# Best Practices for Growing Manufacturing in North Carolina

## Essentials for Success in Industry 4.0

NORTH CAROLINA DEPARTMENT of COMMERCE

NCMEP
North Carolina Manufacturing Extension Partnership

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*This report is the product of continuing work initiated through North Carolina's participation in the National Institute of Science & Technology (NIST) Manufacturing Extension Partnership (MEP) Policy Academy on Strengthening Your State's Manufacturers. The Policy Academy originally consisted of members from the NCMEP at NC State University, the NC Department of Commerce, the NC Community College System, the Economic Development Partnership of NC, the NC Business Committee for Education, and several private manufacturing employers, with facilitation by the Center for Regional Economic Competitiveness.*

NORTH CAROLINA
DEPARTMENT of COMMERCE

Roy Cooper
GOVERNOR
Machelle Baker Sanders
SECRETARY

May 5, 2024

We are proud to introduce the collaborative report, "Best Practices for Growing Manufacturing in North Carolina," a comprehensive analysis and strategic guide developed jointly by the North Carolina Department of Commerce and the North Carolina Manufacturing Extension Partnership at NC State University. This research highlights best practices and a framework for revitalizing and advancing North Carolina's manufacturing sector, emphasizing innovation, sustainability, and global competitiveness.

As we navigate the complexities of the 21st-century economy, the manufacturing industry stands as a cornerstone of North Carolina's economic strength and potential for growth. This report identifies critical areas for development, including the adoption of advanced "Industry 4.0" technologies, workforce enhancement, support for small manufacturers, and strengthening of supply chains. Our collaborative effort underscores a commitment to ensuring that North Carolina remains at the forefront of manufacturing excellence and innovation.

The best practices identified within this report are designed to serve as a launching point for policymakers, industry leaders, and community stakeholders, guiding our collective efforts to foster a vibrant, technologically advanced manufacturing sector. An approach like this can secure a prosperous future for North Carolina, creating high-quality jobs and reinforcing our state's position as a global manufacturing leader.

We invite you to engage with the insights and framework of this report, as we believe it introduces important concepts that need addressing to drive economic development and prosperity across our state. Together, we can leverage the strengths of North Carolina's manufacturers and workforce to achieve remarkable growth and success.

Sincerely,

Machelle Baker Sanders
Secretary, N.C. Department of Commerce

Phil Mintz
Director, NC Manufacturing Extension Partnership

State of North Carolina | Department of Commerce
301 North Wilmington Street | 4301 Mail Service Center | Raleigh, NC 27699-4301
919 814 4600 T

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# Executive Summary

North Carolina's manufacturing sector stands at a pivotal juncture, poised to embrace a new era of innovation and growth driven by advanced technologies and strategic initiatives. This report, a joint publication of the North Carolina Department of Commerce and the NC Manufacturing Extension Partnership at NC State University, outlines a forward-looking blueprint designed to elevate the state's manufacturing landscape to new heights of productivity, sustainability, and global competitiveness.

Historically, manufacturing has been a cornerstone of North Carolina's economy, but the sector has faced significant challenges from globalization and technological evolution. Today, the integration of new "Industry 4.0" technologies (e.g. robotics, automation, the internet of things, big data analysis, AI, cloud computing, 3D printing, and virtual reality) offers a transformative opportunity to not only revitalize the sector but also ensure its long-term resilience and growth. The research report identifies best-practices implemented in other states, revolving around four strategic priorities essential to achieving this vision: fostering the adoption of Industry 4.0 technologies, enhancing workforce development, providing targeted support to small manufacturers, and strengthening supply chain resilience.

**Today, the integration of new "Industry 4.0" technologies offers a transformative opportunity to not only revitalize the sector but also ensure its long-term resilience and growth.**

**Adopting Industry 4.0 technologies** is pivotal for maintaining competitiveness and sustainability. This involves better enabling North Carolina manufacturers to overcome financial, technological, and capacity barriers to embrace new technologies. The report suggests supporting technology investments, initiating public-private innovation hubs, and enhancing cybersecurity education and support as key strategies.

**Enhancing workforce development** is crucial to ensure the sector has a pool of skilled workers adept in advanced manufacturing practices. The state's role in fostering partnerships between educational institutions and the manufacturing industry, enhancing technical education, and expanding apprenticeship and work-based learning opportunities is necessary for developing this talent pool.

**Supporting the growth and scale-up of small manufacturers** recognizes the vital role of small- and medium-sized enterprises in the state's economic vitality and innovation. Enhancing financial accessibility, fostering a supportive ecosystem for mentorship, and operational efficiency are outlined as strategies to help these businesses overcome growth barriers.

**Strengthening supply chain resilience** is foundational to North Carolina's competitive edge and the sustainability of its manufacturing sector. Growing local supply chains, encouraging manufacturers to source materials and services within North Carolina, and enhancing supply chain visibility and collaboration are vital components.

The report underscores the need for a multi-faceted and actionable commitment from the state, alongside active engagement with manufacturing employers, to realize these strategic priorities. By marshalling resources, developing policies that encourage innovation, education, and collaboration, and engaging employers in the strategy development process, North Carolina can secure a thriving future for its manufacturing sector. This collaborative approach ensures that the initiatives are not only ambitious but also achievable, aligning with the industry's needs and direction.

North Carolina is presented with a unique opportunity to redefine its manufacturing sector for the future. Adopting a proactive stance, committing to comprehensive and actionable strategies, and securing the necessary resources for implementation will bolster the state's economic development and position it as a leader in manufacturing innovation.

# Strategies & Policies for North Carolina

Thirty years ago, North Carolina's manufacturing was at its apex—logging record numbers of jobs and output after decades of strong and steady growth. In 1994, manufacturing accounted for one out of every four jobs and one-third of private GPD in the state. Unbeknown at the time, a combination of globalization and technology would soon completely reshape the sector—bringing waves of new, innovative high-tech industries and companies and sweeping away hundreds of thousands of jobs. Today, some argue North Carolina stands at the brink of another transformative era in manufacturing, this one driven by the integration of advanced technologies and innovative practices. How can we seize this opportunity and secure North Carolina's position as a global manufacturing leader while steering clear of devastating losses that have haunted the sector and our communities in the past?

This paper highlights the imperative for a strategic vision to harness these opportunities, with the aim of bolstering the state's manufacturing sector to new heights of productivity, sustainability, and global competitiveness. Central to this vision are four strategic priorities:

**Priority 1: Supporting Adoption of Industry 4.0 Technologies**

**Priority 2: Developing a Skilled Workforce**

**Priority 3: Supporting Growth and Scale-Up of Small Manufacturers**

**Priority 4: Strengthening Supply Chains**

Together, these strategies form a comprehensive roadmap designed to propel North Carolina's manufacturing industry forward, ensuring its position as a leader in the new industrial landscape. By leveraging state strengths, including a diverse manufacturing base and a robust educational system, North Carolina can achieve a future where its manufacturing sector not only thrives but also drives economic growth and job creation across the state.

# Introduction

Manufacturing is a cornerstone of North Carolina's economy, offering a pivotal platform for innovation, employment, and economic development. In the face of rapidly evolving global markets and technological advancements, there is a critical need for strategic action to ensure the sector not only sustains but thrives. This paper presents a forward-looking strategy aimed at enhancing North Carolina's manufacturing capabilities.

A technological revolution—often referred to as "Industry 4.0" and led by advancements in robotics, automation, the Internet of Things (IoT), big data analysis, AI, cloud computing, 3D printing, and virtual reality—is already beginning to fundamentally change production, operations, and management of manufacturing companies worldwide. Embracing Industry 4.0 technologies is essential for maintaining competitiveness in a technology-driven market, necessitating a workforce that is both skilled in advanced manufacturing practices and adaptable to new technological paradigms. For small manufacturers, which are vital for innovation and economic diversity, overcoming barriers to growth and scale is crucial. Additionally, the resilience and efficiency of supply chains are foundational to the sector's sustainability and ability to grow and attract companies and jobs.

In 2019, North Carolina was selected to participate in a Manufacturing Policy Academy funded by the National Institute of Standards and Technology. North Carolina was one of ten states chosen by NIST to participate in the national policy academy, with a goal of bringing together policy makers and the manufacturing support ecosystem to produce a framework for the growth of manufacturing in our state. Representatives from several state agencies participated in the policy academy, followed by work sessions with additional associated public and private organizations, resulting in ongoing collaborations and contributions to this document. By integrating insights from state and national manufacturing plans, including those from Iowa, Maryland, Connecticut, the White House, and the MEP National Network, the Policy Academy team produced a findings and recommendations report, outlining several key strategy areas to consider in a statewide manufacturing strategic plan. This report synthesizes best practices into a unified framework, and positions North Carolina to capitalize on its manufacturing strengths, ensuring its readiness for the future and its continued contribution to the state's economic prosperity.


# Strategic Priorities for Growth

The economic vitality and future readiness of North Carolina's manufacturing sector hinge on strategic priorities that are both ambitious and actionable. In developing this growth plan, a multi-dimensional approach should be utilized, focusing on the adoption of advanced technologies, the cultivation of a highly skilled workforce, the bolstering of small manufacturers, and the enhancement of supply chain robustness. Each priority is anchored in comprehensive research and analysis of state and national manufacturing strategies, ensuring that North Carolina's approach is informed, innovative, and inclusive.

## Priority 1: Supporting Adoption of Industry 4.0 Technologies

Adopting Industry 4.0 technologies is crucial to fortifying North Carolina's manufacturing competitiveness and sustainability. This priority is rooted in helping small and medium-sized enterprises (SMEs), which form the backbone of the state's manufacturing ecosystem, overcome financial, technological, and human capacity barriers to embrace these new technologies. However, the sheer expense and difficulty of purchasing equipment, training staff, and upfitting facilities create barriers for even some of the state's larger employers and legacy industries. Some degree of assistance in helping all manufacturers fully adopt these advanced technologies will likely be required for them to just remain globally competitive. By creating a supportive environment for technological advancement, North Carolina can ensure its manufacturing sector thrives in the digital age.

Supporting technology investments, initiating public-private innovation hubs, and enhancing cybersecurity education and support are broad thematic strategies that the state can explore. These strategies encompass fostering investments through financial instruments like innovation funds, adjusting depreciation schedules, providing hands-on experiences with new technologies through demonstration centers, and bolstering cybersecurity—a critical aspect of digital operations. With a focus on these areas, North Carolina can create a robust framework that encourages manufacturers to innovate, upgrade, and secure their operations, thereby positioning the state's manufacturing industry at the forefront of the fourth industrial revolution.

## Priority 2: Developing a Skilled Workforce

The success of North Carolina's manufacturing sector is inextricably linked to the capabilities of its workforce. As Industry 4.0 technologies take center stage, the need for a workforce adept in advanced manufacturing, digital literacy, and technical problem-solving becomes increasingly critical. This priority underscores the state's commitment to cultivating a talent pipeline that is prepared to meet the demands of modern manufacturing environments.

Developing a skilled workforce involves a comprehensive approach that starts with education and extends to on-the-job training. North Carolina can play a pivotal role by fostering partnerships between educational institutions and the manufacturing industry to ensure curricula are aligned with the evolving needs of the sector. Enhancing technical education, from K-12 through post-secondary levels, and expanding apprenticeship and work-based learning opportunities are fundamental strategies to build this skilled talent pool.

Moreover, targeted initiatives to re-skill and upskill the existing workforce are necessary to keep pace with technological advancements. By investing in continuous learning and development programs, the state ensures that its manufacturing workforce remains competitive in a global market.

## Priority 3: Supporting Growth and Scale-Up of Small Manufacturers

As previously mentioned, elevating small manufacturers is pivotal for North Carolina's economic vitality. While nimble and innovative, they often grapple with unique challenges that hinder their ability to scale. Recognizing this, the state's role becomes instrumental in creating pathways for growth that allow these businesses to flourish. This entails a holistic approach that not only addresses financial accessibility but also fosters a supportive ecosystem for mentorship and operational efficiency.

Key to this priority is the enhancement of financial accessibility, ensuring small manufacturers have the capital and technology access needed for growth. Facilitating access to modern manufacturing tools and infrastructure is equally important in removing barriers to growth, enabling small manufacturers to innovate and compete more effectively. Additionally, the development of a supportive network, providing mentorship and sharing of best practices, can help small businesses navigate the complexities of expansion. Mentorships and technical support also promote equity of opportunity within the industry, enhancing knowledge, networks, and capital and technology access for rural and women- and minority-owned businesses.

## Priority 4: Strengthening Supply Chains

The resilience, efficiency, and integration of supply chains are foundational to the competitive edge and sustainability of North Carolina's manufacturing sector. Recognizing the importance of robust supply chains, this priority focuses on fortifying the supply network within the state, thereby creating a more interconnected and resilient manufacturing ecosystem.

A formal strategy should emphasize the development of local supply chains, encouraging manufacturers to source materials and services from within North Carolina. This approach not only supports local businesses but also encourages foreign direct investment that brings new supplies and original equipment manufacturers (OEMs) to the state. This promotes expansion as well, while reducing vulnerabilities associated with global supply chain disruptions. Initiatives aimed at enhancing supply chain visibility, such as mapping the capabilities and capacities of in-state suppliers, can lead to improved collaboration and innovation among businesses. Additionally, facilitating networking events and establishing partnerships between OEMs and SMEs are key to building a cohesive supply chain network.

By investing in these areas, North Carolina can achieve a dual objective: ensuring the manufacturing sector's ability to respond adaptively to market changes and driving economic growth. Strengthening supply chains within the state not only enhances operational resilience but also fosters a collaborative manufacturing community, poised to capitalize on new opportunities and navigate challenges effectively.

# Conclusion

As North Carolina stands at the cusp of significant manufacturing evolution, the imperative for a proactive and comprehensive strategy cannot be overstated. The strategic priorities outlined in this paper—embracing Industry 4.0 technologies, developing a skilled workforce, supporting the growth and scale-up of small manufacturers, and strengthening supply chains—form the blueprint for a resilient and innovative manufacturing sector. However, the realization of these priorities requires more than just strategic vision; it demands actionable commitment from the state and active engagement with employers across the manufacturing landscape.

The state should take a leading role in marshalling the resources necessary to deliver tangible results. This involves not only financial investment but also the development of policies that encourage innovation, education, and collaboration. By doing so, North Carolina can create an environment that nurtures growth and competitiveness in its manufacturing sector.

Engaging employers in this process is crucial. Their insights, experiences, and advocacy will generate a more grounded and effective strategy that addresses real-world challenges and opportunities. This collaborative approach ensures that the state's initiatives are not only ambitious but also achievable and aligned with the industry's direction.

In conclusion, North Carolina is presented with a unique opportunity to redefine its manufacturing sector for the future. By adopting a proactive stance, committing to comprehensive and actionable strategies, and securing the necessary resources for implementation, the state can ensure its manufacturing sector thrives. This will not only bolster North Carolina's economic development but also secure its place as a leader in the next era of manufacturing innovation.

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# Appendix A: Best Practices from Other States

The following are examples of best practices that have been proposed and/or operationalized in other states. Many are not unfamiliar to North Carolina and have been previously discussed or initiated to various degrees.

### Supporting Adoption of Industry 4.0 Technologies

- Create a Manufacturing Innovation Fund to provide matching grants to manufacturers, especially SMEs, to support purchases of Industry 4.0 equipment, software, and other technologies. Examples of other states that have deployed innovation programs: Indiana, Rhode Island, New Mexico, California, Massachusetts, Minnesota, and Illinois.
- Accelerate depreciation schedules for manufacturers who make qualifying technology investments, improving their short-term cash flow.
- Develop state-of-the-art demonstration centers within research universities, equipped with the latest technologies, where manufacturers can engage in hands-on testing and learning in real-world scenarios before purchasing.
- Fund initial centers with technologies and staff expertise with broad appeal (augmented reality, collaborative robots, 3D printing, etc.). Public-private partnerships may help reduce costs.
- Develop mobile demo labs to increase accessibility beyond fixed locations to manufacturers across the state.
- Host industry learning, networking, and collaboration events and workshops at the centers, focusing on topics relevant to digital transformation and Industry 4.0.
- Provide free or subsidized cybersecurity evaluations and planning support conducted by experts, especially for SME manufacturers—followed by detailed planning support to implement recommended improvements.
- Leverage academic resources and expertise to create instructional programs to strengthen the cybersecurity posture of manufacturers. This will facilitate access to cutting-edge cybersecurity research and collaboration opportunities.
- Raise awareness and understanding of cybersecurity among manufacturers through education and workshops focusing on cybersecurity standards, best practices, and preparedness strategies.
- Financially support SME manufacturers, through matching funds or grants, in implementing critical cybersecurity improvements identified in assessments.

### Developing a Skilled Workforce

- Provide funding, such as internship/apprenticeship matching grants and other incentives, to boost the number and quality of work-based learning opportunities in advanced manufacturing fields like robotics, automation, and digital manufacturing.
- Provide incentives to employers to participate in apprenticeship programs, such as grants, subsidies, or other benefits.
- Develop coordinated statewide campaigns to promote all formats of work-based learning to students, job seekers and other targeted audiences. Launch marketing and informational campaigns across various media platforms highlighting the benefits and opportunities of careers and training in advanced manufacturing.
- Partner with community colleges on related instruction components to enhance the educational quality of apprenticeship programs. Partnerships between manufacturing companies and community colleges can strengthen technical courses and classroom learning.
- Expand youth apprenticeships and pre-apprenticeship opportunities—increasing workplace tours, job shadowing, and introductory training.
- Encourage and support community colleges and universities in developing non-degree programs in Industry 4.0 skills. Build faculty and institutional capacity to focus on skills like data analytics, cybersecurity, industrial IoT, etc., that align to manufacturer needs in the curriculum development process.
- Provide scholarships, enrollment discounts, childcare or transportation subsidies, and other incentives to attract disadvantaged populations and low-wage workers into identified programs of need by Industry 4.0-adopting companies.
- Offer credentials through online, in-person, and hybrid formats to accommodate the diverse needs and schedules of working professionals.
- Provide funding assistance for companies sending employees for retraining in credentialing programs.
- Expand access to STEM-focused high schools, thereby cultivating early interest and proficiency in these fields

among students. Increasing funding and support for the establishment and expansion of STEM-focused schools across the state can ensure equitable access for students in both urban and rural areas.

- Provide curriculum resources and professional development for STEM teaching. Enhance the quality of STEM education by equipping teachers with the latest resources and professional development opportunities, focusing on innovative teaching methods and emerging technologies.
- Increase funding for hands-on STEM learning opportunities that complement traditional classroom learning. This includes resources for equipment, lab facilities, and experiential learning programs like science fairs, robotics clubs, and coding camps.
- Offer incentives for industry partnerships with schools on STEM Projects. Greater collaboration between the manufacturing industry and schools will provide students with exposure to real-world STEM applications and career opportunities, including joint projects, mentorship programs, and workplace visits.
- Promote manufacturing careers through school engagement initiatives to increase awareness and interest in manufacturing careers among students from a young age. This may include featuring guest speakers from the industry, manufacturing-focused career days, and interactive workshops.

### Supporting Growth and Scale-Up of Small Manufacturers

- Create grant and/or loan programs targeted specifically at high-growth small manufacturers looking to scale up. This will ensure small manufacturers demonstrating high growth potential and clear plans are financially positioned to expand in North Carolina. The focus should be on small manufacturers with a track record of innovation and growth.
- Offer tax credits and incentives for investors providing growth capital to small manufacturing startups and scale-ups.
- Develop public-private partnerships to fund manufacturing acceleration programs for scale-ups. Focus should be directed to funding and operating acceleration programs, offering mentorship, networking opportunities, and business development resources.
- Continue to provide state matching funds for federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards received by manufacturing startups to amplify the impact of federal research and development funding for small manufacturers.
- Connect high-potential entrepreneurs and small manufacturers with experienced executives and advisors through formal mentorship programs. This will enable the next generation of entrepreneurs and small manufacturers to learn directly from experienced executives and advisors who have a proven track record in the manufacturing industry.
- Facilitate peer mentoring roundtables for small company presidents/CEOs to share growth experiences and challenges.
- Develop an online portal to link startups to manufacturing resources, advice, and potential mentors.
- Promote collaboration through competitions, hackathons, industry-project based learning to foster innovation and collaborative problem-solving within the manufacturing community. This will encourage collaboration between different players in the manufacturing sector, including startups, established companies, and educational institutions.
- Enhance and subsidize customized strategic planning assistance, through agencies like the NC State University Industry Expansion Solutions (IES), the North Carolina Manufacturing Extension Partnership (NCMEP) network, and SBTDC, focused on growth, where experts help small manufacturers identify and address their unique challenges. State funding for established manufacturing assistance programs enables NC to access federal matching dollars, increasing the resources available to support small manufacturers.

- Provide incentives, such as favorable loans or grants, for investments in new facilities/equipment needed for scaling-up their operations.
- Provide low-cost access to prototyping lab space and advanced equipment for small manufacturers to develop and test new products.
- Develop programs to assist with adoption of operational best practices as small manufacturers grow their operations, focusing on efficiency, sustainability, and quality control.
- Promote and enhance workforce training grants for adding new capabilities and skills necessary for operating new technologies and processes.

### Strengthening Supply Chains

- Provide matching grants for joint supplier development projects between OEMs and SMEs.
- Fund supply chain mapping initiatives to identify and document the capabilities and capacities of in-state suppliers.
- Host networking events to connect OEMs and potential new suppliers.
- Establish a "Made in NC" labeling/marketing program to highlight and promote products that use a significant percentage of inputs from North Carolina suppliers.
- Identify industries well-aligned to bring production to NC from overseas. Conduct comprehensive market analyses and feasibility studies to identify industries that can benefit significantly from relocating or expanding their operations to North Carolina, considering factors like the state's existing industrial strengths, workforce skills, and logistical advantages.
- Develop focused financial and non-financial incentive packages to attract foreign investment projects, such as grants or infrastructure support, tailored to the needs and expectations of foreign investors and aligned with the state's economic development goals.
- Enhance economic development initiatives that promote foreign direct investment, including international trade shows and investment forums to showcase North Carolina's strengths and opportunities to potential foreign investors.


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