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process-based workforce

DEVELOPMENT IN THE NEW ECONOMY

By Nancey Green Leigh, Ph.D., FAICP and Benjamin R. Kraft

INTRODUCTION

Since the Civil War reconstruction, southern U.S. states have been associated with aggressive industrial recruitment, often based on direct subsidies or future tax reductions on top of already low labor and land costs (Cobb, 1993; McMath, 1991). This strategy, alternatively called "first wave" economic development (Bradshaw & Blakely, 1999; Eisinger, 1995), "smokestack chasing," or "corporate welfare," persists. However, in reaction to the heavily supply-side, export-oriented first wave, several additional trends in economic development, such as place-based entrepreneurship, industry cluster development, and local self-sufficiency have also emerged (Fitzgerald & Leigh, 2002; Leigh & Blakely, 2013). Now, several layers of strategies and approaches often exist simultaneously in U.S. state-based economic development.

The growing emphasis on the role of human capital in economic growth (Clarke & Gaile, 1998; Florida, 2002; Garmise, 2006; Glaeser & Mare, 1994; MacManus, 1986; Mathur, 1999) is one of the forces that has shaped this evolution. While states continue to use tax incentives and cost-reduction strategies such as anti-union "right to work" laws to compete for mobile capital, there is increasing acknowledgement that industrial recruitment must be accompanied by workforce development and retention efforts in order for places to achieve sustained benefits from capital relocations (Lowe, 2012). North Carolina's life science initiative, documented by Lowe (2007) and Leigh and Walcott (2002), is an example of how a comprehensive workforce development program can complement recruitment to grow a sector's presence in the state – in this case biotechnology.

In the case study presented here, we describe a recently implemented southern state workforce initiative that also exists in tandem with larger manufacturing recruitment efforts. This initiative, called the Alabama Robotics Technology Park (RTP), shares characteristics with a number of existing economic and workforce development strategies and paradigms, but is also unique in that it focuses entirely on a process technology – robotics – rather than a sector or industry.

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This one-of-a-kind endeavor has significant implications not only for workforce and economic development as separate pursuits, but also for how the two may be coordinated in the future. Further, it raises fundamental questions of how the goals of increased productivity and employee wages can be reconciled with the potential for overall reductions in employment and increasing basic science, technology, engineering and math (STEM) knowledge requirements for traditionally middle class jobs.

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THE CASE OF THE ALABAMA ROBOTICS TECHNOLOGY PARK

The Alabama Robotics Technology Park (RTP) is a unique facility and public workforce development program that provides robotics training and research and development space to Alabama manufacturing firms and their employees. In this case study, we describe how the RTP originated out of a recognition that cultivating a local robotics skill-base could fortify business attraction and retention efforts, and how it differs from traditional workforce development models by focusing on an emerging technological process rather than an industry sector. The study also addresses how the RTP aligns with existing statewide economic and workforce development programs and considers future implications for this model in a time of rapid technological change.

THE ROBOTICS TECHNOLOGY PARK AND THE EVOLUTION OF ECONOMIC DEVELOPMENT

The Alabama RTP is similar to the aforementioned biotechnology workforce program in North Carolina in that it is a state-supported workforce development intermediary that grew out of the recognition that new skills were necessary to attract and keep advanced manufacturing companies in the state.

However RTP, differing from North Carolina's biotechnology initiative in a number of ways, is a unique type of workforce intermediary in its own right. The fundamental difference is that the RTP is an entirely *process*-based program. That is, it trains employees to work with a firm's specific manufacturing process technology, regardless of the firm's industry. This is a departure from the increasingly popular sector-based workforce development strategy, which focuses on training for a specific industry or cluster of industries (Conway, 2014). North Carolina's biotechnology initiative is an example of a sectoral strategy.

However, the RTP's model is not necessarily at odds with the sectoral approach. Since industrial robots are used almost exclusively in manufacturing, the RTP could be seen as a de facto sector-based program (the sector being manufacturing). Still, the entire manufacturing sector is much broader than what a typical sector-based strategy would address.

Alabama's manufacturing base spans a range of subsectors (see Table 1). The state's largest and most rapidly growing subsector, transportation manufacturing, includes automotive, aerospace, and ship and boat manufacturing – all industries that Alabama has aggressively recruited, and all intensive users of robots. Automotive manufacturers were the earliest adopters of robots. They continue not only to operate significantly more robots than other sectors, but also to add robots to their production operations at a faster rate (International Federation of Robotics, 2014). At the same time, food and fabricated metal manufacturing – Alabama's second and third largest sectors – are also increasing their robot use (International Federation of Robotics, 2014).

Another way that the Robotics Technology Park differs from the North Carolina biotechnology initiative is that it is a "rediscovery of the foundations" (Shapira, 2005, p. 199) because of its emphasis on the technological upgrading of Alabama's mature industries, as well as its availability to both large multi-national corporations

TABLE 1: Alabama Manufacturing Subsectors, Employment and Establishments, 2005-2015

NAICS Code	Type of Manufacturing	Establishments 2015	Establishments 2005	Employees 2015	Employees 2005	Employment Change, 2005-2015
31-33	Manufacturing (all)	4,158	4,953	248,033	282,136	-34,103
336	Transportation equipment manufacturing	297	231	57,228	35,290	21,938
311	Food manufacturing	285	287	30,232	35,428	-5,196
332	Fabricated metal product manufacturing	896	982	25,557	26,391	-834
331	Primary metal manufacturing	107	127	19,133	16,540	2,593
326	Plastics and rubber products manufacturing	174	212	17,537	17,933	-396
321	Wood product manufacturing	329	453	14,469	21,469	-7,000
325	Chemical manufacturing	186	185	12,160	11,994	166
333	Machinery manufacturing	260	276	11,076	13,888	-2,812
322	Paper manufacturing	62	84	10,411	13,147	-2,736
337	Furniture and related product manufacturing	261	432	8,850	15,594	-6,744
334	Computer and electronic product manufacturing	100	128	7,781	12,440	-4,659
339	Miscellaneous manufacturing	280	343	6,621	7,795	-1,174
327	Nonmetallic mineral product manufacturing	273	336	6,208	8,225	-2,017
314	Textile product mills	91	102	4,802	7,721	-2,919
335	Electrical equipment, appliance, and component mfg	66	68	4,785	5,450	-665
323	Printing and related support activities	327	401	3,325	5,175	-1,850
313	Textile mills	30	80	2,430	12,706	-10,276
315	Apparel manufacturing	50	138	2,229	10,239	-8,010
324	Petroleum and coal products manufacturing	30	38	2,021	2,219	-198
312	Beverage and tobacco product manufacturing	42	32	1,125	2,332	-1,207
316	Leather and allied product manufacturing	12	18	53	160	-107

Source: U.S. County Business Patterns

Photo Credit: Nancey Green Leigh

RTP's main training space containing workcells for several types of robots.

and local small-and-medium sized enterprises (SMEs) alike. In the Southeast, this function has traditionally been performed by local Manufacturing Extension Partnership (MEPs) branches, which are part of a national network administered by the National Institute of Standards and Technology. Several Midwestern regions, such as Chicago and Cleveland, also have private non-profit retention and expansion intermediaries that assist manufacturers with technological upgrades. However, an entire regional facility dedicated to one technology – like the RTP – is a new approach.

In summary, the novelty of the RTP makes it difficult to characterize, although elements of existing economic development strategies are embedded in its model.

We suggest that the RTP's distinctiveness is related to its focus on the specific process technology of robotics. As opposed to life sciences manufacturing in Lowe's (2007) example, where students must master a comprehensive set of specific skills such as "chemical mixing, solid dose tableting, and coating" (p. 346), robotics is a process technology that automates a wide range of existing skills. This is especially true for painting and welding, where there are extensive sets of competencies and certifications (particularly for welding) that a worker must master, regardless of whether the application is manual or automated.

In the words of an RTP employee, to be a good robotic paint technician one must "know paint" in addition to knowing how to operate the robot. An RTP instructor also noted that, since most students are incumbent employees, they have some prior knowledge of automation. Only in rare cases do they come to classes without any prior experience, and students who do lack this knowledge have significant difficulty mastering class material. In other words, to get the most out of a robotics course, one must already be familiar with basic automation concepts and the applications to which they are learning to apply robotics technology. Thus, the RTP requires a significantly higher level of preparation from its trainees than traditional workforce development programs would require.

This situation raises the question of whether the success of the RTP will generate a "skill-biased" (Autor, Levy, & Murnane, 2003) effect in Alabama's labor market. That is, will the attainment of robotics skills benefit most (in the form of wages) those who already have a specialized or codified industrial skill that robots can complement? If this is the case, what will happen to the larger but less skilled industrial labor pool whose jobs may simply be replaced? Table 1 shows that Alabama's manufacturing workforce declined by over 34,000 between 2005 and 2015, while its average manufacturing wage increased from 84.9 percent to 89.3 percent of the U.S. average manufacturing wage during the same period (Table 2). The potential success of RTP and Alabama's larger industrial strategy may need to be balanced with other initiatives aimed at different strata of the workforce.

TABLE 2: Average Wages of Manufacturing Workers in Alabama and the U.S.

Year	Alabama	United States	Alabama Wage as % of U.S. Wage
2005	$37,309	$43,951	84.9%
2015	$50,517	$56,591	89.3%
% chg, 2005-2015	35.4%	28.8%	—

Source: U.S. County Business Patterns; calculated as annual payroll/number of employees. Not adjusted for inflation

ORIGINS AND ADMINISTRATION

The Robotics Technology Park is one of several specialized training centers in the portfolio of the Alabama Industrial Development Training (AIDT) agency. AIDT was established by the Alabama legislature in 1971 under the Alabama Department of Education, at a time when the connections between workforce development and economic development were not widely recognized (Harper-Anderson, 2008). However, the Agency moved to the Department of Commerce in 2012, reflective of its emerging prioritization as an economic development – as opposed to a workforce development – engine.

This type of realignment is not unique to Alabama. For example, in Kansas, Missouri, and Oklahoma in the 1990s and early 2000s, economic development agencies absorbed workforce development agencies (Garber & Altstadt, 2007). Georgia followed suit in 2014. While not all state economic and workforce development departments have merged, greater coordination between the two has been a theme since the 1980s for state governments (MacManus, 1986).

In its first decade, AIDT provided mobile training services to companies in Alabama, traveling to sites across the state to provide job training based on companies' needs (Marlowe, 2009). While it maintains 38 mobile training units (MTUs), it has also built 11 stationary training facilities throughout the state.

Trade and professional economic development publications have credited AIDT with the successful recruitment of Mercedes-Benz auto assembly plant in the mid-1990s, and the several other foreign auto-makers that followed (Marlowe, 2009). However, two more critical peer-reviewed accounts of the Mercedes-Benz deal do not mention AIDT as a factor (Gardner, Montjoy, & Watson, 2001; Spindler, 1994). Nevertheless, its model of employer-centered recruitment and training, largely aimed at heavy manufacturing, expanded throughout the state. Examples of other AIDT stationary centers are pre-employment training centers for Hyundai and Honda and the sector-based Maritime Training Center in Mobile, AL, that provides training for the shipbuilder Austal and other maritime-related businesses. These centers, with their pre-employment recruitment and screenings, provide more traditional workforce development functions than the Robotics Technology Park.

The strategy of complementing business attraction with workforce preparation and development is also common. Hanley and Douglass (2014) find that expenditures for these two activities tend to track together statistically across states, constituting a hybrid approach they call "education-driven recruitment." Indeed, a state economic developer confirmed that he and his team heavily emphasize AIDT (and individual centers where appropriate) in marketing and recruitment efforts. So the model may be effective, but it is not necessarily innovative, and it is in fact widely used. The authors' institution, the Georgia Institute of Technology, was in fact founded in part with industrial recruitment in mind in 1885 (McMath, 1985; Shapira, 2005). More recently, however, education-driven recruitment is usually sector-based (e.g. biotechnology in North Carolina). It remains to be seen whether the process-focus of the Robotics Technology Park will provide a first-mover advantage to Alabama that increases its national competitiveness.

The RTP, opened in 2011, is Alabama Industrial Development Training's newest and most unique center. In fact, RTP employees claim that it is the only one of its kind in the world. This statement is not without justification: as a facility comprised of three buildings and occupying over 130,000 square feet dedicated entirely to robotics training, our research has not been able to identify a comparable facility elsewhere.

Each of the three buildings, constructed in successive phases, has a different purpose. Phase 1, the Robotics Maintenance Training Center, is where the basic robotic training classes are held. Phase 2 provides facilities

Side view of RTP mobile educational trailer. The trailer provides hands-on robotics demonstrations to youth in communities across Alabama.

Photo Credit: Nancey Green Leigh

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Photo Credit: Nancey Green Leigh

Rear view of RTP mobile educational trailer listing corporate partners.

to companies engaged in research and development in robotics and automation. Phase 3 was originally supposed to function as an incubator for robotics-based entrepreneurs and integrators,[1] but after several companies requested training specifically for robotic painting and dispensing,[2] the size of the planned building was doubled to provide space for this specialized training. During our research visit to the RTP, the space for the paint facility had been built, and much of the equipment that had been donated by nearby companies was waiting to be set up and assembled.

While the RTP fits within AIDT's strategic purpose of providing workforce support to complement industrial recruitment and retention, the story of its conception is literally a "back-of-the-napkin" story. As it was related to us:

> "What happened was, we had a company fixing to expand down in Cullman, AL, and we had the Governor down there, [and] our boss, Ed Castile...and one of our coworkers… As they were there for the expansion, basically the CEO stepped up on the stage, he was going to make a presentation and welcome everybody, well, a person walked up on stage and whispered in his ear, and he turned around and apologized to the Governor and said 'well, I'm sorry I only have a few minutes and I have to leave because our line has crashed, and I've got to go out and handle that situation.' Governor Riley…says, 'Well, send your maintenance man, let him go fix it,' and [the CEO] said, 'I would, but he just quit,' so he [the Governor] said, 'Well send his backup.' He said, 'I would but we don't have one. You promised that when we would come here we'd have a trained, qualified workforce. We're having to go up north to hire those people. That's an issue for us.' [My coworker here, a robotics instructor] told the CEO of the company…'If you let me go with you I'll see if I can get you back up and running.' And so Art went with him, and when Art was gone, Governor Riley took a paper napkin and drew these three phases on it and passed it over to our boss, Ed Castile, and said, now you make this happen."

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Governor Riley's successor, Governor Robert Bentley, has continued to be supportive of the RTP, and so has the local state senator, Arthur Orr, who supported the necessary budget increase for the paint and dispensing space.

The location of the RTP in Tanner (between Huntsville and Decatur), while not arbitrary, was also not necessarily strategic. The site – a remediated brownfield – was chosen because the state already owned the property and the county (Limestone) was willing to contribute funds to the park's development. Essentially, the park could have been anywhere in Alabama because its most important locational aspect is that it is more convenient to both Alabama businesses and robotics companies than Michigan, the state where most robotics companies maintain their U.S. headquarters and base their training operations. Until the RTP was constructed, Alabama companies that needed training on specific robotic platforms either had to pay for trainers – usually based in the Midwest – to travel to their Alabama plants, or they had to send their own employees to the trainers in the Midwest. Both options are expensive and inconvenient.[3]

RELATIONSHIP WITH COMMUNITY COLLEGES

While sector-based workforce training programs often take place in community colleges, the RTP's model makes for an awkward fit with these traditional secondary education providers. Rather than being structured on a semester system, the RTP's classes are taught in its facility, in week-long (40-hour) modules. The classes are designed to provide employees with intensive training that will enable them to return to their jobs the following Monday morning and apply what they have learned. Beyond current employees, only students in community college who are in the last semester of their programs are permitted to take RTP classes. This restriction is in place because unaffiliated workers with RTP certifications are highly sought after by recruiters, and a lucrative job offer may lure a student away from completing a diploma or degree.

In this way, the RTP model sidesteps a critique of the economic development function of community colleges – that they are gradually becoming beholden to industries' needs at the expense of the needs of students (Dougherty & Bakia, 1999). By only focusing on employer needs and accepting advanced students, the RTP eliminates the possibility of duplicating this conflict.

However, it also reduces the incentive for corporations to provide their own training, further devolving education responsibilities to the public sector. As a heavily "employer-centered" training program, it becomes difficult to evaluate whether the RTP is offering publicly subsidized training that companies would otherwise pay for on their own (Osterman & Batt, 1993). This is the "but for" question central to evaluations of economic development incentives and subsidies, but rarely asked and answered (Persky, Felsenstein, & Wiewel, 1997).

In revisiting the RTP's "origination" story, we might ask whether the company with the robotics malfunction may have been able to solve its labor shortage on its own initiative and remain in Alabama. Still, providing "excess" training (and training capacity) can also be interpreted

Because of their employer-centered model, RTP staff members believe they are better positioned to provide quality robotics training than their community college counterparts, precisely. This is because robotics – like other types of industrial automation – is a highly proprietary field. Aside from several basic standards, robotic systems from different vendors are not always readily compatible with each other.

as an implicit goal of the RTP. If the RTP eventually produces an embedded stock of robotics expertise in Alabama, it may serve as a valuable asset in future attraction and retention efforts. If auto-makers and suppliers leave Alabama, many employees are likely to stay behind. With recent "reshoring" trends in manufacturing, Alabama policy makers may be confident that other firms will take their place because of this skilled robotics labor pool.

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WORKFORCE GOALS

With such a specific training focus, the Alabama RTP is not a "work first" or "welfare-to-work" (Brown, 1997; Giloth, 2000) oriented workforce intermediary. The only individuals eligible to take classes at the RTP are those who are currently employed by Alabama companies or advanced students in the Alabama Community College system. As such, RTP does not teach "soft" or basic skills, nor does it address the needs of hard-to-employ Alabamans, both of which may be required under federal programs. One interviewee emphasized the fact that the RTP does not receive any federal funding, which means that it does not have to follow federal mandates or regulations. While neither the Workforce Investment Act (WIA) nor its updated version, the Workforce Innovation and Opportunity Act (WIOA), were specifically mentioned, the RTP does not appear to have been designed with any of the traditional WIA elements in mind, such as one-stop shops or Workforce Investment Boards.

DISCUSSION

Our case study of Alabama's Robotics Technology Park raises a key question: What will a state-funded strategy to automate its workers' existing skills ultimately mean for its economic development trajectory?

Alabama is part of the evolving century-and-a-half long strategy of industrial recruitment by southern states that began after the Civil War to replace a plantation economy with an industrial economy, a strategy founded on attracting northern firms. After World War II, southern industrial recruitment was very successful promoting its low cost of doing business, cheap labor, and land. Then towards the last quarter of the 20th century, southern industrial recruitment began to focus on advanced, high skill and wage industries. In doing so, it benefited from northeastern and midwestern firms' desires to move away from unionized labor.

Today, Alabama has made a major investment in combining advanced technology (i.e. robotics) with workforce training to be competitive in its economic development strategy. While a complex set of factors is behind Alabama's relative increase in average manufacturing wages (Table 2), increased levels of roboticization may be having an impact. RTP staff and state economic developers have expressed confidence in the ability of the Robotics Technology Park to provide workers with more rewarding and higher paying career paths, and to increase employment via productivity-driven firm growth.

Our case study of Alabama's Robotics Technology Park raises a key question: What will a state-funded strategy to automate its workers' existing skills ultimately mean for its economic development trajectory?

Concerns, however, have been raised over whether advanced technology adoption is leading to a decoupling of the long held relationship between productivity and earnings, that is: higher productivity leads to higher wages. (Bivens & Mishel, 2015; Fleck, Glaser, & Sprague, 2011). To look for evidence of this trend in Alabama requires analyses of detailed manufacturing sectors, as well as computation of their median wages and wage distributions, for which data is not readily available. We cannot identify those who work with robots from traditional U.S. public data because robots are treated only as subcategories of machinery in the North American Industrial Classification System (NAICS) and Standard Occupational Classification (SOC) codes. Hence, future research requires primary data collection, (e.g. case studies and surveys) to examine how economic development strategy promoting workers using robots affects the productivity-earnings relationship and ability of local economies to retain and grow industry.

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ENDNOTES

1 Integrators are engineering consultants that design and/or manufacture robotics and other industrial automation systems. Integrators play an important but often overlooked role in robotic automation. See Leigh and Kraft (Leigh & Kraft, 2017).

2 Dispensation of paint and other industrial liquids has been a common robotics application, especially for machinery manufacturers. Robotic dispensation has the advantages of removing humans from toxic spraying environments and increasing the accuracy and efficiency of material application (Hägele, Nilsson, & Pires, 2008; International Federation of Robotics, 2012; Svejda, 2016).

3 Proprietary and contract training for industrial applications is a subject worthy of study in its own right. One instructor at the RTP had previously worked as a traveling instructor for a large automation company, but left the position when the trips became too frequent and distant.

4 While estimates of the structure of the industrial robot market vary widely, it is evident that several brands, including the four mentioned here, are most widespread in factories worldwide. An investor-focused industry profile from 2012 attributes nearly 17 percent of global market share to these top four brands (MarketLine, 2012), while a trade website in 2015 estimates that their share is closer to 70 percent of all installations (Montaqim, 2015), with several other robot suppliers maintaining significant presences. The RTP trains on each of these and several other brands.

REFERENCES

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *Quarterly Journal of Economics,* 118(4), 1279-1333. doi: 10.1162/003355303322552801

Bivens, J., & Mishel, L. (2015). Understanding the Historic Divergence between Productivity and a Typical Worker's Pay: Why It Matters and Why It's Real. Economic Policy Institute http://www.epi.org/files/2015/understanding-productivity-pay-divergence-final.pdf

Bradshaw, T. K., & Blakely, E. J. (1999). What are "Third-Wave" State Economic Development Efforts? From Incentives to Industrial Policy. *Economic Development Quarterly,* 13(3), 229-244.

Brown, A. (1997). Work First: How to Implement an Employment-Focused Approach to Welfare Reform. Manpower Demonstration Research Corporation. http://www.mdrc.org/sites/default/files/full_616.pdf

Clarke, S. E., & Gaile, G. L. (1998). The work of cities (Vol. 1): U of Minnesota Press.

Cobb, J. C. (1993). *The selling of the South: The southern crusade for industrial development 1936-1990:* University of Illinois Press.

Conway, M. (2014). A Brief History of Sectoral Strategies. In M. Conway & R. P. Giloth (Eds.), *Connecting People to Work: Workforce Intermediaries and Sector Strategies*. New York: The American Assembly, Columbia University.

Dougherty, K. J., & Bakia, M. (1999). The New Economic Development Role of the Community College. Community College Research Center, Teachers College, Columbia University.

Eisinger, P. (1995). State economic development in the 1990s: Politics and policy learning. *Economic Development Quarterly,* 9(2), 146-158.

Fitzgerald, J., & Leigh, N. G. (2002). *Economic revitalization: cases and strategies for city and suburb*. Thousand Oaks, Calif.: Sage Publications.

Fleck, S., Glaser, J., & Sprague, S. (2011). The compensation-productivity gap: a visual essay. *Monthly Labor Review,* 134(1), 57-69.

Florida, R. L. (2002). *The rise of the creative class : and how it's transforming work, leisure, community and everyday life*. Basic Books: New York.

Garber, R. F., & Altstadt, D. (2007). Aligning Workforce Development and Economic Development: Opportunities for Ohio. Community Research Partners. http://www.communityresearchpartners.org/wp-content/uploads/Reports/Workforce/Alignment-Policy-Brief-1-31-07.pdf

Gardner, E. I., Montjoy, R. S., & Watson, D. J. (2001). Moving into Global Competition: A Case Study of Alabama's Recruitment of Mercedes-Benz. *Review of Policy Research,* 18(3), 80-93.

Garmise, S. (2006). *People and the competitive advantage of place: building a workforce for the 21st century.* M.E. Sharpe Inc.: Armonk, N.Y.

Giloth, R. P. (2000). Learning from the Field: Economic Growth and Workforce Development in the 1990s. *Economic Development Quarterly,* 14(4), 340-359.

Glaeser, E. L., & Mare, D. C. (1994). Cities and skills. National Bureau of Economic Research.

Hägele, M., Nilsson, K., & Pires, J. N. (2008). Industrial Robotics. In B. Siciliano & O. Khatib (Eds.), *Springer Handbook of Robotics* (pp. 963-986): Springer Berlin Heidelberg.

Hanley, C., & Douglass, M. T. (2014). High Road, Low Road, or Off Road? Economic Development Strategies in the American States. *Economic Development Quarterly,* 28(3), 220-229.

Harper-Anderson, E. (2008). Measuring the Connection Between Workforce Development and Economic Development: Examining the Role of Sectors for Local Outcomes. *Economic Development Quarterly,* 22(2), 119-135.

International Federation of Robotics. (2012). *World robotics: Industrial robots 2012*.

International Federation of Robotics. (2014). Executive sumary: World robotics 2014. http://www.ifr.org/service-robots/statistics/

Leigh, N. G., & Blakely, E. J. (2013). *Planning Local Economic Development: Theory and Practice.* Los Angeles: SAGE.

Leigh, N. G., & Kraft, B. R. (2017). Emerging robotic regions in the United States: insights for regional economic evolution. *Regional Studies,* 1-13. doi: 10.1080/00343404.2016.1269158

Leigh, N. G., & Walcott, S. M. (2002). Building a bioscience workforce: The southeast versus the vanguard states. *Southeastern Geographer,* 42(2), 262-273.

Lowe, N. J. (2007). Job creation and the knowledge economy: Lessons from North Carolina's life science manufacturing initiative. *Economic Development Quarterly,* 21(4), 339-353.

Lowe, N. J. (2012). Beyond the deal: Using industrial recruitment as a strategic tool for manufacturing development. *Economic Development Quarterly,* 0891242412467365.

MacManus, S. A. (1986). Linking State Employment and Training and Economic Development Programs: A 20-State Analysis. *Public Administration Review,* 46(6), 640-650. doi: 10.2307/976231

MarketLine. (2012). Global Robots. Marketline Industry Profile.

Markusen, A., & Nesse, K. (2007). Institutional and Political Determinants of Incentive Competition. In A. Markusen (Ed.), *Reining In the Competition for Capital* (pp. 1 - 41). Kalamazoo: W.E. Upjohn Institute for Employment Research.

Marlowe, S. (2009). *Implications of the Triple Helix Model: A Case Study of AIDT and "Mega Projects"*. (Doctor of Education), University of Alabama, Tuscaloosa, Alabama.

Mathur, V. K. (1999). Human capital-based strategy for regional economic development. *Economic Development Quarterly,* 13(3), 203-216.

McMath, R. C. (1985). *Engineering the New South: Georgia Tech, 1885-1985:(publication Done in Commemoration of the One-hundredth Anniversary of the Georgia Institute of Technology)*: University of Georgia Press.

McMath, R. C. (1991). Variations on a theme by Henry Grady:"Technology, modernisation, and social change". In J. P. Dunn & H. L. Preston (Eds.), *The Future South: A Historical Perspective for the Twenty-first Century:* University of Illinois Press.

Montaqim, A. (2015, July 21). Top 10 Industrial Robot Companies and How Many Robots They Have Around the World. *Robotics and Automation News.*

Osterman, P., & Batt, R. (1993). Employer-Centered Training for International Competitiveness: Lessons from State Programs. *Journal of Policy Analysis and Management*, 12(3), 456-477. doi: 10.2307/3325301

Persky, J., Felsenstein, D., & Wiewel, W. (1997). How do we know that "but for the incentives" the development would not have occurred? In R. D. Bingham & R. Mier (Eds.), *Dilemmas of urban economic development* (pp. 28-45).

Shapira, P. (2005). Innovation challenges and strategies in catch-up regions. In G. Fuchs & P. Shapira (Eds.), *Rethinking Regional Innovation and Change: Path Dependency or Regional Breakthrough?* (pp. 195-221). New York, NY: Springer New York.

Spindler, C. J. (1994). Winners and losers in industrial recruitment: Mercedes-Benz and Alabama. *State & Local Government Review,* 192-204.

Svejda, P. (2016). Progress in Robotic Painting Systems: Improved Performance and Reduced Complexity. International Federation of Robotics. http://www.ifr.org/industrial-robots/case-studies/darr-germany-ifr-partner-17/