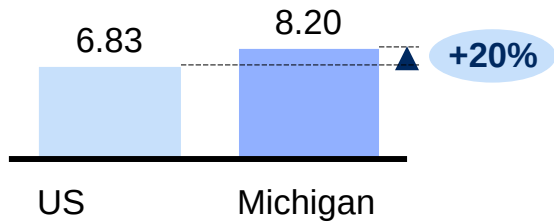

- Productivity driven innovation will continue to be the growing segment of the economy
- Multi-disciplinary engineering approaches, such as Mechatronics, likely to drive signifi-cant productivity gains in manufacturing

## B Feasibility for Michigan

**Patent activity**

### Patents Per 10,000 Employees

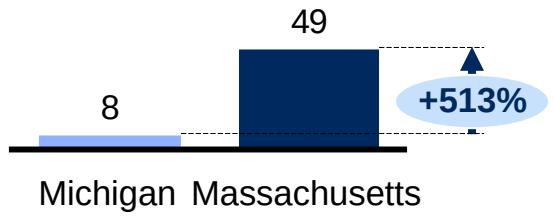
2009




**Innovation Output**

### Startups generated by major research institutions

2009




- Michigan outperforms US average in patent activity
- However, there is sufficient room to improve commercialization of research, supporting an "Engineered in Michigan" brand identity

SOURCE: US Bureau of Economic Analysis; McKinsey Global Institute analysis

# C Potential enablers – What needs to happen to successfully pursue the opportunity?

| Stakeholders | Role | Requirements | Key enablers | Case examples |
|---|---|---|---|---|
| **Businesses** | ▪ Backbone of the economy | ▪ Resource and infrastructure<br>▪ Commercial opportunities<br>▪ Business friendly environment | ▪ Modernized infrastructure<br>▪ Competitive business climate<br>▪ Business friendly regulations | ▪ Delaware |
| **STEM talent** | ▪ Key human capital asset | ▪ Job opportunities<br>▪ Quality of life | ▪ “Frictionless” job markets<br>▪ Vibrant cities/strong quality of life<br>▪ Development of entrepreneurs | ▪ California |
| **Institutions** | ▪ Educational and R&D infrastructure | ▪ Availability of raw talent<br>▪ Availability of funding and resources | ▪ Innovative K-12 education<br>▪ Capital availability | ▪ Massachusetts |
| **Investors** | ▪ Funding and resources | ▪ Strong partnership with the other stakeholders | ▪ Pro-growth culture across stakeholders | ▪ Wolfsburg, Germany |

# C Potential enablers – What needs to happen to successfully pursue the opportunity?

| Enabler | Potential actions | Case Example |
|---|---|---|
| 1 Improve talent retention | ▪ Develop an urban agenda that includes incentives, policies and funding that attract people to live near engineering centers<br>▪ Renovate transportation infrastructure to improve ease of commute for engineering professionals | ▪ Wolfsburg, Germany |
| 2 Diversify expertise | ▪ Attract qualified teachers in math and science with the right incentives | ▪ China<br>▪ California |
| 3 Increase availability of skilled labor | ▪ Promote on-shoring of jobs by scaling engineering investments for companies in MI using underutilized engineers and retrain them | |
| 4 Create competitive business environment | ▪ Enable R&D investments for manufacturing and engineering service companies by creating targeted policy incentives<br>▪ Reduce Michigan business taxes to move Michigan significantly towards becoming a “Top Ten” state in low tax burden | ▪ Pittsburgh<br>▪ Delaware<br>▪ Massachusetts<br>▪ India |
| 5 Encourage immigration reform | ▪ Enable availability of desired talent for the sector through immigration reform | |
| 6 Improved international connectivity | ▪ Foster stronger relationships with international trading partners / regions to create and sustain demand for products and services | |

# Case examples

Case examples parallel to Michigan

NOT EXHAUSTIVE

**Pittsburgh**
- Pittsburgh has successfully transformed from a steel production powerhouse to a global center of medical services and high tech equipment manufacturing, through innovation

**Massachusetts**
- Massachusetts has successfully built a community of entrepre-neurs and business startups around cap-abilities of MIT labs and Harvard research facilities

**Wolfsburg, Germany**
- Top talent, industry knowledge, trade links, and smart capital are all brought together in a cluster, fueling innovation and growth.
- Success of one company in the cluster increases the value added of the entire network

**China**
- Built a $250M engineering service industry from ground up through leadership of top players and investment in education
- Nominal wage increase of 16% annually is key to attracting and retaining top talent in its engineering service industry

**California**
- Successful public and private partnership leveraging existing R&D capabilities and talent pools, aimed towards commercialization of new ideas
- An ecosystem built on new business models that focus on long term growth

**Delaware**
- Delaware is home to many international corporations with billions of economic impact, thanks to innovations in business laws and friendly policies

**India**
- Leveraged existing IT capabilities to build an automotive engineering services market with > 30% annual growth rate and increased sophistication that will service other industries such as aerospace

SOURCE: McKinsey Automotive R&D offshoring initiative, McKinsey Global Institute. team analysis

# Pittsburgh – Cross pollination of clusters builds a new and diversified economy centered around innovation

| | |
|---|---|
| **Idea** | ▪ Preexisting industrial culture catalyzed the development of new industries |
| **Key Lessons** | ▪ **Innovation drives prosperity:** Built industrial core through advances in new technology<br>▪ **Local competition drives innovation:** New ideas come out of competitive business climate<br>▪ **Diversification across several clusters:** helps to buffer regional economy<br>▪ **Leadership is vital:** Strong and unified regional leadership helps to push forward regional cluster development initiatives |

## Case facts

- Pittsburgh weathered a deep decline in steel and other manufacturing industries in the 1980s
- Subsequently the region has successfully established strong positions in advanced manufacturing by creating specialty products
- Preexisting industrial culture catalyzed the development of new industries

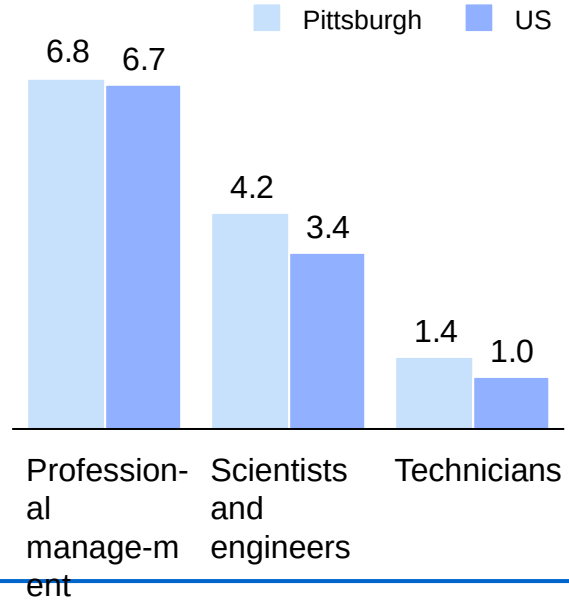
### Similarities to Michigan

- Long and rich history in manufacturing
- Strong research base
- Vibrant economy built around clusters

## Economic impact

**Skilled workforce base in Pittsburgh and United States, 1998**

Percentage of employed workforce




**Pittsburgh's performance across all Index measures ranks the metro as the top region in the state and 32nd in the nation, a leap up from 109th in 2009**

SOURCE: BLS, McKinsey Global Institute, team analysis