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Centering Work: Integration and Diffusion of Workforce Development within the U.S. Manufacturing Extension Network

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ABSTRACT

As the U.S. economy rebounds from the COVID-19 pandemic, strategies that promote long-term transformation toward high-quality jobs will be critical. This includes workplace-improving interventions that enable employers to upgrade existing jobs, often while enhancing their own competitive position. This paper focuses on the Manufacturing Extension Partnership, a national network of federally funded centers that support small and medium-sized manufacturing firms. We document the range of workforce- and workplace-enhancing strategies that MEP centers have adopted since the network's inception in the mid-1990s. While workforce development is unevenly implemented across today's MEP network, leading centers within the network are devising transformative strategies that shape underlying business practices in ways that can improve the quality of front-line manufacturing jobs. The pandemic recovery, along with federal commitment to reenergize domestic supply chains, presents an opportunity to establish NIST-MEP as a national workforce-development leader while also strengthening localized institutional partnerships to center that effort on inclusive economic development and recovery.

JEL Classification Codes: L6, R11, J81

Key Words: Industrial policy, industry studies,economic development policy, workforce development policy

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U.S. manufacturing is at an inflection point, identified as a priority area for federal investment and poised for future growth, with the possibility that this could also add and improve manufacturing jobs. And yet there are present-day challenges that if not sufficiently addressed could undermine this growth trajectory—most notably long-simmering workforce shortages, which have further intensified in the wake of the COVID-19 pandemic. In the lead-up to the pandemic, there were an estimated 500,000 unfilled manufacturing job openings (Rogers 2019). For some legacy manufacturing regions, especially those with large numbers of older establishments that have not modernized or updated technologies in many decades, difficulties with worker recruitment and retention are especially pronounced. The "Great Resignation" of 2021–2022 has only worsened matters, as workers have voluntarily quit jobs at historically high rates. This has led to increasing worker turnover, which, although a labor market–wide phenomenon, has added to the challenges facing the manufacturing sector.

Workforce shortages spill over into other aspects of manufacturing business planning. They influence which technologies manufacturers can adopt, as well as which markets they might serve. And these workforce effects can be even more consequential for society at large, determining whether manufacturers can meet national and global product demand—a point reinforced throughout the Covid-19 pandemic as worker shortages disrupted essential-manufacturing supply lines. While workforce is often treated as secondary to other organizational objectives, its far-reaching and foundational effects on manufacturing decisions and development raise the need for more holistic and integrated approaches.

On their own, traditional workforce-development institutions—such as community colleges, other vocational training centers, or even worker-advocacy groups—are not likely to resolve this sector-wide challenge. Many focus too narrowly on preparing individual jobseekers

to enter the manufacturing labor market, rather than helping manufacturing businesses themselves develop and sustain effective in-house workforce solutions. Others, while offering desired forms of institutional support, are disconnected from surrounding manufacturing communities, with few trusted industry connections and alliances upon which to build. Manufacturing firms need institutional assistance when it comes to workforce development, especially smaller-sized, resource-constrained firms, but that help must involve institutions with a deep working knowledge of established manufacturing systems and practices, along with sufficient network reach to influence meaningful and enduring change.

This paper illustrates a promising institutional fix: centering workforce development within the Manufacturing Extension Partnership, a program based within the U.S. Department of Commerce at the National Institute of Standards and Technology (NIST). Since the late 1980s, MEP centers have supported small-to-medium enterprise (SME) manufacturers through an industrial extension framework, serving tens of thousands of firms each year that collectively employ hundreds of thousands of workers. Workforce development—defined as programs and institutions that support investments in workforce skills and more generally improvements to jobs through career pathways—is an evolving focus for MEP. A strategic redirection by NIST-MEP at the national level in 2008, in combination with mounting worker shortages in U.S. manufacturing—made more acute with the COVID-19 pandemic—has led more MEP centers to elevate workforce development as a strategic priority and, with it, also enhance their influence over employment decisions at the business establishment level. While state- and local-level MEP centers universally promote process and product improvements, growing numbers are experimenting with complementary strategies that push changes to workplace structures and

routines and, in the process, increase front-line worker retention by improving the manufacturing work experience.

This experimentation creates an opportunity to reflect on the types of workforce strategies that MEP centers have adopted and the degree to which these efforts could be further enhanced in support of a more equitable economic recovery, the theme of this special issue. With that in mind, we draw on a mix of data sources to explore the following research questions:

- To what extent have individual MEP centers and the NIST-MEP network as a whole prioritized workforce development in their services to small and medium-sized manufacturers?
- How has this priority changed over time?
- What types of institutional strategies have centers adopted, and with what potential effect?
- What are the barriers to scaling and integration of workforce development functions within and beyond the MEP network?

WORKFORCE CHALLENGES IN THE CONTEXT OF U.S. MANUFACTURING

For decades, federal and state workforce development systems, including those focused on U.S. manufacturing, have sought to address purported skills shortages, rather than tackle broader concerns related to worker retention and turnover. This traditional skills approach rests on a widely held assumption that individual workers are excluded from high-quality, better paying jobs because they lack "in-demand" skills (Autor et al. 2003; Laboissiere and Mourshed 2017). Viewed through this lens, the primary goal for workforce development is to support

individuals in their search for better work alternatives—alternatives believed to be in reach once individuals acquire skills that are desired by local employers.

The call within economic development scholarship to shift the focus of workforce development toward engaging employers is hardly new (Harper-Anderson 2008; Schrock 2013), but increasingly, scholars and practitioners are realizing the value of problematizing employer practices in an effort to also resolve broader industry development challenges (Kalleberg 2011). Instead of assuming that low wages and limited career mobility are a function of individual (worker) shortcomings, these analyses situate those outcomes in relation to organizational contexts, which include choices about product market (competitive) strategy and process technologies utilized in the workplace. As Paul Osterman (1987) observed many years ago, firms' employment systems are shaped by imperatives of cost effectiveness, predictability, and flexibility (maximization), which are difficult for firms to optimize in practice. But, critically, it implies choice on the part of employers, which Osterman (2018) and others (Appelbaum et al. 2000) describe in relation to "high road" practices of employers—most centrally, paying above-market wages and benefits to front-line workers, but also investing in skills development, providing opportunity for workers to voice their concerns (and in some cases, to organize through labor unions) in general, but especially in decisions impacting the workplace. Core to the theory of what Zeynep Ton (2014) calls the "good jobs strategy" is the recognition that improvements in job quality pay off for employers as well. In high-quality work environments like this, workers are more likely to stick around and for longer, but as a result, they also become active contributors to improved business performance and longer-term profitability.

Focusing on the qualitative features of a job—not just job numbers in the aggregate—also means recognizing that wage increases alone may not suffice. Beyond gains in family-

sustaining wages and other income-enhancing benefits, a good job can also entail lower levels of stress, along with greater personal satisfaction, with opportunities for worker autonomy and decision making and also more predicable scheduling, so that workers have the ability to plan their futures. As this implies, job quality—even within sectors of the economy associated with better average pay, such as manufacturing—is not a single, reduceable measure; it is a "bundle" of reinforcing qualities (Cohen 2020; Osterman 2018), or what the United Nations has called "decent work," which some workers enjoy more fully, while others appreciate as a choice set for achieving a work-life balance—lower pay for less stress, for example; fewer hours of work, but with greater personal freedom.

In the context of manufacturing, this broader job-quality framing raises not only the possibility for employers to make improvements to the jobs they currently provide, but equally the need to consider barriers that might prevent some manufacturers from achieving that desired goal. In U.S. manufacturing, job-quality differences often stem from variations in firm size as well as supply-chain position. Comparisons of large versus smaller-sized U.S. manufacturing firms bear this out, with smaller firms paying significantly lower wages while also investing much less in overall workforce development (Armstrong et al. 2021; Berger 2013). And this is not necessarily due to inherent greed or preference on the part of firm owners. Smaller manufacturing firms are often buried deep in national and global supply chains and are characterized as price takers, with limited maneuverability to raise wages and improve working conditions, even if firm owners might desire that result. Pressures on smaller suppliers to meet tight production deadlines—or what in manufacturing are often referred to as *lead times*—can stymie employer support for skill development and career mobility, especially if time set aside for workers to master new tasks is viewed as an existential threat to current and future production

contracts (Forbes 2018). Smaller firms in the throes of daily production routines are thus forced to make difficult trade-offs that can counteract their desire to improve or change working conditions (Helper et al. 2011; Theodore and Weber 2001).

Concerns over worker retention add a further constraint, paradoxically undermining the very strategies that are needed to slow the vicious cycle of churn. The fear that workers might leave after the manufacturing firm invests good money and resources in building their skills can forestall all but the training basics, such as new-worker orientation. Reinforcing this point, Weaver and Osterman (2017) in their 2016 survey of U.S. manufacturers, found that smaller-sized firms were more likely to indicate a struggle with having skill and worker shortages, due in large measure to their inability or unwillingness to invest in ongoing skill development. And it is not just employees that suffer as a result of this disinvestment. Armstrong et al. (2021) draw out the broader implications for U.S. manufacturing productivity: low-paying jobs and weaker commitments to upskilling among smaller-sized suppliers constrain their ability to adopt new technologies and further innovation. Larger downstream manufacturers are then forced to adapt—some taking on greater responsibility for technology-intensive production, others diminishing their dependence on smaller local suppliers altogether through greater offshoring.

Job-quality challenges facing manufacturers, especially SMEs, suggest opportunities for new forms of institutional action and intervention. A promising start involves strategies of workforce intermediation, which extend far beyond more standard "supply-side" training programs to support access to better, more rewarding jobs (Benner et al. 2007; Conway and Giloth 2014; Fitzgerald 2004; Giloth 1998). But this intermediation is not just limited to "matching" job seekers to existing high-quality alternatives, though that is certainty done. More-pioneering workforce intermediaries go a step further, using a mix of employer engagement

strategies and reinforcing institutional supports to help manufacturing employers commit to paying higher wages, as well as guaranteeing robust benefits packages, more predictable work schedules, and better-illuminated career ladders (Lowe 2021). Enhancing skill development, including formalizing work-based learning options, is often a focus of workforce intermediation, but those efforts are typically done to encourage employers to accept greater responsibility for ongoing forms of worker training while also doing much more to create a high-quality, career-supporting work experience.

Numerous examples of manufacturing-focused workforce intermediaries have been documented over the years (Lowe 2021; Melendez and Harrison 1998; Schrock 2014). But these are often isolated cases, which struggle in achieving scale, systems integration, and sustained public support. Related to this, existing intermediaries often operate as relatively small boutique programs funded through a combination of public and foundation support, where their small scale enables them to have a degree of intimacy and quality control over results. In many cases, they are also disconnected from broader public workforce-development funding streams (e.g., the federal Workforce Innovation and Opportunity Act), limiting their reach within an urban and regional context.

But perhaps the biggest challenge is that most workforce intermediaries, including those focused on jobs in manufacturing, have expertise *only* around workforce-related issues and not the broader range of organizational challenges facing employers, such as competitive strategy and process technology. This means that workforce intermediaries are typically working downstream, helping manufacturing employers and workers to address symptoms of poor job quality—low wages, anemic benefits, high turnover, insufficient skills development—rather than

the underlying organizational or operational causes. This limits their capacity to intervene effectively to influence change.

For this reason, existing programs like the Manufacturing Extension Partnership have significant potential as institutional infrastructure for engaging manufacturing employers around job quality. Because they help business owners and managers address a range of operational and competitive challenges, MEP representatives are potentially well-positioned to diagnose and intervene on job quality and other related workforce problems, either through their own internal expertise and capacity or through relationships with other workforce intermediaries.

Still, while this institutional alignment is both promising and possible, relatively little is known about the extent of MEP engagement with workforce development. Some MEP centers have embraced their role as workforce providers, even experimenting with novel strategies of intermediation through which to shape and reshape workplace practices. Others are newer to workforce services, some with aspirations to do much more in the future, opening up the possibility for institutional support to help them become more active in this space. This ultimately creates an opportunity to reflect on workforce development capacity within and across the national MEP system, including the challenges that could limit further diffusion.

MEP DATA AND METHODS

We rely on a mix of primary and secondary data sources to build our understanding of MEP's current approach to workforce development. In October and November of 2020, we conducted interviews with leadership from the national MEP system, including with directors from 10 MEP centers, in order to gain insight into how MEPs have helped manufacturers navigate employment challenges and opportunities. These interviews also informed our

identification of promising workforce strategies that centers have developed in recent years, including those in response to the COVID-19 pandemic. In reporting on workforce strategies, we are careful to avoid "best" or "exceptional" cases that appear to be institutional outliers, choosing instead to present multilocation strategies that suggest an opportunity for further replication.

We identified the 10 centers by reviewing client service data and soliciting input from MEP leaders, selecting centers that had prepandemic experience with workforce development. In this regard, our case selection was not designed to be representative of all 51 centers, but rather intentionally focuses on a subset of centers that are considered established workforce leaders, with the goal of drawing to light their experience with this particular area of service delivery and to glean insights in how to advance system-wide workforce commitments. To supplement and help contextualize what we learned through these interviews, we also reviewed MEP activity reports and case studies spanning a 20-year period.

Second, we obtained anonymized administrative data from NIST-MEP on projects completed with employers throughout the MEP network, dating back to Q1 2011 and updated through Q4 2021, during which time more than 148,000 total projects were completed. Each project represents a defined service activity between an MEP center and an employer and is coded into 1 of 11 discrete "substance codes," one of which is "Workforce." Additionally, projects are coded for service date and number of hours, allowing for another measure of effort, although here we primarily rely on project totals as our measure of activity. Combined, these data show evidence of intensifying MEP support for workforce development, though also a pattern of spatial unevenness, which we detail below.

MEP WORKFORCE HISTORY AND OVERVIEW

The Manufacturing Extension Partnership dates back to the late 1980s with the adoption of a suite of federal industrial policies designed to boost the global competitiveness of regional manufacturing economies in the United States. The nationwide network of federally recognized centers emerged in the early 1990s, drawing together a half-dozen existing state-level extension systems while also creating a dedicated federal funding stream to enable other states to join that ongoing effort (Shapira 2001). Today, every state in the U.S. plus the territory of Puerto Rico has at least one MEP center. Combined, these centers, along with dozens of substate field offices, employ around 1,400 manufacturing specialists, who provide technical assistance to more than 11,000 small and medium-sized manufacturing firms annually.

Workforce development has been part of the MEP agenda since its inception, reflecting initial experimentation with workforce development by once independently operated state-level industrial extension programs[1] (Southern Technology Council 1988). As they formalized the national MEP network, NIST leaders took concurrent steps to further promote workforce development activities. In the mid-1990s, NIST created a full-time workforce manager position to assist extension centers with workforce-related client services. Soon after, NIST launched an official workforce working group that met several times a year, enabling participating centers to share ideas and experiences and request advice from workforce experts. One center in particular, CAMP (Cleveland Advanced Manufacturing Program), was especially active in shaping those formative discussions.[2] Based in Cleveland, CAMP (renamed the Manufacturing Advocacy and Growth Network, or MAGNET, in 2007) started experimenting with manufacturing workforce

[1] Email message to the authors on community college NIST history from Stuart Rosenfeld, 2021.
[2] Email message to the authors on MEP workforce history from Mark Troppe, 2021.

services in the early 1990s. By the time NIST-MEP initiated the working group, CAMP had several full-time workforce professionals on staff supporting a broad range of workforce services, including matching manufacturing firms with local community colleges to customize and implement incumbent worker training.[3]

Over the course of the next decade, other MEP centers added workforce programming to their service portfolio, leveraging insights gained through working-group participation to meet growing requests for workforce assistance from manufacturing client firms. NIST-MEP expanded its national workforce leadership team, also tracking state-level efforts, publishing internal reports and case vignettes that documented the various workforce initiatives being developed by individual MEP centers (Troppe and Reesman 2004). In 2000, for example, the MANTEC MEP center in South Central Pennsylvania began offering human resource services to smaller firms that employed fewer than 100 workers. These services ranged from helping firms write job descriptions and employee handbooks to more extensive support in conflict resolution and industry compensation analysis. Catalyst Connection in Pittsburgh also experimented with workforce programming in the early 2000s, focusing initially on raising awareness of manufacturing careers among middle and high school students as well as providing placement support for college student internships. In Massachusetts, MassMEP initiated workforce programming in 2005 to help machine shops address severe hiring and workforce retention constraints. As part of that effort, they created a collaborative platform called the Manufacturing Advancement Center in Workforce Collaboration. The purpose of this center was to give smaller manufacturers a direct line of communication with community colleges, which would

[3] Email message to the authors on MEP workforce history from Mark Troppe, 2021.

serve to inform manufacturing-related training programs and curricula (Manufacturing Extension Partnership 2014).

In 2008, national leaders at NIST-MEP attempted to push wider adoption of workforce development, signaling strong institutional support through a new strategic redirection called *Next Generation Strategy*. Within this growth-oriented framework, workforce development was presented as one of five reinforcing priority areas for promoting profitable manufacturing development—the four others included technology acceleration, continuous improvement, supplier development, and environmental sustainability (Manufacturing Extension Partnership 2008).

Workforce Adoption in the 2010s: Patchwork Expansion and Experimentation

In the decade that followed the creation of the *Next Generation* framework, the MEP network saw a significant overall expansion in workforce service delivery activities. Between 2011 and 2019, the total number of workforce projects reported by MEP centers grew by nearly sevenfold, increasing their share of all MEP projects from a mere 3 percent to 12 percent (Figure 1). But even within the decade, workforce activities waxed and waned. There was a significant surge in workforce projects between 2013 and 2015, led by centers in states like Ohio, Pennsylvania, Illinois, and Iowa, which ebbed to some extent in 2016 and 2017, only to bounce back after 2018. Unfortunately, it is unclear from the NIST administrative data whether this expansion was driven by changes in how centers coded projects, by a growing orientation and attentiveness toward workforce issues by centers, or by underlying changes in workforce issues facing SME manufacturers during this period.

Although an effort in 2010 by NIST-MEP to roll out a workforce initiative called SMARTalent failed to gain traction systemwide, by mid-decade individual centers were

experimenting with related approaches to engage employers in a holistic way around workforce issues. As an example, a similarly named SmartTalent initiative was launched by the Oregon MEP (OMEP) in 2015, inspiring other centers in Hawaii, Montana, Tennessee, Puerto Rico, and most recently New York State to follow Oregon's lead. Around the same time, the Illinois Manufacturing Excellence Center (IMEC) launched its Genesis Movement initiative, which sought to elevate "people" (i.e., the workforce) alongside "process" and "product" interventions with employers (Lowe et al. 2021). Other centers joined in this effort, with at least three states (Florida, Maryland, and New Jersey) establishing formal apprenticeship programs, whereby the MEP center would be the sponsor on record, also preparing documentation for federal Department of Labor registration on behalf of participating firms and their employees.

Although there remained some variation in workforce activity among centers, by the end of the 2010s this variation had lessened significantly. By 2019, workforce projects represented at least 10 percent of total projects for 30 out of 50 centers, and the degree of variation in centers' workforce project share (measured in terms of coefficient of variation) had fallen by almost half across the system (Figure 2). All of these are indicators of systemwide diffusion in workforce programming over the course of the decade.

By 2020, NIST-MEP had made a renewed effort toward a national, system-wide approach to workforce development programming. The major difference was that this time, instead of attempting to diffuse a model from above, it sought to promote learning and diffusion across nodes within the system, by providing a three-year grant totaling $1 million to the Missouri MEP to start a new initiative called America Works. Implemented in partnership with

MEP centers in northeast Ohio, New Jersey, Iowa, and Indiana, and managed by workforce staff from Cleveland-based MAGNET, America Works is designed to centralize and

coordinate workforce services across the national network, also identifying and scaling "effective solutions beyond local MEP Centers to catalyze national workforce development improvement" (Fieldman 2001). Within its first year, America Works has helped co-organize a system-wide MEP workforce conference (held in June 2022) in addition to hosting monthly webinars and workforce-focused working groups. In late 2020, America Works initiated a small grants program to encourage centers to experiment with workforce development programming. The first round of funding supported seven distinct projects, several of which involve multiple MEP center partners.[4]

In summary, these various efforts speak to an ongoing commitment to workforce development by national leaders at NIST-MEP. In recent decades, NIST-MEP has signaled strong support for workforce development and has targeted resources and assistance to help various centers develop their own workforce programming. That said, because it is a large, decentralized system, constraints have emerged over the years, some more intractable than others, which also means there is uneven network capacity to support workforce services. A small group of MEP centers have persevered, committed to experimenting with and advancing novel, regionally sensitive workforce strategies. In the final sections of this paper, we outline some of the persistent barriers that limit other centers from joining or sustaining that effort. Before turning to that discussion, however, we will first outline some of the strategies used by various workforce-leading centers, reflecting as well on their industry impact and value and how to more systematically assess that impact going forward.

[4] Email message to the authors about America Works's funding from Matt Fieldman, 2021

STRATEGIES BY WORKFORCE-LEADING MEPS

Our discussions with MEP network leaders and center directors point to three concurrent strategies that MEP centers have adopted to better integrate workforce solutions into their service delivery model. The first strategy entails *close coupling of workforce services with other high-demand business services*. This intermingling is intentional, with MEP center staff using their pitch for more commonly requested strategies to introduce the need for concurrent improvements on the workforce side. And this is not a new approach, but rather dates to the early days of workforce experimentation by local MEP centers.

Starting in the late 1990s, for example, workforce-leading MEP centers combined workforce services with point solutions that were designed to promote "operational excellence" through what are commonly referred to as "lean manufacturing" techniques. With lean manufacturing, the emphasis is on streamlining production processes and reducing delivery times by removing inefficiencies or redundancies. In this context, workforce services are presented as a supporting action to ensure that changes to production processes and schedules save the company money by eliminating unnecessary waste or duplicated steps. Under the lean banner, worker training raises awareness among the front-line manufacturing workforce of the added costs or unjustified time delays they generate for the company.

By the early 2000s, most MEP centers had broadened their service offerings well beyond lean solutions to help client firms adopt new technologies and explore new market segments. There was growing recognition among manufacturing experts at the time that lean manufacturing principles—with a primary goal of smoothing variable costs—could only go so far in protecting U.S. manufacturers from increasing global competition (Luria 1997). By offering a more expansive set of extension services, the hope was for MEP centers to help smaller-sized

manufacturers stay ahead of mounting pressure from low-wage competitor nations in Latin America and Asia by driving growth through innovation and market reorientation rather than through endlessly cutting costs, which would test resource and capacity limits. In the context of rising global competition, technology adoption offers the potential to raise productivity, in turn allowing manufacturers to reorient resources and worker attention to new product development. Design services, for their part, provide a direct means for raising "top-line" revenue, allowing manufacturers to offer product engineering and prototyping services to their clients, while also avoiding the inevitable price wars common to more standardized or commodified product markets.

In theory, the expansion by MEP centers to include technology and design-focused services can produce an immediate follow-on workforce effect, *if* those actions raise awareness among manufacturers of the importance of design and technical skills and the need to temper counterproductive strategies that "lean out" workforce talent through layoffs or attrition. But workforce-leading MEP centers have not left this possibility to firms to discover on their own. Rather, they have been proactive in offering reinforcing supports that help smaller manufacturers align workforce development with technology upgrading and market repositioning. As an example, workforce-leading centers offer design-supporting certificates in blueprint reading, in "trade math," and in ISO quality standards, thus ensuring that the manufacturing workforce has foundational knowledge from which to contribute to product design processes. Similarly, these MEPs have partnered with equipment and machinery vendors, as well as with vocational educational providers, to deliver a range of workforce solutions, including on- and off-site technical training courses.

This active promotion of technology and design solutions has not meant that lean manufacturing services have faded away, nor that their corresponding worker training programs have dwindled. To the contrary: lean-related services remain a go-to favorite among MEP manufacturing clients, and MEP centers across the entire network actively promote their use to new and existing clients. To a certain extent, lean manufacturing is the manufacturing extension equivalent of what in retail is commonly referred to as a "loss leader"—a low-priced, readily available option that can be used to attract new clients with the ultimate goal of building a trusted connection to encourage eventual use of higher-value services and supports. Yet in the hands of MEP centers, lean manufacturing principles have also evolved considerably in ways that help reinforce workforce development goals. A wider variety of tools are available not only to identify and reduce inefficiencies and waste, but equally to enhance coordination across multiple business and production activities, including standardizing processes to better support workforce development through cross-training and job rotation. Lean manufacturing today is thus more encompassing than it was in the 1990s, with greater points of tangency for exploring alternative workforce solutions.

As this overview indicates, workforce-leading MEP centers have closely tethered workforce solutions to a more expansive set of point solutions, including more sophisticated iterations of lean manufacturing. But this is not the only approach taken by these centers to elevate workforce development within the manufacturing communities they serve. Some MEP centers also offer a strategic planning overlay to push even tighter integration across discrete service areas and also to center workforce development in a more holistic way. One example is the Genesis program created by the Illinois MEP center (IMEC), which was piloted with a few dozen manufacturing clients in the Greater Chicago region in 2014 before becoming the default

statewide approach to IMEC's manufacturer engagement. Genesis-like programming starts with the premise that workforce practices are central to business operations, productivity, and competitiveness, and therefore manufacturing extension services need to promote improvements to job quality in support of long-term business success (Lowe et al. 2021). To move this goal forward, IMEC staff implements a 51-question employee engagement survey from the outset, gathering perspectives of front-line production workers on the work and firm environment, which they use to guide a multiyear strategic planning process. Oregon's MEP (OMEP) employs similar up-front assessment tools in order to customize a workforce-centered course of action for individual firms. While well-established point solutions remain in play, including a mix of lean-related options, this strategic visioning process enables OMEP staff to determine the best combination and sequencing of discrete solutions for elevating the workforce impact.

From Workforce to Workplace Development

As we have outlined thus far, MEP centers are moving to deepen complementarities across seemingly distinct service categories in order to elevate interest in workforce services within their respective catchment areas. Some centers are going a step further to also *reframe* the underlying logic of workforce development. These centers are increasingly shifting their emphasis from preparing individual workers to move into or out of jobs to instead preparing the *workplace* to attract, retain, and nurture the manufacturing workforce.

Workplace-focused actions are based on a different set of assumptions from more traditional *workforce* development. They are not individually centered, nor do they present low wages or limited career mobility as an individual failing or skills mismatch. Rather, the guiding workplace principle is that poor-quality jobs—rather than unprepared applicants—are the greatest drag on local labor markets and thus need to be improved through coordinated

institutional action. Workplace improvements therefore target the job itself, striving to upgrade its quality by identifying and resolving problematic organizational, interpersonal, or institutional dynamics. Emphasizing the difference between workforce and workplace actions, Matt Fieldman from MAGNET MEP put it this way in a recent blog post for NIST-MEP: "There is an urgent need to improve our people development systems to a point where our efforts to attract, train, and retain people *create an environment* that values people for their personalities and qualities, not just their productivity" (Fieldman 2021; emphasis added).

Still, as this quote also implies, workforce and workplace development are not inherently competing—these logics intersect. This integration has long been promoted by a subset of workforce providers mentioned earlier that are commonly referred to as workforce intermediaries, which some MEPs are now starting to emulate. So, what do workplace-improving services look like when delivered by an MEP center? First, MEP centers that take this approach do not restrict training and technical skill development to front-line manufacturing workers, but rather extend that support to include front-line supervisors as well as higher-ranked managers and executives. MEP centers have a long history of offering managerial education and leadership development. Workforce-leading centers enhance this learning commitment, recognizing that technical know-how does not automatically translate into good supervision—even the most technically sophisticated workers, as well as top-level managers and executives, need to learn how to supervise and lead. Training offered to higher-ranked decision makers is therefore designed to enhance their ability to inspire and motivate others under their supervision: often this training emphasizes communication and fairness, as well as conflict resolution. To reinforce this effort, MEP centers also improve on-site supervision by helping firms establish

formal mentoring systems, while opening lines of communication to ensure that front-line workers feel valued and supported, rather than controlled or restrained.

Beyond better supervision, MEP centers also use a variety of other workplace-improving actions to help firms enhance worker morale and convey to prospective employees the company's commitment to a good work experience. While the list of actions taken by MEPs can vary from center to center and even firm to firm, what is key is a shared emphasis on resolving an "interest" rather than a "skills" gap—in other words, recognizing that workers may have considerable choice in how they spend their work time and creative energy, and that therefore the job of their employer is to provide a supportive environment that values worker ingenuity and supports ongoing career success. Reinforcing this point, one MEP director stressed, "We are helping with careers, not jobs! We are educating our [manufacturing] clients on careers where the employees stay and grow with the company" (Manufacturing Extension Partnership 2014, p. 1). A worker's being supported at work increases the likelihood that that worker will stay put.

With this broadening of workers' skills and interests occurring from workforce to workplace, MEP centers effectively shift the onus from individual workers to the employer, pushing them to nurture "interest" at the workplace, not only among the incumbent workforce, but also with an eye toward future recruits. MEP centers help firms treat the manufacturing workforce as creative partners that enable the organization to grow, contributing to new and innovative products and processes while supporting the transition to more stable or profitable markets. This means fostering a work environment that is exciting and interesting and that is worth an employee's time and effort. Higher pay, better benefits, and more stable scheduling, along with healthy and safe workplaces, are clearly important contributors to raising job-quality standards. But to borrow philosopher Joshua Cohen's words, so is having a sense of "purpose,"

which means that beyond more commonplace "job standards," we also "have reason to *want* in our work" (Cohen 2020, p. 10).

Pivoting in Pandemic

The strategies described above predate the COVID-19 pandemic, which raises the question of how and in what ways they have been further refined or augmented over the course of the pandemic. MEP leaders interviewed for this project, both at the national and subnational level, have acknowledged the COVID-19 pandemic as an opportunity for scaling workforce development service across the entire MEP network. Yet, they are also quick to note that the COVID-19 pandemic has not created entirely new pressures. Rather, this far-reaching crisis has exacerbated preexisting concerns that have been building slowly over the course of a decade or more. Worker shortages, for example, have been a recurring challenge for smaller manufacturing firms, which the pandemic has only intensified, as some production workers have had to stay home to care for younger children that are kept out of school, and others have stayed away to cope with their own illnesses or those of a family member. Still, in the way that it has not only deepened preexisting workforce challenges but generated new and unexpected ones, the pandemic has created a focusing moment for further workforce exploration.

Given this historic juncture—and the possibility that this pandemic portends future crises—it is useful to consider which workforce- and workplace-supporting services have become more salient with the pandemic, and how those strategies intersect with and even heighten what was provided in the lead-up to 2020. More immediately, the pandemic has raised concerns about workplace safety, and, not surprisingly, this has become a top priority for most MEP centers, not just those already at the workforce-development frontier. A large number of MEP centers offered some form of programming in 2020 to help client firms reopen their

factories safely after an initial closure and avoid a subsequent shutdown by minimizing the risk of the virus spreading throughout the worksite. Information on COVID-19 safety procedures was often made available online or discussed through a recorded, MEP-hosted webinar, although some centers also offered to visit factories to assess and improve workplace-safety protocol.

Beyond this, workforce leading centers found the pandemic particularly useful for also reinforcing the interconnection between business performance and employee benefits, including paid sick and family-care leave, which enable workers to stay home and care for themselves or family members, further reducing the risk of workplace infection. Some of these pioneering centers even explored options for helping their clients navigate school closings: at least one taking time to evaluate the pros and cons of forming learning or child-care pods to support production workers with young children.

Another widely shared pandemic concern raised for MEP clients involved ongoing workforce training. In response, some MEP centers were able to help their manufacturing clients determine which elements of their existing training systems could easily transition to an online format, as opposed to which ones required an immersive, in-person experience and thus needed to be rescheduled for later, when the risk of COVID infection was reduced. Throughout the pandemic, growing numbers of MEP centers established a formal, third-party contract with Tooling U-SME, a well-known and highly regarded virtual training platform designed for manufacturing firms. Others worked with in-house or third-party trainers to transfer existing programs and content to a virtual format, which in normal times would be delivered live and in person. Some centers even initiated new training programs during the pandemic, including augmented and virtual-reality training options they codeveloped in partnership with local

technology firms, pitching these novel applications as a means to make manufacturing more attractive to a younger generation of tech-savvy job seekers.

Still, improvements in workplace safety, as well as modifications to existing work-based training systems, are low-hanging fruit in the world of workforce development. Some MEP centers have gone well beyond these more obvious targets, creating entirely new forms of workforce support in 2020 and 2021 that may prove useful beyond this pandemic. An especially novel solution was developed in the early months of the pandemic by Polaris MEP in Rhode Island. Called the Talent Exchange, this statewide initiative initially helped connect manufacturing firms with furloughed workers from other factories, enabling the latter to showcase their skills and secure short-term employment contracts with firms that were able to retool their production systems to meet emergency demand. This matchmaking program met with some initial resistance from a few smaller manufacturing firms that, for a variety of reasons, faced a longer pause in production or could not easily repurpose their factories to address local pandemic demand. These particular firm owners worried that this labor exchange might result in their skilled workforce leaving the company for good. While sympathetic to these concerns, Polaris staff recognized that the feared outcome was not inevitable but contingent. As such, the Talent Exchange also provided an opening to help these and other employers deepen their commitment to their existing workforce.

At first glance, these responses imply a return to a narrower set of workforce-focused solutions, insofar as online training, local talent sharing, and even improved safety protocols center on manufacturing workers, be that in support of personal development or bodily protection. But stepping back, we can see that these actions represent another inflection point in MEP's workforce-development evolution. MEP centers are using the COVID-19 pandemic to

accentuate the need for adaptive organizational strategies to enable manufacturers to more easily rebound from this particular crisis, but also to prepare for those that lie ahead. As part of that effort, MEPs are making a stronger case that functional flexibility requires a steady and continuous investment in workforce skill, along with concurrent improvements to front-line manufacturing jobs. With pandemic needs in mind, including initially heightened demand for personal protective equipment (PPE), MEP centers across the country have helped client firms retool production systems and repurpose existing supplier-matching systems. But equally, some centers are helping clients recognize that this need for change is contingent on a highly capable and engaged workforce, and from there, they reframe workforce and workplace development services as resources for ongoing organizational learning and adaptation. In this regard, the pandemic has provided a test bed for MEP centers to further deepen the interconnection between business assistance and workforce support—for helping smaller manufacturers, as well as their surrounding manufacturing communities, become more resilient to future crises, whether health- or climate-induced.

Institutional Creativity and Change from Below

As the strategies outlined above indicate, MEP centers are clearly doing much more than just responding to SME needs for "in-demand" workforce services. Centers that are prioritizing both workforce- and workplace-development strategies are intervening in ways that also shape and shift underlying business practices in an attempt to improve the quality of front-line manufacturing jobs. For the most part, centers have developed these strategies on the ground, experimenting and iterating with models that resonate with their clients, and often with potential funders. Together they are effecting "institutional change from below," helping to move the MEP network toward a greater strategic orientation to workforce issues.

At this point, our capacity to assess the efficacy of this shift is limited. We did not set out to assess the impact of these strategies on individual workers, nor to measure the gains for manufacturing businesses that receive workforce assistance from MEP centers. Nor did we seek to count how frequently a strategy is used by each and every MEP center. Rather, our research approach is more in line with strategy discovery: using interviews, client data, and archival analysis to better understand how MEP centers approach the task of delivering workforce development, and qualitatively describing commonplace strategies by MEP centers that are leading workforce efforts. To our knowledge, there are no system-wide evaluations of MEP-provided workforce services, though studies exist of individual centers and their workforce programs that do indicate that benefits accrue to participating businesses and workers alike (Jain et al. 2019). This topic is therefore ripe for further analysis, including research that uses wage records and other administrative data sources to evaluate the effects of MEP assistance across the manufacturing workforce.

What is clear from our analysis to date is that NIST-MEP network leadership has been active over the course of several decades, raising awareness and stimulating interest in workforce services among participating MEP centers and the SME clients they serve. That effort, combined with growing demand for workforce assistance from manufacturing firms, has led to a notable uptick in workforce-development activities across the MEP network since 2010. Not every MEP center is fully committed to, or engaged with, workforce development. Some centers have only recently begun to focus on the workforce, while others have been at this process for much longer, and as such have had more time to tinker with their approach, including combining and recombining established tools and practices in response to evolving and emergent challenges and opportunities, such as the COVID-19 pandemic.

In this regard, we find evidence of "institutional creativity," in that service areas are not treated as static or fixed but are *in motion*, continuously iterated and improved (Berk et al. 2013). But with that creativity also comes institutional and spatial unevenness, suggesting that MEP centers are in very different places in their internal capacity to actively support workforce services and convince manufacturing clients of their value and relevance. This limits the MEP program's potential for achieving impacts nationally. We conclude by outlining some of the major challenges to wider network adoption that have surfaced throughout this research, ending with a reflection on how they might be resolved through further institutional intervention and coordination.

CONCLUDING REFLECTIONS ON MEP'S WORKFORCE FUTURE

The manufacturing sector in the United States stands at a critical juncture. Market forces and policy attention from the federal to the local level are working in favor of a revitalized industry, but long-run restructuring processes have taken their toll on job quality, skill formation systems, technological absorptive capacity, and supply chain resilience, especially for SMEs. In this context, the acute pains felt by employers around workforce recruitment, retention, and development in the wake of the COVID-19 pandemic and Great Resignation can be understood as a symptom of chronic conditions across multiple dimensions—i.e., product market strategy, manufacturing process, and operations—that have accumulated over time. The interconnected nature of these problems limits the potential efficacy of isolated workforce development interventions; more holistic approaches are needed.

The U.S. Manufacturing Extension Partnership (MEP) represents an important institutional platform for supporting the vitality of the manufacturing sector, and in particular

these stubborn problems of job quality. As we have shown, the NIST-MEP system has made periodic efforts over the years to incorporate workforce development into its strategic framework, most notably with the 2008 Next Generation Strategy. We found that in the subsequent decade of the 2010s, MEP centers did more and more workforce-oriented projects with their business clients, and a cadre of workforce-leading MEP centers emerged that have been experimenting with service integration in progressive ways. These experiments reconcile job quality with both short-run operational excellence and long-run success and business resiliency.

Still, each MEP center (and within some states, localized subrecipient centers) has considerable discretion over goal setting and strategy implementation (Brandt et al. 2018; National Research Council 2013). As we have illustrated, this decentered approach enables centers to align their industrial extension services to regional circumstances and to motivate workforce strategy development and experimentation. But decentralization also means considerable cross-network variation, which constrains the collective impact that can be achieved at the national level.

Our interviews and analysis suggest opportunities for targeted federal support to increase MEP network workforce capacity and encourage more centers to enhance the reach and impact of workforce programming. As we have learned, workforce-leading centers typically rely on supplemental funding from state-level sources or private foundations, enabling them to consistently offer workforce-development services while also increasing demand by initially offering those services at a reduced or subsidized rate. But our interviews also indicate that individual centers have varying levels of financing and staff availability, meaning that for some, there are limited resources for offering new, non–core services, such as workforce development.

A related financial challenge raised by interviewees is the extensive reliance by centers on fees collected from clients for services, which is required as a local match to draw down federal funding. That expense can lead companies to prioritize more immediate cost-saving measures or revenue-generating activities, rather than investing in workforce solutions that can take longer to implement or reveal their value (National Research Council 2013).[5] In the past, MEP centers have relied on special-use grants and other funding sources to subsidize workforce development activities, passing those savings along to their clients to encourage greater uptake. This suggests an opportunity for NIST-MEP leaders to push for increased levels of federal support while also ensuring that their deepening commitment to workforce development adds to, rather than merely reshuffles, existing federal and state workforce funding.

Our interviews also reveal the limitations of current NIST-MEP data collection systems. These limitations obscure the scope and scale of workforce activities but equally constrain efforts to monitor and assess workforce impact. Currently, NIST-MEP uses client surveys to quantify the number of jobs created or retained at client firms and track firm-level increases in workforce investment that result from projects. While these measures are a useful first approximation of MEP's impact, they can mask other equally important workforce effects. As an example, there is no corresponding metric that captures the effect of MEP support on the quality of jobs, nor the cumulative impact of workforce interventions on productivity and operational success. In this respect, there is ample room for NIST-MEP to test out alternative data collection and assessment tools that reach well beyond job counts to recognize the critical work of MEP centers in raising job-quality standards and enhancing system capacity to support SME workforce needs more broadly. Efforts to improve data-collection protocol could also extend to

[5] Email message to the authors on MEP workforce challenges from Mark Troppe, 2021.

the classification of MEP service activities, replacing the current system of categorizing projects in single-field, discrete service "boxes" with one that enables centers to select across multiple fields and thus capture linkages between strategic priorities more robustly.

Interestingly, this challenge with incorporating job-quality measures, including establishing a stronger connection to enhanced business performance, is not unique to MEP. Most federal- and state-funded workforce development programs are grappling with this same concern, and they are looking for alternative frameworks to assess and motivate quality gains through formal monitoring and evaluation (Lam 2020). Some of this shift is motivated by claims that technological advances could reduce the overall workforce head count in U.S. manufacturing, while still raising the prospect that remaining jobs become higher in quality. In this regard, there may be an opportunity for NIST-MEP leaders to insert themselves into a much larger institutional discussion about how to shape the future of manufacturing employment growth and development, while also playing a leading role in coordinating a multiagency response.

But strengthening MEP's role in shaping this workforce future also requires deepening its connection to local and regional "ecosystems" of workforce intermediaries. As we have learned throughout our research, workforce-leading centers often rely on local workforce-supporting institutions—including community colleges and other community-embedded institutions—to cocreate client solutions. Individual MEPs have also partnered with each other to codevelop programs and share innovative strategy tips on a variety of topics. This suggests a further role for national leadership in forging stronger ties across MEP centers, but beyond that by including other local workforce-supporting institutions.

Related to this, we have also learned that it takes time to teach others what you know and what you have learned, concerning the possibility for NIST-MEP to formalize network learning, not only in expediting the flow of information across regions but also in creating a formal space for further workforce iteration and experimentation (Sabel 1996). With that possibility in mind, researchers at MIT's Industrial Performance Center have recently recommended the creation of a brand new national workforce development institute as part of the larger Manufacturing USA network—a group of 16 federally funded institutes, each focused on a unique technological specialization to advance national manufacturing capacity (Armstrong et al. 2021). NIST-MEP's involvement in that effort could ensure that this workforce-focused institute, if launched, elevates the standing of SME manufacturers and improves the quality of the jobs they create.

Our interviews suggest there are multiple options available to NIST-MEP to encourage further experimentation with workforce solutions and, with it, to move workforce development from the margins into MEP's service core. In that role, national leaders might also consider drawing attention to an emergent workforce challenge under consideration by several workforce-leading MEP centers: the need to promote racial diversity, equity, and inclusion within U.S. manufacturing. As we have discovered through various interviews, this issue is clearly on the minds of MEP leaders, who are waking up to the realization that U.S. manufacturing jobs are racially inequitable: long-standing racial wage disparities persist in this sector, along with occupational segregation and low rates of business ownership by people of color.

In response, several workforce-leading MEP centers have initiated new processes to confront this troubling legacy head on, including exploring options for promoting change within manufacturing firms, as well as within their own organization. Some centers have created committees that include staff members and firm owners, tasked with learning and strategizing

around racial equity. Center directors in various states are also exploring ways to diversify the MEP workforce itself to bring more people of color into positions of influence while extending MEP career pathways to ensure entry-level employees of color can move up into leadership roles. America Works—the national workforce initiative initially proposed by Missouri's MEP and managed out of MAGNET in Cleveland—is also providing structured support to MEP centers to help them make a concerted commitment to racial equity. With this in mind, they established a racial equity task force in 2020 to support national visioning.

These efforts feed directly into MEP attentiveness to workforce and workplace development, enabling centers to confront racial bias in hiring, wage-setting, advancement, and ownership structure, devising solutions that improve not just jobs in manufacturing but their broader social and community impact as well. But they also point to another focus area in need of national leadership: the desire by MEP centers to now support racial equity and inclusion could be further facilitated by expanding the network reach to include national and regional organizations with racial equity expertise, including those from communities of color with lived experience of racial inequities. There are deep pockets of experiential knowledge within certain MEP centers that could be drawn out as a shared resource for helping others within the national network understand what steps can be taken to promote a more racially equitable manufacturing future. Still, advancing racial equity involves a complex and iterative set of actions and decisions—few MEP centers will be able to advance racial equity goals on their own, raising the need for new and further-reaching institutional partnerships. While network formation and reach might vary from one region to the next, a promising model is Industry and Inclusion 4.0, a racial equity initiative launched by the Urban Manufacturing Alliance and The Century Foundation in 2019 to connect Ohio's MAGNET MEP center and two Manufacturing USA institutes with

community-based workforce intermediaries in Cleveland, Chicago, and Wisconsin. NIST-MEP leaders could hold up this and other examples to inspire an ongoing commitment to lasting change.

In raising these suggestions, we recognize the potential for more MEP centers to become leaders in workforce design and implementation. Yet we also acknowledge gains from having this next workforce push codeveloped with workforce intermediaries and other community-embedded organizations. This partnering should not be a complete hand-off, as early "third-wave" economic and workforce advocates once envisioned (Ross and Friedman 1990). Rather, equitable development and recovery, particularly the push for greater racial diversity and inclusion in U.S. manufacturing, requires that the MEP network first learn from others how to enact changes within its own organizational setting, practicing internal racial equity before training others. This, in turn, can create the institutional foundation for driving manufacturing resilience and broadly shared success.

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Figure 1

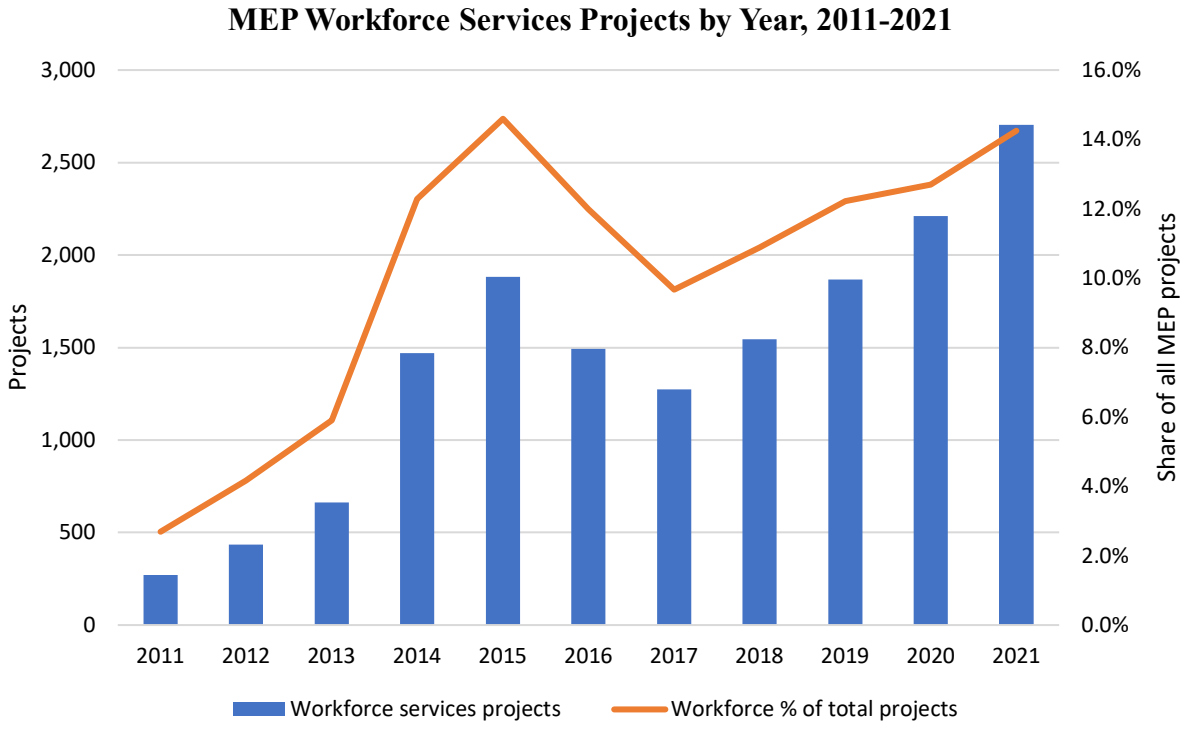

Figure 2