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Institutions of Higher Education as Engines of Small Business Development

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Abstract

Universities today exert an ever-increasing stimulus to small business development, contributing to national and local economic development as the general economy becomes increasingly knowledge-based. The transition to a knowledge-based economy, coupled with the passage of the Bayh-Dole Act in 1980, has resulted in stronger university-industry partnerships in technology transfer, promotion of business incubators, and entrepreneurship development. Today, over two-thirds of all licenses and options executed annually by academic institutions are conducted with small businesses; in 2002, academic discoveries led to the formation of 450 companies, and 569 products based on university research were made commercially available. At the local level, about 25 percent of business incubators are sponsored by universities, while institutions of higher education are also emerging as major players in local community revitalization and economic development through funding from federal agencies including HUD, Labor, Commerce, and the SBA.

Introduction

Universities are crucial elements of the social fabric, playing a critical role in national and local economic development. Despite the nation's preoccupation with large corporations, small businesses often drive innovation and constitute the most dynamic sector of the American economy. Small businesses, however, face many challenges that make them risky undertakings; most firms fail within a few years of start-up. How have universities in the past helped strengthen and sustain this important sector of the American economy, and how can they augment this function? The two primary modes of intervention are technology transfer and community development.

Technology Transfer

The traditional role of universities, especially the major research universities, has been to provide the development of knowledge and personnel training that can then be infused into

the economy. Universities typically experience internal tension as they balance one type of mission—generating pure knowledge and educating students for citizenship—with another: the applied aspect of technology transfer. In recent years, however, universities have almost universally placed increased emphasis on research funding from sources interested in workable, practical products. In part, this emphasis is due to the increasingly knowledge-based economy, which leads government and the private sector to increase their support for many kinds of research. The National Science Foundation (NSF) and the National Institutes of Health (NIH) have played a critical role here, while the more controversial military and security research emanating from the Department of Defense and other security agencies has helped universities expand their applied research functions. Similarly, direct support from such industries as information technology and pharmaceuticals has motivated expanded practical research initiatives. Increasingly, these research activities both feed the large corporate sector and stimulate new small businesses initiated by faculty or other entrepreneurs who link themselves to the university.

Community Development

Knowledge creation and technology transfer constitute only one role that the university plays in stimulating small business. The physical presence of universities in distressed, undercapitalized communities has in recent decades led to university-community partnerships for the holistic revitalization of local areas. Universities often now see great opportunities to influence the communities and regions in which they are located through active engagement in community development and economic revitalization. Such contributions of universities to communities and economic development are widely recognized, and universities have come to be acknowledged as powerful engines of economic growth and development *(Appleseed, Inc. 2002)*.

In part, this initiative comes from enlightened self-interest; in part, it has evolved from increasingly knowledgeable local stakeholders insisting on university accountability to the public, holding these mighty presences in the community responsible for the community around them. In part, federal stimulus for such partnerships has come from U.S. Department of Housing and Urban Development (HUD) and U.S. Department of Health and Human Services (HHS) revitalization programs as well as community-oriented requirements in NSF and NIH programs.

University-community partnerships generally include an important role for small business development, since economic development is central to any sustained community development effort. The specific roles for the university coming from this side of the economic development process include technical assistance to existing and start-up businesses through the Small Business Development Center (SBDC) program of the Small Business Administration (SBA), for which universities typically provide extensive matching support; business incubators, with technical assistance and some material support for innovative initiatives; and university-based purchasing by students, staff, and university units from local businesses. Thus, while this set of roles is not entirely divorced from the knowledge production and technology transfer function—incubator projects in particular bridge both roles—the role of the university as a powerful local institution with particular technical and financial strengths plays a central role in community economic development, complementing the university's broader role as a key component of economic development at the national level.

Knowledge Creation and Technology Transfer: Traditional Roles Today

Universities have long been considered society's primary source for the creation and dissemination of knowledge. Even when, one hundred years ago, leaders of private colleges such as Johns Hopkins University and Columbia University spoke of an urban mission connected to their communities, and while land-grant schools spoke of the boundaries of the University of Wisconsin being the borders of the state,[1] the primary university function remained knowledge creation, in particular the generation of educated and skilled graduates for the national economy and culture. The universities effectively fulfilled this role through teaching and research, and continue to do so today with even greater effect.

The broadening of the role of universities—from generating educated graduates to powerful engines of economic development—emerged with the knowledge-based economy over the last three decades. The exponential growth rates in technology development, the information and communications technology revolution, and globalization and its associated competitive challenges transformed the world's leading economies. Today the production, dissemination, and use of knowledge enhance economic growth,

job creation, competitiveness, and welfare more than ever. The knowledge-based economy reflects the accelerating importance of innovative ideas and technology embedded in services and manufactured products. As the World Bank has noted,

> Today's most technologically advanced economies are truly knowledge-based. And as they generate new wealth from their innovations, they are creating millions of knowledge-related jobs in an array of disciplines that have emerged overnight: knowledge engineers, knowledge managers, knowledge coordinators. *(1998/1999, 16)*

Economics has long recognized, at least nominally, the importance of knowledge to economic development. Nineteenth century economist Alfred Marshall noted in 1890 that knowledge was the most powerful engine of production; Joseph Schumpeter similarly noted in the twentieth century the interconnection of entrepreneurship, innovation, and technical change *(Marshall 1920; Schumpeter 1934)*. Standard neoclassical economic growth models, however, have tended to focus on the accumulation of physical capital and the growth of labor as the primary ingredients of economic growth; technological progress tends to be treated as strictly exogenous and is captured in residual parameters in the models. More recently, economists have introduced measures of ideas, research, and knowledge into the production function *(Romer, 1993)*, thus modeling economic growth and productivity as functions of the rate of technical progress and the accumulation of knowledge. The World Bank notes that

> . . . for countries in the vanguard of the world economy, the balance between knowledge and resources has shifted so far towards the former that knowledge has become perhaps the most important factor determining the standard of living—more than land, than tools, than labour. Today's most technologically advanced economies are truly knowledge-based. *(1998/1999, 16)*

Agreeing, Alan Greenspan, chairman of the Federal Reserve Board, stated that "over time and particularly during the last decade or two, an ever increasing share of GDP has reflected the value of ideas more than material substance or manual labor output" *(2001)*. Similarly, the Progressive Policy Institute argues that the net stock of intangible capital (e.g., education and research and development) has grown faster than that of tangible capital (e.g., buildings, transportation, roads, and machinery). Moreover,

it argues, federally financed intangible capital has increased from 60 percent of the value of federally financed physical capital in 1970 to 93 percent today *(Progressive Policy Institute 2004)*.

With these transformations, a variety of models of collaborations among universities, public research institutions, and private companies have emerged. For instance, the Southern Growth Policies Board reports on a variety of university-industry partnership activities, including technology transfer, industrial extension and technical assistance, entrepreneurial development, industry education and training partnerships, and career services and placements *(Tornatzky, Wagman, and Gray 2002)*.[2] Similarly, Appleseed, Inc., in its seminal report on the economic impact potential of the eight Boston area research universities, claims that international companies are coming to the Boston region to take advantage of the research generated by these universities *(2002)*[3] while the universities are also playing an active role in the promotion of industry clusters *(Paytas, Gradeck, and Andrews 2004)*, consistent with Michael Porter's 1998 study on the vital role that universities play in cluster-based economic development.[4] Paytas and colleagues *(2004)* expanded both Porter's insight and the findings of the Appleseed study in their review of eight universities across the nation that are stimulating industry clusters in their respective regions. The report found that, within a region, universities are best able to affect the growth of young, emerging clusters, although such cluster support requires a "broad commitment of significant university resources across a variety of departments aligned with the needs of the cluster" *(ii)*.

Three types of university-industry partnerships have evolved within the traditional role of universities and influenced by the knowledge economy process. They are research and technology transfer, business incubation, and entrepreneurship development.

Research and technology transfer: University technology transfer activities include (1) research partnerships with industry; (2) patenting and licensing university intellectual property; (3) technical and managerial assistance programs; (4) business incubators; (5) research parks; (6) venture capital and start-up activities; and (7) continuing education *(Matkin 2000)*.Universities were engaged in industry-based research and product development prior to the passage of the Bayh-Dole Act in 1980; nevertheless, the act was instrumental in strengthening and consolidating the university-industry relationship in the field of research and transfer of technology. Until the passage of this act, federal agencies retained the

intellectual property rights resulting from research that they funded, limiting the transfer of technology to businesses for commercialization. However, the Bayh-Dole Act and the subsequent policy regulations permitted universities and small businesses to take ownership of inventions made under federal funding and become directly involved in the commercialization of these inventions. The funneling of federal funds for research and development (R&D), combined with ownership rights over their inventions, provided universities with the opportunity to expand their research activities in collaboration with companies.[5] U.S. academic institutions spent $33 billion on R&D in 2002, of which federal agencies provided an estimated $19 billion or about 58 percent, academic institutions about $7 billion, state and local governments about $2.2 billion, and industry $2.1 billion, or 6.8 percent. Between 1972 and 2002, the average R&D growth rate of the academic sector was 4.5 percent. This R&D growth resulted in the increase in patenting by academic institutions from 250 in the 1970s to 3,200 in 2001 *(National Science Board 2004)*. Academic R&D funding by the industrial sector grew faster than funding from any other source during the past three decades, evidencing the close relationship between university R&D and industry. Furthermore, federal regulation now provides that in the marketing of their inventions, universities must give preference to small business firms, provided such firms have the resources and capability for commercializing the inventions *(Rights to inventions 1999)*. According to the National Science Board *(2004)*, "University-industry collaboration and successful commercialization of academic research in the United States contributed to the rapid transformation of new and often basic knowledge into industrial innovations, including new products, processes, and services."

"The federal government encourages university-industry partnerships, often with a focus on the small business sector of industries, through a variety of specific federal programs."

The majority (over two-thirds) of licenses and options executed in 2002 by academic institutions (including universities, hospitals, nonprofit research institutions, and patent management and investment firms) were done with small existing companies

or start-ups, undoubtedly influenced by the Bayh-Dole Act's mandate that universities give preference to small businesses. In cases of unproven or very risky technology, universities often opt to make an arrangement with a start-up company because existing companies may be unwilling to take on the risk. Faculty involvement in start-ups may also play a key role in this form of alliance. The majority of licenses granted to small companies and start-ups are exclusive; that is, they do not allow the technology to be commercialized by other companies.

The Association of University Technology Managers (AUTM) notes that academic institutions reported 15,573 invention disclosures and 7,741 new U.S. patent applications filed *(AUTM 2003)*. Of the 4,594 licenses and options executed in fiscal year 2002 by academic institutions, 68.2 percent of new licenses and options were with newly formed or existing small companies; of licenses to start-ups and existing small companies, 91 percent and 45.4 percent respectively were exclusive. In 2002, academic discoveries led to the formation of 450 companies; 83 percent of these were located in the same state as the academic institution. About 569 products based on university research were made commercially available to the public in the same year.

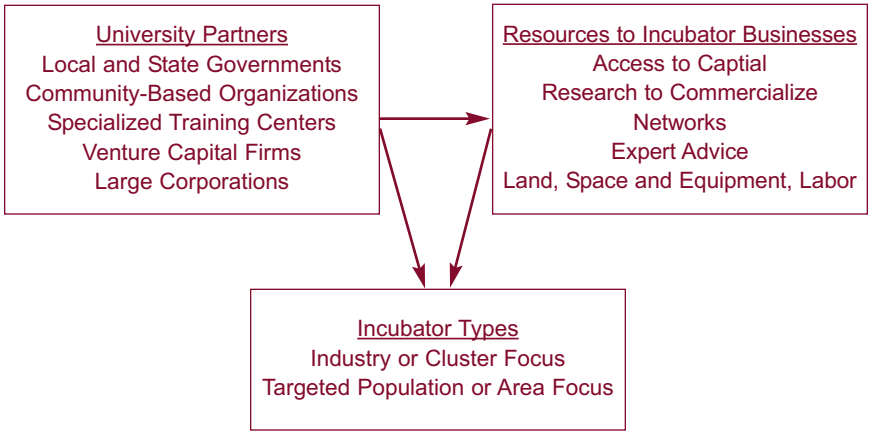
The federal government encourages university-industry partnerships, often with a focus on the small business sector of industries, through a variety of specific federal programs. These include the Small Business Technology Transfer Program (STTR) and the Small Business Innovation Research (SBIR) of the U.S. Small Business Administration. SBIR encourages small businesses to explore their potential for innovating new technologies often developed at universities, and it provides the incentive to profit from their commercialization. By reserving a specific percentage of federal R&D funds for them, SBIR protects small businesses and enables them to compete on the same level as larger businesses. SBIR funds the critical start-up and development stages and encourages the commercialization of the technology, product, or service. Since its creation in 1982, as part of the Small Business Innovation Development Act, SBIR has helped thousands of small businesses to compete for federal research and development awards, often in partnership with universities and sometimes under the leadership of key university faculty.

STTR is a small business program that extends funding opportunities in the federal innovation research and development arena. Central to the program is the expansion of the public/private

sector partnership to include joint venture opportunities for small business and the nation's premier nonprofit research institutions, including colleges and universities. STTR reserves a specific percentage of federal R&D funding to award to small business and nonprofit research institution partners. While R&D efforts may be beyond the means of many small businesses, and nonprofit research laboratories may focus on exploratory and theoretical research rather than practical applications, STTR attempts to combine the strengths of both entities by introducing entrepreneurial skills to high-tech research efforts. The technologies and products are transferred from the laboratory to the marketplace. The small business profits from the commercialization, which, in turn, stimulates the U.S. economy.

Business incubation: A logical offshoot of growing technology transfer from universities and research institutions to small businesses is assisting these businesses with the commercialization of research efforts through business incubators. Business incubators nurture new and small businesses by supporting them through the early stages of development with a wide range of services, including the provision of management guidance, access to financing, technical assistance, and consulting tailored to young, growing

Figure 1. Relationships in a Workable University Engagement Model



Source: ICIC and CEOs for Cities 2002

companies. Incubators usually also provide clients access to appropriate rental space and flexible leases, shared basic business services and equipment, technology support services and assistance in obtaining the financing necessary for company growth.

As of 2001, there were over one thousand business incubators in the United States, compared to a total of twelve in 1980 *(NBIA 2004)*. The incubation model has been adapted to meet a variety of needs, from fostering commercialization of university technologies to increasing employment in economically distressed communities to serving as an investment vehicle. Most American business incubators (about 90 percent) are nonprofit organizations focused on economic development; 47 percent of these incubators are "mixed-use," assisting a range of early-stage companies, while 37 percent focus on technology businesses. In 2001 alone, American incubators assisted more than 35,000 start-up companies that provided full-time employment for nearly 82,000 workers and generated annual earnings of more than $7 billion *(Linder 2003)*.

"[A]bout 25 percent of American business incubators are sponsored by academic institutions."

Universities are the biggest sponsors of business incubators. According to the NBIA, about 25 percent of American business incubators are sponsored by academic institutions, 16 percent by government entities, 15 percent by economic development organizations, 10 percent by for-profit entities, and 10 percent by other types of organizations. Figure 1 shows the relationships in a workable university engagement model.

Entrepreneurship development: Universities encourage entrepreneurship through academic programs, cocurricular activities, and community outreach. These methods of strengthening the small business sector represent an important model of university support for small business. The Ewing Marion Kauffman Foundation, the leader in the United States for entrepreneurship education, reports that the United States outranks all other developed countries on entrepreneurship *(2004)*. American universities have been playing a major role in entrepreneurship development. With more college courses and programs in entrepreneurship than ever before, more than 1,500 colleges and universities offer

some form of entrepreneurship training—a trend that started in the early 1990s and continues to flourish *(FastTrac 2003)*.

> Indeed, the United States continues to be a leader in entrepreneurship education and training at the undergraduate and graduate levels. The recent development of joint programs between engineering and business schools and the increasing number of university incubators are just two signs of the appreciation developed in the United States for entrepreneurship education. *(Ewing Marion Kauffman Foundation 2004, 26)*

The Kauffman Foundation itself promotes university support of entrepreneurship through grant programs. In 2003, it provided $25 million to eight universities to transform the culture of these schools by creating university-wide entrepreneurship programs that touch every student in the school. One of these eight schools, Howard University, implemented a university-wide requirement that freshmen participate in entrepreneurship training, including a Saturday "Entrepreneurship Boot Camp" designed to stimulate the spirit of entrepreneurship among the students. Other grant programs are more modest. Kauffman's Entrepre-neur Internship Program has provided $10 million to 171 academic and support organizations to give college students hands-on experience working side-by-side with active entrepreneurs, while the Kauffman Collegiate Network encourages innovative approaches for making entrepreneurship a common and accessible experience for all college students through grant programs.

"Besides teaching enrolled students, higher education institutions also provide education and training to existing business owners and entrepreneurs through community-outreach programs . . ."

Besides teaching enrolled students, higher education institutions also provide education and training to existing business owners and entrepreneurs through community-outreach programs such as FastTrac, a curriculum designed to provide entrepreneurs with business knowledge, leadership skills, and professional connections in order to create or expand businesses. This program is provided by 270 partner organizations in 49 states *(FastTrac, FastTrac Fact Sheet)*.

Many universities are combining campuswide initiatives with their SBA-sponsored Small Business Development Centers. For instance, at the University of Georgia, the SBDC approached the university's College of Veterinary Medicine, College of Pharmacy, Law School, College of Agriculture, and School of Psychology and created a partnership with the two former schools for this broader initiative. Both schools revised their curricula to include significant courses promoting entrepreneurship among the students, with considerable success in business creation in these professional fields *(Sanford 2004)*.

Kauffman considers this approach—strengthening the U.S. economy through university-industry-government-entrepreneur collaborations—a model for the world economy, with the caveat that government pays inadequate attention to the entrepreneurship component of the equation *(Schramm 2004)*.

Small Business Development Centers

The U.S. Small Business Administration (SBA) administers the Small Business Development Center (SBDC) program to provide management assistance to current and prospective small business owners through a network of more than 1,100 service locations. Each state has a lead organization, frequently a university, that manages the SBDC program and provides program services through subcenters and satellite locations in each state. These service sites are located in colleges, universities, community colleges, vocational schools, chambers of commerce, and economic development corporations.

SBDCs, cooperative efforts of the private sector, the educational community, and federal, state, and local governments, offer one-stop assistance to individuals and small businesses by providing a wide variety of information and guidance in central and easily accessible branch locations. The SBDC program is designed to deliver up-to-date counseling, training, and technical assistance in all aspects of small business management, including finance, marketing, production, organization, engineering, and feasibility studies. Special SBDC programs and economic development activities include international trade assistance, technical assistance, procurement assistance, venture capital formation, and rural development. Since 1980, over nine million entrepreneurs have been served by the SBDCs. In fiscal year 2003 alone, SBDCs counseled and trained more than 687,000 clients *(SBA 2004)*.

Howard University has operated the District of Columbia's SBDC since 1976 and has demonstrated through its work the value of such university support for small business development. Through tens of thousands of counseling sessions and thousands of training sessions, small businesses have achieved remarkable successes. Through the SBDC's efforts, millions of dollars of federal procurement contracts have been brokered and millions more in loan packages prepared. Businesses served range from gas stations, small trucking companies, and catering businesses to translation service providers, security services, retail operations, and professional service providers. Extensive partnerships with community development corporations, federal agencies, local businesses, and business organizations have enmeshed Howard University, with its extensive set of resources, in the economic life of its surrounding city. When combined with the new entrepreneurship initiative engaging thousands of students in entrepreneurship preparation, an even closer connection between the university and small business development is being fostered. Similar stories of university-led SBDC initiatives hold throughout the nation.

The Office of Small Business Programs (OSBP) in the Department of Labor makes a special effort through its minority colleges and universities program to enlist the assistance of hundreds of the nation's minority schools in obtaining procurement opportunities for small businesses, small disadvantaged businesses, women-owned small businesses, HUBZone businesses, and businesses owned by service-disabled veterans.

Economic Development and Revitalization

Institutions of higher education are also playing an important role in the holistic revitalization of their communities. A college or university can be a major employer in its region, often one of the largest employers. Such institutions are a major source of income flow to localities and regions from spending streams from students, staff, and the institution itself. For instance, the economic impact of the eight universities in Boston on the regional economy is more than $7 billion *(Appleseed, Inc. 2002, 6)*. In Washington, D.C., Howard University similarly plays a major role in the economy, with 4,456 staff, 1,598 faculty, and approximately 10,000 students. About 40 percent of the students live in dormitories in the city, and about 38 percent of the off-campus students live in the Shaw neighborhood adjacent to the university,

constituting an important source of local demand *(Hammer, Siler, George Associates 1994; Howard University Office of University Research and Planning 2004)*. The combined purchasing activities of this one university constitute an economic stimulus in the tens of millions of dollars in its locality *(Muhammad, Manong, and Green 2000; Hammer, Siler, George Associates 1994)*. With over a dozen institutions of higher education in the Washington, D.C. area, the impact on small businesses from the local educational sector is profound. Since many students are from other states and other countries, universities constitute a significant "export industry" bringing in revenues to the locality.

"[T]he economic impact of the eight universities in Boston on the regional economy is more than $7 billion . . ."

Several universities now have developed clear strategies to build strong relationships between student bodies and communities through a wide range of activities. Such activities may include student internships and placements, consultancy, workforce development, and service-learning. A prominent model of university-business relationship focusing on economic growth includes six activities: purchasing from local businesses, employing local residents, using university real estate development to anchor local economic growth, offering incubation services, building the local business capacity, and addressing local workforce needs through workforce development *(ICIC and CEOs for Cities 2002)*. Strategies developed by several universities to build a relationship with local businesses have helped small businesses find steady customers and clientele and, through their growth, spur the economic revitalization of their respective communities.[6]

The U.S. Department of Housing and Urban Development has recognized for over a decade the importance of university-community partnerships. Through its Office of University Partnerships (OUP), many university-community partnerships that include important components of small business development have emerged. For instance, the University of Hawaii–Leeward Community College (UH-LCC) provides small business incubation services, including support for start-up and incubation of local professional services agencies that will provide technology services to local businesses and organizations in the communities

of the Waianae Coast, an isolated coast of the Hawaiian island of Oahu. The business incubator program is part of a Digital Technology and Telecommunications Institute that UH-LCC is helping to establish at Waianae High School. The program includes community access to digital media; video production services for local businesses that need assistance with the Internet; and public and cable television production. Waianae Coast Coalition, an active community organization of Waianae residents, pioneered the business incubation program with its Com-munity Business Development Institute.

"[A]ctions and initiatives by institutions of higher education are driving both local revitalization efforts and surging local economic development."

In the same vein, historically black colleges and universities (HBCUs) and other minority educational institutions have long had, and continue to have, a strong hand in economic revitalization of communities in their neighborhoods. The U.S. Department of Housing and Urban Development (HUD) administers a grant program that specifically targets HBCUs as innovators and supporters of community revitalization projects. Similar smaller programs exist for Hispanic-Serving, Tribal, Alaska Native, and Native Hawaiian institutions of higher education. These programs are designed to assist HBCUs in expanding their role and effectiveness in addressing community development needs in their localities, including the facilitation of the establishment and expansion of microenterprises (OUP). Over $75 million has been made available by HUD to HBCUs under this program. Howard University, for example, has accessed this program to help fund and strengthen its role in its surrounding community. Its endeavors have included the encouragement of small business development through a microloan program and community-based business training.[7]

The Community Outreach Partnership Centers (COPC) program of HUD's Office of University Partnerships is open to all institutions of higher education and provides funds to four- and two-year universities and colleges to set up centers that will provide, among other community-based services, job training, financial assistance, and technical assistance to new businesses.

With federal support, foundation funding, and internal mobilization of resources, hundreds of institutions of higher education have moved into a more aggressive posture in support of small business development in their communities, whether through direct services to small businesses or through broader community revitalization initiatives. These efforts complement and help focus the direct economic impact of the universities as sources of demand for small business.

Conclusion

Nationally, universities have played and continue to play an important role in the development of small business. The traditional strength of institutions of higher education is the generation and dissemination of new knowledge that can lead to important economic developments. They also train many of the skilled technicians and entrepreneurs who make an impact on the nation's economy. As the knowledge-based economy transcends the historical economy in which growth was based on physical capital and labor, this role can only grow in importance and global reach. Small businesses brought about directly by faculty members as well as by university-business collaborations will continue to influence the pace and quality of the U.S. and world economies.

Locally, deliberate as well as unplanned actions and initiatives by institutions of higher education are driving both local revitalization efforts and surging local economic development. These projects are often supported through federal grants, which provide the incentive for many universities to turn their attention to the communities in which they are located. Business development in these communities is a critical part of any urban revitalization process, and small business as the most flexible form of transformation will continue to be fueled by government initiatives.

Can universities do more without deviating from their fundamental missions? In fact, they are likely to be driven by real-world developments around them to undertake this strategy. Funding crises in both public and private higher educational circles are leading innovative administrations to seek more entrepreneurial methods for financing their institutions. At the same time, the world's leading economies are becoming more and more dependent on the skill, insights, and breakthroughs developed at universities. The path ahead is likely to be more of intersecting partnerships: universities with their surrounding communities,

universities with large and small businesses, and interuniversity partnerships to stimulate the knowledge base of the society. Close attention by institutions of higher education to the needs of the small business community in their neighborhoods and in their spheres of interest will be handsomely rewarded by broad economic and social progress in the coming decades.

Endnotes

1. Seth Low, president of Columbia College (now Columbia University) from 1890 through 1901, argued that "the city may be made to a considerable extent, a part of the university." In "The University and the Workingman," Low noted that the "workingmen of America . . . [should know] that at Columbia College . . . the disposition exists to teach the truth . . . without fear or favor, and we ask their aid to enable us to see the truth as it appears to them" *(quoted in Bender 1987, 282)*. Bender *(1987, 279–84)* and Harkavy *(1992)* offer further discussion of this broad vision.

2. The case studies of universities presented in the report include Georgia Tech, North Carolina State University, Ohio State University, Pennsylvania State University, Purdue University, Texas A&M University, University of Wisconsin, Virginia Tech, University of California at San Diego, University of Utah, Carnegie Mellon University, and Stanford University.

3. The universities studied in the Boston area include Boston College, Boston University, Brandeis University, Harvard University, Massachusetts Institute of Technology, Northeastern University, Tufts University, and University of Massachusetts–Boston. See http://www.masscolleges.org.

4. Porter defines industrial clusters as geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (such as universities and trade associations) in particular fields that compete but also cooperate.

5. *Working Together, Creating Knowledge: The University-Industry Research Collaboration Initiative* by Business-Higher Education Forum *([Washington, D.C.], 2001)* presents an excellent summary of university-industry research collaboration practices and the problems associated with it. The Business-Higher Education Forum is a partnership of the American Council on Education and the National Alliance of Business. For details see http://www.bhef.com.

6. The study was based on a survey of twenty colleges and universities, including Howard University, Columbia University, Virginia Commonwealth University, Pennsylvania State University, Yale University, and University of Illinois.

7. Descriptions of the University of Hawaii–Leeward Community College and Howard University case studies are based on information at the Web site of the Office of University Partnerships, http://www.oup.org.

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