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Abstract

As heavy industry and even newer service sector jobs contract in many parts of the United States, regional schemes for economic redevelopment turn increasingly toward high-tech areas, including the many scientific and engineering specialties embodied under the term “nanotechnology.” In southeastern Pennsylvania, a partnership among government agencies, industrial firms and educational institutions has emerged in the last decade to prepare a new workforce for this nanotech sector. The Pennsylvania Nanofabrication Manufacturing Technology (PaNMT) Partnership promises new jobs for un- and underemployed citizens in large numbers. This paper considers the optimistic projections about nanotechnological growth that fuel this initiative. In the face of unclear promise about that sector's future, we consider the consequences of such plans for the most marginalized groups of workers; a sector disproportionately minority in make-up.

To indicate the origins, consequences, and robust nature of such optimism about new technologies in American culture, we compare discourse surrounding the PaNMT Partnership to earlier positive invocations of technology as a means of economic uplift. We consider how planners in Chicago, facing decaying heavy industry and shrinking employment in the 1960s, turned to similarly upbeat depictions of emerging technologies and the post-secondary training of workers for that sector. We identify ways in which those depictions associated disadvantaged Chicagoans with technical jobs below the level of engineering, and indeed, supported such hierarchical distinctions among occupations rather than a turn to more vertically integrated sorts of labor. PaNMT’s vision of widening opportunities in nanomanufacturing and Chicago's approach to computing and other new technologies in the 1960s both have represented confident projections of corporate expansion and economic uplift for disadvantaged citizens. In both settings, economically marginalized groups have been promised employment in technician and other semi-skilled positions in emergent industries. These outlooks have in part been accurate, but in part overly optimistic. Nanotechnology remains, in Pennsylvania, an area of very slow expansion. They also help to distance certain communities from the pursuit of more desirable, engineering occupations. We ask how this optimism regarding a new industrial realm comes to be among educators and policy makers, and what ideologies regarding work, skill and opportunity in technology based industries it may reflect and promote.

Introduction

This paper examines the role of cultural ideologies in technical workforce development. We look specifically at rationales offered by planners, educators and employers for training programs intended to equip American workers for new industrial employment opportunities. This training, in secondary and post-secondary schools, has been part of the nation's economic development since the late nineteenth century. In every era, educators, economic analysts and policy makers have sought to forecast the productive needs of American industry and to train workers, at many levels of skill and career mobility, to fulfill those labor needs. For generations, planners have

called for the instruction of highly qualified engineers and less trained technicians, along with minimally trained laborers, to serve the national economy and provide economic opportunity to individual citizens. Owners and managers of industrial firms have often contributed to this discourse, including through their participation on government commissions and in accreditation organizations. The possibility that technological change and modernization may benefit both the economy as a whole, as well as individual workers, has been a near constant theme in these forecasts. We consider how such optimistic projections, however well intentioned, may nonetheless reflect very selective views of industrial employment prospects, as they leave aside the complexities of implementing technological change. We indicate, also, the very mixed outcomes that industrial modernization may have for different communities when it does occur. Often, attaining access to training for the highest level engineering jobs is far more difficult for poorer and minority Americans than for others. Preparation for less secure, less lucrative, and less intellectually fulfilling technical work is disproportionally common among poorer and minority students. We suggest that uncritical invocations of technological change as a collective good may support inequitable occupational opportunities among communities of American workers.

This emphasis on the inequitable nature of uncritical workforce projections draws on long-standing concerns among analysts of technical labor. Since the early part of the twentieth century, cultural critics have indicated how hierarchically organized workforces reproduce (to use the Marxist concept) class or other social inequities. We depart from strict structural analyses that see the social relations of industrial cultures as determined by their reliance on skilled labor. Instead, we believe that ideas about distributions of skill and opportunity in industry, and ideas about racial, gender or other differences in identity, dynamically reinforce one another. That is, as organizational sociologists have put it, ideas about desirable kinds and levels of diversity in a workforce are reflected in, "who is hired or given positions of responsibility in organizations, who gets access to organizational resources or decision making, and who gets rewarded for their contributions and on what basis."[1] Technical training and education play a tremendous role in associating more and less advantaged social groups with eligibility for different kinds of jobs.[2] We here consider the nature of technical curricula in American two-year colleges as expressions of overarching ideologies about differential opportunities in the world of work. In particular, we are interested in how enthusiasm regarding manufacturing modernization naturalizes such inequities, making them seem an inevitable and even desirable aspect of national economic growth.

We proceed on the assumption that the historical circumstances in which labor and economic opportunity play out shape the social relations of workplaces, an outlook established some time ago by labor historians but more recently embraced by some management scholars.[3] We compare with this paper two episodes of such technological optimism and its social consequences. The most recent episode we discuss is the enthusiastic support of two-year nanotechnology training programs by state agencies, educators, and their industrial partners in Southeast Pennsylvania since the mid-1990s. With a focus on a single government-school-industry initiative, the Pennsylvania Nanofabrication Manufacturing Technology (PaNMT) Partnership, we are currently studying invocations of nanotechnology as a body of new knowledge and productive practices that will solve un- and underemployment problems in the region. Through the creation of two-year certificate and Associate's degree programs, the PaNMT initiative is intended to lead

to employment for its graduates in nanomanufacturing settings. Such jobs would ostensibly replace those lost in recent years through the outsourcing of textile manufacturing, assembly, machining, and other regional enterprises to cheaper labor markets. We have found, however, that many of the promised areas of industrial expansion projected to employ people trained in nanotechnology fields remain small, if they exist at all. Businesses that self-identify as nanotech-related operations (and this does remain a very diffuse term) employ very few technical personnel holding credentials below the doctoral, let alone below the bachelor's degree, level. We are interested in discovering how the development of two-year nanotraining programs and the enrollment of un- and underemployed Pennsylvanians in those programs retain their desirable aura in spite of what we see as unlikely or very delayed success.

To probe how positive feelings about new technology have historically fueled such overly optimistic projections, we examine similar invocations in an earlier period: The provision of vocational and technical education (V&TE) programs for poorer communities in inner-city Chicago in the 1960s. Like Southeastern Pennsylvania today, Chicago in that era faced a decline in industries that had sustained it for generations. Large-scale manufacturing and processing operations in the "rust belt" city were failing and unemployment was far higher than civic leaders and citizens deemed acceptable. As nanotech-industries today seem to promise replacements for lost jobs in failing extractive and manufacturing operations in Pennsylvania, so computing and high-tech assembly seemed to promise economic redemption for Chicago in the 1960s. The city's leaders pressed for the creation of two-year programs in related technical areas, such as computer repair and maintenance, to provide employment for disadvantaged citizens. Chicago's city colleges expanded greatly during the 1960s and 1970s and their proponents' expressions of faith in technological expansion justified the colleges' focus on technical training, rather than on liberal arts or pre-professional curricula. This focus led to constrained opportunities for those it was meant to aid, and like the nanomanufacturing training programming of the PaNMT Partnership, may have left economically disadvantaged citizens with fewer, rather than more, prospects of secure and rewarding employment.

Supporters of the PaNMT initiative and Chicago's V&TE efforts have both invoked societal benefits of technological expansion. That belief in the nearly automatic and collective uplifting action of technological modernization constitutes an important feature of the cultural context in which all levels of technical education in America take shape, and is the focus of our paper. We describe first the contemporary embrace of this optimism, and then the historical antecedent that may indicate the deep and enduring nature of this perhaps misleading faith in technology.

The Nanotechnology Promise

"Take matter [sic] into your own hands....One million skilled nanotechnology workers will be needed in the United States...by 2015. Graduates are receiving job offers of up to $55,000 a year."[4] These claims are found on the website that constitutes a part of a larger promotional effort by the PaNMT to encourage enrollment at the partnership's 29 member schools across Pennsylvania. Among these schools are public and private universities, including Pennsylvania State and Lehigh Universities and a large number of community colleges. These statements do more than simply promise a secure future in an emerging high-tech industry for enrollees, however. They also suggest that responsibility for this future is in the hands of potential students,

and thus shift the onus of its fulfillment onto students and away from industry, in a rhetorical sleight of hand reminiscent of what Loïc Wacquant might say is the neoliberalization of the disadvantaged through the individualization of responsibility. If potential nanomanufacturing students fail to attain control of their destinies now, their opportunities in the future nanoeconomy may never materialize.[5] A sense of possibility is unavoidable. We may ask for whom this sensation is intended, and why.

Initiated at Pennsylvania State University in 1998, the PaNMT has garnered the support of industry, government agencies, including the National Science Foundation, and other higher education institutions for dozens of certificate and associate's degree programs in such areas as "nanotechnology fabrication" and "nanobiotechnology" at two- and four-year colleges. Many PaNMT-supported certification programs are concentrated at community colleges in towns and cities that have lost their industrial bases and have, for years, experienced substantial employment losses. Overall the state still ranks at 49th in job creation, a ranking Pennsylvania has hovered around for the past 20 years.[6] One of these cities, Philadelphia, has the highest poverty rate among the 10 largest American cities, and has realized a 57 percent increase in unemployment since 2007.[7] During this decade only 20 percent of Philadelphians hold college degrees, and 25 percent of adult city residents have not graduated from high school.[8] While enhanced higher education opportunities are clearly needed, including those in emerging technological fields, the promises made by the PaNMT to students are in many ways an overselling of the potentials of nanomanufacturing to redevelop the regional economy and provide secure futures for at-risk populations. These promises starkly contrast with the very slow, nearly static, emergence of nanofabrication as a sector of Pennsylvania's productive economy, despite massive, ongoing efforts to create a regional "nanotech hub" that is competitive nationally and globally out of the ashes of the region's deindustrialization.

Nanomanufacturing, at this point in the field's commercial development, is still largely conducted within university laboratory settings and in clean rooms; in the lab spaces of high-tech start-ups; or in R & D departments of large chemical and biomedical companies that have close university ties and which often employ PhD students. Jobs for two-year college graduates in these settings are scarce. In 2008, for instance, Pennsylvania's Workforce Development office listed "Industrial Engineer Technician" at the associate degree level, the employment category that we are concerned with, as a high-priority occupation for the state but estimated that there were at that time 43 openings for this position annually in Pennsylvania.[9] The PaNMT has graduated slightly more than 500 students from its certification programs since 1998, or about 45 students a year so far. The partnership does not provide numbers on job placement, but claims that "virtually all have found nanotechnology jobs in more than 70 firms."[10] It is not clear whether these firms are located within the state or in other regions, so it is not possible to say with certainty that the PaNMT is helping to train a nanomanufacturing workforce that will fill jobs created within Pennsylvania. Given the disparate and relatively small grouping of industries that claim to be involved in nanotech-related activity within the state, however, the outlook for jobs in nanotechnology within the Philadelphia area is not as certain as nanomanufacturing promoters claim.

One of the biggest challenges to large-scale commercialization of nanotech is the scalability of manufacturing processes.[11] These challenges have implications for both workforce development

and nanomanufacturing training opportunities at two-year colleges. The production of carbon nanotubes, for instance, a material fundamental to much research and development in nanotech, requires synthesis in a laboratory setting, utilizing a variety of methods such as laser ablation, arc discharge or chemical vapor deposition to produce quantities that are measured in grams. Considering these constraining material conditions, it is difficult to see that nanomanufacturing will reach any of the nanotech job-creation projection claims for 2015 made by the PaNMT. The meanings of "nano-related labor" are themselves somewhat difficult to pin down in some optimistic claims. When a worker in an automobile manufacturing plant is given a coating enhanced with nanoparticles to apply to a chassis instead of conventional coatings, does her job constitute a new position or one requiring knowledge of nanoscience or technology? Most likely not. Yet it is just these kinds of categorical slippages that are readily invoked by promoters of the promises that nanomanufacturing will drive job creation in the coming nanoeconomy and therefore should be the focus of training programs for community colleges.

Dr. Steve Fonash, the founder, director and public promoter of Pennsylvania's nanomanufacturing partnership, recently stressed in *Nano Today* the need to educate technicians in nanomanufacturing as key to "reclaiming" the manufacturing economic base lost to the services and financial sectors over the past decades.

> [M]aking 'things', and not simply relying on a service and financial products economy, is critical to a nation's economic resiliency. A country must have the technology infrastructure needed to compete on the world manufacturing scene. ...For the good of a country and its citizens, workers must have the educational background that allows them to move from job to job as sectors wax and wane. These points necessitate a strong workforce——strong across the board from researchers to manufacturing-floor technicians.[12]

Fonash points to the need to develop a technician class of nanoworker, an area that has been long overlooked by workforce development in the highest-tech areas and one he claims is the backbone of a manufacturing base, whether one is manufacturing auto parts or carbon nanotubes. Yet, ironically, the service economy jobs that have replaced the nation's lost manufacturing jobs have nothing to do with staying competitive globally on high-tech innovation. They may be seen instead to promote the globalized race-to-the-bottom, where jobs can be outsourced and performed by those living in countries with lower wages, lower opportunities, and fewer labor rights and protections. American manufacturing has historically seen few impediments to the pursuit of the lowest paid labor pools possible, and those pools are not now made up of workers who reside in the United States. Regardless, nanotech-promoters today customarily point to a new "industrial" revolution that will require a novel kind of manufacturing, dependent upon a lower educated workforce (not only a small elite of highly trained personnel) to work in nanomanufacturing.

If historical hiring trends, and empirical findings about the nature of jobs and overall rate of growth in nanotech-related manufacturing, seem to point away from near-term opportunities in that field, how is it that so many interested parties, including students in associate's degree and certificate programs, find the recent promotional claims of PaNMT compelling? This is of course not a question of only academic interest. While regional economic improvements may

reasonably be expected to play out only over a period of years, the PaNMT Partnership's enthusiastic claims for impending nanomanufacturing development in Southeastern Pennsylvania are going to have immediate negative consequences for enrollees who pay for training (often by taking out costly loans) and then cannot find jobs. We need not ascribe duplicitous intentions to those who organize and promote schooling in nanotechnology fields. We would suggest instead that traditions of putting tremendous faith in emerging technologies as instruments of national strength are well established in the U.S.; this faith translates into an uncritical acceptance of high-tech training as a reliable means of collective and individual economic uplift. For educators, employers, and students, the attraction of such acceptance may outweigh its risks. But those who stand to lose the most, the students, are also the least likely to have the means to alter this misleading arrangement when nanotechnology job opportunities fail to materialize upon graduation.

The mostly highly trained technical personnel in our economy, scientists and engineers, receive instruction that is far more transferrable than that offered in sub-baccalaureate programming. While some engineering skills do become obsolete, significant engineering unemployment is a relatively rare problem in the United States, and both the content and credentials associated with university engineering curricula pose far fewer risks to their enrollees than do those of two-year programs.[13] Engineering degrees are of course far more costly to obtain than are two-year degrees in technical fields, but the latter are disproportionately sought by persons of relatively lower economic means than are college degrees. Thus, the sense of promise for two-year nanofabrication or nanobiotechnology training, apparently felt by both its providers and its consumers despite countervailing evidence, would seem well worth some exploration. By focusing on an earlier episode of this kind, we may see how deeply interconnected conceptions of technical change and personal well-being are in the culture, and shed new light on this current case.

Technology As a Social Good

The decade immediately following World War II brought to American culture a strong association of technology with enhanced national security and personal material gain. The vast mobilization of personnel and materiel during the war was understandably felt to reflect solid new national capacities; the shift of those industrial resources to the production of affordable consumer goods after the war made many securely employed Americans newly appreciative of technological investment and resulting advancements. Increasingly through the 1960s, critical voices called attention to atomic weaponry, environmental degradation, and other risks of scientific and technological expansion, but corporate and political leaders by and large maintained their faith in "technology's progressive value," standing apart from the intellectual and moral crises of the era.[14] Perhaps predictably, the fact that this industrial expansion and modernization brought differential benefits to various sectors of society was not conventionally a focus of development discourse. However, the exclusion of such ideas in the face of growing civil rights sensibilities and national concerns with urban poverty represented an active choice.

As Southeastern Pennsylvania today seeks solutions to its un- and underemployment situation through nanotech-related technical education, so Chicago turned to modernized technological

operations as it faced decaying heavy industry and spreading unemployment in its inner city some 50 years ago. Chicago's politicians and planners worried in particular about an urban minority population that was inclining towards poverty and unrest. This concern centered on black communities that commonly faced fewer education and employment options than the city's majority citizens, and that intermittently erupted in riots in response to deeply entrenched inequities. The broad cultural vision shared by many of Chicago's policy makers in this period, in which industrial change would bring enlarged employment but maintain a stratified economy, built in part on very selective, highly deterministic understandings of technology as a category of human enterprise. As did observers in many locales, Chicago's planners in the 1960s conceptualized technology as a welcomed engine of uplift, but often also as an exogenous or unstoppable force, proceeding on its own power. Sputnik's launch had recently lent a great imaginative force to American scientific and technological enterprise, and here that appeal extended to updating industrial processes through technological advancements. The characteristic features of modernized industry, especially automation and computer control of machine-based work, appear in many planning documents of this era to be self-evident goods. The displacement of humans by machines is to be lauded, and education and job creation should pursue that ideal. As Richard Kraft, a workforce and education specialist, put it, the "relationship between labor and technological change…should be of great concern to the educational decision maker" for entirely positive reasons: "the most significant employment implication of automation is not mass unemployment but new areas of employment."[15]

Crucially, automation also appears in these prescriptions to be inevitable, given the ostensibly relentless and accelerating character of technology. Thus, what were actually choices about the optimal organization of educational resources and productive labor came to seem like necessary and inevitable actions. The commitment of human resources to certain kinds of work, and the maintenance of a vertically divided technical labor force, appear not only to be irreversible but virtually without human causation. In the absence of deeply critical examination of such presumptions, even schemes based on the goal of progressive economic or cultural change could encourage social stasis.

Chicago's educational and civic leaders promoted in this period four-year engineering curricula for a select group of eligible minority young persons in the city (at the new Chicago campus of the public University of Illinois), but two-year vocational and trades training for a much larger group of un- or underemployed inner-city minority citizens.[16]Analysts explicitly characterized this latter labor pool demographically (as trending towards female, non-white, and younger--under 24 years of age—groups of workers) and as well suited, when seen as a category, for training and employment at this sub-baccalaureate, sub-professional level. Industries in the area would increasingly need "maintenance technicians" and similar semi-skilled personnel, and economically marginalized Chicagoans required jobs; matching demand and supply would seem to have been a scenario with few downsides.[17] While the rhetoric found in the PaNMT's promotional literature tends to downplay that program's focus on developing a nanomanufacturing "technician" class (in part through its promise of high-paying jobs upon graduation), its curricula for two-year colleges tell another story that is resonant with Chicago's tiered approach to industrial employment. The curricula for one of the PaNMT two-year college programs states that certificate holders will be able to: "Repair malfunctions in electrical and electro-mechanical instruments; Fix electrical and electro-

mechanical instruments; Regulate scientific and industrial instruments; and Demonstrate safe and appropriate maintenance techniques for basic semiconductor processing equipment."[18] As had educational and job development plans in Chicago, the PaNMT promotes the fact that its curricula is industry-led and designed to help attract jobs to match the technical skills the program is developing in students at two-year schools.

That prevailing conceptualizations of both demand and supply would limit the occupational opportunities, pay, and intellectual reward faced by working inner-city Chicagoans in the 1960s seems not to have entered analysts' calculations at that time. Nor do PaNMT's promoters actively critique such conceptualizations. Perhaps not surprisingly, the division of high-tech work into highly-skilled engineering and lower-skilled technician jobs has seemed economically the most rational to analysts and employers in both episodes. This is, after all, the way that industry has long understood its personnel requirements. But ideas about modern technology have made any questions about that division of labor seem nearly irrational; automation and divisions of labor that result in lower level, unrewarding industrial jobs cannot easily be critiqued. In the work of the experts tasked with assessing Illinois industrial and employment situation, technology held only positive associations. A study committee appointed by Illinois Governor Otto Kerner equated material and human betterment, writing in 1963 that, "Advancing technology not only substitutes more productive for less productive processes, it substitutes more productive people for less productive ones." Similarly, we can recall Fonash's 2009 association of a growing nanotech training with "the good of a country and its citizens."[19]

In Chicago's planning for a changed industrial economy we can see a merging of the received functions of education as means of individual and collective uplift. The former was summarized by Richard Kraft in 1970 as, "…the eminent need of the democratic society (past and future) for the improvement of human capacity" and the latter as the necessity for "educational decision-makers" to "adapt the structure, methods, and content of technical education to the new situation of fluctuating labor market requirements."[20] Such formulations make the preparation of "maintenance personnel" and "technicians" for industry (rather than persons with vertically integrated skills, who might both design and maintain machines, for example) seem inevitable; surely the economy needs technical workers at multiple levels and those in need of jobs may find them where openings exist.

But even if one accepts that some technical jobs must be of lesser complexity and sophistication than others (a central imperative of mass production when it is organized as divided labor, but not, we should note, of artisanal production), a different occupational sorting mechanism might be suggested. Why not cultivate the eligibility of all citizens for the highest levels of education and employment, rather than presume that some pre-defined groups of people will not excel at that level? This alternative actually resonates with a long-standing debate regarding the economic function of post-secondary technical education, especially regarding the relative roles of practical and liberal curricula for students of different capacities and backgrounds.[21] An account of this debate is beyond the scope of this paper, but we should point out that much two-year technical programming held limits for empowering economically marginalized Americans, many of whom were minorities. Neither sub-baccalaureate education nor subsequent employment opportunities were intended to revolutionize social patterns in the nation, even as

the industrial economy itself modernized. This socially conservative function for sub-baccalaureate training continues to characterize high-tech development schemes, such as nanotraining and -manufacturing initiatives, today, despite promoters' inclusive intentions. [22]

Conclusions

Inquiry into the social features of technical workforce preparation--ideas about requisite skills, optimal divisions of labor, or fair distributions of opportunity--seems to us a necessary first step in correcting discriminatory occupational patterns. With each emerging technology that comes on the horizon, be it in 1960s Chicago, or presently in Pennsylvania, we may expect that an unexamined technical education, as Althusser states, will reinforce and reproduce labor power that is essential to maintaining the established stratified workforce.[23] Alternative organizations of industrial labor may create, by their nature, new social relations in manufacturing; certainly worker-management schemes, strengthened and diversified unions, and other "bottom up" strategies may redistribute power in American industry. Direct address of racial, ethnic and gender ideologies by managers and organizational experts are also necessary if diversity agendas are to achieve efficacy.[24] We suggest that broad or deep changes to prevailing occupational categories and opportunity structures have been most likely in cases where observers questioned not only the design of industrial operations but also cultural presumptions about technology.

In a culture enamored, in its economic planning and daily life, of material expansion and technological change in service of that expansion, models for such criticality are not common but can be found. Of particular interest to us are such critiques of technology that engage with matters of equity. James E. Wall, an expert on vocational instruction, wrote in 1972 about the "double edged sword" of technology. In some ways, he reiterated passive conceptions of technology in which citizens and workers needed to meet the "demands of an increasingly complex technological society," much like others writing at the time about technology as a cultural endeavor. But Wall, who spent a portion of his career at the historically black Mississippi State University, bluntly and unusually also points to the differential effects that technology has on different groups within society. He lists the detrimental environmental effects of excessive production and consumption, adopting a more critical outlook than that offered by many analysts of industrial change.

Most interestingly, Wall emphasizes that "our social problems stem not from total failure but from partial success" in technological and industrial realms. As an example, he offers "cybernation," the combination of automation (substituting mechanical processes for "human muscle and dexterity") and cybernetics ("substitution of electronic circuitry for mental or cognitive skills"). Wall noted that this trend held the potential to eliminate jobs, but unlike the Illinois' Governor's Committee, which called for worker adjustment to these situations (in part through vocational education), Wall's discussion acknowledges "vast social and economic dislocations" that "are bound to result from this development." With that formulation he creates an opening for much more ambitious critical assessment of specific technological changes, rather than their characterization as "inexorable."[25] Wall warned, almost uniquely among education policy makers, that industrial growth for its own sake was problematic: "...the notion of gross national product can be a kind of trap into which we all tend to fall." He saw the imperatives of mass production as related not only to environmental degradation, but to the proliferation of

nuclear weapons, as nations sought economic and military dominance over one another. Those examples led him to recommend educational policies that "more evenly" distributed opportunities "among the people," equipping as many as possible not only for employment but also for the critical analysis of technological change through liberal arts curricula.[26] This contrasts notably with the adaptive model offered in the Chicago workforce report, in which all technology was to be welcomed on principal. Whatever its influence at the time, Wall's vision provides us with a comparative case in terms of criticality.

In eras of both economic growth and threatening recession, reported employment levels offer Americans a widely accepted index of national well-being. The proportion of the population with secure livelihoods has long been taken to reflect both the strength of the nation's commercial sector in the aggregate and the availability of opportunities for individual economic uplift. There is an unassailable logic to this formulation: the nation requires a labor force in order to sustain itself, and the majority of adults have no other road to economic security besides paid employment. In good times and bad, economists, politicians and media commentators remind us daily that collective and individual fortunes are linked in this way. But even in the current recession, nearly five decades after the Civil Rights act, black Americans are experiencing job losses at a far higher rate than non-Hispanic whites.[27] The centrality of "workforce needs" in economic policy making can undermine the correction of social injustice because perceptions of such needs can readily reassert historical inequities. Ideas of what types of labor the nation might require; of what might be considered fair or safe working conditions; of who might be the "right type" of person for a given job; and even of tolerable levels of unemployment have all historically been contingent on the acceptance of an economically stratified society in the United States.

More specifically, manufacturing, construction, and service industries customarily rely on the minute division and mechanization of human labor. Dramatic challenges to those objectives that might displace hierarchical organizations of work (say, worker management of factories; or environmentally sustainable, artisanal production models) have been considered by only a handful of seemingly radical social visionaries.[28] Instead, most calls for an enlarged technical labor pool, and associated training and education programs, including those developed in Chicago in the 1960s and in Pennsylvania since the 1990s, have articulated the compatibility of commercial expansion and individual empowerment. This formulation, intentionally or otherwise, asserts the existence of invariably shared economic interests among management and labor so that the complex social consequences of technological choices are elided.[29] So too the optimistic projections of growth in particular industrial areas may lead to disadvantageous choices by those seeking employment but without the means to test those claims. The industrial modernization and related technical training schemes delineated here fell short of democratizing opportunity structures, leaving significant features of inequitable regional economies in place. Heightened awareness of these historical precedents may aid reform-minded engineering planners and educators today. Crucially, these two episodes, separated by decades, show that political and legislative change may not alter prevailing opportunity structures in American industry. They show, too, that even when reformers do not choose to pursue the most radical societal or economic restructuring possible, they may study such ideological positions to learn more about that stubborn and regrettable feature of American life and labor.

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