

## THE CHICAGO MANUFACTURING RENAISSANCE COUNCIL

# Closing the Gap, Surpassing the Competition: City Colleges of Chicago, Manufacturing, and International Best Practice

## Plan for a Benchmarking Evaluation

31 November 2006

We have to learn how to compete with IIT. I don't mean the Illinois Institute of Technology down the street, I mean the Indian Institute of Technology.

- Wayne Watson, Chancellor of the City Colleges of Chicago, speaking to the Executive Committee of the Chicago Manufacturing Renaissance Council.

### PREFACE

*Closing the Gap, Surpassing the Competition: City Colleges of Chicago, Manufacturing, and International Best Practice* describes the rationale and a plan for a benchmarking evaluation of the manufacturing programs offered by the City Colleges of Chicago.

This paper is the result of a yearlong effort by an expert team working in conjunction with City Colleges and other advisors. At the outset it was our thought that such an evaluation was an essential immediate step to assist City Colleges in formulating and implementing needed improvements, incorporating best practices. As a result of our study of City Colleges' manufacturing programs we began to modify this thought. With a few exceptions, the manufacturing programs as they exist today are simply not developed enough to benefit from the kind of study originally envisioned. While the benchmarking study would reveal a stark comparison it would not be immediately helpful. First, the very basics of contemporary manufacturing education programs must be put in place. We are in discussions with City Colleges' leadership and it appears hopeful that this will be done.

Once the fundamentals are in place a benchmarking study as designed will be extremely useful. The plan can be put aside and utilized as part of a second phase of an improvement effort.

The work we have done has been fruitful. There is much in the present paper that can be utilized in the first foundation phase of the improvement project. Characteristics of successful programs have been researched and are described, peer institutions from which to learn are identified, and appropriate evaluation criteria examined. Beyond the provision of these tools, the work undertaken has led to a much more profound understanding among stakeholders of the current state of affairs and a commitment for improvement.

## REPORT

In the last year, top city leaders in government, the business community, labor, and education have created the Chicago Manufacturing Renaissance Council (CMRC) to enable Chicago and Illinois to become the destination for global High Performance/High Value-added manufacturing. The purpose is to revitalize and further develop our economy in order to rebuild communities—particularly those devastated by de-industrialization in the 1980s and 1990s. Having a world-class education system is a pre-requisite for achieving this goal—both to meet the needs of companies for a highly educated and innovative workforce and to provide working citizens with clear career paths in all aspects of advanced manufacturing. Our clear objective is for Chicago to “lead the race to the top” and meet or exceed best international practice in all aspects of the manufacturing economy, and particularly in education.

The Chicago Manufacturing Renaissance Council is sponsoring this study. We seek a completely candid assessment of the manufacturing programs in the City Colleges in comparison to best national and international practice. This will provide the required foundation for a detailed, multi-year blueprint for reform of the City College system to help it meet and then exceed best international standards for the provision of manufacturing training. The goal is to create an advanced training infrastructure that supplies area manufacturers with the highly skilled and educated incumbent and entry level employees they demand.

This study is one part of CMRC’s effort to develop a comprehensive view of *all* of our public education and governmental programs and systems, as well as the performance of the private sector in relation to our international competition. We are all responsible for the weaknesses of our various public and private systems and we will all be part of their transformation as we the race to the top in global high performance manufacturing.

This paper will identify the key variables that facilitate comparison between the manufacturing programs offered by the City Colleges of Chicago and leading community colleges/post secondary education systems elsewhere, including best international practices. Benchmark institutions have been identified and a plan for a benchmarking/evaluation is described. When undertaken, this benchmarking research project will address the following research questions:

- What should a community college manufacturing occupation program achieve?
- What should be measured to determine achievement of these objectives?
- What is the breadth and depth of current Chicago City College manufacturing programs? How well are these programs meeting the needs of students, employers, CCC staff and the general public?
- How do these programs compare to best practices nationally and internationally?
- What specific academic structure and curriculum is most appropriate to enhance City College manufacturing offerings?
- In short, how can Chicago City Colleges become the best community college system in the world?

We provide tentative answers for the first two questions here; refinement of these and answers to the remaining questions await completion of the larger study.

## **WHY IS AN EVALUATION OF CITY COLLEGE'S MANUFACTURING PROGRAMS NECESSARY?**

The education system in the Chicago area is underperforming. It does not supply the local manufacturing community with the quality of skilled labor that it requires to be productive and globally competitive. And it does not provide individuals entering the labor market with the skills they need to sustain themselves, or their communities, in a healthy and prosperous way.. This section describes and frames the gap between need and reality.

The prosperity of Chicago, Illinois and the United States is, and will be into the foreseeable future, dependant on manufacturing. American manufacturing is healthy and growing in real terms. But it is confronted with significant competitive challenges that increasingly make a highly trained, innovative and productive workforce indispensable for continued success. Well trained manufacturing workers today must be skilled not only in specific technology but in teamwork, math, literacy and the ability to continually adapt, innovate and learn.

The centrality of skills and training in today's manufacturing environment stems from the unremitting, volatile and often contradictory pressures firms face to both innovate and reduce costs. In virtually all manufacturing sectors and markets, technological change is rapid, its consequences are unpredictable, and product life cycles are becoming shorter and shorter. To stay alive in this environment, firms must constantly commit resources to innovation and to the upgrading of their capacities. Since resources are not limitless, producers must redirect funds from those areas of the firm that are not central to innovation or profitability to those areas that are. Concern for cost reduction is thus intimately linked to the commitment to innovation. Eliminating waste, reducing inventory, optimizing workflows to improve productivity are all practices that have emerged as part of a culture of innovation and cost reduction.

Finally, it is important to point out that in this new environment of constant innovation and cost reduction, those dimensions of the production process that are not deemed to be core competencies, or central contributors to firm profitability or innovation, are increasingly outsourced to more specialized supplier firms. Outsourcing firms place the same demands for innovation and cost reduction on their suppliers that they place on themselves. The result is extensive decentralization in industrial structures in which all players in all locations feel constant pressure to simultaneously innovate and reduce costs.

In this context, manufacturers find that it is imperative that they upgrade the competence and skill level of their workforce, even as they seek to reduce the number of workers they require through productivity increases and cost reduction techniques. Coping with constant change requires ingenuity and great flexibility in the workplace. Firms that have access to highly trained and flexible workforce have an advantage in today's marketplace. Those who do not have access to such a workforce are at a disadvantage. For this reason, training infrastructure is increasingly emerging as an indispensable dimension of manufacturing competitiveness. Indeed,

it is becoming a centerpiece of industrial policy within the world's most successful manufacturing regions.

Yet American manufacturers report that it is increasingly difficult to find skilled workers.<sup>1</sup> Perhaps this is not surprising given the dismal outcomes of American education in comparison to other Organization for Economic Co-operation and Development (OECD) countries.<sup>2</sup> Besides ill-prepared young people entering the workforce many dislocated workers do not have the skills for contemporary advanced manufacturing. Again this is not surprising because layoffs tend to be concentrated at plants that have failed to change with the times and have neglected to train and develop their workers. Many laid off workers with long, solid work histories are bewildered when they discover they are unable to pass entry-level tests to gain work in advanced firms. Clearly we need to do a better job at preparing new entrants and reskilling dislocated workers.

This national problem mirrors the situation in Chicago. In 2001, the Center for Labor and Community Research (CLCR) in partnership with the Chicago Federation of Labor prepared a major analysis of the Cook County manufacturing workforce development system for the US Department of Labor.<sup>3</sup> DOL asked us to identify gaps in the present manufacturing workforce development system. Instead of gaps we found chasms, chasms into which thousands of citizens and millions of dollars have fallen while placing at risk the 400,000 existing Cook County manufacturing jobs – jobs that form the bedrock of the regional economy. The report showed that Cook County manufacturers will need around 10,000 new and replacement workers each year. Local manufacturers overwhelmingly said they cannot find workers with the skills they need to fill these jobs, including entry level workers. At the same time there are thousands of Cook County residents out of work, including 86,200 disconnected young persons 16 to 21 years old who are out of school and out of work. The problem is quantitative (there are not enough people enrolled in manufacturing programs) and qualitative (many existing programs fail to adequately prepare people for work in contemporary manufacturing). Clearly the present efforts at manufacturing workforce development have failed to meet the needs of employers or workers.

The CLCR/CFL study concluded that the best way for the Chicago area workforce development system to move in the direction of meeting manufacturer needs was to adopt a system based on standards, certification and credentialing. Skill standards that embody the actual requirements of real jobs can provide an organizing principle: either a training or education provider adopts a curriculum that results in graduates who can meet these performance standards or it does not. Programs (and instructors) that are able to produce graduates who meet the standards can be certified so both potential students and employers know what they are getting if they choose to obtain services from that provider. Similarly, graduates who can perform to the standards can be certified, making the employment process easier for all concerned. This type of system is not new and has been successful in other places, as we shall discuss shortly,

#### CRITICAL DEFINITIONS

A **skill standard** is a compilation of the skills, or behaviors, required to adequately perform a particular specified job for multiple employers. A skill standard sets forth the skills required by all employers; each individual employer will very possibly have additional company specific requirements. There are many different sets of skill standards of varying quality and utility. The best standards contain *all* of the skills needed to perform the job and these skills

are measured at a sufficient level of specificity so that employee and employer both know that someone who has attained that standard can do the job.

There are different ways to measure skill. In manufacturing, paper and pencil tests can be used to measure knowledge or theory. **Competency based** testing measures the ability to actually do the behavior required, e.g., repair a programmable logic controller. Knowledge and competency are not the same thing. Think of fans that have a great deal of theoretical knowledge of basketball but don't possess the skill or competency to play in the NBA. The gold standard in manufacturing skill standards is a procedure that tests both knowledge *and* competency. For example the National Institute of Metalworking Standards (NIMS) requires both actually making a part according to the specifications in a blueprint and taking a knowledge test.

In this context a **credential** attests to the ability of the individual earning the credential to meet the requirements of the skill standard. Some organizations that establish standards certify programs. A **certified** program has met the requirements of the standard setting organization as able to produce credentialed graduates. Instructors may also be certified or credentialed. A credentialed instructor is one who has attained the standard he is teaching. It is logical that instructors have both good pedagogical skills and are able to demonstrate the competencies that they are teaching.

From the student's viewpoint the most valuable credentials are **portable**, that is multiple employers recognize them. This is increasingly important in our modern world where lifetime employment is mostly a thing of the past. Skill standards must be developed by and with industry. Generally the wider the group of employers involved the more portable the standard. The challenge is to be sure that standards developed by a broad group still are specific enough to assure that those meeting the standard can really do the job.

Real time 2006 data confirms that the situation is much as was described in the 2001 report.

In 2004 the Workforce Boards of Metropolitan Chicago began a multiyear, multiphase project to identify and begin to correct the critical skills shortage in the Northeast Illinois' manufacturing sector. The project is funded by the Illinois Department of Commerce and Economic Opportunity's Critical Skills Shortage Initiative (CSSI). The first phase of the project identified "critical occupations" in the durable and non-durable goods manufacturing sector using Illinois Department of Employment Security data on permanent vacancies and the Hudson Institute's *Jobs, Occupations, Workforce, Education (JOWE)* database. The report identified a total of 52 "critical shortage occupations" for non-durable and durable goods manufacturing. The report also identified a list of 27 priority occupations in need of immediate intervention. Shortages were determined by looking at permanent vacancies and availability of skilled labor. Occupations are considered "critical" if they are "... vitally important to the overall health of the industry... experience strong employment demand, provide good wages, are critical to industry competitiveness and are appropriate for targeting for the workforce system."<sup>4</sup>

In a July 2006 survey conducted by the Tooling & Manufacturing Association 73 employers with 616 production employees said they had openings for 199 additional employees, a projected demand equal to 32% of these firms' existing workforce. This does not mean that TMA projects a 32% increase in manufacturing employment. It does mean that the responding members, concentrated in the high end of the metalworking industry, have a substantial number of openings for high skilled persons.

The TMA results are consistent with data from the Chicago Workforce Center for Manufacturing, a specialist in manufacturing recruitment. Among very difficult to fill skilled jobs are CNC operators, setters and programmers; industrial maintenance mechanics and technicians; and welders. Even some machine operator jobs are tough to fill as companies seek people who can multi-task, work in teams, communicate in English, work with computerized processes, and continually learn new ways of doing things.

The current crisis is a shortage of skilled production and maintenance workers but in the medium and long term the health of manufacturing also depends upon an adequate supply of support persons and managers.

Happily Chicago's leadership has recognized the need to address these issues. The Chicago Manufacturing Renaissance Council (CMRC) is rapidly moving forward on a number of fronts. Currently there are four major workforce development related initiatives underway. The first is the Chicago Workforce Center for Manufacturing; a City of Chicago funded manufacturing specific service center offering recruitment and placement along with a suite of other business services. The second is the design and development of Austin Polytechnic; a high school designed to simultaneously prepare students for a rigorous post-secondary education and careers in manufacturing. The third is a research project to identify the potential of NIMS certification in Chicago and to introduce NIMS to companies that are not familiar with its benefits. The fourth is this project to provide assistance to City Colleges in improving its manufacturing programs. Each of these initiatives is designed to fill some of the gaps identified in the DOL report.

### **City Colleges of Chicago's own perceived need**

CCC will be a full partner in this initiative. CCC is already engaged in an effort, led by Chancellor Watson, to benchmark their programs to international best practice, beginning with their remedial programs. He welcomed this initiative as consistent with his vision and immediate objectives. His support also reflects his commitment to the Chicago Manufacturing Renaissance Council. (He is a member of the CMRC Executive Committee.) The Chancellor's Office has been enthusiastically engaged with the design of this proposal and two key executives will be participating as the project moves forward.

CCC has a long-standing commitment to education linked to the manufacturing sector. They are interested in any initiative that strengthens this linkage—particularly if it sets the objective of becoming world-class, as Watson's statement at the beginning of this paper indicates.

CCC does think that this study must lead to a similar evaluation of Chicago Public Schools and the not-for-profit training and education community. CCC is affected by the entire system and should be evaluated in light of the strengths and weaknesses of that system as well as the international comparisons.

This study will contribute to very specific programmatic objectives, to the potential for increased funding and political support, and for greater coordination of efforts between those engaged in workforce development, economic development, and education.

The evaluation of the manufacturing programs offered by City Colleges will help identify strengths and weaknesses of current programs along with opportunities to move to world class status. The purpose is to assure that City Colleges can educate the tens of thousands of skilled, employable, well rounded persons needed by area manufacturing companies in the coming years.

The leadership of City Colleges is an active participant in CMRC activities. The City Colleges have embraced the need for improvement.

Fortunately we need not reinvent everything here. There are other educational systems that are more successful internationally and within the United States. The core of this project is to benchmark City College of Chicago's manufacturing programs against four other systems: Denmark, Australia, North Carolina and Phoenix. Each of these systems has been successful. Of course, no system is perfect. The point is not to hold up one or more systems as a model that should be duplicated but to learn about what has worked elsewhere so that those approaches that are suitable to Chicago can be adapted and implemented. While we concentrate on benchmarking City Colleges to these four systems we will also provide data from other systems from which we can learn.

The report for the DOL identified gaps and presented a systematic approach to filling those gaps. It did not contain an institution level step by step plan. By providing detailed comparative data about successes elsewhere this project will provide the foundation for a practical road map for the kind of improvement Chancellor Watson calls for. The information generated will not be theoretical but *practical* because it will be about programs that are actually operating successfully.

Everyone involved recognizes that community colleges are part of a much bigger educational and economic system. Improvement in outcomes of community colleges should logically start by improving preschool education, then elementary, then secondary. All of these steps are necessary. But there are practical challenges. We can't wait for 18 years for students who have experienced root and branch educational reform to reach college age. The need for skilled workers is here today and must be addressed urgently. If we don't respond other states and other countries will. So we must craft practical reforms at the community college level that will work *now* while we await the fruits of an improved K-12 system.

## **BENCHMARKING CASES**

Community colleges are crucial providers of advanced training for manufacturers and people seeking to enter manufacturing labor markets. The contemporary manufacturing environment has placed specific kinds of demands on Community Colleges to adapt their curricula and their capacities generally to the dynamic needs of the manufacturing community. We have identified four areas as especially important:

***Strong ties to client manufacturing community.*** Colleges need to have much closer and systematic ties with their client manufacturing community so that they have an intimate and continuously self up-dating sense of the training needs in the community. Cooperation with stakeholders in the manufacturing community (firms, unions, community groups) over the design of the curriculum, agreement upon standards, updating of training infrastructure—etc, is the only way to insure that the training that is being provided is actually the training that is needed in the community.

***Teaching to competency standards.*** Colleges must offer courses that teach to recognized and acknowledged competency standards, so that students receive training that is portable and so that firms receive trained labor with internationally competitive competencies. Moreover, since these standards are being continuously updated and improved, colleges must develop procedures to insure that their curriculum is constantly up-dated.

***Follow students as quality control and self-monitoring.*** Colleges must track their students through the curriculum and into the labor market. Colleges should know where students are placed and there should be follow up with the students and their employers. This allows colleges to engage in quality control—tracking is a way of identifying weaknesses and strengths in your program. Follow – up also helps to identify potential new areas for training as they are emerging, which is a valuable competitive asset.

***Colleges need to be flexible as organizations.*** Innovation and rapid product change places great pressure on firms to be internally flexible and avoid rigid functional structures. The constant recombination of capacities and relationships both follows from and fosters innovation. Firms need to develop the organizational and personnel skills that will enable them to do this. If colleges wish to keep up with their manufacturing customers, they will have to exhibit similar skills in internal recombination. The capacity, for example, to rapidly develop specialized curricula emphasizes that cut across older disciplinary divisions will be increasingly demanded in the contemporary environment. The development of the capacity for cooperation across disciplinary specialties and professional hierarchies will be indispensable for competitive training institutions.

In more cases than not across the world, adjusting to these demands has imposed very significant processes of institutional change on community college systems – processes that are still on-going, even in the most successful of cases. Traditional curricula, orientations to stakeholders, tracking practices and internal organizational structures at community colleges were developed to serve a very different kind of manufacturing environment than the one that we have today. Adjustment to the new demands has involved a great deal of resistance, experimentation, false starts, development of new competencies. Since the Chicago Community College system will not be able to escape this turbulence of change, a major goal of our analysis will be to understand how processes of system transformation have been negotiated by successful systems in other places. We will be interested both in piecemeal successes, i.e., where specific things are done well in particular systems, as well as in successfully negotiated reform at the whole system level.



There are many community college level systems, both in the US and abroad, that have managed to very creatively implement some (though in few cases all) of the above features of a competitive training system. We have selected four college systems for concentrated benchmarking attention, two international cases and two domestic. Denmark and Australia are our international cases. Both are systems where the reform process has been relatively successfully negotiated, but each has emphasized different aspects of system transformation. The Danish case is a fascinating example of how reform in the training system is linked to reform of the welfare state and in which well organized stakeholders help to shape changes at all levels. Australia is a case of dramatic and innovative reform initiated by the state, and where the changes in curriculum and certification have been profound, but where stakeholder commitment has been erratic and at times highly problematic. Despite their differences, the two international cases we have selected are widely regarded as examples of training system “best practice”.

We have organized the domestic benchmarking cases in a slightly different way. Rather than target individual cases, we have targeted systems that have had success at different levels and in different areas. For us, the primary distinction at the domestic level is between state level community college systems and city level (urban) community college systems. The interesting thing for us about state level systems, apart from the fact that the Chicago City College System is part of a state level system in Illinois, is that increasingly there has been successful reform of community colleges at the state wide level by incorporating the community college system into a larger strategy of economic development, nearly always involving the creation of very close ties between the training providers and the client manufacturing community. North Carolina is a leader in this kind of reform. But there are other state level cases that we will also be watching and comparing to the North Carolina case. In particular the Wisconsin system of polytechnics is relevant in this regard.

At the level of urban community college systems, we intend to survey a range of cases that have strengths in areas that are especially relevant for the kinds of pressures facing the Chicago City College system. One successful urban system that we intend to analyze in depth is the Maricopa Community College system in greater Phoenix. That system has in general been very successful in developing training programs in conjunction with client business communities. But its specific efforts at the GateWay Community College are of interest to us because it involves reforms directly in the industrial manufacturing area. There are other innovative urban programs involving the integration of stakeholders, the development of appropriate curricula and standards, and the development of organizational flexibility in Milwaukee, Cleveland and St. Louis that we intend to keep abreast of.

The international and domestic cases are outlined in more detail below. We present them in ways that highlight the dimensions of best practice that are most usefully used as benchmarks for the Chicago system.

A note on our methodology is in order. In benchmarking the Chicago Community College system against other systems in other places, we are not suggesting that the Chicago Community Colleges should adopt, whole cloth, what other systems are doing. Rather, we have identified a variety of problems that the Chicago Community College system has to solve: the general problem of how to negotiate system level change, and the particular problems identified in the

four criteria we outline above. Then we surveyed the relevant global landscape of post secondary training providers to see who is solving these particular problems in creative and effective ways. Primarily we will be looking at pieces of systems and comparing them to pieces of other systems. In so doing, it is naturally important to be aware of how those pieces are embedded in larger systems. Pieces of systems are not standardized modules that can be transferred easily across platforms. But making local actors aware that there are solutions to the problems that they are contending with can be extremely valuable. It stimulates creative thought and broader discussion regarding the range of possibilities for change in the local institution. We seek to highlight benchmark cases that are effectively solving problems felt acutely in Chicago.

Finally, efforts to benchmark outside systems should not be viewed as a rejection of internal improvement efforts. Rather, we understand the benchmarking procedure as one that seeks to support and enhance existing efforts so that they can better do what they are already seeking to accomplish.

In what follows, we briefly outline the relevant features of the four systems that we propose to use as benchmarks.

### **The Danish System of Continuing Vocational Training**

Denmark has radically reformed its entire training system in the last twenty years. The aim has been to make Danish firms more competitive in the current environment and to help Danish workers gain the flexibility and skill they need to be able to continually adjust to changes that constant innovation and competition present. The current Danish training system is a highly successful system aimed at continuous training and re-training of workers in areas that are deemed most likely to provide a trainee with employment and contribute to the competitiveness of the employer. It is a stakeholder governed system in that representatives of regional employer groups, trade unions, social welfare agencies and training centers meet on a regular basis to monitor the quality of the curriculum and ensure that offerings match the needs of both trainees and their employers. The system is also highly subsidized and integrated into the larger government effort to minimize unemployment and increase manufacturing competitiveness by supporting worker mobility. Workers who leave their jobs, either voluntarily or involuntarily, are encouraged (given financial incentives) to enter a training program in which they participate in school based learning combined with in firm applied training. They are compensated at a level at least as high as the local collectively bargained minimum wage. The Danish state provides employers with a fixed hourly wage subsidy set at the minimum wage level to support the trainee. Employers may add to that salary if they regard the unemployed student as a potentially attractive future employee. Employers are under no obligation to hire trainees and trainees are not obligated to take positions in the firms that train them. But firms are likely to find trainees to be at least potentially attractive as the curricula offered in local training colleges are tailored, by committees of stakeholders, to emerging regional skill needs. Schools and state appointed social workers also systematically track the progress of students through the curriculum and into the labor market.

The Danish system has many of the features we identified above as constituting best practice in community college training. Schools have intimate ties to their client stakeholder community, they teach to standards and constantly upgrade their standards, they track the progress of students into the labor market and they have highly flexible internal structures capable of changing the curricula as the needs of trainees and client firms change. The system supports extremely high labor market mobility—Denmark has the highest rate of labor market mobility in Europe and one of the highest in the world. Despite the high rates of mobility, Denmark has among the lowest unemployment rates in the world. Danish firms are globally competitive in an array of high technology manufacturing sectors and Denmark is one of the most attractive locations in Europe for Foreign Direct Investment in manufacturing. The system of stakeholder governed skill training is widely regarded both in and outside of Denmark as a cornerstone of the Danish success.

### **The Australian Community College System**

Australia began a complete overhaul of its vocational training system at all levels with several key educational reforms at the end of the 1980s. The core of the reformed system has two key features that involve intimate coordination between stakeholders in national industries and training providers: 1.) the shift from academic to competency standards in training, and 2.) the creation of industry wide career ladders that involve continuous interaction between employers and training institutions.

Competency standards are standards for the practical application of knowledge in real workplace contexts. Rather than teach in a way that will encourage a student to achieve academic excellence with abstract knowledge of their vocational specialty, the new standards regime requires students to demonstrate their competency in practice. The standards are set (and re-set) by national industry boards (e.g., the metalworking industry board). Successful achievement of competency requires intimate contact between learning institutions and industrial workplaces. The advantage of competency standards for employers is that they are able to have greater certainty regarding the capabilities of a new employee. The advantage of competency standards for the trainee is that they apply across an entire industry and hence afford the trainee significant mobility across employers.

Industry wide career ladders involve the coordination of continuing education and re-training on an industry wide basis with the active participation of training providers. The idea is that students enter into an industry at a relatively low level of skill and then are able to advance in their careers by improving their education in a variety of clearly outlined vocational paths. Again, the advantage to employers of this type of structure is that they are intimately involved in the formation of curricula that serve their very precise industrial needs. The advantage to trainees is that they have a clear sense of how to advance, not only within a firm, but also within an industry.

The Australian system is very attractive from these two points of view. It is important to recognize, however, that the Australian system is still very much in formation and many of the most basic contours of the system are highly contested. For example, the most basic principle of

training being provided according to industry wide criteria is resisted by the largest corporations in the Australian economy, who would prefer to have training tailored more specifically to their own corporate criteria. Similarly, Australian trade unions complain that they are not as directly involved in the composition of training curricula, career paths and the setting of standards as the original legislation had intended them to be. Thus there are disputes about the specific content of the notion of “competency”, how demanding and hence general it should be construed, etc.

### **State level Community College Systems: Community Colleges as an economic development tool**

At this domestic level, we intend to look at the way community colleges have been integrated into larger regional economic development strategies. In this context, the North Carolina system is the most interesting case in the nation and we will focus our research efforts on learning about how this system has been successful. But there are other state level systems that have been innovative and successful in the US, and, to the extent that their success has been achieved in ways that are substantially different than in North Carolina, we will investigate how this has been the case. We describe briefly below why we think that the Community College System in Wisconsin presents a suggestive alternative example.

As in Denmark, the community college system in North Carolina plays an integral role in that state’s economic development strategy. The state community college system dates back to the formation in 1958 of so-called Industrial Education Centers. These centers were designed to provide customized re-training and new training to workers displaced from declining or outdated sectors of the economy (in particular agriculture). The current Community College system grew out of this initial mission and the current system has 58 colleges across North Carolina, enrolling more than 800,000 people annually. Colleges are allocated across the state in ways that allow the vast majority of students living in metropolitan areas in North Carolina to commute to a college within less than 30 minutes. The general capacities of the colleges tend to mirror the regional economic specializations within North Carolina, with colleges in the eastern region of the state more focused on Agriculture and services and those in the western and central portions focused on industrial and business specialties. Community colleges in specific regions are deeply embedded in servicing the needs of the manufacturing community. The Research Triangle area around Raleigh and Durham, for example, has significant concentrations of both IT and Biotechnology manufacturing firms. Biotech firms in particular employ 32,000 workers in 228 companies, generating more than seven billion dollars in annual revenues. The state community college system claims to have trained approximately 60- 70% of these employees and re-trained roughly 30-40% of them

A key dimension of community college training in North Carolina is the willingness of community colleges to collaborate with industry and state agencies in creating courses and curricula to train workers in new and emerging industries—such as biotech and IT. In addition, a so-called NEIT program—New and Expanding Industry Training—provides subsidies and facilities directly to firms to upgrade the qualifications of their workforce. Cooperating entrepreneurs work with college faculty to develop training regimes that the firm needs and both the college and the firm receive funding from the state to underwrite the program.

The current North Carolina Community College system has built on its original mission to train and retrain workers displaced by economic change. The system's strengths are its coverage and its ability to adapt its curriculum to the local needs of its client manufacturing community. Interestingly, unlike the Danish system where linkages between the community college system and the stakeholder client community are formally institutionalized, in North Carolina the principle of service to industry seems to be institutionalized, but the actual character of ties between industry and colleges is unsystematic and varied. The system has demonstrated an impressive capacity to adapt its curriculum to the changing needs of its client community however. There does not appear to be any systematic data on the degree to which manufacturing related courses are taught according to national standards—though this seems to be a dimension of customized training arrangements. Tracking of students exists in parts of the system, but it is in general underdeveloped.

The Wisconsin system is an interesting alternative to the North Carolina case in that it has demonstrated a good ability to institutionalize ties between manufacturing employers and community college programs. Training in this way is continually optimized to the needs of the local community. There have been, moreover, very interesting innovations for the development of special programs between incumbent manufacturing employers (not new inward investors) and groups of polytechnics for dedicated training initiatives. The Wisconsin Supplier Training Initiative, in which major Wisconsin manufacturers (John Deere, Case New Holland, Harley Davidson, and Ariens) joined forces with several central Wisconsin community colleges to develop a curriculum for managers and workers in the component suppliers for those major firms, is a prominent example. Wisconsin will receive less attention in our investigations than North Carolina, but it is an important case.

### **Urban Community College Systems: Organization flexibility and innovation in the delivery of services.**

At this level, our primary case will be the Maricopa Community College system in Phoenix. Though we are interested in the successful reforms that have taken place in general in the Maricopa system, the innovative manufacturing training program at the GateWay community college is of particular interest because of its specific manufacturing emphasis. Other innovative community college programs that we will have to be aware of are in Milwaukee, Cleveland and St Louis.

The GateWay community college industrial training program has developed an innovative delivery system for its training in direct response to manufacturer needs. Prior to the reform of the training delivery system, training courses at GateWay were offered within the rigid time frames established by the community college semester system. Classes and courses of study were organized in 16-week blocks and success was measured by the completion of a set number of semester credits. Manufacturing employers informed instructors at GateWay that this traditional system was ill suited to the kind of time availability their workers had. Many firms and employees were not entering training programs because courses and classes could not be fit into the rigorous scheduling demands of active manufacturing companies. In response, GateWay

developed a curriculum that broke classes down in to sub-modules of short intervals of training. Workers could receive intensified and focused training at particular times of day and for much shorter periods of time. Training turnaround for firms and employees was vastly improved as a result. Moreover, in the process, GateWay instructors also agreed to upgrade all of their instruction so that it was in conformance with industry standards.

In order to achieve this kind of innovation in their delivery system, GateWay instructors had to submit their organization to a rigorous self-analysis, using six sigma methods. The GateWay case is thus interesting from the point of view of a variety of our benchmarks. It was developed and is currently maintained by very systematic and intimate contacts with the client community, and it involved the creation of a very flexible internal organization that is capable of re-organizing curricula and specific courses of study rapidly in response to the changing needs of the client base.

Gateway is also interesting for the Chicago Community College system in that it is part of a larger urban community college system—the Maricopa community colleges. The way in which relations between the individual college and the larger system are established is hence of intrinsic interest to us.

There are several other urban community college systems that have developed very innovative techniques for the delivery of manufacturing training. The Milwaukee Area Technical College is of interest because of the long standing involvement of area manufacturers in curricula development, and its close and open relations with area trade unions. Such ties pay benefits in the quality of equipment that the colleges can use in their training (client manufacturers donate up to date equipment, or make it available at a reasonable rate). Curricula are more innovative and current with this stakeholder involvement. Not only is the MATC seeking to develop a curriculum that teaches to national training standards, providing workers with portable skills, it is also trying to augment the narrow technical demands of manufacturing training by offering training in related qualitative areas, such as the dynamics of team work, the principles of cellular production, and basic managerial skills. This reflects the tendencies in industry itself with increased demands for more broadly trained flexible workers. Innovation in curricula can produce more productive and more broadly skilled workers—and thereby enhance the competitiveness of the enterprises that employ them.

As in Phoenix, offering a “relevant” curriculum for a stakeholder community imposes great demands for organizational flexibility and upgrading on the training organizations themselves. Looking at how large urban systems, such as in Milwaukee (and Phoenix), successfully meet these challenges will be a crucial aspect of our benchmarking activities for the Chicago Community Colleges.

## **EVALUATION CRITERIA**

**What should a community college occupational program achieve?**

In deciding what to measure in this benchmarking project the first step is to identify what good outcomes of a community college manufacturing program look like. We have adopted a stakeholder approach to answering this question.

From the student's perspective: Most students that enter a career oriented community college program first and foremost want it to lead to **employment**, generally **in the occupation for which education was sought** with reasonable **compensation** and **career opportunities**. It is also very much in the student's interest to enter a program that offers **portable skills**, that is skills that can be used at many companies, not just one. This is increasingly important as the frequency of job changes increases. The rapid changes in manufacturing methods also require that a program serve as a **foundation for additional learning**.

From the employer's perspective: Employers seek graduates **fully qualified for entry** into firm at the level for which the education is provided, recognizing that further firm specific training may be required. These qualifications include basic, hard and soft skills. Employers want to be able to trust that the **credential** issued by the school is an indication of specific, demonstrated competencies, not simply time in the seat. And employers require the ability to **continuously learn and adapt** to future changing technology.

From the public perspective: The public subsidizes community colleges so the public deserves a good return on its investment. Graduates **employed in a family sustaining job\*** eliminate the need for future public subsidy. Programs should teach **portable skills** so that minimum additional public retraining investment is required if the worker needs to change jobs and so that the program does not end up simply being a subsidy for one or a few employers. Programs should have a reasonably high **completion rate** so that the investment in the first courses for a student actually pays off with a skilled graduate. Society needs an adequate pool of **skilled workers** to sustain and grow the economy. Finally, the education must be adequate for **citizenship**. ("Education adequate for citizenship" does not refer to civics classes. In a democracy basic skills, the ability to learn and process new information and the ability to collaborate are all citizenship skills. The same kind of broad education required for modern manufacturing is useful for citizenship.)

From the college administrator's perspective: Administrators naturally want to do a good job of educating students so they are concerned with the placement of their students in jobs and with the ability of students enrolled in their systems to complete courses of study. But administrators also are concerned with institutional imperatives, in particular with the financial health of the

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\* By family sustaining we mean a wage that allows the wage earner to support her family at a reasonable level of comfort without outside assistance. Translating this simple concept into a specific number isn't easy, however. There are many experts with somewhat differing opinion on what is "family sustaining." Assuming that a reasonable family sustaining income for a major metropolitan area is 200% of the federal poverty level for a family of four, that equates to about \$39,500 per year. Family size, the number of people employed in the family, overtime, bonuses and other factors make coming up with a single number for all workers difficult. See, for example, "Appendix: Defining Economic Self-sufficiency Realistically" in Tom Waldron *et al*, *Working Hard, Falling Short*, Baltimore: Annie E. Casey Foundation, October 2004 and *Working Poor Families in Chicago and the Chicago Metropolitan Area*, Chicago: The Chicago Urban League, Northern Illinois University and Roosevelt University, 2004.

college and with its growth. They seek to achieve stable or growing *enrollment* and must concern themselves with the *cost* per student and per program. Fundraising and financial concerns are thus of paramount concern for the administrators

From the college instructor's perspective: Instructors want to be able to provide students with training that is up to date and of maximum use for students in the labor market. They are thus concerned with what the technical requirements of the client manufacturing community and with the appropriateness of the internal resources of the community college system (modern learning technologies and training equipment etc). Instructors also realize that resources often need to be recombined in innovative ways to be able to train students in ways that match the needs of dynamic and continually changing employers, so they tend to be concerned with the internal flexibility of colleges as organizations. They are also naturally concerned with the *demand* for their subject. We wish to capture and understand instructors' aspirations and their frustrations.

These stakeholder-desired outcomes will be measured directly, to the extent possible, in the benchmarking/evaluation project, as described in the next section of this paper. But we also need to take into account the analysis of the forgoing section. There we identified four crucial factors that make the attainment of desired outcome more likely and these will also be measured:

***Strong ties to client manufacturing community.***

***Teaching to competency standards.***

***Follow students as quality control and self-monitoring.***

***Flexibility as an organization.***

As we describe the specific information and data to be collected, examined and analyzed it will be apparent that stakeholder outcomes and these four factors drive this effort.

We acknowledge that there is controversy about what constitute the best measurements of community college success, especially around completion rates and employment. Some students may enroll to see if college is for them, decide it is not and leave. Others transfer to a four-year school prior to completing a degree. Some may leave school as soon as they become employed. Still others, especially in areas such as manufacturing, wish to acquire a skill but not necessarily a credential.<sup>5</sup> While not completely discounting that these cases may be successes for some students we nevertheless believe that the forgoing seem to be reasonable objectives for *occupational programs*. If a student enters a manufacturing *program* instead of just enrolling in a *class* she must have some reason for doing so, and this reason would logically seem to be related to the expected outcome of the program. These outcomes are typically intended to be employment in the field of study. A student may see no benefit in a degree *per se* but would presumably intend to complete a program that he perceived offered a recognized, portable credential that enhanced earnings and employment stability. One of our research objectives is to test the hypothesis that employment and completion are useful measurements of community college occupational program success.



## What should be measured to determine achievement of these objectives?

### *Hard data*

Each program: “Program” is defined as a course of study the successful completion of which is intended to qualify a graduate for employment in a specific occupation. A program may result in a degree or certificate. This project will also consider customized training programs for companies. We will not look at the result of a student taking individual courses without signing up for a program.

#### 1. For each program cohort we will examine:

The number of students enrolled.

The number and percent of enrollees completing the program.\*

The number and percent of enrollees earning a certificate or degree.

The number and percent of graduates that are employed.

In a job related to the field of study

The percent employed compared to the percent of the same age range in the community generally.

The percent employed compared to the percent with the same educational level in the community generally.

Average wage

The number and percent of non-completers who are employed, compared to the community generally, as above.

The extent to which colleges routinely collect this data will help tell us how well they follow their students.

#### 2. Overall enrollment trends in the program.

3. Competency based standards are an important mechanism for assuring portability, assuring that curriculum is aligned with industry requirements, and providing employers with a credential that equates to demonstrable skills.

Is there a nationally recognized standard in this occupational area? If yes:

Is the program’s curriculum based on this standard?

Is the standard competency based?

Is credentialing an expected outcome?

Is credentialing required for graduation?

What percentage of instructors have the credentials related to the competencies they are teaching?

Is there any impediment to preparing students to obtain a credential, e.g. inadequate equipment?

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\* Completion and award rate statistics are time related. Apparently the US standard is to calculate the percentage of completions for a cohort at 150% of the normal time to complete. For a two-year program this means at the three-year point. This may be unrealistic for program with a number of part time students.

The number and percent of students attaining the credential.

4. What is the cost, per program and per student?
5. To what extent are there formal or informal articulation agreements and mechanisms between secondary education and the program? Between the program and further higher education?
6. To what extent does this program fit into a formal or informal career lattice?

College and System Data (College” and “system” may not be the correct terms when looking at other countries.) Program data must be aggregated to the college and system level.

1. What are the differences among programs, individual colleges and systems in the forgoing measures?
2. What evaluation and student tracking is currently done? What criteria and methodology are employed? What are the evaluation results?

### ***Factual qualitative information***

Great care will be required to separate reality from possibly self-serving and politically correct comments.

1. How prepared are program entrants? What amount of remediation is required? What is the process for providing required remediation? Do admissions standards pose a barrier to enrollment? How is this barrier overcome without compromise to program outcomes? How is remediation funded? Is remediation delivered contextually?
2. The question of connection to employers is one of the most important, as noted earlier. To what extent is curriculum developed in conjunction with employers? Do employers on committees and advisory boards actually hire graduates? What percentage of graduates referred do these companies hire? How is curriculum updated? How frequently? To what extent, and by what mechanism, are curriculum updates connected to the requirements of employers?
3. Is curriculum regularly updated? What are these updates based on? How are changes in industry translated into curricular changes?
4. How flexible is the delivery system -- including class scheduling, course design for specialized needs, and the ability to deliver outside of a traditional academic structure? To what extent does the institution allow or encourage flexibility?
5. What institutional relationships does the college have? How did they develop?
6. What is the impact of public policy on programs and outcomes?

7. What is the impact of student and community culture on programs and outcomes? This does include race, ethnicity and gender issues.

### *Systematically collected opinion*

#### 1. From students

To what extent did the program meet the student's expectations?

To what extent did the program meet the intent as described by the college?

In cases of non-completion

Why was the program not completed?

Did the student achieve benefits despite not completing the program?

#### 2. From employers

Are graduates employable?

What information, testing, etc is required for an employer to know if a graduate is employable?

How does the success of graduates compare to other employees entering the firm at the same point?

Are former graduates attempting to switch jobs mid-career into your firm more or less employable than other job changers?

What are the competitive advantages of graduates?

What are the competitive disadvantages of graduates?

Is program content/curriculum appropriate? What is missing? What is unnecessary? (This same set of questions should be explored for attendees that did not complete the program.)

3. We will also collect the opinions of faculty and administrators concerning all of the criteria discussed in this paper.

### *Narratives*

The criteria discussed so far are all amenable to being arranged on an orderly chart and easily compared. This sort of data is vital but not sufficient. The benchmark institutions we will study each have some unique characteristics. These arise out of the institution's history, the culture of the society surrounding the institution, the political environment, and the local economy. In other words each school develops in a context and we need to understand this context if we are to understand the feasibility of adopting successful practices in Chicago. We will therefore collect the stories of the benchmark institutions. We want to end with a full, rich picture of why and how best practices developed and why other best practices were not adopted. We need to understand the obstacles that arose and how they were overcome, if they were.

While we will systematically study four benchmark institutions we will be alert to including illustrations from other schools that help inform a conclusions or illuminate the discussion.

## **Expected results**

We anticipate that the collection and analysis of data as described in this section will provide useful to CCC leadership and advisors for:

1. Establishing achievable benchmarks for CCC. The outcomes collected from other institutions reflect real world achievement, not abstract targets, so they should be obtainable in Chicago.
2. Determining what internal and external factors are important for success which will in turn be helpful as CCC plans improvements.
3. Developing specific plans for strengthening City College's manufacturing programs.
4. Answering some broader questions that go beyond Chicago, including:

What is the correlation between earning a credential and employment and earnings?  
What is the correlation between teaching to standards and employment and earnings?  
What is the correlation between credentialed instructors and employment and earnings?  
What is/are the most useful measure(s) of program outcomes?  
Is completion of a program important?

## **EVALUATION PLAN AND METHODOLOGY**

***Literature review and collection of background materials.*** We have begun a review of literature about community college manufacturing programs in general and about specific systems of interest, including CCC. The first step in the larger project will be to do a more comprehensive review of all available published and non-published data about CCC and the four benchmark systems. Included will be data collected by the institutions themselves, local and state regulatory agencies and by national and international organizations. Special attention will be reserved for any evaluations previously done. (We know that City Colleges has collected considerable data, but has not done a comprehensive evaluation of its manufacturing programs.)

***Unstructured interviews.*** Again this has already begun with each benchmark institution and, of course, City Colleges. However we need to widen and deepen these discussions and be sure to include representatives of each class of stakeholders.

***Evaluate literature, data and informal interviews and plan formal steps.*** At this stage we will have amassed a great deal of material. We need to carefully this material and determine what we know for certain, what we think we know subject to further verification and what we don't know. For example, we might know completion rates because institutions generally collect this but we might not have adequate data on students' reasons for non-completion. From this base we will design formal mechanisms to collect the information we are lacking.

In order to minimize expense, we anticipate that no travel will be required to get to this point. Part of the planning process will be to tightly arrange our on site time.

**Structured Interviews.** We anticipate using face-to-face and telephone formal interviews as a key research strategy. We will prepare structured interview protocols in order to insure uniformity. There will be a different protocol for each class of stakeholder (students, instructors, administrators, employers, representative of the public) in each location. Although we will get comparable data from each location we do anticipate that the protocols will be different in order to take into account local circumstances, language (Australian and American English are not identical), and to avoid asking duplicate questions about information that has been reliably collected by others.

Although the interview protocols will be structured they will also be open ended in order to capture maximum information and nuance. Every interview will be conducted by the principal investigator or a researcher working with the project from the onset, assuring a knowledgeable dialog. Interviewers will be fully informed reporters, not call center employees. This approach has been proven in many situations over many years.

The numbers of teachers, administrators and employers involved in any institution will be relatively small and manageable. Although the sample sizes of interviewees will be small (20 or so per category in each institution) they will constitute a significant proportion of the universe. Interviews with students will be more problematic. Their numbers will be large and they can be expected to have varying backgrounds, motivations and experiences. They will also have been enrolled in different programs within the institution. Therefore we plan to conduct 100 student interviews in each of our five locations. A further complication may be student privacy concerns that will require close cooperation with the institutions to be studied.

In order to maximize our opportunities to be exposed to stakeholders we will attempt to take advantage of any gatherings scheduled for other purposes, such as employer advisory committees. We may be able to be an item on the agenda of such events and conduct “mini-focus groups.” At this time we do not plan on using focus groups as a primary method.

We believe that the cost, low response rate, and lack of nuance make written surveys inappropriate for this project.

**Data analysis.** The data will be analyzed using both quantitative and qualitative methodologies. Quantitative analysis will include frequency distributions charting the responses of key stakeholders to a series of questions related to structure, resource availability and allocations, relationships to manufacturing community and graduation and placement outcomes. Comparisons will be made relative to the convergence and divergence of the responses of respondents with respect to the quality and outcomes of the CCC manufacturing-related activities.

Qualitative analysis will include statements and observations obtained through the interview processes that identify and clarify strengths and weaknesses of the CCC manufacturing offerings/curriculum. Non-numerical Unstructured Data Indexing, Searching and Theorizing (NUDIST) software will be used to organize and analyze text documents and interview transcripts, field notes and unstructured conversations. The qualitative analysis will provide

insight into patterns of responses and observations by various constituencies that can offer both critical assessments and solid recommendations for improvement.

## **Leadership Team and Staffing**

The Center for Labor and Community Research has been appointed to staff the Chicago Manufacturing Renaissance. In that capacity CLCR is applying for funding for this project and will be responsible for its execution. The project will continue to be actively overseen by the same team that has worked on it to date:

Dr. Gary Herrigel, Associate Professor of Political Science, University of Chicago. Gary's research and writing have focused on the social construction of industrial practice in Europe (primarily Germany), Japan, and the United States. He is a senior associate in the Advanced Manufacturing Project (AMP) a research consortium with colleagues at the University of Wisconsin-Madison, Case Western Reserve University and the Michigan Manufacturing Technology Center as well as the SOFI Institute in Göttingen Germany. Gary's publications include *Industrial Constructions: The Sources of German Industrial Power* (Cambridge 1996) and *Americanization and its Limits. Reworking US Technology and Management in Postwar Europe and Japan* (Oxford, 2000) with Jonathan Zeitlin.

Dr. Michael Bennett, Director of the Egan Urban Center and Associate Professor of Sociology, DePaul University. Michael has led a number of evaluations for the federal government and for foundations. His two most recent publications are as co-editor of *The New Chicago: A Social and Cultural Analysis* (Temple University Press, 2006) with John Koval *et al*, and *Economic Development in American Cities: The Pursuit of an Equity Agenda*, (forthcoming from SUNY Press, 2007) with Robert P. Giloth

Jim Wall, Deputy Director, National Institute of Metalworking Skill Standards. Jim is responsible for the nationwide implementation of NIMS skill standards in educational institutions and companies. Previously he was an educator/administrator at Lehigh Career and Technical Institute in Pennsylvania.

David Pflieger, CLCR policy and education consultant and principal of Thornton Pflieger Inc, a management and public policy consulting firm. David combines years of manufacturing management and human resources experience with research and writing on manufacturing education and workforce development policy. He was coeditor of the 2001 DOL report *Creating a Manufacturing Career Path System in Cook County*. David is an active participant in several Chicago Manufacturing Renaissance council activities.

Dan Swinney is Executive Director of the Center for Labor and Community Research and of the Chicago Manufacturing Renaissance Council. He will spend approximately 20% of his time hiring and directing staff, integrating this project with the other work of the CMRC and working with the advisory board and senior leaders at CCC. Matt Hancock will assist him.

The project staff will consist of a Principal Investigator and five research assistants. One the research assistants will be assigned to the study of each institution. In addition, an administrative support person will be retained. We believe that there is twelve months of work to be done so the budget is for one year. However, we anticipate that the budget will be expended over a period of 18 months. This is to allow for the inevitable time lag between a funding decision and hiring staff and the start of the project. We also must take into account delays due to scheduling issues at the institutions we will be studying.

## Advisors

It's important that we have recognized leaders providing insight and input at each stage of this study in order to insure high quality as well as to increase the depth of support for our assessment and recommendations. These advisors include:

Tom Cokins, Vice Chancellor, Workforce Development, City Colleges of Chicago

Gene Cottini, Manager Training & Development, S&C Electric, Chair of the Chicago Manufacturing Renaissance Council (CMRC) Education Committee

Brian Fabes, CEO, Civic Consulting Alliance

Wilfried Kruse, Director, Sozialforschungsstelle (SFS) Dortmund, Germany

Jorge Ramirez, Secretary Treasurer of the Chicago Federation of Labor and Co-Chair of the CMRC

Bob Sheets, State of Illinois, Department of Commerce and Economic Opportunity

Chris Wilkerson, Executive Director, Business and Industry Services, Wright College, City Colleges of Chicago

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## ENDNOTES

<sup>1</sup> See, for example, *2005 Skills Gap Report – A survey of the American Manufacturing Workforce*, Washington DC: Deloitte Development LLC, December 19, 2005 available at

[http://www.nam.org/s\\_nam/sec.asp?CID=202426&DID=235735](http://www.nam.org/s_nam/sec.asp?CID=202426&DID=235735) and Ilan Brat, "Where Have All the Welders Gone, As Manufacturing and Repair Boom?" *Wall Street Journal*, Aug 15, 2006, B1.

<sup>2</sup> Programme for International Student Assessment, *Learning for Tomorrow's World*, Paris: Organization for Economic Cooperation and Development, 2004. See also J.B. Presley, *College readiness and choice: The longitudinal study of the Illinois class of 2002*, Edwardsville, Illinois: Illinois Education Research Council, 2005; Jon Van, "U.S. science 'in a crisis,' says Nobel winner," *Chicago Tribune*, November 19, 2005.

<sup>3</sup> Dan Swinney, David Pflieger and James Jacobs, eds., *Creating a Manufacturing Career Path System in Cook County*, Chicago: Center for Labor and Community Research, 2001, available at [www.clcr.org](http://www.clcr.org).

<sup>4</sup> Critical Skill Shortages Report on the Manufacturing Sector for the Northeast Illinois Economic Development Region, June 4, 2004, accessed online:

<http://www.workforceboardsmetrochicago.org/upload/ManufacturingCSSRtoDCEO060404.pdf>

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<sup>5</sup> For a nice summary of these arguments see, for example, Dougherty, Kevin J. & Esther Hong, *State Systems of Performance Accountability for Community Colleges*, Boston, Jobs for the Future, July 2005.