AI/Robotics Value Chain Analysis

Executive Summary

Objective:

Team Pennsylvania engaged BEAM Collaborative (with U3 Advisors) to produce the Commonwealth's first statewide evaluation of the AI & Robotics value chain. The objective was to:

1. Map Pennsylvania firms across the value chain (Direct Materials, Direct Services, Software & Integration, Professional/Indirect Services) using a category hierarchy (86 categories) and NAICS/web-scrape validation
2. Synthesize quantitative supplier data with qualitative stakeholder input (industry, public sector, academic, survey) to identify strengths, gaps, and bottlenecks
3. Recommend near-term opportunities and policy pathways that strengthen the connection between research → production → adoption and catalyze local economic development.

Deliverables:

The following deliverables fulfill the scope of work outlined in the project agreement.

1. Quantitative Value Chain Analysis

A statewide mapping across 86 detailed supply chain categories, organized within a four-tier hierarchy (Direct Materials, Direct Services, Software & Integration, Professional Services and Innovation Resources). The analysis identified firm density, regional specialization, and category-level participation within robotics, AI, and data-center infrastructure supply chains. The TEAM

2. Data Methodology and Classification Framework

A transparent and replicable methodology detailing the process of NAICS code selection, data acquisition through Data Axel, and custom web-scraping to validate firm specialization. This framework enables future updates and cross-sector comparisons as the ecosystem evolves.

3. Qualitative Ecosystem Assessment

A series of 16 in-depth stakeholder interviews and a statewide survey capturing perspectives from industry leaders, academic institutions, manufacturers, and public-sector organizations. These insights provided context for interpreting the quantitative data and identifying operational barriers, opportunities, and policy levers.

4. Integrated Statewide Synthesis

A comprehensive synthesis aligning quantitative and qualitative findings, presented through the section "Statewide Findings and Strategic Opportunities." This deliverable connects supply-chain data to actionable insights and outlines clear pathways for research translation, supplier development, workforce alignment, and policy coordination.

5. The Gaps Analysis

An evidence-based narrative identifying discrepancies between data and perception — clarifying where Pennsylvania's strengths are real, where they are overstated, and where the Commonwealth can compete effectively. This section distinguishes between *capacity potential* and *operational readiness*, helping policymakers target investment where it will have the greatest impact.

6. Strategic Recommendations and Next Steps

A detailed, forward-looking framework containing six actionable insights that directly respond to the findings and hypotheses in the SOW. Each recommendation integrates data evidence, stakeholder perspective, and remaining unknowns to define concrete actions for Team PA's next phase.

7. Final Report Presentation

A companion slide presentation summarizing key findings, regional maps, category dashboards, and policy implications. This visual deliverable enables stakeholders to quickly interpret results and supports briefing, outreach, and implementation planning.

8. Company Directory and Data Files

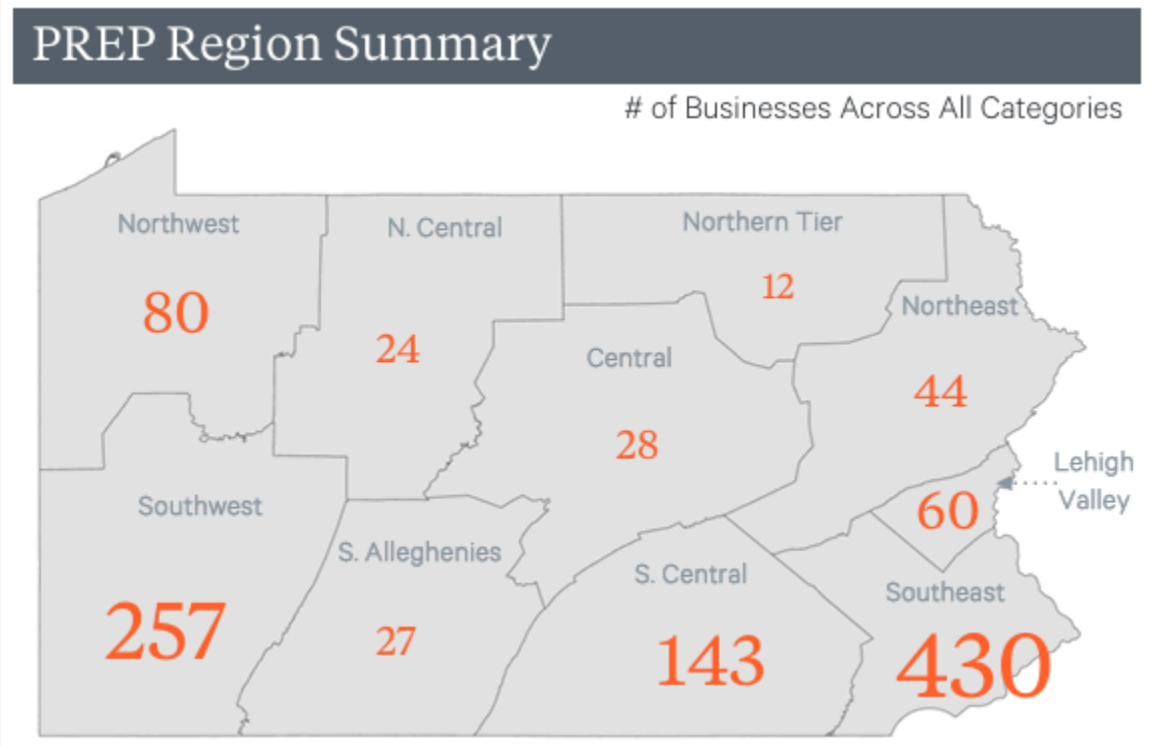
An internal dataset containing the full list of relevant firms, categorized by value-chain segment, regional location, and specialization level. This dataset serves as the baseline for future validation and supplier engagement.

Together, these deliverables provide Team Pennsylvania with a complete Phase I foundation — establishing the state's robotics and AI baseline, confirming areas of strength, identifying policy levers, and defining the next steps required to move from analysis to implementation.

Key Findings

Partnership for Regional Economic Performance (PREP)

This map represents all the businesses identified in the value supply chain and their location based on the 10 PREP regions.



Direct Materials

Detailed Category	Total Businesses	Experience in Robotics	Experience in Similar Industries
Aluminum Alloys / Materials	42	10%	52%
PLCs / Automated Systems	34	65%	32%
DC-DC Converters	33	18%	48%
Copper Alloys / Materials	30	7%	57%
Steel Alloys / Materials	30	3%	43%
Printed Circuit Boards	30	13%	60%
Semiconductors	23	26%	57%
Cabling and Connectors	23	39%	68%
Nickel Alloys / Materials	18	6%	56%
Optical Sensors	18	44%	61%
Power Transformers (Data Centers)	16	38%*	50%
Actuators	15	60%	47%
Silicon Carbide	14	14%	79%
Titanium Alloys / Materials	14	0%	79%
Power Dist Units (Data Centers)	13	69%*	38%
Poly-Carbonates	13	8%	46%
Thermo-Plastics	12	8%	42%
Power Transformers	12	25%	50%
Global Positioning Systems	11	27%	45%

**Experience with Data Centers for these two categories*

What the Data Shows

Overall, the supplier base for direct materials used robotics supply chains is more constrained than the supplier base for manufacturing-affiliated services (discussed in the next section). Pennsylvania's supply base shows strength in metals, alloys, and fabricated components, with more limited representation in electronic components and advanced materials. The data did reveal small concentrations of semiconductor and PCB manufacturers, but a sizable number of these firms are not headquartered in Pennsylvania. Aluminum, steel, and copper firms dominate the dataset (augmented further when including machined components, covered in the next section), but less than 15% of these companies demonstrate direct robotics experience. Regional density appears strongest in the Southeast, Southwest, South Central, and Lehigh Valley regions.

What Stakeholders Said

Interviewees consistently described a narrower set of firms truly capable of producing robotics-grade components. Stakeholders agreed that Pennsylvania is "good at metal, not microchips." They saw realistic opportunity in structural assemblies, actuators, enclosures, and energy-infrastructure components but little competitive edge in semiconductors or optics. Several emphasized the need to modernize mid-tier manufacturers so they can meet higher precision, certification, and digital-integration standards.

What We Don't Know

- Which machining firms have robotics-grade certification capacity (ISO, ITAR, IPC)?
- What modernization investments are needed to pivot them toward robotics supply chains?

Recommendations

- Modernize Precision Manufacturers: Launch a supplier readiness initiative providing grants or co-investment for digital and process upgrades.
- Cluster Support: Focus resources in Southwest and South Central regions to align machining and metals clusters with robotics buyers.
- Anchor Linkages: Facilitate procurement pilots connecting precision manufacturers to utilities and automation firms.
- Avoid Overreach: Do not pursue semiconductor fabrication capacity; emphasize attainable, high-value metal and component production.

Direct Services

Detailed Category	Total Businesses	Experience in Robotics	Experience in Similar Industries
Direct Services			
Fab and Machining – Structural	384	12%	44%
Fab and Machining – Plastics	78	6%	32%
Contract Manufacturing	74	30%	69%
Fab and Machining – Enabling	41	10%	46%
Electromechanical Assembly	39	26%	64%
Robotics Integration	23	96%	52%

What the Data Shows

Fabrication, machining, and contract manufacturing dominate this segment, with more than 500 relevant businesses statewide. Only about 12–30% show direct robotics alignment, though many serve adjacent industries such as aerospace, defense, and electronics. Integration and field-service firms cluster around Pittsburgh and Philadelphia.

What Stakeholders Said

Stakeholders viewed system-integration capacity as a core strength but noted that on-site installation and maintenance capabilities remain underdeveloped and limited by local demand. Many referenced the "missing middle" between prototyping and scalable deployment. Several stakeholders noted that Pennsylvania's strong skilled-trades base provides a foundation for developing future automation and robotics talent. However, interviewees emphasized that clearer pathways and consistent project demand are needed to translate this workforce potential into practice.

What We Don't Know

- Which firms are capable of full system integration versus specialized sub-assembly?
- What proportion of field-service firms could expand regionally if steady demand existed?
- Which employers are willing to pilot service-based procurement collaborations?

Recommendations

- Create Demand through Anchors: Pilot automation procurement projects in utilities, logistics, and infrastructure sectors.
- Develop Regional Integration Labs: Establish joint testing facilities linking integrators, manufacturers, and end users.
- Upskill the Workforce: Support technician training programs aligned with automation service needs.
- Formalize a Statewide Integrators Network: Connect regional firms to promote collaboration and shared standards.

Software & Integration

Detailed Category	Total Businesses	Experience in Robotics	Experience in Similar Industries
Machine Learning Models	134	60%	46%

Predictive Analysis Software	85	56%	48%
AI Algorithms / Integration	81	67%	44%
Machine and Comp Vision	29	62%	59%
Motion Detection Software	24	63%	58%
Conversational Interfaces	14	50%	43%
Gesture Control Software	5	67%	33%

What the Data Shows

AI and software development firms are concentrated in Philadelphia (AI, computer vision) and Pittsburgh (autonomy, integration). Machine learning and predictive analysis software represent the largest categories, with more than 300 firms statewide—over half reporting robotics or automation experience. The state's universities provide world-class R&D capacity, but few small or mid-sized firms advance beyond pilot contracts in the state due to limited patient risk venture capital and production partners.

What Stakeholders Said

Academic and private leaders agreed that Pennsylvania excels in research and prototyping but struggles to translate innovation into commercially marketable products. Firms described a "lab-to-market bottleneck," where proven concepts lack pilot-scale manufacturing or testbeds. Stakeholders cited fragmented collaboration—strong labs, isolated startups, and weak ties to manufacturers. Data and AI literacy gaps among technicians further slow adoption. Local demand for these products remains thin.

What We Don't Know

- How many innovations are currently stalled between prototype and production?
- What shared facilities, capital, or partnerships would bridge that gap?
- How can state investment complement federal commercialization programs?

Recommendations

- Bridge Research and Production: Fund pilot-scale integration labs adjacent to major universities.
- Support Commercialization Grants: Create translational funding to move prototypes into production.
- Promote Cross-Sector Partnerships: Pair AI developers with integrators and manufacturers for applied projects.

- Establish a Robotics & AI Council: Coordinate R&D commercialization priorities statewide.

Professional Services

Detailed Category	Total Businesses	Experience in Robotics	Experience in Similar Industries
Professional Services			
Legal – IP / Freedom to Operate	117	12%	32%
Legal – Talent/Immigration*	42	17%	33%
Legal – Data / AI	41	29%	56%
Legal – Product Safety	26	31%	50%
Legal – ITAR / EAR / Exports	20	35%	60%

What the Data Shows

Over 150 legal firms demonstrate experience in practice areas relevant to robotics (IP, data/AI, immigration, safety). However, few other professional services directly reference robotics or automation. Most are clustered in Philadelphia and Pittsburgh.

What Stakeholders Said

Interviews revealed that professional-service providers—finance, legal, design, consulting—are critical but disconnected from the robotics ecosystem. Awareness and risk aversion limit private investment in automation startups, and support programs often run parallel to, rather than integrated with, technical clusters. Workforce and training initiatives show similar misalignment with industry demand.

What We Don't Know

- Which service categories (finance, IP law, export control, design) are most needed by robotics firms?
- What incentives would draw financial institutions and advisors into the sector?
- How can state and regional programs better connect business services to technical industries?

Recommendations

- Build an Ecosystem Integration Program: Connect legal, finance, and design firms to robotics manufacturers through innovation networks and accelerator partnerships.
- Create a Professional Services Consortium: Offer specialized training on robotics sector needs (IP, export controls, safety).
- Link Advisory Pools to Procurement Pilots: Ensure professional services support local supplier development.
- Track Participation: Use Team PA's platform to measure cross-sector engagement and deal flow.