CHAPTER 4

THE EVOLUTION OF CAREER AND TECHNICAL EDUCATION IN THE UNITED STATES

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In 2000, the Organisation for Economic Co-operation and Development (OECD) released a report called *From Initial Education to Working Life: Making Transitions Work.*[1] The United States was one of fourteen countries that participated in the study which preceded the report. To help readers understand the variation among the participating countries, the study team created a typology based on how the countries organized their upper secondary education systems to prepare young people for the transition from school to work. The typology had four categories: *apprenticeship countries* (more than 50 percent of students in apprenticeship); *mixed pathways countries* (fewer than 50 percent in apprenticeship, but most in vocational education); *school-based vocational countries* (more than 50 percent of students in vocational education, mostly school-based); and *general education countries* (more than 50 percent in general education). In the first category were Switzerland and Germany, the "dual system" countries. In the second category were Austria, Denmark, Norway, and the Netherlands. In the third category were most other European countries, including France and the UK. And in the final category, those that rely *mostly* on general education to prepare students for the transition to employment, were countries including Canada, Japan, and the United States.

What "mostly" means in this context is that only about 20 percent of US high school students are vocational "concentrators," meaning that they take at least three courses in a single vocational field during their high school

years. When the OECD revisited the issue of how its member nations prepared young people for work a decade later, it decided not to include the US in a comparative chart showing the percentage of upper secondary students in VET (vocational education and training).[2] This decision surprised and dismayed US vocational policy makers, who, in addition to citing the 20 percent concentrators figure, also pointed to the fact that 75 percent of students take at least one career and technical education (CTE) course. How could OECD officials conclude that the US had virtually no students in vocational education? The OECD's answer was that, in its view, the requirement of only three courses was so minimal that it didn't meet the international threshold. By contrast, in Switzerland, a VET student at that time typically spent three eight-hour days forty weeks a year for three years in an apprenticeship at a work site and at least another day a week taking classes at a vocational school.

Why is the secondary-level vocational system in the United States so limited in scope? It is not because the US has a federal governance system within which education is principally a state and local responsibility. After all, the same could be said of Switzerland and Germany, yet those countries have made explicit decisions to create national upper secondary VET systems within federalist structures in recognition of their link with national economic and labor market policy. The US system evolved as it did because of unique features of the nation. Above all, the US's failure to build a strong national vocational education system at the secondary level reflects a continuing debate about the purposes of K–12 education, a debate that began in the late nineteenth century.

Despite these challenges, promising VET models do exist in the United States, and these are now being scaled up through partnerships formed at the state and regional labor market levels. In this chapter we examine the development of VET in the US and show how disagreements about the purposes of education, along with issues of race and class, a historic separation between high schools and postsecondary education, and a lack of connections between schools and the workplace, among other factors, affected this development. We also look at some promising approaches and show

how the US system is continuing to evolve and offer suggestions for how a high-quality VET system can be implemented within the US context. A strong American-style VET system can be built, one that will enhance the chances that many more young people can prepare for productive careers. If the OECD revisits its study in 2020, it will find that the United States in a different place than it was a decade earlier.

THE HISTORY OF VOCATIONAL EDUCATION IN THE US

From the Committee of Ten Report to the Smith-Hughes Act, 1893–1917

The easiest way to understand the historical roots of the debate around vocational education is to contrast two seminal reports about secondary education in America, both sponsored by the National Education Association (NEA), the oldest and largest organization representing US educators. The first of these reports, issued in 1893, resulted from the deliberations of a ten-person committee chaired by Charles William Eliot, president of Harvard University, and made up primarily of university presidents and other higher education leaders. The Committee of Ten was appointed in 1892 and charged with addressing fundamental questions about the purposes and structure of the American public high school. Public high schools were at that time still a relatively new phenomenon on the education landscape, and they were serving fewer than 5 percent of the fourteen-to-seventeen-year-old population. However, the massive wave of immigration that had begun in the 1880s was already well under way, and there was rising pressure to expand access to secondary education. The US economy was also becoming more industrialized, and there were increasing calls to strengthen the connections between schooling and the needs of a rapidly changing economy.

The Committee of Ten's report called for a uniform grade structure—four years of high school after eight years of primary education—and for a college preparatory curriculum for all students: "Every subject which is taught at all in a secondary school should be taught in the same way and to the same extent to every pupil so long as he pursues it, no matter what the probable destination of the pupil may be, or at what point his education is to cease."[3]

The report was seen as a call for reform and modernization in that it argued for the inclusion of the sciences and modern languages alongside the traditional classical subjects and for space in the curriculum for elective subjects. But its primary contribution was the powerful case it made that all high school students deserved access to the same rigorous liberal arts education, not just those headed for college.

By the time the next NEA commission issued its report, in 1918, "The Cardinal Principles of Secondary Education," the recommendations of the Committee of Ten had been overtaken by the economic and demographic changes of the intervening twenty-five years. By 1918, over 25 percent of fourteen-to-seventeen-year-olds were attending high school, and immigration had changed the composition of the high school population dramatically. The schools were seen as the principal vehicle for not only socializing newcomers into American mores and values but also for preparing them for employment in an increasingly industrialized economy.

The Commission on the Reorganization of Secondary Education that issued "The Cardinal Principles" report was very different from the composition of the Committee of Ten. This time it was education professors and school leaders, not university presidents, who issued the prescription for the organization and programmatic focus of high schools. Under the banner of democratization and the recognition of individual differences, the commission articulated a new set of seven objectives for secondary education: health, command of fundamental processes, worthy home membership, vocation, civic education, worthy use of leisure, and ethical character. Of these, the only one that addressed the academic purposes of education was "command of fundamental processes" (literacy and numeracy), which was a far cry from the rigorous academic program the Committee of Ten laid out for all students.[4]

"The Cardinal Principles of Secondary Education" created an opening for those organizations most interested in strengthening the connection between the world of schooling and the world of work. Although "vocation" was only one of the seven principles, a broad business-led coalition had formed around the turn of the century on behalf of vocational education

and greater diversification of the high school curriculum, both to engage an increasingly diverse student population and to meet the needs of an increasingly skill-based economy. The coalition included trade union leaders who saw vocational education as a vehicle for dignifying the importance of skilled labor, philanthropists, and social reformers who believed in inculcating the moral value of work, and education reformers who saw hands-on vocational education as an antidote to the stultifying pedagogy that characterized high school instruction at the time.

In 1906 this diverse reform coalition created the National Society for the Promotion of Industrial Education, a lobbying group to promote the expansion of vocational education at the state and local levels and to argue for federal support as well. In response to the society's efforts, Congress appointed in 1914 a Commission on National Aid to Vocational Education, arguing that vocational training "would vitalize general education and democratize schooling by adapting it to the real needs of children, promote industrial efficiency and national prosperity, decrease labour and social unrest, and promote a higher standard of living for workers." The commission recommended federal grants to the states to promote vocational education, with a particular focus on training vocational teachers. It proposed legislation that was later introduced by two of the commission's members, Senator Hoke Smith and Representative D. M. Hughes, both of Georgia, and passed by Congress (with minor modifications) in 1917 as the National Vocational Education Act, subsequently known as the Smith-Hughes Act.[5]

Smith-Hughes was the first federal grants program in K–12 education, providing matching funds to states to support the expansion of industrial education as well as agriculture and home economics. The law created a Federal Board of Vocational Education to distribute funds to states, and states were required to designate an existing entity or create a new state body to administer the funds, thereby acknowledging and abetting an increasing state role in local communities and schools. It gave states flexibility in determining whether to use the funds to support vocational programs in full-time high schools or to support students who enrolled in part-time vocational centers. In the early years following enactment, over 90 percent of the funds

went to support programs in part-time centers, but over time federal funding helped support the development of full-time vocational schools as well as the development and expansion of the comprehensive high school, where academic and vocational programs coexisted under one roof.

Tracking and the Rise of the Comprehensive High School, 1920–1950

The big story of the period 1920 to 1950 was the extraordinary, unprecedented expansion of secondary education in the US, which far outstripped the pace of growth in any other nation at the time. At the turn of the century, only about 5 percent of the high-school-aged population was enrolled in school, and by 1910 that percentage had increased only to 18 percent. But by 1940 the percentage had arisen to an astonishing 73 percent. High school attendance had become the norm; it was no longer reserved only for the handful of young people going on to college. And most young people attended comprehensive high schools, a uniquely American invention.

Although the advocates of vocational education hailed it as a democratizing force, critics warned that the Smith-Hughes Act would encourage the development of a two-track secondary education system, one that would reinforce rather than weaken social stratification, separating those going on to manual labor from those aspiring to the professions. The battle over incorporating vocational programs into existing schools versus creating separate vocational high schools played out most vividly in Chicago, where, even before the federal law was passed, business leaders had argued that only in separate vocational schools could the curriculum be designed to fit the specifications of industry. The education community and the trade unions mobilized against this idea, fearing both an unduly narrow and company-specific training and a retreat from the ideal of the common school, where children from all backgrounds learned to live and work together.

The debate came to a head in 1913 when the Chicago Association of Commerce drafted a bill to separate Illinois schools after grade 6 into vocational and general schools. A pitched battle ensued in the legislature, with the education community arguing it would lead to permanent class divisions. One of the fiercest critics of the proposed separation of the system

was John Dewey, the country's leading proponent of applied education, or "learning by doing," who called the legislative proposal "the greatest evil now threatening the forces of democracy in education."[6] Ultimately, the educators and their allies prevailed. The truth is that neither the hopes of the vocational education advocates nor the fears of its critics were fully realized in the three decades following passage of the Smith-Hughes Act. Vocational enrollments never rose much over 20 percent, and most vocational students continued to take the core academic subjects along with their occupational courses.

The themes sounded in the Chicago legislative battle have haunted discussions of vocational education through the decades. Critics have continued to raise concerns about the undue influence of industry in advocating for an overly narrow and utilitarian conception of education, one that may suit the needs of employers at the expense of equipping young people with a sufficiently solid foundation of academic knowledge and skills to be informed, engaged citizens and lifetime learners. Critics have also been quick to point out that while the comprehensive high schools that flourished in the suburbs in the 1940s and 1950s might seem to have been democratizing institutions, the reality was that mostly separate tracks were organized in ways that largely reflected the existing social class structure. The sons and daughters of professional families were assigned to honors or college prep tracks, and the children from low-income and minority families were mostly assigned to vocational programs or to a third "general education" track that resulted in a high school diploma but prepared people neither for college nor work.

The Legacy of Racial Discrimination

The story of vocational education in America is inextricably linked to issues of race and poverty, and those issues have played out primarily in urban and rural school districts, not in suburbia. While the battles over separate versus comprehensive secondary schools were fought in industrialized urban centers like Chicago, a more fundamental struggle took place in the southern states, where schools remained segregated by law until the 1950s. Despite the rhetoric of "separate but equal," the education of black children in the decades

following the Civil War was almost entirely limited to schools designed to prepare them for manual labor, initially in the fields and later in factories.

The manual or industrial training that emerged after the Civil War had a specifically racial theme: how to teach the virtues of hard work to black people, whom many southerners thought had weak moral character and lazy work habits developed during enslavement. Booker T. Washington, the president of Tuskegee Institute and the most prominent black leader in the late nineteenth century, famously argued that black advancement required an acceptance of the social order that prevailed in the South and that black people needed "to learn to dignify and glorify common labor . . . No race can prosper till [*sic*] it learns that there is as much dignity in tilling a field as in writing a poem."[7] Washington's views were challenged by the leading black intellectual of the period, W. E. B. Du Bois, who pressed the case for an education to prepare black students for exercising the rights and aspirations of fully emancipated citizens through a classical liberal arts education. Because black children were seen by white southerners as fit only for relatively low-level agricultural, industrial arts, or home economics training, while the schools prepared white children for a broader array of academic and vocational choices, it is not surprising that many black leaders today continue to see vocational education as the denial of opportunity rather than a route to upward mobility.

In the North, where by law blacks were entitled to equal educational opportunity, issues of race and class and vocational education played out in more subtle ways. Boston serves as an example. Like many northern urban districts, Boston historically had a mix of citywide and neighborhood-based high schools. Its three leading citywide high schools admitted students by examination and, until quite recently, were the only high schools exclusively focused on college preparation. The eight or nine neighborhood high schools typically offered college, general, and vocational tracks but had low completion rates and even lower postsecondary enrollment rates. There was only one citywide vocational school, Boston Trade, but its reputation was so abysmal that it was closed in the 1970s. There were two avenues for upward mobility in Boston through the 1950s and early 1960s for young people

with only a high school education—the trade unions and the civil service—and getting access to those avenues depended at least as much on family connections as on paper qualifications.

It was changing student demographics and a changing economy that together finally brought about change in the schools. Several years of protest by leaders of the African American community—which needed the high schools to function for its children, because they did not have access to the informal networks to place them in the trades or public service jobs—led to a sweeping federal school desegregation order in 1974. The protests cast a searchlight on not only the glaring inequities in access and opportunity based on race but on the reality that the only high school students well-served by the system were those in the three citywide examination schools.[8] Hopes for a modernized and revitalized vocational education system in Boston rested on the construction of a citywide Occupational Resource Center, which opened with much fanfare in the mid-1970s but was never given anything like the resources and support needed to fulfill the ambitions of its advocates. Today called Madison Park Technical Vocational High School, under new leadership it is overcoming its history, building industry-aligned programs in partnership with local employers and higher ed institutions.

It is important to note that during this period there were also much-celebrated examples of strong vocational high schools in other northern urban centers, most notably in New York City. These were typically specialty schools focused on preparing young people for work in a specific industry that had very strong support from industry partners. Aviation High School and the High School of Fashion and Design, established in the 1920s, maintained strong national reputations in the 1960s and 1970s and continue to be leaders in the field. Several such specialty schools exist today as part of a resurgent CTE sector in New York. The city counts 50 CTE schools among its 400 high schools, nearly half of which have been opened since 2010, and there are an additional 220 CTE programs in 75 comprehensive high schools. Together, these CTE high schools and programs serve about 25 percent of New York City's high school population and are increasing in popularity.[9] While New York City has had its own history of troubled racial

politics surrounding the schools, especially during the bitter fight over community control in the 1960s, its best vocational schools have continued to enjoy broad community support.

Federal-Led Expansion in the 1960s

While cities like Boston and New York had their own versions of locally controlled vocational education, many states developed systems of stand-alone vocational schools. Indeed, Massachusetts was the national leader in this regard, when in 1908 it opened three industrial schools. Such schools developed across the US over the following decades.

However, a major expansion of vocational education did not take place until the 1960s, supported in substantial measure by the passage of the Vocational Education Act of 1963 that provided funding to support the construction of area vocational centers and enable comprehensive high schools to grow their vocational offerings. The expansion was fueled by the entrance of a large cohort of students, the baby boomers, into schools. Policy makers believed that more young people would need to be trained for the expanding industrial labor market and that the current supply of vocational programs could not meet this need. This legislation also required states to provide explicitly for disabled, bilingual, low-income, and disadvantaged students living in economically challenged communities. Additionally, it mandated that there be strategies for attracting youth to occupations not traditional for their gender.

The role of this federal law is significant, because in the United States elementary and secondary education (including vocational education) is primarily the responsibility of state and local governments. In fact, over 90 percent of the funds supporting schools comes from state and local taxes. One of the intriguing features of the US system is the disproportionate policy influence federal programs can have despite the government's modest financial contribution to the overall education budgets of states and school districts. This is the case, in part, because there is so little state and local funding deliberately earmarked to support reform and innovation.

From "Vocational Education" to "Career and Technical Education"

The 2006 reauthorization of the Perkins Act was titled the Carl D. Perkins Career and Technical Education Act.[10] This title change was designed in part to underscore the importance of upgrading and modernizing vocational programs to prepare young Americans to compete in an economy increasingly characterized by globalization and the speed of technology-driven change. The new law introduced some substantive changes as well. Although the law continued to require that 85 percent of funds be distributed to eligible local recipients—school districts, area technical centers, community or technical colleges—there is a new focus on encouraging states to use the 10 percent state set-aside for "leadership activities" to support the development of regional consortia bringing together employers, high schools, and postsecondary institutions. In a recent survey of state CTE directors, forty-two states reported using at least some of their leadership funds to support this kind of partnership activity, while most of this funding remained focused on technical assistance and professional development, two functions essential for program improvement.[11]

Two other aspects of the Perkins Act have marked the transition from vocational education to CTE. One important innovation added in the 1990 reauthorization reflected a new emphasis on career—meaning entry and advancement in an industry, not just preparation for a first job. All Perkins-funded CTE programs are now required to include a component designed to introduce students to "all aspects of the industry" in which their particular program is situated. This means, for example, that high school students enrolled in a certified nursing assistant program should develop some understanding of the larger health-care industry.

A more fundamental shift has been the increasing attention paid to outcomes. This has been part of the larger focus on accountability that has characterized the federal role in education over the past two decades. Although there has been considerable pushback on this aspect of the federal role in the last two or three years, with the pendulum now swinging back from federal to more state control, the insistence on measuring program impact

by looking at such indicators as high school graduation and postsecondary enrollment rates, certificate or degree completion, and successful transition into the labor market will only grow stronger. There are a handful of states where the development of longitudinal databases makes it is possible to link wage records to student records so that policy makers and parents can track the returns to academic majors or technical programs for at least a decade postgraduation. As these kinds of data become more available to policy makers and to parents and students, it should provide additional momentum behind the growing movement to reform and modernize CTE programs to better align them with the needs of regional labor markets.

Another key element of the 2006 Perkins Act is the support for "aligned programs of study" that begin in high school and seamlessly connect to majors and specializations in technical and/or community colleges. Although the law now mandates that all local recipients of Perkins funds must offer at least one program of study, nearly half the states require that at least 50 percent of all Perkins funds distributed to localities be spent on programs of study, and twelve states require that all Perkins funds distributed to local secondary programs be used to support programs of study.[12] The revised law ensures that secondary and postsecondary planners work together to create a broad sequence of courses leading to the completion of a two-year degree, certificate, or license.

VOCATIONAL EDUCATION IN THE US TODAY

The structure of the US education system differs sharply from those of European countries, and, as a result, vocational and technical education operates quite differently as well. In European nations, upper secondary vocational education begins when students are sixteen and ends at when they are nineteen or twenty. In those three or four years, students get the equivalent of the last years of a US high school CTE program and a community college career-focused credential that enables them to enter the labor market directly. Thus, while vocational education is the mission of a single institution in European

systems, career and technical education in the US spans two sectors—K–12 and higher education. This cross-sector need for alignment and collaboration makes for a complicated and, some would say, ineffective workforce preparation strategy for young people in the US.

High School Programs

The "college for all" message that has pervaded education in the last two decades means that the academic side of high schools has received much more attention from policy makers than CTE during this time. Most states have worked to have all students meet the same high school graduation requirements, whatever their post–high school path: four years of English, three of math (Algebra I and II, geometry), three of lab science (biology, chemistry, physics), three and a half of social studies (chosen from US history, world history, geography, economics, and government), and two of a language other than English. In some states, this has become the default course of study, requiring parents who object to opt out of this curriculum for their children. As the 2000 OECD report noted, the implicit assumption is that a rigorous general education constitutes the best preparation for work and career, leaving little time for other coursework.

Programs and courses offering career preparation at the high school level are delivered in many different forms and structures as school leaders attempt to fit career-focused learning into a demanding academic program of study. The comprehensive high school is the predominant structure in both rural areas, where they are regional and serve a dispersed and varied student body, and most suburbs, where there is one (or, at most, two or three) high school. Comprehensive high schools have both academic and CTE tracks, although some proportion of CTE students are placed in the higher sections of academic courses with their college prep peers. In some instances, these large schools have been broken down into smaller learning communities or even separate schools with their own principals housed in a single large building. Such smaller entities, often called career academies, are organized around career themes—media, health care, leadership, social jus-

tice, business, information technology, and the like. While they often sound like career-preparation programs, most of these academies are not intended to lead directly to work after graduation. In addition, they rarely have the equipment and resources needed to teach the trades. Instead, the idea is to engage young people in school by providing applied learning that demonstrates the relevance of schooling and therefore stems dropout. At best, they integrate career learning into the traditional disciplines, which may include internships, a partnership with an employer, or a community service opportunity for the purpose of career exploration. In these instances, the boundary between CTE and academics begins to blur. These small programs also pose definitional problems, since students may or may not be counted as CTE participants.

CTE is also delivered through schools devoted primarily to career preparation, although such schools only constitute 4 percent of US high schools: high schools in large urban areas devoted to a single career area (e.g., aviation science, health, engineering, and information technology careers); stand-alone vocational schools offering multiple programs serving either an entire region or a smaller city; and, finally, vocational-technical centers that serve students who are transported there for part of the school day. All these variants share the goal of preparing students to enter further education, most frequently a two-year community college, or, in a decreasing number of cases, to enter the workforce directly from high school. Increasingly, CTE programs provide licensure or industry certifications conferred through assessments set by the state or by a sector organization (e.g., X-ray technician license, CISCO certification). CTE schools are increasingly also mounting demanding science and technology programs in addition to the trades (plumbing, electrical, automotive). Examples include biomanufacturing and cyber security, both courses of study that lead to state certification with clear pathways into two- and four-year degrees.

We offer short profiles of exemplary schools or centers to illustrate the range of institutional models that provide high-quality career-focused education in today's US secondary school landscape.[13] Each serves a substan-

tial proportion of low-income students. Most have impressive high school graduation and postsecondary enrollment rates. Some represent models that have already been scaled, and others models that could be scaled. While all have work-based learning opportunities built into their design and show significant evidence of engagement with employers, none (with the possible exception of Worcester Tech) sees itself as *primarily* in the business of preparing young people for employment immediately after high school—a responsibility that, in the US context, is assigned primarily to postsecondary education, not to high schools.

Model 1: Worcester Technical High School, a Stand-Alone Urban CTE High School

In June 2014, President Obama gave his only high school commencement address of the year at Worcester Technical High School on the outskirts of Worcester, Massachusetts, a city of 181,000 and the second largest city in New England. Although in 2006 "Worcester Vo-Tech" was declared a failing school, today it is one of the highest-performing schools in a state known for high academic achievement. The president used his address to highlight the many opportunities available to the largely low-income population. Indeed, 57 percent of students are classified as "high needs" and 44 percent as "economically disadvantaged." The growing interest in CTE that began in the 2000s has brought nationwide attention to Massachusetts's vo-tech schools, as they are called, as being engines preparing young people for the many open technical and technology jobs in the new economy.

A US Department of Education Blue Ribbon School housed in a $90 million state-of-the-art building on a 400,000-square-foot campus, Worcester Tech represents the best of the full-time vocational high school model. Perhaps most impressive is the work experience the 1,400 students gain at Worcester Tech. Students work in profit-making enterprises, both inside the school and externally. The student-run 125-seat restaurant serves meals to the public at reasonable prices. Also operating at the school are a salon and day spa, a sixteen-bay automotive service center, a full-service bank with

ATM, and a state-approved preschool. Partnered with one of the highest-ranked veterinary schools in the country, Tufts at Worcester Tech provides subsidized animal care to low-income families in the Worcester area; students pair with Tufts veterinary medicine students to participate in the treatment of more than 250 animals per month. The carpentry, plumbing, and electrical students built the veterinary clinic, which is housed in a wing of the school; also, the graphic students created the name and designed the logo and brochures, and the painting and design students created the signage. But the school does not neglect important skills, like writing, that are highly valued in the workplace and in college. A current instructional focus in all classes, both academic and technical, is having students demonstrate their ability to write for a variety of audiences. Students are creating writing portfolios and must demonstrate both their ability to write in technical language as well as to do close reading of texts.

For over forty years, Worcester Tech, like all the Massachusetts vo-tech schools, has followed a unique schedule: the first four months of ninth grade, students circulate among each career area offered, after which, with advising, they pick their area of concentration. There on, the schedule alternates—a week of academics, a week of shop. With higher-than-state-average low-income and special education populations, along with the full array of vocational programs, the vo-tech schools offer Advanced Placement courses and dual enrollment for college credit. Today, many of the twenty-six regional vocational high schools and three agricultural schools have waiting lists, show strong results on Massachusetts' state assessments, and boast higher high school completion rates than the state average.

Model 2: Center for Advanced Research and Technology, a Regional CTE Center

A part-time regional career center located in Clovis, California, near Fresno, the Center for Advanced Research and Technology (CART) provides half-day programs for thirteen hundred eleventh and twelfth graders from fifteen area high schools.[14] While CART uses CTE funds and has some programs that are standard to California's Regional Occupational Programs, nothing

is standard about a CART education, from the facility to the approach to learning. With echoes of the Coalition of Essential Schools, a popular high school reform effort in the US begun in the 1980s, CART states that the vision for the school is "to create an environment where the students learn to use their minds well."

The 75,000-square-foot CART building, designed to replicate a high-performance business atmosphere, is organized around four career clusters: professional sciences, engineering, advanced communications, and global economics. Instead of classrooms, teachers, business partners, and invited experts work in large open spaces filled with equipment, work stations, and student work; these spaces are similar to those in a high-tech start-up, a maker space, or a science lab. Within each cluster are several career-specific laboratories in which students complete industry-based projects and receive academic credit for advanced English, science, social science, and technology coursework. Boundaries between disciplines don't exist since students are problem solving and learning just as they would in the real world. Students do everything from testing water in the Sierras, to trying out aviation careers by flying planes, to learning aquaculture. Teaching teams include business and science partners, and many of the teachers themselves have extensive professional experience.

The school's website captures the flavor of CART by featuring "This Week at Cart," short pieces written by students about their current work. Student Amaya DeVore recounted her activity: "My project team and I are raising Chinook Salmon. Aletha and Tom Lang at Aquarius Aquarium decided to take the time to be our mentors for this project. They teach us the necessary techniques to hatch salmon, and learn about the fragility of our planet's aquatic resources and animals. In May we will be releasing our Salmon into the river and they will finally live their life in the open water."[15]

There are no grade or test requirements for admission to CART; students must make the case for themselves as appropriate to the CART philosophy and demands. Through learning plans, individualized attention, and collaboration with business partners, teachers, and parents, students design programs of study that qualify them to pursue the postsecondary path of

their choice, from entry-level positions, to industry certification, to university admission. A 2011 study commissioned by The James Irvine Foundation showed that "CART has successfully increased community college and CSU/UC attendance for all students regardless of gender, ethnicity or economic background . . . Results for African American students were particularly dramatic with 68% of students from CART entering community college compared to only 32% of African American graduates statewide."[16]

In 2015, journalists Deborah Fallows and James Fallows visited a number of small towns for Atlantic's Futures Project "to see how people are adjusting to the economic, environmental, and technological opportunities and challenges of this era." CART was among the schools they visited. Deborah Fallows noted, "We have by now visited several career-track high schools and community colleges around the country . . . but have never seen a school quite like CART."[17]

Model 3: Wheeling High School, a Comprehensive High School

An example of a comprehensive high school with a STEM focus for all, Wheeling High School serves seventeen hundred students from six communities in the northwest suburbs of Chicago.[18] While the programs and career exploration opportunities Wheeling offers may be similar to those in a less diverse, more affluent suburb, the Wheeling student population is 59 percent Hispanic and 31 percent white, with the remaining 10 percent having black and Asian backgrounds, and about 41 percent of the students are low income. In addition, many students speak a language other than English at home. *US News & World Report* recently recognized Wheeling as one of the best high schools in the state of Illinois. On graduation, nearly 90 percent of its students pursue postsecondary opportunities.

Wheeling offers challenging academic coursework, including twenty-four Advanced Placement and college credit courses in business, engineering, architecture, and nanotechnology. Students can also earn industry-recognized certifications in automotive technology, computer technology, health careers, and manufacturing, credentials that can provide access to a job to

supplement the costs of further education. Indeed, Wheeling has partnerships with a number of area universities and community colleges, and at one community college students can earn a full associate degree at no cost.

Technology is woven throughout the school. There are fifteen computer labs, Smartboards in classrooms, and a twenty-first-century media library. Also, every student gets an Apple iPad Air to use during their years in the school and to keep after graduation. Wheeling High School also benefits from a unique new Center for Career Discovery, which serves six high schools in District 214. The center facilitates the development and coordination of customized, authentic learning experiences, many outside of classrooms, that provide opportunities to support all students in their skill development and decision-making and with determining their postsecondary goals and future career paths. Students can choose supported, independent, and micro internships, each with different requirements. In addition, students can participate in industry tours, job shadowing, and classes cotaught by an industry professional and school faculty. These experiences provide students the opportunity to observe and engage with professionals in their typical work setting; learn specific job tasks of the person they work alongside; gain insight into the career planning process; identify potential career opportunities with possible majors of study; develop critical thinking competencies and problem-solving abilities; and have the opportunity to improve the ability to communicate, including developing and utilizing networking skills. For example, Wheeling students participating in the engineering and manufacturing program's Project Lead the Way are working with NASA to build brackets and handles for the International Space Station.

Model 4: Energy Tech, a CTE Early College High School

Energy Tech, a career-focused high school founded in 2013 as part of the City University of New York early college network, specializes in preparing students in engineering and technology fields. Early colleges offer students at risk of not completing a postsecondary credential the chance to earn up to an associate degree while in high school. The average early college student

graduates with a year of college credit. Career-focused or CTE early colleges start students on a broad pathway aligned with regional labor market demand.

The students at Energy Tech in Long Island City, Queens, are as diverse as the city's population, and admission is open to all. Asians make up 18 percent of the student body population, blacks 10 percent, Hispanics 53 percent, and whites 15 percent. But as is unfortunately typical in science and tech programs, the student body is 79 percent male and 21 percent female. The small school—fewer than five hundred students—performs well, with 95 percent of the students completing the approved college- and career-readiness curriculum, a percentage substantially above that of either the Borough of Queens or New York City as a whole. Indeed, the school has gained a reputation for excellence in its years of existence, with applications far exceeding spots in the ninth-grade class.

On a typical day at Energy Tech, as the school website explains, some students are engaged in discussion about *Macbeth* and others are in the science and engineering labs testing the solar ovens they designed and built, while still others are constructing prototypes for deliberately complex machines. Later in the day, some students may be off campus learning from a New York City energy company about what the work world entails.

To build a pipeline of young job candidates, Energy Tech partners with Con Edison and National Grid. These companies work closely with the school to provide job shadows and internships and to help shape the school's curriculum by connecting classroom learning to what happens in their industry. The school's industry liaison, who recruits new companies and works with National Grid and Con Edison to develop and manage student experiences, said:

> In addition to all their core academic subjects, and the career and technical education within the engineering, [students are] also getting what . . . we like to call twenty-first-century or leadership skills—how to speak to professionals, how to network, how to have a polished resume, even if you're just getting out there in the workforce for the first time. You're infusing what the work-

> force needs right here in this school, making sure we're mapping backwards from the skills that are needed at entry-level jobs to what they're learning in the classes . . . to make sure they're the most competitive candidates for what the engineering and energy industries need for tomorrow.

Energy Tech also partners with nearby LaGuardia Community College to provide free college courses to students starting in grade 10. The school's principal noted that students "will leave us with not only a high school diploma but also an associate's degree and the experiences needed to go directly into competitive STEM jobs or four-year colleges. We believe they will take these skills, understandings, and qualifications, and will go on to solve complex problems and make our world a better place."[19]

Model 5: Districtwide Career Academies in Long Beach, California

Among the highest-quality career-focused high school reform strategies in the country, Linked Learning is an approach now deeply embedded in nine California districts and expanding elsewhere.[20] A decade of support from The James Irvine Foundation and a multitude of partners, including Jobs for the Future (JFF), has provided districts with technical assistance, capacity building, research, and resources to build out the Linked Learning approach. Certified Linked Learning pathways are built around four elements: rigorous academics, real-world technical skills, work-based learning, and personalized support. California has passed legislation to expand Linked Learning and appropriated $500 million for the California Career Pathways Trust, an initiative that draws in part on the Linked Learning approach.

Starting in 2009, Long Beach Unified School District (LBUSD) embraced Linked Learning as a districtwide structure for redesigning all its high schools, and now almost all its students are currently in career-themed pathways. LBUSD high schools are large, some with more than four thousand students. Prior to Linked Learning, they had been organized into smaller learning communities, but not with industry-connected themes. Today, the high schools have pathways in architecture, construction, and engineering; media and communications; health science and medical tech-

nology; engineering and design, manufacturing, and product development; and public service.

Because LBUSD committed to enabling students to experience the real-world applications of their classroom work, the district had to make substantial changes in the way it did business. California State University, Long Beach, established a Linked Learning teacher-training program and in-service workshops to support teachers in providing project-based, integrated academic and career-focused units of study. LBUSD also provides teacher externships in industries to enable teachers to design projects and assignments reflective of the demands of employers. And because of stable and trusted district leadership and the close proximity of both Long Beach City College and Cal State Long Beach, partnership agreements forged between these institutions mean that LBUSD graduates can matriculate into pathways aligned with their high schools' Linked Learning theme.

Postsecondary CTE Programs

While these five models represent promising approaches to CTE at the high school level, most career and technical preparation occurs at the postsecondary level in community colleges.

The challenge community colleges face is that they have multiple missions, only one of which is career preparation. Their two major missions, transfer and workforce preparation, have their origins in the history of two-year colleges. In some states, junior colleges, as they were once called, developed out of high schools to provide college preparation at a time when private universities wanted to shed the first two years of undergraduate, general education work. They also had a vocational mission to prepare accountants, clerical workers, and salespeople. In the early decades of the twentieth century, two-year programs included private "finishing schools" for young ladies wanting to be stenographers and secretaries should they have to enter the labor market. Public, municipally owned, and private junior colleges continued to grow through the first half of the twentieth century. For much of this period of development, these institutions suffered from a confusion

about whether they were "expanded secondary schools or truncated colleges."[21] But the real boom in *public* community colleges came as the birth rate swelled in the 1950s and 1960s and as the GI Bill of 1944 provided support for older students to return to college. The women's movement of the 1960s and 1970s had further impact on community college expansion as women entered higher education in large numbers.

Community college workforce programs fall into two broad categories: noncredit and credit-bearing leading to a degree or certification. Noncredit programs include the myriad revenue-generating programs that community colleges mount to meet employer needs, as well as short-term noncredit credentials for the general population wanting reskilling or upskilling. Credit-bearing programs provide the basic courses or requirements for a major in a four-year institution and for entering the workforce with an associate degree. The best community colleges have designed their workforce programs so that they meet both the transfer and immediate labor market entry goals. For example, Bunker Hill Community College in Boston offers a biomedical engineering degree that prepares students to enter the labor market and to transfer to a four-year institution. The course catalog states that "the Associate of Science in Engineering Program is offered as part of a response to the long-term shortage of skilled workers in the engineering workforce . . . and to address the workforce demands of Greater Boston. The curriculum is structured to mirror the freshman and sophomore years of a university engineering degree . . . The curriculum offers two options: a Biomedical Engineering Option and an Engineering Transfer Option."[22]

How States Organize CTE

Across the US, how credit-bearing career education is delivered in community colleges and how it is described mirrors the following fuzzy definition—that all learning in community colleges is either immediately or ultimately career focused. States set up career-focused postsecondary education using a variety of designs. An online search for "Massachusetts community colleges CTE" nets information about high school CTE and about

vocational high schools' articulation agreements with community colleges but produces nothing about community college CTE, but, of course, every community college mounts career-focused programs. They just don't use the term "CTE." But a search for "California Community Colleges CTE" pulls up a long list of citations, headed by several 2017 news articles announcing the rebranding of postsecondary career and technical education in California and touting the offerings of CTE. This is a consequence of an ambitious five-year effort led by the Vice Chancellor for Workforce Development to make the community college system the principal engine of workforce development for the state. Operating under the banner "Doing What Matters for Jobs and the Economy," the California system has gained substantial support for this mission from employers and legislative leaders, as reflected in substantial investments to increase the capacity of the colleges to carry out this agenda.[23]

This is a shift for California. A 2011 research study about the state's community college system found that 75 percent of students majored in one of three liberal arts areas, with the remaining, largely older, college-ready adults choosing a CTE offering.[24] Consequently, CTE primarily served well-prepared adults, likely many of them career changers with specific career choices already made. As the study points out, most young people were counseled into liberal arts. The study was written as the community college sector was beginning to focus on data that confirmed the low degree-completion rates of community college students. However, the data also showed that students who chose a career-focused program of study—a structured pathway through to a degree with an increasingly specific sequence of courses—were completing at significantly higher rates than those who took the general education courses required for transfer to a four-year degree program.

Georgia has taken a different approach with its postsecondary CTE. It is one of the few states that still has a technical college system comprised of fifty-five institutions focused solely on two-year career preparation programs. The Technical College System of Georgia (TCSG) says it "provides a unified system of technical education, adult education, and customized busi-

ness and industry training through programs that use the best available technology and offer easy access to lifelong education and training for all adult Georgians and corporate citizens." While the TCSG provides the majority of CTE, some career-focused associate degrees are also awarded at Georgia's public four-year colleges and universities. For example, East Georgia College provides a two-year degree in fire and emergency services, the credits for which can be transferred to the college's bachelor's degree program in fire service management.

All states use federal Perkins funds to supplement their own investments in CTE, but Perkins dollars and requirements have a much greater impact on how career-focused education is carried out at the secondary level than at the postsecondary level, in large measure because public high school education is mandatory and thus more subject to state and federal regulation regarding curricular content, hours in class, distribution of credit, and outcomes. There is much less uniformity in how career education is delivered among the community colleges systems than among secondary schools, and there is little correlation between how a community college system publicizes and carries out career-focused education and the Perkins dollars it receives.

For example, Georgia and California split the funds almost equally between high school CTE and postsecondary programs, while in Massachusetts, with its very strong vo-tech high schools, only a small percentage of Perkins dollars are allocated to the community colleges (73 percent versus 27 percent). In both California and Georgia, college students choose between an academic program and a career program, while in Massachusetts the boundaries are blurred between the two. In fact, all two-year degrees in Massachusetts require students to complete a set of general education courses that allow transfer should the student choose that option. However career and workforce programs are structured, today community colleges, which serve almost half of all college-going students and the majority of low-income students and students of color, are in the spotlight as major engines of upward mobility. Students choosing a pathway are increasingly aware that the economic value is higher for a well-chosen two-year degree than for some

bachelor's degrees, and much less of a financial investment. For example, in a recent study for the American Enterprise Institute using Florida data, Mark Schneider and Rooney Columbus showed that of the top-earning sixteen occupations five years after graduation, five require only an associate degree and one just an apprenticeship.[25]

The Guided Pathways Movement

Community colleges continue to struggle with expectations that they can do everything for everyone seeking a postsecondary education at a low cost. Employers continue to complain that they do not do a good job preparing the entry-level workers they need, even though educators assert that that is just what they are doing. Poll after poll shows a 70–80 percent confidence gap between what employers say and what educators say. There are many reasons for this. Lack of alignment with employer needs is only one of the problems. Employers also complain that community college graduates have not learned on up-to-date equipment or with the most recent technology. But, to put these complaints in context, employers also complain that four-year college graduates have too theoretical an orientation and that all young people lack employability or professional skills.

Today, community colleges are coalescing around the idea that colleges should require students to sign on to a roadmap outlining their path to completion, a plan that shows students just what they will need to do to complete a degree and, at best, that guarantees the courses they need will be available and relevant to labor market needs.[26] Roadmaps are an antidote to the traditional "cafeteria" curriculum model, where the underlying assumption is that more choice means greater satisfaction, when in fact too many choices can be overwhelming and results in students not completing the coursework necessary to earn degrees.[27] Low-income students in particular, who often have very complicated and demanding lives beyond the classroom, are at risk of making uninformed decisions, ultimately wasting both time and money. Wrong choices also take a toll on a student's motivation to succeed.[28] A 2015 study from the Community College Research

Center shows a correlation between students who enter a community college program of study early (taking three courses in their chosen program) and higher completion rates.[29]

This best practice of providing students with a bounded and coherent set of courses within their broad area of interest increasingly falls under two related categories: guided pathway and meta-major. Both build on a strong evidence base that students do much better when they are counseled into a default program of study with a structured schedule rather than encouraged to choose among a bewildering array of courses. *Guided pathway* is the broader term for the roadmap; *meta-major* refers to an array of majors grouped into clusters that that lead to several related career areas. For example, Valencia College in Florida, well-known for its innovative practices and significant completion and job placement rates, describes its eight meta-majors as Arts, Humanities, Communication and Design; Business; Education; Health Sciences; Industry/Manufacturing and Construction; Public Safety; Science, Technology, Engineering, and Mathematics; and Social and Behavioral Sciences and Human Services.[30]

But young people with low skills still face hurdles in entering the most competitive community college career programs. While community colleges are open admission, that does not guarantee entry into the credential program of choice. Nursing is a prime example. Students must complete developmental courses (if needed) and then prerequisites, such as college-level mathematics, composition, anatomy, and physiology before they are accepted into the major. They may also have to take the Test of Essential Academic Skills VI (TEAS VI).

Nursing has limited slots available, and priority often goes to students who already have bachelor's degrees, work experience, and/or no remedial needs or who are transferring in substantial college-level work. Among these are growing numbers of well-prepared students who want to save money by taking their first two years at a community college. The same goes for many medical certificate programs, which tend to cater to adults who already have a bachelor's degree and are changing fields.

Community Colleges: Looking to the Future

Like the guided pathway movement, the career pathways movement emerging from CTE is attempting to create a more coherent and up-to-date system, and community colleges are major players in that work. Demographic and economic pressures are also forcing community colleges to change. With a declining number of high school graduates due to decreases in the birth rate, and with increasing numbers of immigrant, older, and first-generation students entering their doors, forward-thinking community college leaders see their task as modernizing their programs and improving completion rates to remain the "go-to" institutions for training the middle-skill and technical workforce that fuels regional economies. They are also increasingly relying on evidence that 80 percent of community college students enter saying they are going to transfer to a four-year college, although only 18 percent complete a four-year degree. Even more worrisome, the 42 percent of students whose associate degree is in liberal arts or general education have very weak outcomes in the labor market. Indeed, those with the liberal arts two-year degree fare little better in the labor market than those with no college degree, while the returns to various certifications and technical associate degrees can yield family supporting wages, career ladders, and good prospects for increasing income.[31]

Community colleges are struggling to manage and thrive in a climate where change is accelerating, demographic shifts are coming, and the old rule about four-year college as the best post–high school choice is eroding. Despite limited and, in many cases, decreasing state support, community colleges are working to improve the quality, array, and accessibility of their career or CTE pathways and to strengthen their advising services for young people who seek a leg up in the labor market. Majors and certificate programs are being revamped in consultation with industry to better serve as engines of workforce preparation. In addition, particularly in systems historically prioritizing the preparation of students for transfer, community colleges are pivoting to refine and improve career-focused programs, as California is doing. To do so, many face challenges in updating and adding the equipment and software to meet employer needs and in implementing "earn

and learn" programs that allow students to work in a field linked to their future career while attending school.

Community colleges are also competing with the array of new options for delivering learning at lower cost through technology and short-term prep programs. New providers—boot camps, short-term certificate programs, for-profit vendors—are stepping in with delivery models focused on competencies and skills, unbundling the notion of coherent, vertically organized degree programs. The new providers argue that consumers should choose what they need based on efficiency, cost, and access. More students are willing to abandon the four-year university because the costs are too high and the outcomes in the labor market are unpredictable. This pressure is having a positive impact on community colleges, pushing the best of them to revamp, be creative, and incorporate the latest technologies to improve their outcomes and meet the satisfaction of students and their future employers, and to do so with very limited means.

THE *PATHWAYS TO PROSPERITY* REPORT AND THE CASE FOR THE NEW CTE

If the growth and development of vocational education in the United States in the twentieth century was driven in large measure by the increasing industrialization of the economy, what is the role of CTE in a twenty-first-century economy in which information, ideas, and innovation are the drivers of growth? Beginning in the 1990s and continuing through the first decade of the new century, US policy makers and their business leader allies argued that the most important thing schools could do to prepare young people for the new economy was to raise academic standards to ensure that all students leave high school with a solid foundation of core academic skills and knowledge. While no one could reasonably argue against this goal, somehow this focus on common high academic standards for all was transformed into the idea that the principal focus of US high schools should therefore be to prepare all students to go on to a four-year college or university. In a world in which "college for all" became the new mantra, high schools focused on

students completing more rigorous core academic courses (and intervening with those who were behind), and CTE was seen as unimportant in the quest for college. More families now got the message that mastering the 3Rs was the ticket to college. The percentage of CTE concentrators, students taking three or more CTE courses in a related area, dropped precipitously during this period, from roughly one in three students to fewer than one in five.[32]

In 2011, the Harvard Graduate School of Education (HGSE) published a widely cited report pushing back against the "college for all" movement. *Pathways to Prosperity: Meeting the Challenge of Preparing Young Americans for the 21st Century* challenged the warnings of many economists that the middle of the US economy was "hollowing out" and that we were moving into a world in which there would only be two kinds of jobs: those with high skills, requiring at least a four-year degree, and low-skill, low-wage jobs for everyone else. The report's authors, economist Ronald Ferguson, journalist William Symonds, and Robert Schwartz, cited evidence that at least 30 percent of jobs in the next decade would be in the middle-skills category. The best of these jobs would be technician-level jobs in such sectors as IT, health care, and advanced manufacturing, requiring a strong STEM foundation and some education or training beyond high school but not necessarily a baccalaureate degree.[33]

The pushback against the "college for all" mantra was aided by three other types of evidence. First, while young people and their families clearly heard the message about the importance of college, as reflected in the rising proportion of high school graduates enrolling in four-year colleges and universities, the proportion of young people attaining a baccalaureate degree by their midtwenties remained flat at roughly one in three. Second, it became increasingly clear during the 2008–11 recession that the economic returns for a four-year degree were no longer guaranteed. In 2014, the Federal Reserve Bank of New York reported that over half of BA holders in their midtwenties were underemployed (44 percent), working in jobs that traditionally did not require a four-year college degree, or unemployed (8 percent).[34] Since the end of the recession, those numbers have gotten better, and there is evidence

that virtually all of the jobs that have come back since then have gone to college graduates, but the underemployment phenomenon persists.

Third, there has recently been compelling state-level data from Mark Schneider at College Measures that compares the earnings of graduates of four-year degree programs, two-year degree programs, and one-year postsecondary certificate programs after one year, five years, and ten years in the labor market. Schneider found that in some states those with two-year technical degrees were earning about the same as those with four-year degrees even after ten years.[35] His research confirms an analysis done earlier by Anthony Carnevale at the Georgetown Center on Education and the Workforce showing the increasing overlaps among the earnings of those with occupational licenses, certificates, and those with two- and four-year degrees. Carnevale found, for example, that nearly a third of community college graduates were outearning the average BA holder. The headline from both of these studies is that while it remains true in the aggregate that the more education you have the better off you are in the labor market, it is no longer simply a matter of how much education you have but how well your skills match the demands of your regional labor market.[36]

The fourth source of evidence is the experience of other countries, especially the dual system countries, in helping a much larger portion of their youth population make a successful transition from the end of schooling into the labor market. (See especially our discussion of the Swiss VET system in chapter 2.)

THE CAREER PATHWAYS MOVEMENT

Nearly fifty years ago, US Commissioner of Education Sidney Marland gave an interview in which he explained the distinction between vocational and career education:

> Speaking just in terms of schools, career education—as I see it—would embrace vocational education but would go a good deal further. I suppose all of us are familiar with the situation of a young person finishing high school or even college with no idea of what kind of work he would like to follow. This is

> a depressing proposition for the student and in my view a failure on the part of the schools. So what I would hope for is a new orientation of education—starting with the earliest grades and continuing through high school—that would expose the student to the range of career opportunities, help him narrow down the choices in terms of his own aptitudes and interests, and provide him with education and training appropriate to his ambition . . . [The goal is] that every student leaving school will possess the skills necessary to give him a start on making a livelihood for himself and his family, even if he leaves before completing high school.[37]

What is interesting about this explanation is the recognition that all students (not just the young men referenced in Marland's use of gendered pronouns) would benefit from a stronger focus on the world of work and careers, not just those who were enrolled in vocational education. The career pathways movement comes out of the idea that all students must be prepared for *both* college (some form of education or training beyond high school) *and* career. This means that the old dichotomy between "college-bound" and "work-bound" students no longer holds and that high schools need to design programs that integrate academic and career-focused education and provide all students the opportunity to explore both worlds.

While high school CTE programs and career academy programs both embrace the goal of college *and* career, CTE programs tend to prioritize the career goal while academies prioritize the college goal. The common denominator, however, is that both types of programs stop at the end of high school. Career pathways programs are deliberately designed to span both high school and at least the first year or two of postsecondary and end at the point of initial employment. The argument for creating pathways that span the last years of high school and the first year or two of community college is that, given the structure of the American high school and the core curriculum requirements for graduation, the opportunity for students to get either in-depth technical education or an extended leaning experience at a workplace is extremely limited during the high school years. The goal of career pathways programs is to see young people through to the attainment

of a first postsecondary credential with value in the labor market and then to help that young person actually get launched into the job market.

In 2012, in response to the demand generated by the *Pathways to Prosperity* report, our respective organizations, HGSE and JFF, joined forces to launch the Pathways to Prosperity Network.[38] While at the time there were a few other national or regional organizations working with networks of high schools on CTE reform or the development of career academies—most notably the Southern Regional Education Board and the National Academy Foundation (NAF)—there was no other organization focused on helping states build career pathways sytems that spanned grades 9–14 and designed to help students attain a first postsecondary credential with value in the labor market. Seven years later the Pathways Network is no longer alone in this field. Thanks in substantial measure to New Skills for Youth, a $75 million grants program launched by the JPMorgan Chase Foundation, there are now several other organizations working with states and localities on career pathways. Consequently, there is now a growing career pathways movement that incorporates CTE but is aimed at a broader career-readiness-for-all agenda. Because we cofounded the Pathways Network and know it best, we use it here to exemplify some of the core principles and practices that characterize the broader career pathways movement.

The Pathways Network began in 2012 with five states. Although each of the five expressed somewhat different motives for joining, one common denominator was a desire to strike a better balance between the narrowly academic purposes of education and the broader career and civic purposes. While the national conversation was moving from "college for all" to "all students graduating high school college and career ready," in most high schools there continued to be much more focus on college preparation, college choice, and admission than on career choice, a problem exacerbated by the notion that the first two years of college could be just about broad liberal arts subjects and that career choice could come later.

We developed a simple five-part framework to guide our work (figure 4.1). The core commitment we asked states to make was to create career

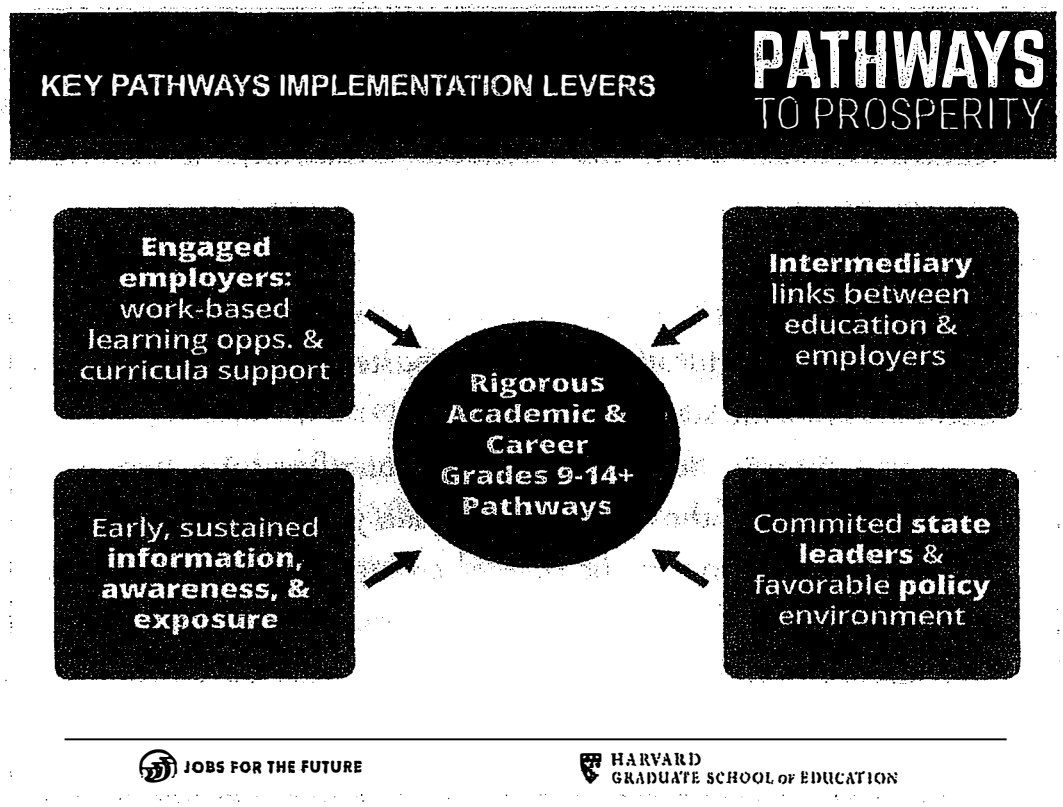
pathways systems that spanned grades 9–14 and combine rigorous academics with relevant career-focused education. Around that central commitment we developed four "implementation levers":

- early and sustained career information, advising, and exposure;
- strategies to engage employers as partners and codevelopers;
- identification of employer-facing intermediary organizations to help scale work-based learning opportunities; and
- supportive state policies.

In addition to their agreeing to work on the development of these implementation levers, there were three other key commitments we sought from states. While we encouraged them to begin the work in one or two regions where key assets were already in place (e.g., strong secondary or postsecondary CTE programs, motivated employers), we discouraged them from joining the Network unless their goal over time was to build a statewide career pathways *system*. Because system-building is a long-term process, we also asked states to make a three-year commitment, the minimum time needed to help states lay the path for the system-building journey. And to support the ability of our Pathways team at JFF to work with them, we required states to pay an annual membership fee in return for customized technical assistance and the opportunity to bring a leadership team to semiannual Network institutes designed to promote cross-state learning.

Our states have adopted diverse paths and strategies to initiate the process of building statewide career pathways systems. In Tennessee, for example, the first state to join the Network, it became clear after our initial exploratory visits to two regions that it was a strong CTE state, with virtually all high school students having access to course offerings in two or more traditional CTE fields of study. The challenge, as identified both by key state leaders and employers, was to modernize CTE programs to ensure their alignment with the needs of regional labor markets and to build stronger connections and alignment between secondary and postsecondary programs. In 2014 Governor Bill Haslam launched a major statewide initiative focused on

FIGURE 4.1 Pathways to Prosperity framework



increasing postsecondary attainment in order to attract and retain the kinds of employers needed to grow the state's economy, which only strengthened the case for the modernization and alignment strategy. In the years since Tennessee joined the Network, the state has made substantial progress. A 2017 case study on Tennessee Pathways reported that significant numbers of old CTE programs had been closed, to be replaced by programs in such emerging fields as cybersecurity and human resource management; that 83 percent of high school students had access to at least one of the three priority career clusters the state had identified (IT, health care, and advanced manufacturing); that 77 percent of high schools are now offering dual enrollment courses; and that nearly half of the students who graduated in 2016 were CTE concentrators. This suggests that the work of building a modern career pathways system is well under way in Tennessee.[39]

California, which joined the Network in 2013, chose a different starting point and pathways strategy. Most traditional high school CTE in California takes place in regional occupational centers, not in comprehensive high schools. But since the 1980s, the state has also been a big believer in the career academies model. California Partnership Academies, a state-funded competitive grants program, are small schools-within-schools with an industry focus; they integrate academic and technical education, have industry partners, provide work-based learning, and are focused on preparing all students for postsecondary education. There are currently nearly four hundred such academies across the state.

In 2014, the California Senate, inspired by Long Beach Unified's Linked Learning program and by the Swiss and German youth apprenticeship systems, inserted $250 million in the budget to support the creation of the California Career Pathways Trust (CCPT), a competitive grants program designed to support the development of regional consortia across the state to build nine to fourteen pathways aligned with high-growth, high-demand sectors in each region's economy. In 2015, after a second round of similar funding, there were eighty regional consortia across the state bringing together high schools, community colleges, employer organizations, and workforce boards to provide pathways to postsecondary education and employment for thousands of young people throughout the state.[40] At the same time, the California community college system is rapidly modernizing its CTE programs in ways that will support this state investment.

Tennessee and California represent not only the two principal avenues our Network states and regions have taken in order to move to scale but also the differing strategies of some of the older, best-established national organizations and networks in the broader career education space. The Tennessee approach, modernizing its CTE programs and better connecting them to aligned postsecondary programs, exemplifies the orientation of High Schools That Work (HSTW), a network of over twelve hundred high schools in thirty states that operates under the umbrella of the Southern Regional Education Board.[41] Because CTE programs throughout the South have historically enjoyed strong public support, especially from employers in

a predominantly low-skill, low-wage economy, the strategy of working with those programs to upgrade and modernize them to prepare young people to function in an economy demanding a higher level of skills makes political sense. HSTW, rooted in the South for three decades, has made a major contribution in bringing CTE programs in the schools in its network into the twenty-first century.

By contrast, the National Academy Foundation has been the principal source of support for districts and schools seeking to adopt and expand the career academy model. Led from its inception by Sanford Weill, a longtime leader in the financial services industry, NAF has evolved from its origins as a sponsor of one Academy of Finance in New York City to an organization now serving nearly 100,000 students in 675 academies in 5 sectors (engineering, finance, health, hospitality and tourism, and information technology) in 36 states. As NAF has scaled up, it has increasingly focused on districts, not just schools, as the appropriate unit of change, and it has especially focused on trying to deliver on the promise of providing all of its students the opportunity for a significant internship or some other extended work-based learning experience.[42]

As our own work has evolved over these past seven years, and as the Pathways Network has expanded to include four metropolitan regional members, two big city members, and now nine states, our thinking has evolved about the problem of scale and the best ways to help a diverse set members get there. In those states where most students have access to well-developed CTE programs, whether in separate vocational schools, part-time area centers, or comprehensive high schools, the strategy should be modernization, alignment with regional labor markets, and (using dual enrollment and early college designs) enrollment of students in aligned postsecondary technical programs while they're still in high school.

Delaware, which joined the Network in 2014, is the state that has made the most rapid progress in this area, moving from having one small program for high school students in advanced manufacturing housed at Delaware Technical (Del Tech) Community College in 2014 to having more than twelve thousand students across the state participating in career pathways

programs in fourteen sectors in 2018. Delaware's goal is to have twenty thousand students in career pathways by 2020, all of which will be aligned with postsecondary programs at Del Tech or other four-year colleges in the state. That goal represents roughly half of the high school cohort in Delaware, which means that this will become the mainstream system in the state, the way most young people will experience high school.[43]

In states that do not have a history of such broad access to traditional CTE programs, a more mixed model approach is needed. For example, Massachusetts has a very strong, well-developed network of regional vocational schools and several excellent district-run vocational schools. The best of these schools outperform the comprehensive high schools in their regions, and they have waiting lists. But these schools and the vocational programs in comprehensive high schools only serve about 20 percent of Massachusetts high school students. While the state has recently made significant investments in equipment and infrastructure to support these schools, its capacity for expansion is extremely limited, and there is little interest at the state level in investing in building additional vocational schools. Consequently, policy makers have recently been focused on how to increase opportunities for students in the comprehensive high schools to experience some form of career-focused education. In 2016, Massachusetts received a New Skills for Youth grant, which it is using to strengthen career advising and generally expand its High Quality College and Career Pathways program.

This leads us to one final example from the Network. In 2016, New York City became the first large city to become a member. While New York has a strong collection of CTE high schools, as well as a large number of other high schools with CTE programs and a small but powerful set of tech-focused early college high schools, what it doesn't have is a strategy to ensure that *all* young people in the city gain enough exposure to the world of work and careers to make an informed choice about the best education or training pathway after high school. This is the problem that prompted leaders from the three key public agencies—the city's education department, CUNY, and the Mayor's Workforce Office—to come together to address through the development of CareerReady NYC: A Compact to Support Universal Career

Readiness. The idea, drawing partly on earlier similar compacts in Boston and Los Angeles, and reminiscent of the case made by Sidney Marland for career education for all, begins by asking, What sequence of career-oriented experiences and activities—in school and out of school, year after year, beginning in grade 6 and continuing through high school graduation and into postsecondary education—would ensure that all young New Yorkers are prepared to meet a serious standard of career readiness? The New York Pathways team believes the most promising strategy to ensure career readiness is to provide all students before high school graduation an opportunity *both* to get started on college *and* to have a well-structured internship or other extended work-based learning opportunity. Reaching universal coverage on these two opportunities will take several years, but New York has two very substantial building blocks: College Now, a partnership between the school system and CUNY that already provides early college experience for nearly 25,000 high school students; and a 70,000-student summer youth employment program that is being redesigned to better align with the city's broader career-readiness agenda.

Outside the Pathways Network, the most interesting development in the broader career pathways field has been the revival of interest in youth apprenticeship. Youth apprenticeship programs adapt the core principles of apprenticeship—paid on-the-job earning combined with classroom instruction aligned with labor market needs—into a structure specifically designed for high school students. Youth apprenticeship first surfaced in the US in the context of the School-to-Work movement in the 1990s, when Wisconsin launched a statewide initiative in 1991. Today youth apprenticeship in Wisconsin is organized through thirty-three regional consortia that bring together employers, school districts, organized labor, workforce development boards, and others. The fields in which student may apprentice have spread well beyond the traditional trades and crafts to include the arts, STEM, information technology, and finance. While the program is based in high schools, students can earn college credits along the way. The program now serves nearly five thousand students and engages more than three thousand employers. The state funds the infrastructure and staffing to manage the pro-

gram at a cost of about $900 per student.[44] The Wisconsin program offers students two different levels of intensity, both beginning in the junior year. One option provides for 450 hours of workplace learning over two semesters. The other option offers nine hundred hours of workplace learning over four semesters. These workplace hours can readily be accommodated within the typical schedule of a US high school but stop well short of the three full days a week of workplace learning that Swiss students experience in the dual system model.

Colorado is the first state to develop a youth apprenticeship model that more closely mirrors the Swiss approach. After Colorado's governor led a forty-person study tour of the Swiss VET system in 2015, state leaders decided to create a nonprofit intermediary to develop a public/private youth apprenticeship model. CareerWise Colorado, led by the former CEO of a family-owned manufacturing firm, launched its first apprenticeships for 120 students in 2017. The Colorado program is a three-year model. It starts with high school juniors, who spend up to sixteen hours a week in their apprenticeship placement that first year. As seniors they spend up to twenty-four hours a week as the workplace. In the third year they are full-time employees of the firm, earning an industry certification while earning college credits. CareerWise currently offers apprenticeships in five fields: advanced manufacturing, information technology, financial services, business operations, and health care. A sixth field, education, is currently being piloted. CareerWise, launched with $9.5 million in philanthropic start-up funds and now with a staff of forty, has bold ambitions. It hopes to grow from serving a few hundred students in its early years to serving twenty thousand (10 percent) of the state's high schoolers by 2027.[45]

Beyond Wisconsin, Colorado, and long-standing employer-led programs in North Carolina and South Carolina, there are now a sufficient number of states and regions expressing interest in youth apprenticeship to have led the New America Foundation to create the Partnership to Advance Youth Apprenticeship, a collaborative of eight organizations, including JFF, dedicated to support the growth and development of quality youth apprenticeship models in the US.[46]

US CTE IN A COMPARATIVE INTERNATIONAL CONTEXT

Despite the presence of such rich and varied career-focused high schools, why has the United States struggled to create its own version of the strong secondary vocational *systems* that we find in countries like Austria, Germany, the Netherlands, Switzerland, and Singapore?

One barrier to devising such a system is the unfortunate legacy of tracking, which too often resulted in shunting low-income and minority youth into low-skill, dead-end jobs that offered little or no potential for upward mobility. Given the widely shared belief in the US in public schooling as the principal engine of social and economic mobility, the tracking of young people into vocational education increasingly came to be seen, especially by the civil rights community, as antithetical to core democratic values.

A second significant barrier is the culture and belief system of most US employers. In countries with strong VET systems, employers and their associations take an active leadership role in the design and implementation of vocational education; they believe that it is in their self-interest to help socialize teenagers into the world of work before they have become entirely the captives of their peer culture. Employers in strong VET system countries are also much more accustomed to acting collectively through their sector associations on recruitment and talent development needs than are US employers. They do this because by sharing the costs of supporting their VET systems, especially the costs of firm-based training, they are much less concerned about "poaching," or losing their investment in someone they have trained to a free-rider competitor. Also, because their sector association has worked closely with the government to ensure that the standards trainees must meet are rigorous and uniform across the country, even if they lose someone they have trained to a competitor, they can be confident that the person they hire will have been trained to the same national industry standard.

It is difficult to overemphasize the importance of national industry standards and a national qualifications system, both for young people and for employers. A European young person completing an apprenticeship in IT, banking, or carpentry, as examples, has a qualification that is portable any-

where in their home country (and increasingly throughout the European Union). In the US, a Registered Apprenticeship credential is similarly portable, but only a tiny fraction of the workforce has such a credential (roughly 500,000 out of a total workforce of nearly 154 million).[47] The two most common and rapidly growing forms of career-related credentials, other than degrees, are occupational certificates, awarded by postsecondary institutions, and occupational certifications, awarded by industry groups. In the absence of national industry standards and a national credentialing or qualifications system, neither young people nor employers have any way of determining the labor market value of such credentials, a huge problem the country is only now beginning to address.[48]

A third challenge the US faces in developing a strong vocational education system has to do with the structure of secondary education in the US. In Europe, compulsory education typically ends at age 15, at the end of lower secondary school, at which point students choose between vocational and general education paths for upper secondary school. In the US, compulsory education ends in most states between ages 16 and 18, meaning that the natural break point in our system comes at the end of high school, not earlier. It's also the case that the US high school has no real counterpart in other countries. While its core function is academic, it also provides a wide range of other programs and services that are essential to its identity, especially in suburban and rural communities. For many young people, the opportunity to participate in school-run activities like athletics, music, and theater is at least as important as the school's academic offerings, and these activities typically enjoy broad parental and community support as well. Given the role that the high school plays in American adolescent life and popular culture, a proposal to allow 40–70 percent of young people to spend their high school years learning mostly in workplaces rather than schools would mean that a major component of community culture would vanish.

A fourth reason the US does not have a strong VET system has to do with the role and structure of higher education in the US. The United States still suffers from the "college for all" messaging problem, which insists that the best option for nearly all young people after high school is the bachelor's

degree. In fact, university participation in vocational education has increased in several other countries, and many European universities even limit admission or distribute students among tertiary institutions based on national or state examinations.

Finally, the liberal arts tradition in the US impedes the growth of a comprehensive vocational education system. In Europe, students apply to a faculty within the university (e.g., economics, literature, law, medicine, architecture). Having received a solid preparation in the liberal arts and sciences during their upper secondary years, they are therefore ready to choose a field of study and get started on their career path when they enter a university. In the US, however, broad general studies go on for at least two years of tertiary education. This tradition allows students to put off deep commitment to a career until much later in their schooling.

While it is true that at the elite end of our higher education system admission is very competitive, the reality is that only students seeking a place at a handful of mainly private institutions (e.g., Stanford, MIT, Harvard) have a strong incentive to work hard in high school, since there is a place for them somewhere in the higher education system, no matter how weak their academic record. Middle-class American children are brought up to believe that they will go to college or university after high school, and nearly 90 percent of high school seniors say that is their intention after graduation. Two-thirds of high school graduates actually do in enroll in some form of college after graduation, though only about one in three Americans earn a four-year degree by their midtwenties, with another 10 percent earning a two-year degree.

US policy makers have historically been focused on reducing the high school dropout rate, but the college and university dropout rate is in fact much higher: only 6 in 10 who begin a four-year degree program complete within six years, and fewer than 4 in 10 starting a two-year program complete within three years. While there are multiple explanations for these very high college dropout rates—poor academic preparation, weak college advising and support systems, inadequate financial aid, family obligations, poor time management skills—the consequence is millions of young people

reaching their midtwenties with "some college" on their resumes but no academic degree or career qualification, little relevant work experience, and a high likelihood of some student debt. Indeed, many US students work thirty to forty hours per week while going to school to pay not only for tuition but for living expenses. These troubling outcomes are creating rising pressure on higher education institutions to provide stronger career advising services and more internship and other work-based learning opportunities for their students. This adds fuel to the argument that the US needs to reduce its reliance on four-year colleges and universities as the preferred delivery system for equipping young Americans with the skills and credentials to succeed in the labor market.

THE WAY FORWARD

There are a few lessons for the future to be drawn from this review of the history of vocational education in the US and its evolution into career and technical education.

The first is that, as much as we admire the Singapore and Swiss systems (see chapters 1 and 2, respectively), we think it neither desirable nor feasible to return to a bifurcated world in which students are asked to choose between a college path and a CTE path. We are convinced that virtually all of the jobs that can lead to a livable wage in tomorrow's economy will require at least some form of postsecondary education or training, but not necessarily a four-year degree. We are also convinced that all young people would be much better off if they were provided a more systematic and sustained introduction to the world of work and careers during their middle and high school years so they could make more informed choices among the various postsecondary options open to them.

A second conclusion we have reached is that the knowledge, skills, and dispositions that are most likely to prepare young people for a rapidly changing economy are best acquired through some combination of theoretical and applied learning. In particular, the skills that employers keep telling us they value most—problem solving, teamwork, communication, leadership—are

best learned not in classrooms but in well-structured and supported workplace settings, which is one reason we advocate internship opportunities for all.

A third lesson is that while we should definitely focus on strengthening and modernizing traditional CTE programs, as Tennessee and Delaware have done so effectively, we should also be promoting models that can more readily be spread within comprehensive high schools, in particular models like Energy Tech that combine the strengths of career academies and early college high schools.

A fourth lesson, as the New York City example shows, is that while we press ahead to strengthen and expand high-quality CTE and career academy programs, there are limits to the number of students they can serve. There will always be a substantial number of students—in many high schools a majority—who will not be touched by these programs but who should be exposed to the world of work and careers in order to make informed choices about the best path for them after high school. If we are serious about the goal of all students leaving high school prepared for both college and career, the US will need a deliberate, systematic strategy to meet that goal, a strategy that is likely to emerge from the career pathways movement.

Finally, the most important thing we can and must learn from the strongest vocational systems in the world is the critical importance of engaging employers and their associations as codevelopers and co-owners of the career-focused approach. There are very few examples we can point to in our own Pathways Network or elsewhere in the US of demand-driven CTE reforms. Until the demand side of the equation receives equal attention and weight, CTE in the United States will never have the impact on either students or state and regional economies that it has in the Switzerlands and Singapores of the world.

CHAPTER 5

THE FUTURE OF VET IN A GLOBAL, AI-POWERED ECONOMY

Marc S. Tucker

The four countries whose stories are told in the preceding chapters are very different from each other. But those stories have all played out in the same world economy, and that economy has changed dramatically over the last half-century. It is useful to analyze the development of VET in those countries as very different responses to one phenomenon: globalization.

GLOBALIZATION DRIVES THE DEVELOPMENT OF WORLDWIDE LABOR MARKETS

The development of VET systems since the 1970s in Singapore, Switzerland, China, and the United States, and everywhere else, was profoundly affected by the way the integration of the global economy turned local labor markets into global labor markets almost overnight. Prior to the 1970s, most workers competed with others in a labor market that was local, metropolitan, or regional, only rarely in one that crossed national borders. Thus, the price of labor in any one place reflected the overall productivity of the local or regional economy. Economist Lester Thurow once joked in a meeting of NCEE's board of trustees that it was obvious that American economists were better than British economists because the Americans made more money. Actually, he said, the British economists were at least as good, but the British economy as a whole was not as productive. Wages in a country or in a region within a country rose and fell with the health of the whole economy. So factory workers in the United States made far more money than did fac-

tory workers in South Korea or Brazil—but not because they were any more skilled.

Rapid advances in transportation and communications technologies during World War II and in the following decades dramatically reduced the cost of moving goods long distances and made it possible to communicate reliably with any point in the world at practically no cost. Manufacturing companies discovered that they could locate production without regard to where the product would be designed or sold. Also, for manufacturers for whom labor was a big share of the cost of production, and whose workers were mostly unskilled or semi-skilled, this meant that they could locate production in countries where the cost of labor with basic literacy was very low. This would not have worked nearly as well decades earlier, because ordinary workers in many parts of the world were functionally illiterate. But after the war, literacy levels had risen dramatically in the many of the world's poorest countries. To a degree few had realized, large numbers of people in those countries had achieved levels of literacy equal to those of many workers in countries with much higher wages. The stage was set for a massive transfer of low-skill and semi-skilled work to poor countries.

This changed everything. Suddenly, millions of workers in the world's high-wage countries were unemployed and unemployable. The unskilled or semi-skilled labor they had been selling was now a commodity on a newly globalized labor market, and they were charging much more for what they had to sell than global employers had to pay. A giant sorting process ensued. In the rich countries, millions of members of the middle class lost their jobs and were forced to get other jobs that provided less security and paid lower wages, though the returns to those fortunate enough to have more and better education soared. There were growing shortages in the rich countries of people with high skills and growing surpluses of those with low skills.

In September 1977, the CEO of Volvo hired Ira Magaziner, then with the Boston Consulting Group, to conduct a study for Volvo and the Swedish government to find out why key Swedish industries had become uncompetitive after a century or more of steady success. One of those industries was the shipbuilding industry. The managers thought the trouble was with labor.

The unions thought it was poor management. Magaziner, asking where the business had gone, learned that their strongest competitor was South Korea.

After visiting shipbuilders in South Korea, Magaziner told the Swedes that they should give up the shipbuilding business. It would never come back. The South Koreans were using the same advanced technology to build their ships that the Swedes had been using, but that machinery was being effectively operated by low-skill, low-pay workers. He advised the Swedes to tear down their shipyards and, on the ground where they had been, to construct new plants to manufacture products that used advanced technology, which required high-skill labor. The world would pay well for high-tech, high-value-added products that only highly skilled workers could produce, but they would not buy from Sweden high-tech products that low-skill workers could produce much more cheaply elsewhere. He drew them a four-cell matrix:

high-tech/high skill	low-tech/high skill
high-tech/low skill	low-tech/low skill

If Sweden wanted to continue to provide broadly shared prosperity to its citizens, Magaziner said, it would have to develop public policies that would enable it to concentrate on the development of products and services that used leading-edge proprietary technologies, offered innovations that customers all over the world valued highly, and employed highly educated and very skilled workers who would be treated not as cogs in a machine but as knowledge workers whose skills and ideas were valued by their employers. Following Magaziner's prescription, Sweden tore down its shipyards and steel mills and replaced them with car factories and cell phone manufacturers.

In the high-wage countries around the world, the compensation of those who worked with their heads soared as companies figured out Magaziner's matrix for themselves and as the compensation of those with low skills and low literacy nose-dived. The message went out to parents in many of those

countries that the future belonged to those with a university education. VET was increasingly viewed as the education of last resort for those who were no good at academics. This was the case even in rich countries with first-rate VET systems. In Europe, many countries had invited guest workers to come from countries with poor education, poor technical skills, and failing economies to take low-skill manufacturing jobs in their booming economies in the 1960s and 1970s. As these factory jobs became less attractive to many native workers, the lower ranks of the VET programs began to fill with the children of these immigrants. This combined with the increased desire of native-born parents to send their sons and daughters to university to lower the status of VET even further.

NATIONAL COMPETITIVE STRATEGIES AND THE FATE OF VET

Nations reacted to the spread of the forces of globalization differently. Their responses were largely based on where they were on the spectrum of economic development, a trajectory that starts with a country being in poverty and ends with that country becoming a rich nation. The strategy each country chose to compete in a world turned upside-down by the creation of a global market for labor, of course, proved critical in determining how fast a country would move along that trajectory and how far it would get. And there were some countries, most notably the United States, that did nothing at all.

Two of the four countries studied in this volume, China and Singapore, were both very poor in the 1960s. Newly independent Singapore set out to get rich using its low-cost, low-skill workforce as the big draw for foreign investors in the newly globalizing labor market. China set out to get rich a decade later using the same strategy, putting globalization into high gear. Both countries built the massive, high-quality infrastructure, including deep-water ports, needed by global manufacturers interested in employing large numbers of highly disciplined, hard-working unskilled and semi-skilled factory workers. Both created tax-free zones for manufacturing firms and worked hard to find investors to fill them with factories.

From the beginning, Singapore kept raising the skills of its workforce and using those skills to attract firms that were willing to pay higher wages for the higher-skill labor they needed. The government's Economic Development Board understood the logic behind Magaziner's matrix very well and was determined to move Singapore toward a "high-tech/high skill" position as quickly as possible, step by logical step. It was important to the government to create an economy that could provide broadly shared prosperity to its people, because there was no shared national identity to bind the new nation together. In its first move, it placed a high priority on VET, with the training of the carpenters, masons, electricians, and plumbers needed to kick-start the economic development process. But in only a few years raising academic and especially technical engineering skills across the board and building a strong postsecondary education system to support that goal took the highest priority, leaving VET far behind and the educational option of last resort for those with low academic skills. The ethnic Chinese did much better in Singapore's schools than did the minority populations, and the government saw this difference in educational options as the very kind of threat to broadly shared prosperity and political stability that its founders had most feared. The government recognized that the economy would be dysfunctional if it had a strong high-skills sector and a weak middle-skills sector; it could only deliver the goods if both sectors were world class. In response, the Singaporean government made an enormous investment of both money and political capital to build a world-class VET system.

China, a vast country, had to start somewhere, and that turned out to be the coastal provinces, the logical place to build goods for export. Like Singapore's leaders, Deng Xiaoping and his colleagues knew that China would be more prosperous, but would never get rich, using other countries' designs and copying their products, so they set in motion a long-range plan to make China a global leader in science and critical technologies by investing heavily in schooling, postsecondary education and research and development. China did not make a similar push in the area of vocational education, however. This has resulted in a success in primary and secondary academic education in a number of the coastal provinces but also in a VET sector that is largely

disconnected from the industries China is counting on to move its economy forward and that is populated by students who see it as a last resort and staffed by teachers who often have little or no useful experience in the occupations they are training their students for. Some of the best job training was being done at several of China's state-owned companies, but these companies are increasingly doing less and less training. The foreign-invested firms are not being encouraged by the government to train young people, and private Chinese firms have shown little interest in training their future workers.

To some degree, the success of Shanghai and other coastal provinces in international comparisons of student academic performance is related to the millennia-old conviction of Chinese parents that doing well on the school academic exams is the key to future well-being. The converse of that proposition, however, is that working with one's hands and getting those hands dirty in the process is viewed as low class and low status. To some extent, then, the price of China's academic success may be a low status for VET, which could be a growing problem for China's economic growth and political stability.

Yet, there is evidence that the government in Beijing sees the danger. Very large sums have been invested over the last ten years or so in new physical facilities and equipment for VET schools. Considerable emphasis has been placed on the creation of new VET models in many parts of the country. A thousand flowers are indeed blooming. It is also the case that the one of the highest priorities for the central government is making China the world leader in certain key technologies—especially artificial intelligence (AI), robotics, quantum computing, and machine learning—as quickly as possible. They are working hard to build the skills needed at every level of their economy to make good on this goal. So, while China appears to be far behind a number of other countries in VET, and VET seems to have very low standing in the eyes of most Chinese parents, educators, and students, the government seems to be determined to catch up.

Experienced China watchers are unanimous in their conviction that it is both easy and unwise to underestimate the probability that the central government will be able to reach the kind of very ambitious social and economic goals it has repeatedly set for itself and achieved. And culture is not des-

tiny. Singapore, which is largely run by ethnic Chinese who share the same values as the mainland Chinese, saw the danger that China now faces—unemployed university graduates and growing shortages of the highly skilled technicians needed to run a modern economy—and met the challenge by building a vibrant, high-tech, first-rate VET system that is proving to be more and more attractive to young Singaporeans and their parents.

One could easily argue that Singapore and China make a good pairing, because only a few decades ago both countries were very poor and both chose to start their economic climb by selling cheap labor and deep water ports, their principal assets. But one could make just as good a case for pairing Singapore and Switzerland. As Nancy Hoffman and Robert Schwartz note in chapter 2, there was a point at which leading Swiss industrialists gathered together to consider the future of their country and concluded that they wanted to live in a country with broadly shared prosperity. They decided that that could be achieved only if the Swiss workforce was among the best educated and mostly highly skilled in the world, and they then married that competitive advantage to worldwide technological leadership in a few selected industries.

The Swiss deliberately built on a strong tradition of manufacturing excellence and an equally strong commitment by businesses to the development in their firms of the skills of the nation's young people. The Swiss also decided to have few traditional universities, make them world class, and limit the number of professional programs they offered. The decision to limit the scope of traditional university education made room for a flourishing and attractive VET sector, and the decision by Swiss firms to invest heavily in VET in their own firms provided the means by which Swiss young people could get a first-rate applied education that was just as plausible a way to the top ranks of Swiss society and a professional degree. Like Singapore, Switzerland had a clear commitment from the beginning to a design for its economy that could provide broadly shared prosperity for all of its people.

A less obvious pairing, at least on the surface, is that of the United States and China, which are more usually seen as opposites from almost every point of view. Yet both are large countries with enormous variations in almost

every relevant dimension of politics, demography, geography, economic strategy, and vision. And there are further parallels that are very revealing in the context of vocational education and training.

Both China and the US are usefully viewed not as one economy but as collections of economies. In China, some provinces, mostly those along the coast, are economic powerhouses, technologically vibrant, home to highly educated workforces, and getting wealthy quickly. Others, mostly in the interior, look like the coastal provinces did decades ago: relatively poor and with much lower education levels, many fewer professionals, and much-less-advanced technology.

The same is true in the United States. It is mainly the coastal states that are home to many of the world's most advanced economies, while other states have economies that are more like those found in many third world countries. It is as if the states had decided individually how to respond to the globalization of the world economy. Some states that were already home to leading research universities and high-tech firms and had high performing school systems chose, not surprisingly, to behave like Switzerland and Singapore and invest heavily in their education systems and making their states attractive to highly talented professionals worldwide. They were willing to raise their taxes, which were already high, to make their states worldwide leaders in technology, research, and education. Also like Singapore and Switzerland, they did not mind being high cost if that meant they could be a leader in the global market for technological leadership and high-quality products and services. But other states did not see themselves as competitors in the market for high-skilled labor and high-quality products and services. They had long lagged far behind the leading states in both education and technology. And their politics were dominated by business interests that competed not on the basis of quality but on price, which required keeping wages and taxes as low as possible.

All of the states were interested in VET, but their visions were very different. The poor states competing on the price of labor were used to attracting businesses with concessionary tax rebates and the offer of free job training.

And because the firms they were after were looking mainly for relatively low-skill, low-cost labor, the training they wanted was not for high-skill, high-technology jobs but for relatively low-skill, low-technology jobs, and it was also often designed to provide firm-specific skills that the worker could not easily take to another employer. The rich states, however, built a VET system that attracted top-performing high school students by offering a curriculum that combined challenging academics with hands-on experience with high technology. This vision for VET, as seen in the example of Massachusetts, was more like Switzerland's and Singapore's than it was like many other states.

The United States has different economic systems that are spread out along a continuum, and these varying systems offer different visions of VET. As Schwartz and Hoffman point out in chapter 4, there are a number of states, like Tennessee, whose political leaders are working hard to move their states from a low-skills equilibrium to a high-skills equilibrium.

Transitioning an economy from attracting low-skill, low-pay employers to one that attracts high-skill, high-pay employers is anything but easy. Economists describe each kind of economy as typically being in a kind of equilibrium and therefore very hard to change. Economies in a low-skill equilibrium are dominated by firms whose interests lie in keeping taxes and compensation as low as possible. Because that is true, they have little or nothing to invest in education and skills development. Because most of the available work is low skill and low pay, the students they do educate to high standards tend to leave. And because so little is offered to highly educated and skilled workers, firms do not attract workers from the outside. It becomes very hard for far-seeing political leaders to change all of this because they are afraid that raising education and skill levels will not only raise taxes but will also lead to demands for higher pay, which will destroy their business model. The opposite is true in economies powered by high technology and high skills. With this equilibrium, there is strong support for the kind of high-skills, high-pay economy that can lead to broadly shared prosperity and a modern, high-quality VET system.

Another similarity between the United States and China is their approach to the development and spread of education and training policy. They both tend to issue very broad policy statements from the center and then follow up on these mandates not by controlling in detail how they are implemented at lower levels but instead by calling for experimentation everywhere. "Let a thousand flowers bloom" is how Deng Xiaoping began the opening up of China in 1978. As many things are tried in many places, government at different levels takes note, with guidance very slowly emerging based on what seems to work. This style of development is likely not to come up with the one best way for everyone but, rather, will determine the best way for different places at different times. It is messy but flexible.

Yet another important similarity between China and the US is related to the fear Peter Drucker expressed—that the US might adopt the kind of VET systems that the Northern and Central Europeans have.[1] According to Drucker, the great advantage of the US in global trade is its innovation and flexibility, both of which could be severely compromised by a form of VET that requires an elaborate system of formal credentials that change only slowly and are often set to standards that represent not leading-edge practice but average practice. Drucker and others contend that the American belief that anyone with drive, ambition, and discipline can pick up what they need to do the next job, and ought to be free to do whatever the market will reward, is the right idea. Such a system, messy and chaotic as it is, in which education and training institutions of all kinds are constantly offering a wide range of learning opportunities in a fiercely competitive market, will adjust much more readily to market opportunities than one that is highly regulated and governed by a complex system of occupational standards that can seriously interfere with the capacity of an economy to adjust to new technologies and more efficient forms of work organization.

Could it be that the weakness of the American VET system as viewed by experts and the failure thus far of the Chinese to develop a serious VET system are actually advantages for those countries in the global labor market?

THE AI EFFECT

Another factor that must be taken into account by designers of VET systems today is the rapid advance of artificial intelligence and related technologies and their influence on the future of work.

In 1990, for every job the United States was losing to globalization, ten were being lost to automation. As the price of labor has risen since then in emerging countries, much of the manufacturing that moved to countries with low-priced labor has moved back to the US, but many of the jobs have not. The people doing them have been replaced by machines. Even the coastal provinces of China, the principal destination for the jobs that left the US for low-cost producers, are now the scene of vast installations of robots and other automated machinery replacing millions of Chinese manufacturing workers, who are still making much less money than their American counterparts.

Over the last twenty years, digital equipment of all kinds has become vastly more capable and much less expensive. The most vulnerable workers are those in high-wage countries doing relatively routine work that can be captured in a set of standard instructions written in code. A very large number of people who participate in VET around the world do work of this kind, among them cooks, servers, retail clerks, factory workers, truck and bus drivers, legal researchers, warehouse workers, farmworkers, and stocktakers. Researchers have calculated that about half of the jobs now being done in the American economy could be done by automated equipment today.[2] Some observers, alarmed by these developments, have predicted that many workers will become permanently redundant as technology takes their jobs and they are no longer productive members of the community. They are proposing various schemes to provide these former workers with a basic minimum income paid for by taxes on the owners of the increasingly automated production equipment.

Entire industries are being destroyed or rebuilt using these technologies. Retail department stores and malls are in trouble because many people prefer to order from digital retailers from the comfort of home. The people who

work in the warehouses those digital retailers are building are themselves being replaced by automated machines. Giant mines are now being built where ore is mined by automated equipment, taken to the surface by automated equipment, transported to a deep-water port by automated equipment, and put on the boats by automated equipment for transport to distant ports. Pictures that used to be taken on film that used to be processed by tens of thousands of people working in processing centers are now shared digitally using services that make a handful of people fabulously wealthy but employ no one else. Cars with technologically sophisticated drive trains that used to be built by people with very strong technical skills are now being replaced by much simpler electric vehicles that do not require very many people with strong technical skills for their construction or maintenance.

Big companies that used to employ thousands of people are now employing many fewer people as regular employees and hiring many others on a temporary or part-time basis as needed so that they can take advantage of these new technologies as they come on line. Meanwhile, many of their former employees are becoming independent entrepreneurs, taking on part-time clients from many different firms at one time. As the technologies advance, they have to learn new jobs and relearn old ones to stay current. But because the firms can no longer capture the benefits from training their employees, they have less and less incentive to invest in training and retraining them. That means that they expect their new hires and their contract workers to come with all the skills needed to do what is often highly technical work—which means the worker has to spend time and money acquiring new skills in technologies and forms of work organization that are changing so fast that their investment could be wasted.

Some people see the arts as a refuge from the depredations of these technologies. But software can now write popular and classical music that experts cannot distinguish from the best music composed by humans. Programs are now available that will produce diagnoses of medical problems that are more accurate than those of expert doctors. News outlets now publish stories describing sporting events that are written by software, not human journalists. Software is being written that can learn how to solve very complex

problems faster and more accurately than any human being is able to. Some global banks are letting their very high-priced investment bankers go and employing programs to make their investment decisions instead. And software is now available that can write software better than expert software developers!

These technologies are advancing very quickly, and they will certainly have profound effects on global labor markets. It is very difficult, however, to anticipate exactly what those effects will be or what the makers of education and training should do about them, because lead times for the implementation of education and training policy are long and the technological changes are taking place quickly.

BROADLY SHARED PROSPERITY

When we look across the whole skein of VET strategies used by the United States, China, Singapore, and Switzerland, what do we see, and what should we conclude about VET policy and practice?

First, the question of vision in relation to the relative price of labor on the global labor market is crucial. The only nations, states, and provinces that really have the option of competing on the price of labor and staying in a low-skills equilibrium are those jurisdictions in which labor prices are very low compared to global prices for low-skill labor. The future is grim for jurisdictions in a low-skill equilibrium in which wages are nevertheless high in a global context, as in many American states, or moving higher, as in many provinces in China. If they cannot break out of their low-skill equilibrium and move through the middle-income trap, they will get poorer and poorer.

The alternative is moving toward broadly shared prosperity, which requires a very high standard for primary and secondary education for all students, because in high-wage countries the incentives for employers to automate all the routine jobs that can be automated will only grow stronger and stronger, so the jobs that used to be available to people with only a typical high school education will become fewer and fewer. To provide a balanced workforce in which everyone can prosper, high-wage nations pursuing broadly shared

prosperity will have to think hard about how they will create an economy with a good balance between people in middle-skill jobs and others in high-skill jobs—all of whom are making enough money to live well and feel that they are making a strong contribution so they can live in dignity.

On this point, the Swiss and Singaporean models stand out as exemplary. Both have made an explicit all-in commitment to these goals and have developed very effective policies and institutional structures to support that commitment. Both countries have established a very high standard for primary and secondary education. Both have developed a small number of first-class research universities to provide a supply of top-notch researchers, engineers, managers, and political leaders to support an advanced technology-driven, globally competitive economy. Both have built a combination of first-class upper secondary VET programs closely aligned with applied universities in Switzerland and polytechnics in Singapore that are capable of providing their economies with a world-class cadre of middle-skill and high-skill workers.

The biggest difference between these countries' VET models is that the Swiss model is employer based and the Singaporean model is school based. Both models, however, are built on the assumption that students come into the VET system with language and mathematics literacy that is very high compared to VET students almost anywhere else in the world. The question is where students pick up the theory that goes with the work they are training for and the skills needed to actually do that work to a high standard.

Yet, the difference is not as large as it might seem, because the Singaporean government invests so much in building inside the VET schools workplaces that look and feel like their counterparts outside the schools and because many of these simulated workplaces sell their products and services to real customers, often at market prices. Also, Singapore is moving aggressively and imaginatively to create more opportunities for its VET students to work and learn in real workplaces in the real economy.

The Swiss system is built around carefully specified descriptions of skills and knowledge that apprentices are expected to develop for each occupation for which training is available. The length and content of the training are fully specified. Instructors are trained and licensed by the state to com-

mon standards. Employers can offer apprenticeship slots only if they meet certain detailed specifications, and they must pay apprentices wages at levels regulated by the state. Also, training required for an apprentice in the regulations but not offered by the employer must be offered by an intermediary organization.

This complex architecture, which grew out of the medieval guild system, begs the question, Does it build an inherent conservatism into the system that makes it, as Drucker suggests, slow to adjust to increasingly rapid changes in technology and work organization? It also raises the issue of what the right balance is between the chaos of the US system and the order of the Swiss system in the kind of environment likely to be created by advancing digital technologies.

A few years ago, I found myself on a plane with a senior engineer from Siemans, one of the world's leading automation companies, automating everything from factories to entire cities. He had been trained as an engineer in East Germany, behind the Iron Curtain, and while working at Leitz, a company long admired for its high-quality lenses and cameras and precision instrumentation, he had been given a lead role by the Soviet government in the design of the inertial guidance systems used to guide nuclear-tipped missiles to their targets. When the Iron Curtain came down, Siemans had recruited him, and there he became a high-level manager, sent all over the world to turnaround factories that were in trouble for a variety of reasons. He had just completed a succession of assignments in Germany and the United States and was on his way to take over a factory in China. I asked him to compare these three countries, in terms of the strengths and weaknesses of their labor forces.

The Germans, he said, offered first-rate engineering and a first-rate front-line labor force. If you were after a beautifully engineered and beautifully built product, he said, Germany was the place to go. China, in his estimation, was very good at making standard products well at a competitive cost. The engineering was solid, if not imaginative. The manufacturing was not up to the same standard as in Germany but was usually perfectly adequate and a good buy at the low Chinese price. He said that the United States was the

place for imaginative engineering that often met the German standard but was typically more creative or innovative. But you would not go there for quality manufacturing, because American labor was well below the German standard and very expensive compared to what one could get at the same price elsewhere.

This insider's take on the current labor forces serves as a warning for China as its labor gets more expensive: its engineering will have to be more creative and its labor better skilled as its products and services get more expensive. It is also a warning for Germany, because its gift for precision in design and manufacturing will be no substitute for imagination and flexibility in a world increasingly torn apart by digital technologies. The Germans are superb makers of high-performance gasoline- and diesel-powered automobiles, but that may be of no help in a world of electric cars that are much simpler to build. And this is also a warning to American workers that their talent for creativity and innovation will only benefit a small number of engineers whose designs will be built not in the United States but elsewhere in the world unless ordinary workers in the US can develop the high level and range of technical skills that alone will justify high salaries and wages in a truly global economy.

This comparative assessment also sheds some light on the validity of Drucker's warning. Drucker was right in thinking that the flexibility and innovative capacity of the US economy would prove to be invaluable assets. He was also right when, in the late 1970s, he said that the future of work in the advanced industrial countries would be "knowledge work," work that calls for high levels of complex skills and knowledge and the ability of the workers at all levels to exercise the kind of judgment normally accorded only to professionals.[3] But Drucker was wrong to think that the American worker would be better positioned than the workers of Germany or Switzerland for the future he anticipated. The US workplace was more profoundly affected by the mass production model of industrialization than any other country, and that was a model in which workers needed only very modest literacy or skills and were expected to do as they were told—the very opposite of the knowledge worker model.

It was the legacy of the implementation of that model that my engineer seatmate was commenting on. Indeed, data from the Organisation for Economic Co-operation and Development now show that the typical American worker is the least well educated of all the workers in the advanced industrial nations.[4] The poor education of America's front-line workforce is compounded by the poor quality of its VET system. The result, as Schwartz and Hoffman note, is that US employers complain bitterly that American workers lack a strong work ethic, high levels of literacy, and the kind of technical skills needed in today's economy.

So, if Drucker was wrong to hold up the US nonmodel of VET as the model for the future, what is the right model?

A FIRST-RATE PRIMARY AND SECONDARY EDUCATION SYSTEM

Because digital technologies will do more and more of the low-skill routine work, the first requirement for building a strong VET system is to dramatically raise the literacy standard—language, mathematical, scientific, and technical literacy—to which the bottom half of the future workforce will be held. But language, mathematics, science, and technology are not enough. Because new technologies are already causing dislocations in national economies that have direct political consequences, and those dislocations are certain to increase in intensity, it is essential that the high-wage countries give their future citizens the political and historical knowledge and skills they will need to construct societies that will work for them. Thus, the inescapable foundation for a well-functioning VET system in the future will be a first-rate primary and secondary education in the liberal arts.

This broad educational base is not just a matter of literacy and political awareness. It runs much deeper than that. Recall that the digital technologies are creating a new workforce that will be increasingly self-employed in a gig economy that demands learning new skills for new jobs all the time, often jobs that come not seriatim but all at the same time. Recall, too, that the worker in this gig economy will have no employer who is likely to pay for that or give the worker the time to do it. That will put an enormous pre-

mium on learning complex new things quickly and constantly. This means is that our conception of a basic, compulsory education will have to change.

Most industrialized nations have long had one primary and secondary system for its elites and another for everyone else. The one for the elites—seen as the society's future leaders—emphasized leadership qualities like the ability to work independently, teamwork, analytical skills, the ability to synthesize a lot of material from many different sources, problem solving, goal setting, and strategic thinking. It is not at all clear that the reality matched this aspiration in more than a few places in any one country, but it is now clear that these skills are needed by almost everyone, not just the elite.

Some argue that the advance of digital technologies means that the need for the kind of knowledge and cognitive skills that schooling has long been about will recede into the background as the machines outdo humans in those arenas and as the need for distinctly human qualities like ethical judgment, compassion, warmth, and social skills will come to the fore. This argument is made by those who think that the machines will not put people out of work but instead will become complements to, rather than competitors of, humans. Maybe. That is not clear. It is entirely likely that value and ethical judgment will be ever more important, but it is less clear that we will not have to do much thinking. My guess is that we will have to do much better and more effective thinking.

All of this suggests that the demands on our schools to provide what amounts to an elite liberal arts education to all our students will grow increasingly strong, if only to build the capacity our future workers will need to learn quickly and well. Learning quickly and well is a function of the degree to which our education has given us the frameworks we need to absorb and use new information. Those frameworks are both the conceptual structures of the subjects we study in school and the big ideas behind those frameworks. Once we understand those big ideas and have understood the frameworks at a fairly deep level, we can more readily apply what we have learned to real-world problems, draw on multiple bodies of knowledge all at once, learn new things much more quickly, and, by applying the frameworks from one field to problems and challenges in another, create and innovate freely.

This is the heart of a liberal education. A liberal education used to be the birthright of our elites. Now it will have to be the birthright of all our children. And it will have to be provided in record time, mostly during compulsory education.

THE T-SHAPED CURRICULUM

Preparing a large and growing proportion of the professional and technical workforce to learn how to do not just new tasks but whole new jobs with a lot of technical content to a high standard very quickly will be a very heavy lift for national mass education systems. It will amount to raising achievement in terms of both the content and the quality of the academic program to the extent that it essentially changes the shape of the curve of student achievement, radically compressing it and then shifting it far to the right. It will require a T-shaped curriculum, with one leg being a strong broad liberal arts curriculum and the other leg being mastery of a technical subject at a high level. As part of the curriculum, each student would complete their education having at least one technical qualification, whether that qualification was a medical degree or an emergency medical technician certificate, which would allow them to get started in the workforce. We are headed toward a world in which the vast majority of students will get at least two years of education beyond grade 12.

What I see happening in the education and training of high-status professionals is instructive. These are the careers that one attains by taking the university track, not the VET track. But preparation for these careers has been evolving in interesting ways.

For example, in recent years the education of doctors has been transformed. It used to be the case that the undergraduate education of a doctor was followed by years of coursework in the related sciences and medical disciplines, like pathology. And it was only after years of such courses that a young doctor could put on a white coat, start doing rounds under the supervision of a clinical professor, and become a resident. That whole approach assumed that there was a more or less fixed body of medical knowledge to be

learned that would make one a competent doctor, and the student's job was to learn it before learning the practice of medicine.

Now a student's medical education begins with a combination of short courses and rounds, during which the group of students is presented with a carefully chosen case, told to come up with a diagnosis and prescription, and given access to libraries, labs, and doctors as resources. They progress from simple cases to more complex ones, with coaching at every step. They get most of what used to be provided in the full courses, but now they get it when they need it. Most important, they learn how to figure out what they need to know and how to find it, and they learn how to work with colleagues. They learn that the field is developing so quickly that there is no way they can learn everything they need to know before they start working as doctors. Most important, they learn the theory and the practice side by side, not in sequence. They gain a much deeper understanding of the theory and a better-developed capacity to apply what they are learning—they know it better and can use it more adeptly. And they are prepared for a lifetime of learning.

Engineering education has been going through a similar revolution, as have other high-status professional fields. Mixing the understanding of the theory with its application turns out to be a better way to learn both the theory and how to use the theory for some practical purpose. You can, of course, learn how to perform a task by rote, without learning the theory behind it, but application is much easier when you understand *why* and not just *what*. And the practitioner who knows not just what to do in normal circumstances but why that strategy works will be much better prepared when the unexpected or unusually complex case is encountered. Most important, the practitioner who knows why is far better prepared to learn how to use new technologies and even contribute to their development.

The idea of the T-shaped curriculum conjures up an image of a strong academic education and a strong VET education, separate but coupled. It suggests not just that students will need both forms of education, whether they are going to be doctors or emergency medical technicians, but that the boundaries between these two forms of education need to be blurred. VET

needs a stronger academic component, but in a form that is designed to be illuminated by the relevant applications.

The right response is to set a high standard for the common education that all students are supposed to complete by the end of lower secondary school and to do everything possible to make sure that the majority achieve that standard, no matter what they plan to do afterward. Then introduce a T-shaped curriculum to provide a broad and deep general education designed to make it very easy to learn almost anything quickly and well and to master the technical skills and knowledge needed to succeed at the entry level to a career.

In building such a system, the education and training that facilitate and support these trajectories should be designed so that it is possible to move laterally, to change destination. The institutional structure should also allow students who want to pursue a largely intellectual approach to the curriculum to do so, but the system should be designed so that, to the extent possible, the academic instruction requires constant application of theory to real-world problems. The curriculum should also address the development of the social and emotional skills needed to be successful, as well as the cognitive and technical skills.

The choice should not be between VET and a university track but between an applied form of education and a more intellectual form of education that involves less application. Both forms of education should lead to tertiary education, with various credentials offered along the way, so that a student can work at various points along the trajectory and also return for more advanced study and credentials.

BUILDING SKILLS-STANDARDS SYSTEMS THAT WORK

In the United States, anyone with a pickup truck and a ladder can go into business as a roofer. That would be illegal in Germany, however, where one must be a master roofer to do that, and one cannot become a master roofer without demonstrating conclusively that one knows everything there is to know about every kind of roofing material and every approved method of

roof construction. We'd all like some assurance that the roofer we hire is competent, so why wouldn't we want the German system?

This is a crucial question for the development of VET systems. If young people are to be trained for demanding, complex work, it is essential that they be provided a curriculum that imparts the skills that employers are looking for, not those that educators would like to teach. Those responsible for providing training need a specification of the desired skills to develop an effective curriculum. Students need to know what skills are desired in order to choose among potential training providers. Firms need to know whether students have been trained and assessed against industry standards in order to judge the competence of job applicants. One would think, though, that this is a simple challenge to meet; just ask the employers to come up with the standards for the jobs in their industry. But it is not that simple.

In the 1990s I learned from New Zealand's minister for economic development about the country's institution of the world's newest and most powerful occupational skills standards authority, which was charged with setting a very wide range of occupational, educational, and training standards. She recounted how she had recently been visited by one of the authority board members, the head of Toyota's operations in New Zealand, who told her that Toyota was on its way to dominating the auto industry worldwide by instituting radically different methods of organizing the work of assembling cars. Toyota was relying on the judgment of its front-line workers rather than treating them like cogs in the machine, and using robots would do most of the physically hard work. The other automakers in New Zealand, however, were still building cars the way Henry Ford made them and saw no reason to change. He told her that Toyota was pulling out because it would lose its competitive advantage if it went back to the old methods, if it followed the authority's standards.

This was exactly what Drucker warned against: standards that simply encode average practice will retard the development of the whole economy. In considering this case, the answer, I thought, was not to abandon standards for VET but to find a way to create standards that will drive industries forward, not encase them in the past. With standards like that, a nation can

ensure that students are being trained for leading-edge practices and will be the people in their companies who introduce others to those practices and, as a result, make the whole economy more competitive. But how, I wondered, can a country create standards that most firms in that industry were uncomfortable with?

In Switzerland, the government relies on the industry associations to set the skills standards, just like in New Zealand. But New Zealand had long been a supplier of raw materials in a mercantile system controlled by Britain, so it had very few domestic manufacturing companies that were at the leading edge of anything. The big Swiss firms had made a pact to be number one, two, or three globally in any industry they chose to compete in, so the companies that dominated the standard-setting bodies were already defining the state of the art. Singapore was determined to offer a state-of-the-art workforce, so it created a skills-standards system, advised by industry, that was based not on those standards used by the firms *in* Singapore but on those used by the global companies the government wanted to attract *to* Singapore. Denmark's skills-standards system is similar to Germany's, but local groups of industrial firms can apply to the government for the right to use their own standards if they can make a case that they are more advanced and will make Denmark more competitive. If the government approves an exception on this basis, it gives the industry association the option of revising that set of standards. The result is that skills standards are constantly revised to reflect what leading businesses are doing to adjust their technologies and work organizations to suit the changing markets.

A good skills-standards system drives the economy forward; it does not frustrate industrial ingenuity and development.

WORK-BASED LEARNING

No VET system will be effective if the students do not get the opportunity to work in places that are as much like the area in which they are seeking employment as possible. In chapter 3, Vivien Stewart describes VET institutions in China where students are taught by teachers who have no experience

doing the work they're training their students to do, and it is not hard to find students in the United States in auto repair and maintenance programs who are practicing on cars that have no computers in them.

It's not just a matter of acquiring the technical skills needed to hit the ground running in a first job. In chapter 4, Schwartz and Hoffman's description of VET in the United States points to the high social, personal, and economic costs of the high unemployment rates among young people in a society that provides very few opportunities for a smooth transition from school to work. In such a society, students' opportunities to mature as individuals, to learn what it means to be employed, to develop the work habits that make them employable, and to experience the pride that comes from doing work well are all stunted. For students who grow up in poverty, the opportunities to develop the kind of networks that lead to good first jobs and better second and third jobs are similarly limited. As they get through their teens and into their early twenties without a decent regular job, they lose hope and become increasingly unattractive to employers who prefer to hire someone right out of school or someone with a strong work record. Work-based training in the US is largely limited to the apprenticeship programs offered by the building trades unions, and most firms have little or no interest in taking on responsibility for training young people.

The Swiss system of employer-based learning that Hoffman and Schwartz describe in chapter 2 is very attractive. Swiss parents and students select that pathway through their system in very large numbers, and Swiss employers sing its praises and, at their own expense, provide the work-based learning experiences that make it hum. The modern Swiss VET system has evolved and changed greatly from the guilds of medieval times, but it still rests on the willingness of employers to offer opportunities for work-based learning.

China had its own version of the medieval system when it required employers to provide a wide range of social, educational, and training services, as well as housing and food, to their workers. Each firm trained all the workers it needed by taking on the sons and daughters of their employees as apprentices. But after Deng Xiaoping upended that system, the state-owned

companies terminated their apprenticeship systems, and the private companies have assumed very little responsibility for training young people at all.

That leaves the Singapore model of work-based training, which relies mainly on creating virtual employer-based training sites in the VET schools. This is an expensive undertaking, but it is paying off handsomely for the Singaporeans. In fact, the Singapore government is moving aggressively to find more ways to increase opportunities for young people to combine work in real employer work sites with learning.

WHO IS RESPONSIBLE FOR THE VET SYSTEM? IS ANYONE IN CHARGE?

Effective VET at a national scale requires the active engagement of many players. It lives at the intersection of national economic goal setting, economic development, national manpower planning, primary and secondary education, tertiary education, business, and labor.

In the United States and China, educators typically dominate decision-making, and business and labor play largely subsidiary roles. In Singapore, the economic agencies of government dominate. In Switzerland, the business interests play the central role. In many countries, each of these stakeholders occupies their own posthole and pursues their own interests separately. In countries with effective VET systems, the government acts to coordinate and sometimes lead in the development of coherent, powerful strategies that bridge these interests and engage the players in ways that are effective for the students and the economy as a whole. That is very difficult to do. Countries that aspire to build world-class VET systems would do well to look at how the countries with the most effective VET systems govern those systems.

In many countries the VET system is an afterthought, not the main game. But as the advance of AI, robotics, and other related technologies gathers steam, destroying not just jobs but entire industries, ever larger groups of workers who are being dispossessed by these technologies, feeling they have nothing to lose, that neither capitalism nor democracy has done anything for them, could easily decide that willing autocrats have more to offer. And so a

well-designed VET system could provide a path to well-being for millions of people who might otherwise not just face grim futures themselves but also be more than willing to bring down the whole system.

It is precisely because VET sits at the intersection of the workings of the education system and the real economy that it could play such an important role in determining the fate of individuals and nations.