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Abstract: The growth of the IT sector masks important dynamics: occupational complexity; the spread of the IT workforce into other sectors, and a transformation in traditional human resource practices. Handling these tensions is demanding regional workforce development strategies, especially to create institutional connections, or labor market intermediaries, that can assure the flow of talent through specific segments of the educational pipeline, from high school to higher education, and into specific employers, industries, and local sub-regional labor markets. The **Boston Area Advanced Technical Education Connections (BATEC)** is one of such intermediaries. BATEC has created the a basic template of practices that can be used to up-scale its efforts and contribute to shape a regional workforce development system.

Categories and Subject Descriptors
K.3.2 [**Computer and Information Science Education**]: Computer and Information Science Education – *Curriculum, Information systems education.*

General Terms
Economics, Measurement, Management

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Workforce Development, Labor Market Analysis, Labor Market Intermediary, Systems Building, System Netting

I Growth in the IT Workforce

In the US, jobs in IT occupations more than tripled between 1983 and 2000, from 719,000 to 2,498,000 at the peak of the sector's expansion. Unemployment in core IT professions, however, surged in 2000 and reached almost 6 per cent duringthe first half of 2003.[1] Such decline has been attributed to the events of 9/11, growing outsourcing of IT services to other countries like India, and product cycle and market dynamics that have contributed to streamline production processes and corporate structures. Recent press accounts suggest that the downturn has subsided, but industry sources suggest that in the meantime the IT sector and its core occupations underwent a dramatic transformation that changed occupational content and performance requirements, and pushed managers to reevaluate the human resource function of businesses and companies.[2] Governmental sources also say that five in the top fifteen growing occupational categories for 2004-20014 are IT related ones, and all will be expanding more than 38%.[3] In Massachusetts, despite the downswing earlier in the decade, growth in the IT occupational cluster has remained robust and it is projected to continue expanding to 2010. No other occupational cluster of the 22 clusters considered by the Division of Unemployment Assistance shows expected comparable growth.[4] Using 2000 as a base year, the computer specialists cluster is expected to grow by 53% by 2010. Specific occupational categories will grow faster, such as computer support specialists that will grow by 73%, network and computer system administrators by 59%, and network systems and data communications analysts by 60%.[5]

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II Behind the Growth in the IT Workforce

The positive outlook of healthy expansion above, however, requires further dissection for three reasons. First, below the surface, the aggregate picture of occupational growth masks the occupational complexity within the IT sector. In general, the IT workforce and labor market is composed of multiple sub-sectors; of persons engaged in an ample range of activities including the conception, design, development, adaptation, implementation, deployment, training, support, documentation, and management of information technology systems, components, or applications. Such a variety of sectors and activities, combined with other macroeconomic forces ranging from industrial deregulation to globalization, is bound to generate labor markets that do not behave parsimoniously and that always evidence some kind of turmoil. Perhaps, the IT sector and its labor market (and workforce) will always be experiencing some sort of deficit or deficiency, given its historical development, heterogeneity, and the pace of change within them.[6]

More specific reasons behind the turmoil are:

1) The speed of technological change in which "rapid IT diffusion and business transitions reduce the effectiveness of the market in reconciling supply and demand and the effectiveness of many putative policy solutions…";[7]

2) Cost-cutting measures ranging from de-skilling, corporate restructuring, outsourcing, to job exporting that pressure domestic/regional markets;[8]

3) Selection biases (age, race/ethnic, gender), discrimination or ignored pools of workers that produce or exacerbate problems with the size and structure of the IT workforce;[9]

4) Poor communication between IT stakeholders in workforce development that leads to coordination and misallocation problems in consortia or strategic partnerships;[10]

5) Regional/geographic and industrial differences (Silicon Valley, Route 128, Austin, Research Triangle Area) that uniquely characterize IT labor markets;[11]

6) Differences in the concentration of educational and technological development magnets (like federal labs or unique research labs) that anchor various IT sectors.[12]

In rather simplistic terms, the occupational complexity has been portrayed as a series of "shortages" and "tight labor markets", which result from the conventional malfunction of supply and demand mechanisms.[13] In more common parlance, the shortages translate into employers claiming inability finding workers, workers claiming having a difficult time finding jobs, and others constantly warning the public about the impending catastrophic effect of these shortages for the American economy.[14]

Second, it is critical to dissect the general picture of growth because the IT workforce is no longer concentrated in one sector but spread throughout the whole economy, ranging from health, commerce, and manufacturing, and even into some segments of the retail industry.[15] This dispersion and strong sectorial interdependency indicates that the IT workforce is much more than a "labor input" but a "strategic thrust" that serves as the binding force to entire sectors, especially in knowledge-based, high-tech and bio-tech clusters. This dispersion and interdependency happens also on a regional scale, since many of these clusters remain highly dependable on geographic proximity to maintain a competitive edge.[16] Many of these companies are also global economic players which further require flexible IT workers that can handle the technologies of global economic interaction. In this context, workforce development emerges as a regional necessity. The development of regional workforce development systems, however, has not received the necessary attention.

Third, at the enterprise or firm level (workplace), especially in knowledge-based industrial sectors, the traditional human resource (HR) function concerned with accounting, hiring, compensation, and conflict management no longer satisfies the demands of the current technological environment of rapid "open innovation" and competitiveness. A dramatic shift has taken place from traditional HR into human resource development (HRD) which involves a more proactive vision of human resources that anticipates human resource needs, sees training as core value for the organization, commitment to learning, facilitation of self-management and self-learning, skill flexibility, teamwork, and IT fluidity, among other new features.[17] The shift, however, has not been necessarily swift. In this environment of open innovation, stakeholders in the IT sector (industry, government, community, academia) are having difficulty defining the content, scope and currency of their workforce development strategic needs and efforts. The educational challenge is particularly big and complex.

Given the occupational complexity of the sector, the spread of the IT workforce and the competitive interdependencies it creates, and the needs to feed new practices into HRD, what kinds of institutional connections, or labor market intermediaries, are necessary to assure the flow of talent through specific segments of the educational pipeline, from high school to higher education, and into specific employers, industries, and local sub-regional labor markets?

III Collaborations and Labor Market Intermediaries to Preserve the Competitive Edge

Recently, several reports have emphasized that Massachusetts, and especially the Greater Boston Area, have competitive advantages in knowledge- and technology based industries clustered around life-and non-life sciences and cutting-edge interdisciplinary research.[18] These reports outline in detail the scope of such advantages, and the potential of the regional economy to keep ahead given that important policy adjustments are made and strategic alliances are built among numerous actors. Although the state and the area have a large concentration of top public and private academic centers, teaching hospitals, research labs and institutes, and innovative industries, the relationships between them are not necessarily smooth. In that regard, the same reports identify serious weaknesses in the university-industry connection, and in the workforce development infrastructure (public and private), among other strategic flaws that could seriously hamper the capacity of the region to maintain a leading position in the new technological and economic environment of open innovation. The specific deficiencies regarding workforce development and education point to problems, for example, retaining talent, coordinating regional strategies for community colleges and technical workforce development, and a weakened state university system. For example, Massachusetts is good at graduating PhDs, but it falls behind other states in the generations of associate degrees, which is an extremely important educational segment when it comes to maintain leadership in key technological sectors.

Such complex problems of development cannot be solved by any one single agent or by the free action of markets. Collaborative and networked arrangements are more appropriate because the pressures require multi-institutional approaches to workforce development and education in order to collate the needs of these multiple agents at different stages of product and innovation cycles, and regularly carrying business across multiple sectors of technological expertise. In some instances, forming, implementing, and sustaining such collaborations has been the work of emerging labor market intermediaries. These intermediaries, in rough terms, try to match jobs and workers when the labor market and workers are affected by multiple kinds of institutional and educational deficiencies. They function in central cities, embedded within some sectors or clusters, such as health, hospitality and high-tech, or they work at a regional scale.[19]

The Advanced Technological Education Centers (ATE Centers) funded by the National Science Foundation perform some of the roles carried by labor market intermediaries. They seek to create partnerships between industry, business, government, and other education sectors to ensure that students are equipped with the skills they need to gain meaningful employment in high-tech sectors. Some 30 of these centers have been created. Their scope can be rather local and sector-based or they can have an overt regional character.[20] In Massachusetts, the Boston Area Advanced Technical Education Connections (BATEC), created in 2003, is one of these "centers", which in fact is more a collaborative effort than a "physical center" grounded at the University of Massachusetts Boston and connecting multiple agents.

IV Boston Area Advanced Technical Education Connections (BATEC) and the Basic Model

BATEC is a partnership comprised by three community colleges, the Boston Public Schools, nine Boston rim school districts and the University of Massachusetts/Boston. During its first stage, BATEC has been developing a coordinated regional IT education system, and has managed to create a collaborative platform strongly connected to the multiple industrial actors of the greater Boston high-tech sectors. More specifically, BATEC's activities have concentrated in producing internship and education fairs in high schools, new degree programs in community colleges, standard-based courses, "bridge-to-community college" programs with community-based organizations, IT modules, new degree programs and research in 4-year colleges, partnerships with regional institutions, and harnessed tremendous support from employers and industry associations.[21]

BATEC's accomplishments in three years of activity can be easily grasped from its summary report of activities.[22] But the annual summary report does not completely convey the maturation of BATEC's systemic approach to workforce development in IT. Since its inception three years ago, BATEC's approach has been evolving from a set primary activities aimed at engaging the basic actors in the initial grant, community colleges, high-schools, employers, into a more cohesive and geographically bounded platform that can generate workforce development products for a broader set of stakeholders in the Greater Boston Area, which roughly extends to the west to the mid-size city of Worcester, and to the north to Route 128, the state's dynamic high-tech corridor.

BATEC, although not a full-fledged regional workforce development system for IT, in retrospect has been promoting some practices which can be used as guideposts in workforce development system-building. First, it is critical to assemble a team of committed stakeholders in order to harness significant financial support to roll-out a first wave of concrete activities over a sustained period of time (1-3 years). BATEC secured a $3 million anchor grant from the NSF. The University of Massachusetts Boston and individual leadership from BATEC's design team were important protagonists in the process.

Second, in order for the use of the resources to elicit sustained participation in the emerging workforce development system, the network-building philosophy should be driven by openness and "flat" inclusive practices which do not try to impose ready made, one-size-fits-all, or of-the-shelf activities to the potential institutional participants. The network-building philosophical approach simply concentrates in creating the opportunities for the institutions so they could further build upon some of their own strengths and interests in the IT field.[23] Obviously, these strengths and interests are often unevenly spread (and expressed) among institutional participants due to factors such as the inequitable access to educational resources (human and hardware) and to leading-edge technological developments, and socioeconomic disadvantages. In this regard, BATEC also sees itself as an agent of knowledge diffusion that connects some disadvantaged institutional agents to the flow of knowledge resources in IT.

Third, after initial contact with a set of primary actors, it is critical to pursue deeper and individualized strategies of activity-building. BATEC pursued those with community colleges, high-schools, and some employers. The nature of the contacts, mainly short-term activities, intended to pull those actors into a "network space", and facilitate the creation of a common language around workforce development practices in IT. It is no secret that often employers do not know what happens in the classrooms of our academic centers, and even occasionally despise them. To the same extent, often academics do not have a clue about what goes on inside the workplaces of employers in various kinds of industries. Activities to modify this perceptual antagonism pave the way into the communicative practices (and language) that are so much necessary to generate and consolidate a primary arena for networking and broader system-building.

Fourth, along with securing basic funding and organizing primary system-building activities, devising a form of governance for the whole partnership becomes a critical necessity, and the process is, to say the least, not linear. At first, BATEC created a very organic representative structure with members from the main stakeholders in the initial grant layout (high schools; community colleges and employers.) However, BATEC soon realized that this structure was too rigid, and easily overwhelmed by the multi-tasking and frantic pace of interaction generated by the wave of activities in the "micro-arenas" that were forming within and around the primary actors (high schools; community colleges and employers.) This encouraged BATEC to maintain a general "leadership team", formed by those responsible for managing BATEC and its activities, and to expand its "advisory board." Members of the BATEC Advisory Board include executives from local businesses; leaders from industry organizations; representatives from state and local government; and heads of community-based organizations. The Advisory Board is divided into four "leadership subgroups" in education, industry, business, and underrepresented groups. They provide substantial feedback on BATEC's proposed activities, help identify industry trends and workforce needs, and provide support needed to position BATEC for success in its metrics with the National Science Foundation.

Fifth, it is essential to establish a track-record for the partnership so it can build its profile and sustain its visibility over time. This is not a straight marketing exercise because the strategic objective is to attract **and** to maintain stakeholder participation,

and to increase legitimacy vis-à-vis those stakeholders. Workforce development in IT (and in other fields) is hampered by the pervasive misconception that learning is a terminal stage in the life of workers, a "one-shot deal" or an "entry-and-exit" practice into the training or educational market. By contrast, effective workforce development rests on longer-term commitments to learning by all stakeholders. Thus, for the partnership to remain relevant, it must regularly update its supply of products and in connection to the "production function" or the "value-added chain" of the various actors within the partnership and the emerging network as a whole. In addition, this is critical matter when the public higher education system, as mentioned before, has bee lagging in terms of its capacity to address labor market needs in IT. BATEC has concentrated in numerous activities which precisely intend to achieve that. For example, BATEC regularly organizes new courses and offerings for distinct groups, ranging from teachers and job counselors. Also, BATEC puts out its contribution and entices institutional participation and commitment to long-term workforce development though different kinds of outreach venues that range from open IT fairs in high schools and community colleges to more structured industry summits in which educators and industry come together to learn about each others strategies and problems.

Finally, the partnership, within a short period of time, begins to require research capacity for various purposes: (1) new product development; (2) strategic planning; (3) evaluation; (4) case development to document practices and disseminate innovation and learning. BATEC is supporting research, for example, to investigate the needs of the Boston Regional Technological Space and the forces driving the occupational dynamics in key employers of the area, and on how is the skill mix changing in IT jobs to influence employability and IT fluency. BATEC has also been a catalyst for community colleges to generate and use research to create various concentrations that take advantage of technological advances in IT, more specifically in cyber forensics, networking and visual technology.

During the last three years, after organizing and putting in place these practices BATEC has been increasingly devoting greater organizational energy to overall system-wide building efforts. That is, running and growing BATEC is demanding a shift in the scale and scope of its activities. In hindsight, the practices outlined above can offer a template to think through the strategic steps BATEC must take to serve as a leading force in shaping a regional workforce development system in IT. What are the basic items in this template to shape a regional workforce development system?

v Defining and Shaping the Regional Workforce Development System in IT

For the purpose of this paper, a regional workforce development system is defined as those processes and institutions that finance, regulate, provide services, maintain, and link the core functions and activities necessary to prepare and support workers and to respond to the human resources needs of employers on a geographical scale, often inclusive of a central metropolitan area and its surrounding political and local governance jurisdictions.[24] Based on this definition and focus, six interrelated components of a regional workforce development system can be identified:

- Financing
- Oversight and Governance
- Workers' services
- Employers' services
- Research
- System netting

The last component, system netting, is particularly relevant to BATEC's current challenges. System netting refers to activities that concentrate in developing a regional outlook or vision for the system as a whole, the development of policies and programs, structuring partnerships and collaborations among stakeholders, and focusing resources where needed to satisfy the needs of both workers and employers.

For BATEC, regionalizing implies significantly expanding its collaborative platform to incorporate new educational actors in other parts of the state. The governance, management, and programmatic challenges might call for replicating small compacts as the one already developed in the Greater Boston Area. Certainly the Greater Boston Area, given the concentration of jobs and employers in that area, would serve as the anchor of the system, and the regionalizing effort would concentrate in spreading services and knowledge from Boston into other areas, perhaps focusing in the creation of local capacities to sustain IT growth locally to avoid a workforce development drain into the Boston Area. Parallel support with economic development strategies by other agencies would need to be a key component of this overall strategy.

BATEC is assessing the prospects of scaling-up and regionalizing its collaborative platform. In the process, BATEC has to devise concrete practices to augment the connectedness between educational agents, industry and other stakeholders to assure the relevance of its products and value-added contribution to the IT world. In short, BATEC has to think the various aspects of creating a regional workforce development system for IT, which so far has been in the agenda of the partnership, yet not a full strategic goal until recently.

Conclusion

While the IT sector seems to be recovering from the economic downturn during the early part of the decade. Its recovery masks various dynamics that represent a challenge to workforce development practitioners. In Massachusetts, as in other locales, preserving the competitiveness of the IT sector entails regionalizing workforce development. BATEC was formed and has grown with that challenge in mind. Its practices during a first stage of growth can be used as guideposts to shape a regional workforce development in IT. Strategic steps are required in the following areas that comprise the scaffolding of a regional workforce development system: (1) financing; (2) oversight and governance; (3) worker's services; (4) employer's services; (5) research; (6) system netting.

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