RESEARCH REENVISIONED
for the 21st Century

Expanding the Reach of Scholarship at the
University of Massachusetts Boston

A Strategic Opportunity Assessment

Prepared by the Battelle Technology Partnership Practice
Excellence in academic research is critical to the Boston region’s ability to remain economically competitive with other areas of this nation and the world. In the words of Dr. Jack Wilson, president of the University of Massachusetts, and Dr. Robert Brown, president of Boston University, academic research fuels “a virtuous cycle that includes technology transfer, entrepreneurship, manufacturing and further research and development.”

For the first time, the United States is facing competition from developing nations not only in production costs but also in the areas of research, skilled labor, and innovation. This new global competition is felt most acutely in regions, like Boston, that rely on the intellectual capacities of its workers and the technological prowess of its businesses.

UMass Boston’s developing research base has the potential to be an important element in the region’s response to this growing global competition. As the only public university in the Boston region, UMass Boston is positioned to expand its research base in a manner that directly embraces its urban mission—focusing, for example, on “use-inspired basic research” that addresses the gaps in translating innovation between university research and the more applied and development-focused research of industry. In this way, the university can advance research objectives defined in concert with industry and community stakeholders, while seeking to collaborate with private research universities in the Boston area by filling gaps in interdisciplinary research that prevent the discovery of new applications.

A faculty-led panel at UMass Boston, the Research and Graduate Studies Committee, noted in its analysis of the value of research to the university:

The rigorous and innovative basic and applied research of our colleges, institutes, and centers will be admired for its contributions to public policy and the advancement of our understanding of multi-cultural, urban, social, environmental, educational, and technological issues. Business and industry leaders will view UMass Boston as a definitive source for new knowledge and discoveries, as well as a key source of highly trained personnel essential for growing the technology-driven global economy of the 21st century.

Research Reenvisioned for the 21st Century is a fact-based and detailed look at the university’s research activities—how the work of UMass Boston’s scholars is funded, carried out, and applied in real-world and theoretical contexts. An attempt to both define and assess the research initiatives and
Excellence in academic research is critical to the Boston region’s ability to remain economically competitive with other areas of this nation and the world.

Mass Boston has done much to advance its research enterprise in recent years. By nearly all measures of research activity—such as publications, funding, and doctorates awarded—the university is expanding its research base by leaps and bounds.

Publications Activity. The annual number of publications in peer-reviewed journals authored by UMass Boston researchers has increased significantly, from 168 in 2000 to 251 in 2005. This nearly 50% rise far outstrips the national rate of 19% for the same period.

Research Funding. From 2000 to 2006, UMass Boston realized a hefty 75% gain in its annual research base, a jump from $12 million to $21 million in funding. Even without a medical school, UMass Boston kept pace with the average rate of growth in research funding nationwide from 2000 to 2005, a period that partly encompasses the doubling of the National Institutes of Health research budget.2

Doctorates Awarded. UMass Boston offers doctoral study in clinical psychology, nursing, education, computer sciences, environmental sciences, chemistry, biology, and public policy. While there were ups and downs over the period 2000 to 2005, the overall number of PhDs granted rose from 31 to 48 during that period, a gain of more than 50%. By comparison, awarding of doctoral degrees in the same fields rose by only 32% nationwide.

UMass Boston’s achievements in research are not going unnoticed. A recently released “Faculty Scholarly Productivity Index,” conceived by Dr. Lawrence Martin, Graduate Dean at SUNY Stony Brook, and produced by Academic Analytics, rates UMass Boston fifth in the nation among small research universities with respect to publications, grants, and honors accorded to faculty members.3

In the future, nurturing the development of core competencies—or areas of expertise where UMass Boston faculty members can be regional, if not world, leaders—will be critical. For the purposes of this report, core competencies are defined as those areas where a university is equipped to bring...
An in-depth quantitative and qualitative analysis by Battelle identified core research focus areas at UMass Boston, spanning the social sciences and liberal arts, physical sciences, computational sciences, health sciences, and biological and environmental sciences. The quantitative dimension of Battelle’s analysis involved examining research funding, publications, graduate education, and service activities. Complementing this phase of the analysis were qualitative insights—gleaned from extensive field interviews of more than 50 UMass Boston faculty members and administrators—that were helpful in identifying the university’s broad areas of expertise, niche research strengths, and emerging areas of research activity.

Today, much leading-edge research involves multidisciplinary effort, combining core research focus areas into clusters that can address difficult scientific questions or major industry and community needs. In this environment, UMass Boston is positioned to advance a varied and robust set of opportunities that involve interdisciplinary research in applied and basic research.

Together a critical mass of activity—as measured by research, talent generation, and unique facilities and resources—in meeting or surpassing an identified measure of excellence.

**An in-depth quantitative and qualitative analysis by Battelle identified core research focus areas at UMass Boston, spanning the social sciences and liberal arts, physical sciences, computational sciences, health sciences, and biological and environmental sciences.**

### TABLE 1: RESULTS OF BATTELLE IN-DEPTH ANALYSIS OF CORE RESEARCH FOCUS AREAS AT UMASS BOSTON BASED ON QUANTITATIVE AND QUALITATIVE ANALYSIS

<table>
<thead>
<tr>
<th>Extensive Research Focus Areas at UMass Boston – positioned in primarily top and mid-tier levels of activity</th>
<th>Niche Research Focus Areas at UMass Boston – positioned in lower-tier levels of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging research</td>
<td>Applied linguistics</td>
</tr>
<tr>
<td>Clinical psychology</td>
<td>Cell biology</td>
</tr>
<tr>
<td>Disabilities research</td>
<td>Computer sciences</td>
</tr>
<tr>
<td>Early childhood development and education</td>
<td>Criminology</td>
</tr>
<tr>
<td>Ethnic studies</td>
<td>Dispute resolution</td>
</tr>
<tr>
<td>Environmental sciences and systems</td>
<td>Exercise science</td>
</tr>
<tr>
<td>Health policy and disparities research</td>
<td>Green chemistry</td>
</tr>
<tr>
<td>Qualitative and survey research</td>
<td>Lasers and photonics</td>
</tr>
<tr>
<td>STEM education</td>
<td>Organizational change</td>
</tr>
<tr>
<td>Workforce development</td>
<td>Regional economics</td>
</tr>
</tbody>
</table>

**Urban Health and Public Policy**
- Associated UMass Boston core research strengths: health policy and disparities research; aging research; clinical psychology; disabilities research; exercise and health sciences; ethnic studies; dispute resolution
- Linkage to regional drivers: health care

**Developmental Sciences**
- Associated UMass Boston core research strengths: clinical psychology; disabilities research; early childhood development and education; aging research; criminology
- Linkage to regional drivers: health care and biosciences

**Science and Math Education and Learning Research**
- Associated UMass Boston core research strengths: STEM education; early childhood development and education; workforce development
- Linkage to regional drivers: cross-cutting for ensuring quality future workforce

**Transnational, Cultural, and Community Studies**
- Associated UMass Boston core research strengths: ethnic studies; clinical psychology; organizational change; regional economics; dispute resolution
- Linkage to regional drivers: not a specific driver; more overall quality of life and inclusion

**Computational Sciences, Analysis, and Modeling**
- Associated UMass Boston core research strengths: qualitative and survey research; computer sciences; environmental sciences and systems
- Linkage to regional drivers: information technology

**Integrated Environmental Monitoring**
- Associated UMass Boston core research strengths: environmental sciences and systems; green chemistry; computer sciences; lasers and photonics; regional economics
- Linkage to regional drivers: environmental and renewable energy

**Biological Systems and Technology**
- Associated UMass Boston core research strengths: health policy and disparities research; cell biology; lasers and photonics; computer sciences; green chemistry; exercise science
- Linkage to regional drivers: health care and biosciences

**Sustainability and Social Venturing**
- Associated UMass Boston core research strengths: environmental sciences and systems; organizational change; green chemistry; regional economics
- Linkage to regional drivers: environmental and renewable energy

By nearly all measures of research activity—such as publications, funding, and doctorates awarded—the university is expanding its research base by leaps and bounds.
he University of Massachusetts Boston, commonly known as UMass Boston, is a young institution, formed in 1964. Its “urban mission” to actively engage and serve the communities that surround it is a chief reason UMass Boston is a valuable resource for the Boston region.

UMass Boston’s fulfillment of its urban mission is often measured in talent and community service. The only public university in the city of Boston, UMass Boston is dedicated to providing an affordable first-class undergraduate and graduate education to students from a variety of backgrounds. Well more than half of the students enrolled at UMass Boston come from lower-income and minority Boston-area communities, and many are the first in their families to attend college. The university has without question opened many doors to economic opportunity and advancement for its alumni, while developing courses of study specifically designed to generate the talent pools to serve the needs of Boston’s industrial base and its local communities. A large share of the region’s workforce in areas that have traditionally seen shortages of workers with critical skills—such as nursing, education, social services, and business management—are educated at UMass Boston.

UMass Boston has also committed itself to directly serving the needs of the Boston region. Among the university’s many direct community-service contributions are its involvement in the cleanup and continued monitoring of the Boston Harbor and other area waterways, advancement of K-12 science and math learning, focus on enhancing services to those with disabilities, efforts to address health disparities in Boston, and engagement and study of the cultural and community needs of ethnic minority communities in Boston. This record of service to the community recently earned UMass Boston recognition as one of only a handful of universities in the nation to receive the Carnegie Foundation’s “Community Engagement” classification.

Why does research matter to the urban mission of UMass Boston, particularly given its location in one of the nation’s leading regions for university research? The answer is quite simple. Without a broad and vibrant research base, UMass Boston cannot sustain or enhance its ability to generate top-quality talent and offer high-value service programs. This capacity, in turn, reflects the skills and knowledge base of a University’s faculty—the same faculty who play a central role in providing education and service activities.

Because it helps produce top-quality talent pools, university research is a major component of regional economic development. A study by the National Academy of Engineering on the impact of academic research in Boston and the broader region—which involved an in-depth analysis of many industries that drive the region’s economy, including financial services, medical device and network systems, and communications industries—concluded the following:

**The Role of Research in an Urban Mission**

Individuals with research training are highly valued by industry, whether or not they are involved in research for the companies that hire them. In addition to the specific body of knowledge acquired through academic research, industry values research experience because it requires abilities that are prized in any technical endeavor: self-motivation, problem solving, teamwork, an understanding of related research, contacts with other researchers and colleagues, the ability to organize material, and the ability to overcome setbacks.4

Traditionally, a university’s research faculty has been linked with the institution’s efforts to establish and sustain top-flight doctorate-granting programs. For UMass Boston to continue expanding its doctoral-level offerings in fields that demand critical skills—nursing, gerontology, chemistry, biology, computer sciences, environmental sciences, public policy, psychology, and education—it must add to its research faculty in these disciplines. Throughout academe, research training is a growing priority at the undergraduate and master’s levels as well, with more and more degree programs requiring hands-on experience in research labs as a core component. UMass Boston would benefit from offering more such opportunities to its undergraduate and master’s degree students, and that can be accomplished only by hiring more faculty who are actively engaged in research.

Many of UMass Boston’s contributions in service activities have been a direct outgrowth of the quality of its research programs. Take, for example, the active part the university played in the cleanup and ongoing monitoring of Boston Harbor. Integral to this effort was the development of an environmental sciences program, which has led to considerable growth of UMass Boston’s capacities in measuring environmental hazards, advancing environmental remediation strategies, and establishing marine observation and monitoring systems. Similarly, in addressing Boston-area health disparities, the university has drawn on its research strengths in gerontology, nursing, clinical psychology, and sociology. To expand its contributions in this area, the university will need greater capacities in health outcomes research, which in turn will require more faculty in areas such as epidemiology and biostatistics.

In the future, UMass Boston’s research capacities will be critical to the region’s attempt to address new global competition in research and innovation. In attempting to fulfill its urban mission, the university will have to respond to new challenges facing the Boston region. Perhaps none will have as great an impact on the region’s economic vitality as the rise of global competition in research and innovation. Today, the United States faces competition from the developing world in a number of areas, such as production costs, research capacity, and skilled labor. This competition is felt most in regions, like Boston, that rely on its workers’ intellect and its businesses’ technological abilities. According to Jack Wilson and Robert Brown, the presidents of the University of Massachusetts and Boston University respectively, Massachusetts has employed a simple formula to create a vibrant economy: Rely on the innovations produced by outstanding higher education and health care institutions, corporations and individuals to build the enterprises that fuel our economic engine. While this recipe has worked well for a century, it may no longer be enough to secure our economic future. Increased competition is eroding historical advantages in higher education and research that have been at the heart of our success… We must defend our competitive advantage by investing in intellectual capital.5

Throughout academe, research training is a growing priority... with more and more degree programs requiring hands-on experience in research labs as a core component.
The research enterprise at UMass Boston can be an important part of the region’s response to this growing competitive challenge. The only public university in the Boston region, UMass Boston is positioned to develop its research base in a manner that directly responds to its urban mission. For example, the university can focus on “use-inspired basic research” that addresses the distinct approaches to innovation in research conducted at universities as against the more applied research of industry. In so doing, UMass Boston can advance research objectives identified in consultation with local communities and industries, while seeking to work with private Boston-area universities by filling gaps in interdisciplinary research that hamper the development of new applications.

The recently published National Institutes of Health Road Map presents an excellent example of a situation in which UMass Boston has already put “use-inspired basic research” to work. The Road Map recognizes that a dearth of interdisciplinary teams and a lack of focus on reengineering the research environment have resulted in a failure to convert significant discoveries in biomedical research into effective treatments. By bringing research in informatics development, imaging technologies, health disparities, and technological advancements, UMass Boston is working to correct this problem.

**“Use-Inspired Basic Research” Paradigm Critical for Defining Research Success at UMass Boston**

To broaden its urban mission and address new global competition in research and innovation, UMass Boston should help the region bridge the gap in translating innovation between pure basic research and the more applied and development-focused research of industry. The late Professor Don Stokes of Princeton referred to this gap as “use-inspired basic research.” Stokes’s prime example was the work of the great nineteenth-century scientist Louis Pasteur, who made fundamental advances in microbiology inspired by the need to solve several very serious problems in French agricultural methods.

A focus on use-inspired basic research reflects an understanding that technological advancement is most effective when it occurs within a dynamic and interactive process that addresses needs toward which research will be applied and identifies broad areas where knowledge generated by basic research is of significant value.

**Where does that technology come from?**

- **Improved understanding**
  - Pure basic research
  - Use-inspired basic research
  - Existing understanding

- **Improved technology**
  - Pure applied R&D
  - Existing technology


As outlined above, UMass Boston is embracing research and development as a cornerstone of its urban mission. Interviews of more than 50 top faculty members by the Battelle project team reveal that a key attraction of UMass Boston for faculty is the opportunity to pursue research within the context of a university committed to student-body diversity and service to the community. At the same time, UMass Boston is raising the bar for faculty scholarship and investing ever more resources in efforts to improve the university’s research capacities.

This strengthening commitment to research is showing results. By nearly all measures of research activity—such as publications, research funding, and granting of PhD degrees—UMass Boston’s research base is expanding by leaps and bounds. Further confirmation of the university’s improving research profile are the high productivity rankings of its faculty. A just-released “Faculty Scholarly Productivity Index,” conceived by Dr. Lawrence Martin, Graduate Dean at SUNY Stony Brook, and produced by Academic Analytics, rates UMass Boston fifth in the nation among small research universities with respect to number of publications, grants, and honors of faculty members.6

Publication Activities. Tracking of publications in peer-reviewed journals by the Institute of Scientific Information across 106 fields involving basic, applied, and clinical research, revealed that UMass Boston increased its publication activities by nearly 50% in the period 2000–2005—from 168 publications a year to 251. Nationwide, the average growth rate per institution was 19%.

In the future, UMass Boston’s research capabilities will be critical to the region’s attempt to address new global competition in research and innovation.
From 2001 to 2005, 11 fields at UMass Boston produced at least 20 publications, led by fields related to public health; psychology and neurosciences; and ocean, earth, and environmental sciences. (See Table 2 for more details.) Of note here is that slightly less than 50% of all publications generated by UMass Boston researchers from 2001 to 2005 were in these 11 fields.

When considering publication activity by specific fields, it is best to look at a period of at least five years, which allows for adjustment for year-to-year changes. There are two common ways to view publication performance by field; one is the actual number of publications by field, which helps to assess areas of focus, and the other is citations per publication as compared to national averages, which is a means of assessing the quality of publication activity.

### TABLE 2: TOP RESEARCH FIELDS IN PUBLICATIONS ACTIVITY AT UMASS BOSTON, 2001–2005

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Public Health &amp; Health Care Sciences</td>
<td>87</td>
<td>31</td>
<td>9.6%</td>
</tr>
<tr>
<td>Psychology</td>
<td>79</td>
<td>4</td>
<td>18.3%</td>
</tr>
<tr>
<td>Aquatic Sciences</td>
<td>48</td>
<td>24</td>
<td>23.6%</td>
</tr>
<tr>
<td>Neurosciences &amp; Behavior</td>
<td>38</td>
<td>9</td>
<td>27.8%</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>35</td>
<td>0</td>
<td>31.6%</td>
</tr>
<tr>
<td>Medical Research, General Topics</td>
<td>31</td>
<td>6</td>
<td>35.0%</td>
</tr>
<tr>
<td>Environment/Ecology</td>
<td>25</td>
<td>3</td>
<td>37.8%</td>
</tr>
<tr>
<td>Literature</td>
<td>25</td>
<td>6</td>
<td>40.5%</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>24</td>
<td>12</td>
<td>42.2%</td>
</tr>
<tr>
<td>Environmental Medicine &amp; Public Health</td>
<td>22</td>
<td>5</td>
<td>45.6%</td>
</tr>
<tr>
<td>Applied Physics/Condensed Matter/Materials Sciences</td>
<td>20</td>
<td>-7</td>
<td>47.8%</td>
</tr>
</tbody>
</table>

Source: Institute for Scientific Information

With respect to quality of publications, from 2001 to 2005 six research fields with at least 10 publications exceeded the national average for those fields in citations per publication. These fields are the following:

- **Environmental sciences**, with 34% more citations per publication than the national average for that field
- **Health care sciences**, with 27% more citations per publication than the national average for that field
- **Pediatrics**, with 13% more citations per publication than the national average for that field
- **Education**, with 12% more citations per publication than the national average for that field
- **Biology**, with 7% more citations per publication than the national average for that field
- **Aquatic sciences**, with 6% more citations per publication than the national average for that field.

**Research Funding Trends.**

All universities report annually to the National Science Foundation the funding of research fields from all sources, whether federal, state, industry, foundation, or internal. From 2000 to 2006, UMass Boston realized a hefty 75% gain in its annual research base—from $12 million to $21 million. Despite the fact that it has no medical school, the university kept pace with national growth in research funding from 2000 to 2005—which is especially significant because part of the doubling of the National Institutes of Health research budget occurred during that period.7

When research funding at UMass Boston is considered by fields, one statistic stands out: Nearly half of the funding for university research goes to the social sciences; this compares to a per-institution national average of just 4% for the social sciences.

From 2000 to 2005, this concentration in funding grew; social sciences research at UMass Boston accounted for 59% of the increase in research funding during that period. At the national level, the life sciences were the most significant driver of university research funding, accounting for 56% of the total increase in university research—indeed a reflection of the strong gains that resulted from the doubling of support for National Institutes of Health research.
Doctorates Awarded. Another gauge of a university’s research activity is generation of talent as measured by doctorates awarded. Currently, UMass Boston offers doctoral degrees in clinical psychology, nursing, education, computer sciences, environmental sciences, chemistry, biology, and public policy. While there were ups and downs over the period 2000 to 2005, the number of PhD degrees conferred rose from 31 to 48 overall, a gain of more than 50%. By comparison, conferral of doctoral degrees in the same fields rose by only 32% nationwide. One other implication of these statistical trends: In 2005, slightly more than 1% of all U.S. doctoral degrees in these fields were granted at UMass Boston.

UMass Boston is also distinguished by its ranking with respect to doctoral degrees by field. In 2005, the university conferred 17% of all U.S. doctoral degrees issued in gerontology, 11% of those in environmental sciences, 7% of those in nursing and health policy, and slightly less than 3% of those in public policy analysis.

From 2000 to 2006, UMass Boston realized a hefty 75% gain in its annual research base—from $12 million to $21 million.

Over the period 2000 to 2005, the number of PhD degrees conferred [at UMass Boston] rose from 31 to 48 overall, a gain of more than 50%.

| TABLE 3: GROWTH IN UNIVERSITY RESEARCH BY FIELD, 2000 TO 2005, UMASS BOSTON VS. ALL UNIVERSITY RESEARCH IN U.S. |
|---|---|---|---|---|
| **UMass Boston** | **U.S. University R&D** | **Change** | **Percent of Change** | **Change (million)** | **Percent of Change** |
| Total University R&D | $6,090,000 | 100% | $15,688 | 100% |
| Social Sciences | $3,572,000 | 59% | $380 | 2% |
| Life Sciences | $578,000 | 9% | $10,124 | 65% |
| Other Sciences | $486,000 | 8% | $240 | 2% |
| Environmental Sciences | $530,000 | 9% | $778 | 5% |
| Psychology | $514,000 | 8% | $310 | 2% |
| Physical Sciences | $54,000 | 1% | $998 | 6% |
| Computer Sciences | $305,000 | 5% | $527 | 3% |
| Engineering | $88,000 | 1% | $2,177 | 15% |

Source: National Science Foundation, Calculations by Battelle

Source: National Center for Education Statistics, 2005

*Note: For comparison purposes, the only U.S. NCES data used matches directly with all of the Classification of Instructional Program Codes (CIP Codes) that UMass Boston awards doctor’s degrees in. Similar fields with differing CIP Codes, if not awarded at UMass Boston, are excluded from this data.

From 2000 to 2005, the number of PhD degrees conferred at UMass Boston rose from 31 to 48 overall, a gain of more than 50%.
To build a more effective research base, UMass Boston must nurture the development of its core competencies—that is, areas of research in which the university’s faculty members can be regional, if not world, leaders. According to Hamel and Prahalad in their widely acclaimed business strategy book Competing for the Future, “Core competencies are the gateways to future opportunities. Leadership in a core competence represents a potentiality that is released when imaginative new ways of exploiting that core competence are envisioned.”

Simply defined, core competencies are areas where a university is equipped to bring together a critical mass of activity—research, talent generation, unique facilities and resources, and so forth—in meeting or surpassing an identified measure of excellence. In the future, having deep strengths in single disciplines will matter less than the ability to advance interdisciplinary fields that apply technology convergence to key research problems and applications development.

In view of its urban mission, UMass Boston will also benefit if it considers the broader needs of the region, paying particular attention to areas of technology-industry specialization, shortages in areas requiring highly skilled labor, and input from industry and nonprofit associations and economic development agencies.

The aim of this process is to best align UMass Boston’s current strengths in research, talent generation, and service activities with signature areas of research that meet the demands of multidisciplinary scientific progress while addressing the needs of specific sectors—for example, health care, education, and targeted industries.

The Path to Growth: Seizing Strategic Opportunities

A three-step process for identifying areas of strategic opportunity underpins the rigorous and detailed approach undertaken by UMass Boston with the assistance of Battelle’s Technology Partnership Practice.

**Step 1: Identify and Assess Existing Research Focus Areas at UMass Boston**

**Step 2: Consider the Regional Context**

**Step 3: Go from Research Activities to Research Clusters**

The quantitative dimensions of Battelle’s analysis involved examining research funding, publications, graduate education, and service activities. Qualitative insights—gleaned from extensive field interviews of more than 50 UMass Boston faculty members and administrators—were used to identify faculty expertise, niche research strengths, and emerging research activity.

Table 6 on the next page presents an assessment of UMass Boston research focus areas with respect to funding, presence of major grants, publications activity, extent that service activities are incorporated into research, and presence of graduate degree programs. For the quantitative measures of research funding, presence of major grants, and associated publications, each of the fields is rated as top tier, mid tier, or low tier relative to research activity at UMass Boston overall.

UMass Boston’s research focus areas are not all of equal vitality or prominence; rather, two broad categories emerge. The more extensive focus areas, positioned primarily in top and mid-tier levels of activity within the university, are the following:

- Aging research
- Clinical psychology
- Disabilities research
- Early childhood development and education
- Ethnic studies
- Environmental sciences and systems
- Health policy and disparities research
- Qualitative and survey research
- STEM education
- Workforce development

The more niche focus areas, positioned in lower-tier levels of activity within the university, are these:

- Applied linguistics
- Cell biology
- Computer sciences
- Green chemistry
- Lasers and photonics
- Criminology
- Dispute resolution
- Exercise science
- Organizational change
- Regional economics
Step 2: Consider the Regional Context

The Boston region is well known as one of the nation’s leading centers of development for technology-based industries; consequently, aligning the university’s research enterprise with the region’s industrial base is of particular significance. The region boasts an industrial landscape built from successive waves of innovation in areas such as precision machining, electronics, information technology, biotechnology, and, most recently, the emerging area of nanotechnology. Michael Best, a respected commentator on the Boston region’s technology base, notes that the “region has an industrial heritage…in combining and recombining technologies to improve old or develop new products.”

One legacy of the Boston region’s longtime leading role in technology development is that its need for innovation and talent is both broad and deep. As a consequence, important areas of technology-industry specialization in the region may not accord well with the current scope and direction of university research. This may occur, for example, when universities shift their research focus to areas that receive the most federal funding or to areas where scientific research is likely to be strong in the future. Thus, industries born of past university research may no longer indicate where university research stands today.

Analysis of occupational demand, technology-industry presence, industry patent analysis, and input from executives of leading regional industry associations, technology groups, economic development organizations, and university stakeholders suggests that, to align with the region’s technology needs, UMass Boston would benefit from a focus on four broad areas:

<table>
<thead>
<tr>
<th>Primary Research Activity Area</th>
<th>Research Funding, 2006</th>
<th>Major Grants, 2006</th>
<th>Associated Publications from 2001</th>
<th>Extent That Service Activities Are Incorporated Into Research</th>
<th>Graduate Education Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active Master’s, PhD</td>
</tr>
<tr>
<td>Applied Linguistics</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active Master’s</td>
</tr>
<tr>
<td>Cell Biology</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active Master’s, PhD</td>
</tr>
<tr>
<td>Clinical Psychology</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active Master’s, PhD</td>
</tr>
<tr>
<td>Computational Sciences and Modeling</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active Master’s, PhD</td>
</tr>
<tr>
<td>Criminology</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Master’s</td>
</tr>
<tr>
<td>Disabilities Research</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active PhD Clinical Psych</td>
</tr>
<tr>
<td>Dispute Resolution</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Extensive Master’s</td>
</tr>
<tr>
<td>Early Childhood Development and Education</td>
<td>&lt; $1M</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
<td>N/A</td>
<td>Active PhD Clinical Psych</td>
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<td>Ethnic Studies</td>
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<td>&lt; 30</td>
<td>N/A</td>
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**Information Technology**

**Interview Insights:** Information technology competencies and skill sets are viewed as critical to keeping the region competitive across many industry sectors, such as health care, financial services, defense, and biosciences.

**Occupational Needs:** High Demand

**Technology Presence:** High Level of Specialization

**Industry Patent Cluster:** High Share

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**Biosciences**

**Interview Insights:** Not only is the Boston region strong in translational research efforts involving discovery and development of cures and treatments, but the later stages of product development, including biomanufacturing, are a growing focus.

**Occupational Needs:** High Demand

**Technology Presence:** High Level of Specialization

**Industry Patent Cluster:** High Share

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**Health Care**

**Interview Insights:** Workforce needs are considered to be a critical area. Integration of innovative technologies in addressing patient-care needs is an important element of improving the effectiveness of health care delivery systems.

**Occupational Needs:** High Demand

**Technology Presence:** N/A – more a technology user than a driver

**Industry Patent Cluster:** N/A – more a technology user than a driver

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**Environmental and Renewable-Energy Technologies**

**Interview Insights:** This is an emerging area of development for the Boston region, with strong interest in both pollution prevention and clean-energy technologies.

**Occupational Needs:** Modest Demand

**Technology Presence:** Modest Level of Specialization

**Industry Patent Cluster:** Low Share

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**Step 3: From Research Activities to Research Clusters**

UMass Boston’s core research focus areas serve as the foundation, the enabling strengths, upon which to build the university’s future research enterprise. Even so, simply developing these areas in isolation will not serve to improve the university’s research profile; nor will it enhance the university’s contribution to the Boston region’s economic competitiveness and quality of life.

For UMass Boston to develop and maintain an excellent research enterprise, it must advance multi-disciplinary and multi-institutional partnerships in selected research areas. As the Chronicle of Higher Education notes, “Partnerships are proliferating in academe—and slowly changing the face of science—because they offer the best hope for answering some of the thorniest research subjects, including climate change, biodiversity and cancer.” An excellent illustration of the importance of advancing research clusters is Harvard’s recently announced $50 million initiative to encourage interdisciplinary research in the sciences. Says the Boston Globe of the initiative: “The changes are a response to a scathing faculty report, completed last year, which said the university’s entrenched bureaucratic structures stifle collaboration and threaten its leadership in scientific research. Many universities are struggling to find ways to reorganize their approach to science and engineering as the boundary lines between traditional disciplines such as chemistry and biology dissolve.”

**FIGURE 6: LINE OF SIGHT**

Aligning the university’s research enterprise with the region’s industrial base is of particular significance. One legacy of the Boston region’s longtime leading role in technology development is that its need for innovation and talent is both broad and deep.
Core research focus areas serve as the foundation, the enabling strengths, upon which to build the university’s future research enterprise.

• Focus on interdisciplinary research that engages multiple departments and the various research institutes and centers found at UMass Boston, and that is based on the university’s strengths in research, talent generation, and service activity.
• Build on areas that give rise to identified or potential collaborations within the Boston region.
• Look for opportunities that embody the “use-inspired” paradigm of engaging both basic and applied research.

This approach will allow UMass Boston to build on its research strengths and capitalize on partnership opportunities. It will also enable the university to target and “fill in” new research competencies, thus deepening and expanding upon research activities that are already done well.

From Battelle’s analysis and ongoing discussions with UMass Boston stakeholders, the following eight potential research cluster areas have been identified. A more detailed analysis of each cluster is provided in Appendix A.

**Urban Health and Public Policy.** Urban health and public policy research entails interdisciplinary studies investigating the unique challenges present in the urban environment—with the goal of improving treatment modalities and health outcomes, and influencing public policy. Issues include: the impact of the social environment (housing, employment) on health; health disparities related to inadequate physical activity, poor nutrition, and obesity in socioeconomically diverse youth and families; and health care disparities among immigrants, the elderly, persons with disabilities, and racial/ethnic groups.

- Associated UMass Boston core research strengths: health policy and disparities research; aging research; clinical psychology; disabilities research; exercise and health sciences; ethnic studies; dispute resolution
- Linkage to regional drivers: health care

**Developmental Sciences.** Developmental sciences entail the investigation of progressive changes that occur over the life span of individuals. The field is concerned with describing the characteristics of change over time, the underlying principles and causes of these changes, and the health outcomes that may occur as a result of the changes.

- Associated UMass Boston core research strengths: clinical psychology; disabilities research; early childhood development and education; aging research; criminology
- Linkage to regional drivers: health care and biosciences

**Science and Math Education and Learning Research.** The goals of science and math education and learning research are to investigate teaching and learning materials and methods and to apply findings to the improvement of curriculum, instruction, and learning in schools and universities. Research activities include: empirical classroom research that tests the effectiveness of learning technologies; behavioral and cognitive neuroscience methods (such as fMRI) to understand how students read, think about data, and solve complex problems; developing computational models to explain how the brain perceives language; testing the value of informal learning environments, such as playgrounds and museums; and assessment and evaluation of methodologies and research.

- Associated UMass Boston core research strengths: STEM education; early childhood development and education; workforce development
- Linkage to regional drivers: cross-cutting for ensuring quality future workforce

**Transnational, Cultural, and Community Studies.** This is an interdisciplinary social sciences focus involving the systematic study of the history, society, politics, culture, and economics of subsets of the population with common ethnic and racial characteristics or common traits and customs.

- Associated UMass Boston core research strengths: ethnic studies; clinical psychology; organizational change; regional economics; dispute resolution
- Linkage to regional drivers: not a specific driver, but rather overall quality of life and inclusion

**Computational Sciences, Analysis, and Modeling.** Computational sciences, analysis, and modeling represents an interaction of computer science, engineering, applied math, and the sciences (biology, physics, chemistry). The primary focus of the field is the construction of models and numerical analysis techniques to simulate, evaluate, and solve problems using computers. Computational modeling is heavily applications-oriented, with particular emphasis on understanding and solving problems in the areas of biology, medicine, economics, business, and the environment.

- Associated UMass Boston core research strengths: qualitative and survey research; computer sciences; environmental sciences and systems
- Linkage to regional drivers: information technology

Clearly, the urge to merge scientific study and research is being widely felt. As the Research and Graduate Studies Committee at UMass Boston notes: “The identification of research clusters and the investment of significant resources in research infrastructure will permit teams of faculty members and students to be engaged in world-class interdisciplinary, multi-departmental and multi-institutional projects of national and international significance.”

More specifically, a focus on advancing multi-disciplinary research clusters will enable UMass Boston to better align its research activities in a “use-inspired” manner that supports specific sectors in the Boston region, such as health care, K-12 education, and targeted industries. As with the demands for research in basic sciences, resolving the problems these sectors face will require a systems-based approach that integrates a number of academic disciplines.

In addition, a focus on research clusters should enable UMass Boston to more actively seek partnerships within the rich academic research environment found in the Boston region. This in turn will allow diverse teams of researchers from various Boston-area institutions to come together to address basic challenges and specific sectors’ need for applied research.
A focus on research clusters should enable UMass Boston to more actively seek partnerships within the rich academic research environment found in the Boston region.

Integrated Environmental Monitoring. The goal of integrated environmental monitoring is to develop and use modeling and software technologies to advance the science and improve the decision making surrounding resource and environmental issues. Integrated environmental modeling relies on advanced computational technology, dynamic data collection and analysis methods, environmental observation methodologies, and interdisciplinary efforts among ecologists, mathematicians, statisticians, and computer scientists.

- Associated UMass Boston core research strengths: environmental sciences and systems; green chemistry; computer sciences; lasers and photonics; regional economics
- Linkage to regional drivers: environmental and renewable energy

Biological Systems and Technology. Investigations into biological systems analyze the interactions among the components of a biological system and how these interactions give rise to the function and behavior of that system. The systems approach includes a combination of experiments to characterize cell processes at multiple levels (including cellular organelles, nucleus, metabolic pathways, transcription, translation) using computer modeling. Other technologies involved in the mapping of systems include modification of the system via computational (simulation) using computer modeling. Other technologies involved in the mapping of systems include modification of the system via computational (simulation)

- Associated UMass Boston core research strengths: health policy and disparities research; cell biology; lasers and photonics; computer sciences; green chemistry; exercise and health sciences
- Linkage to regional drivers: health care and biosciences

Sustainability and Social Venturing. Sustainable technologies are technologies that use less energy and fewer natural resources, and do not directly or indirectly harm the environment. Examples of sustainable technologies are green chemistry, alternative energy technologies, novel use of renewable materials, design of “green” buildings and infrastructure, and so on. The adoption of sustainable technologies by organizations goes well beyond the technology and requires a systematic approach to thinking about how sustainability can become an organizational mind-set and viable business model, with an integration of for-profit and nonprofit sectors. This is at the heart of organizational change and social venturing.

- Associated UMass Boston core research strengths: environmental sciences and systems; organizational change; green chemistry; regional economics
- Linkage to regional drivers: environmental and renewable energy

In recent years, UMass Boston has achieved a significant measure of success in developing its research enterprise. It has expanded its base of funding, publications, and doctoral degree graduates faster than average national rates in these areas. It has demonstrated areas of core research strength ranging across the social, health, physical, computational, biological, and environmental sciences. Furthermore, UMass Boston has gained recognition for the productivity of its research faculty as compared to researchers at other small universities.

With a shared commitment to research among faculty and senior leadership in place, the future of the research enterprise at UMass Boston looks bright—provided it makes strategic investments in carefully selected initiatives contained within one or more of the research clusters identified in this study. Taking the next leap forward—that is, joining the ranks of the nation’s major research institutions—will require new approaches and a willingness to address a number of key issues. Among the challenges facing UMass Boston in this effort are the following:

- **Broadening the base of funding and publication activities.** UMass Boston’s recent success in expanding its research enterprise has been narrowly focused. A review of its publications and trends in sponsored research suggests strong concentrations of activity:
  - Nearly 50% of publications authored by UMass Boston researchers are concentrated in just 11 research fields out of 106 research fields tracked.
  - 49% of research funding and nearly 60% of growth in research funding at UMass Boston is found in the social sciences. By comparison, the social sciences account for only 4% of university research funding nationally, which suggests that there are many other fields with high growth potential at UMass Boston.

The best way to broaden this base is not to pursue a “field of dreams” approach but to build research clusters from existing competencies by adding targeted enhancements. For instance, the university already has a top-tier clinical psychology department and broad service- and policy-oriented activities for persons with disabilities, early childhood development, and the elderly, so focusing resources on neurobiology and developmental psychology can significantly promote the growth of research in these areas. Likewise for health policy: UMass Boston has demonstrated significant strengths in nursing and sociology, so improving competency in health outcomes research and clinical studies will allow the university to take advantage of opportunities in the growing field of translational research.

- **Establishing the research infrastructure and culture to support multi-disciplinary research.** Research clusters at UMass Boston must become part of how the university expands its research competencies and how it views itself as a contributor to the sciences and their applications. Advancing the research clusters identified in this study—for example, by putting in place the infrastructure, incentives, and culture for multi-disciplinary, multi-college, and multi-institutional research—will require that UMass Boston think and work in new ways. Despite its small size
With a shared commitment to research among faculty and senior leadership in place, the future of the research enterprise at UMass Boston looks bright.

by comparison with the nation’s leading research universities, UMass Boston suffers from the same focus on specific disciplines found at larger institutions, such as Harvard and Boston University. However, it has one distinct advantage over larger universities: It is relatively young and thus better able to shift to an interdisciplinary and “use-inspired” research approach.

- Raising awareness of UMass Boston’s research strengths across sectors in the Boston region. Whereas UMass Boston is nationally recognized for its outreach and service to broad sectors of the community in which it exists, interviews with 20 regional associations, economic development agencies, and other key stakeholders revealed a lack of knowledge of the university’s capabilities beyond its role in generating a much-needed diverse talent pool for the region. To raise awareness of the university’s research strengths in the years ahead, UMass Boston must be more deliberate and proactive in making known the successes of its entire research enterprise—faculty, departments, centers, and institutes alike.
Information Technology
- Occupational Demand: Computer-related occupations are still among the fastest growing in the state, with 26% projected growth from 2004 to 2014 and with total job openings exceeding 40,000. Among the key growth occupations are network systems and data communications analysts, computer software engineers, and database administrators. The most recent (2005) job-vacancy survey for the Boston region found that there were 2,279 vacancies in computer-related positions.
- Technology Specialization: Applications software, computer networking and utility systems, Internet transactions and security, and signal processing and embedded systems. CorpTech identifies 488 firms in computer software, or 4.7% of all such U.S. firms, headquartered in the Boston region, and 279 firms in telecommunications and Internet technology, or 4% of all such U.S. firms, headquartered in the Boston region.
- Patents: 20% of patents found in the computer sciences cluster and another 7% in the signal processing cluster in the 2004 study Choosing to Lead: The Massachusetts Technology Road Map and Strategic Alliances Study.

Health Care
- Occupational Demand: Strong demand for nursing and allied health, with more than 4,000 vacant jobs in Greater Boston in 2005 and expected growth in nursing jobs of 32,940, or 22%.
- Technology Specialization: Significant presence of academic hospitals, key users of health informatics and innovative medical technologies.
- Patents: More a user than a driver of technologies.

Biosciences
- Occupational Demand: Expected growth of 18,850 life scientist jobs, or 16%, from 2004 to 2014.
- Technology Specialization: Innovations in genomics, proteomics, and systems biology. CorpTech identifies 145 biotechnology firms, or 4% of all such U.S. firms, headquartered in the Boston region; 182 firms in medical technology, or 3.6% of all such U.S. firms, headquartered in the Boston region; and 49 pharmaceutical firms, or 4.1% of all such U.S. firms, headquartered in the Boston region.
- Patents: 13% of patents found in genomics and proteomics and 8% found in disease research and drug discovery.

Environmental and Renewable-Energy Technologies
- Occupational Demand: Expected growth of 840 jobs, or 24%, in environmental engineering from 2004 to 2014.
- Technology Specialization: Largely in environmental management and energy services. CorpTech identifies 94 environmental technology firms, or 3.3% of all such U.S. firms, headquartered in the Boston region, and 69 energy technology firms, or 1.5% of all such U.S. firms, headquartered in the Boston region.
- Patents: More a university research–driven area of focus.

Sources
- Technology Specialization: CorpTech and Interviews.
RESEARCH CLUSTER OPPORTUNITY: URBAN HEALTH AND PUBLIC POLICY

Overview
Urban health and public policy research entails interdisciplinary studies investigating the unique challenges present in the urban environment, with the goal of improving treatment modalities and health outcomes and influencing public policy. Issues include: the impact of the social environment (housing, employment) on health; health disparities related to inadequate physical activity, poor nutrition, and obesity in socioeconomically diverse youth and families; and health care disparities among immigrants, the elderly, persons with disabilities, children, and racial/ethnic groups.

Focus of Research at UMass Boston

- State and local policy issues for regional health care, including the effect of such issues as housing and employment
- Isolation and access to health care of the elderly
- Racial and ethnic disparities in mental health policies
- Social impact on medical and legal issues
- HIV/AIDS action studies for the Haitian community in Boston

UMass Boston Departments Involved
College of Nursing and Health Sciences, McCormack Graduate School of Policy Studies, Gerontology Department, Gerontology Institute, Institute for Community Inclusion, Sociology, Psychology, Center for Survey Research, Africana Studies Department, Institute for Asian Amercian Studies, Mauricio Gaston Institute for Latino Community Development and Public Policy, Trotter Institute for the Study of Black Culture, Center for Social Development and Education

Collaborations—Established and Potential
Dana-Farber/Harvard Cancer Center, Children’s Hospital Boston, Mass General Hospital, Boston Public Schools, outreach to immigrant communities, outreach to ethnic communities in the greater Boston region. Potential to broaden collaborations with academic health centers and health care organizations.

Possible Distinctive UMass Boston Approach
- A comprehensive approach to the health care of urban, underserved populations, with a unification of investigations into social, behavioral, and physical impediments to health care access and delivery
- Emphasis on health disparities and health risks to identified population groups
- Application of qualitative research principles to social and behavioral research through collaborations with major academic medical centers to translate social behavior to treatment modalities
- Add a new capacity for clinical and translational research assessment, including clinical research education, management, and design; evaluation of new and experimental treatments and therapies, and overall health outcomes research and bioscience
- Link with policy programs to promote change in the public arena

RESEARCH CLUSTER OPPORTUNITY: DEVELOPMENTAL SCIENCES

Overview
Developmental sciences entail the investigation of progressive changes that occur over the life span of individuals. The field is concerned with describing the characteristics of change over time, the underlying principles and causes of these changes, and the health outcomes that may occur as a result of the changes.

Focus of Research at UMass Boston
A range of scientific disciplines contribute to the advancement of developmental sciences. UMass Boston has many programs that investigate neural/behavioral psychology across the life span, including genetic and social impacts on behavior and health. The institution also has other programs that could support these studies on a more integrated basis.

- Early childhood development (autism, Down syndrome, infant mental health, disruptive behavior in children, and cultural sensitivity)
- Adolescent-to-adult transition
- Adult schizophrenia
- Effects of war trauma
- Elder care and behavior

UMass Boston Departments Involved
Psychology, College of Nursing and Health Sciences, McCormack Graduate School of Policy Studies, Gerontology Department, Gerontology Institute, Institute for Community Inclusion, Center for Social Development and Education, Counseling and School Psychology

Collaborations—Established and Potential
Children’s Hospital Boston, Boston Public Schools, national centers for disability policy and research. Potential to expand and broaden local and national efforts in the future.

Possible Distinctive UMass Boston Approach
- A comprehensive investigative approach to the effects of the urban environment on development, behavior, and health
- Emphasis on cultural aspects
- Focus on translation to advance systematic changes based on science- and evidence-based outcomes
Overview

The goal of science and math education and learning research is to investigate teaching and learning materials and methods and to apply findings to the improvement of curriculum, instruction, and learning in schools and universities. Research activities include: empirical classroom research that tests the effectiveness of learning technologies; behavioral and cognitive neuroscience methods (such as fMRI) to understand how students read, think about data, and solve complex problems; developing computational models to explain how the brain perceives language; testing the value of informal learning environments, such as playgrounds and museums; and assessment and evaluation methodologies and research.

Focus of Research at UMass Boston

- Advanced problem-based learning; assessment and evaluation methodology
- Curriculum and instructional materials development—Active Physics and Active Chemistry
- Information technology skills and workforce development—BATEC
- Achievement gap of urban youth
- Science and math education research involving quantitative and qualitative studies of student learning
- Processes behind early-childhood thinking and learning
- Learning experiences for children with chronic illnesses and disabilities

UMass Boston Departments Involved

Biology, Chemistry, EEDS (College of Science and Math); Curriculum and Instruction, Counseling and School Psychology; Center of Science and Mathematics in Context (Graduate College of Education); BATEC (Boston-area Advanced Technological Education Center), Psychology

Collaborations—Established and Potential

Broad existing efforts, including COSMIC national partners; Urban Massachusetts Louis Stokes Alliance for Minority Participation; Roxbury-Bunker Hill-UMass Boston Bridges to the Baccalaureate; Boston Science Partnership (Boston Public Schools, Northeastern University); Watershed-Integrated Sciences Partnership (Boston, Dedham, Milton Public Schools); COSEE-New England (New England Aquarium, Woods Hole Oceanographic Institute). Potential in future to expand local, national, and international collaborations.

Possible Distinctive UMass Boston Approach

- Build on reputation of faculty having significant content strength
- Draw on strengths of psychology and behavioral neurosciences groups to understand how students learn
- Test the effectiveness of scientific instructional materials and methods through established regional partnerships
- Teacher professional development
- Transnational orientation, including international work

Overview

Interdisciplinary social sciences focus involving the systematic study of the history, society, politics, culture, and economics of subsets of the population that have common ethnic and racial characteristics or common traits and customs.

Focus of Research at UMass Boston

- Language studies—bilingual education; Creole studies
- Community development
- Peer identification, transmission of trauma
- Health disparities
- Aging issues of ethnic and racial groups
- Immigration studies
- Training exchanges

UMass Boston Departments Involved

Africana Studies Department, Gaston Institute, Institute for Asian American Studies, Trotter Institute for the Study of Black Culture, Gerontology Institute, Clinical Psychology, Economics Department, Graduate College of Education, Fiske Center for Historical Archaeology, Applied Linguistics, Research Center for Urban Cultural History, Institute for Community Inclusion, Center for Survey Research, Sociology, Anthropology, Nursing

Collaborations—Established and Potential

Broad connections of communities in Boston with Latino, African-American, Caribbean, Vietnamese, and other Asian-Americans. Active initiatives with federal, state, and local governments.

Possible Distinctive UMass Boston Approach

- Strong transnational research focus at UMass Boston, especially Vietnamese, Haitian
- Emphasis on community development
Overview
Computational sciences, analysis, and modeling represents an intersection of computer science, engineering, applied math, and the sciences (biology, physics, chemistry). The primary focus of the field is the construction of models and numerical analysis techniques to simulate, evaluate, and solve problems using computers. Computational modeling is heavily application-oriented, with particular emphasis on understanding and solving problems in areas of biology, medicine, economics, business, and the environment.

Focus of Research at UMass Boston
• Decision analysis for R&D strategies and technology portfolio management
• Management science and information systems
• Data fusion and visualization; modeling and forecasting, with applications in security, wave movement, weather forecasting, and temperature monitoring
• Complex models using nonlinear dynamic systems
• Biodiversity informatics—information systems at the organism level or higher; focus on specimen databases, provision of metadata in images, “knowledge representation”/“automatic mark-up” research
• "Biophysics”—theoretical data analysis of genomics
• Qualitative and survey research expertise spanning focus group, interviewing methodologies, interaction of qualitative and quantitative analysis approaches, survey design

UMass Boston Departments Involved
Computer Sciences, Physics, College of Management, Center for Survey Research, Sociology, Gerontology, Biology, Chemistry, GIS Core Research Facility

Collaborations—Established and Potential
Mass General Hospital and Brigham and Women’s Hospital in bioinformatics; UMass Medical School. Major potential for key targeted sectors, such as health care and financial services, along with serving to provide enabling systems and modeling infrastructure for a number of research clusters.

Possible Distinctive UMass Boston Approach
• Continue to build an applications-oriented, user-inspired research base of data mining, database design, networking, data fusion, decision sciences, and nonlinear, dynamic systems
• Offer go-to facilities with broad state-of-the-art applications in computational sciences and modeling
• Grid computing—a notable research opportunity area
• Integration of qualitative and quantitative approaches

RESEARCH CLUSTER OPPORTUNITY: COMPUTATIONAL SCIENCES, ANALYSIS, AND MODELING

Overview
The goal of integrated environmental monitoring is to develop and use modeling and software technologies to advance the science and improve the decision making of resource and environmental issues. Integrated environmental modeling relies on advanced computational technology, dynamic data collection and analysis methods, environmental observation methodologies, and interdisciplinary efforts among ecologists, mathematicians, statisticians, and computer scientists.

Focus of Research at UMass Boston
• Data fusion and visualization; modeling and forecasting, with applications in security, wave movement, weather forecasting, and temperature monitoring
• Nonlinear dynamic systems and models
• Design of wireless sensor networks and in situ monitoring methods
• Theoretical and observational biology and oceanology
• Physical and chemical oceanography, focusing on water exchanges between coastal areas and watersheds
• Coastal networks, environmental monitoring and forecasting—projects include Massachusetts Bay
• Applied urban watershed analysis
• Understanding environmental quality and resource sustainability

UMass Boston Departments Involved
Departments of Biology, Computer Sciences, Physics, EEOS (College of Science and Math); College of Management; GIS Core Research Facility

Collaborations—Established and Potential
• Federal, state, and local environmental agencies; New England Aquarium; Woods Hole Oceanographic Institute; City of Boston (Bropont River Watershed); international efforts, including China and South Seas
• Strong potential to assist government and industry as ocean and coastal observation, prediction, and management technologies develop

Possible Distinctive UMass Boston Approach
• Connect with BU, MIT, Northeastern, Tufts on developing coastal biology sensor networks, with Boston Harbor as test bed
• Build working groups around sensor networks involving cell signaling, EEOS, computer science, etc.
• Focus on environmental and coastal monitoring, modeling, and policies

RESEARCH CLUSTER OPPORTUNITY: INTEGRATED ENVIRONMENTAL MONITORING
Overview

Investigations into biological systems analyze the interactions among the components of a biological system and how these interactions give rise to the function and behavior of that system. The systems approach includes a combination of experiments to characterize cell processes at multiple levels (including cellular organelles, nucleus, metabolic pathways, transcription, translation) using computer modeling. Other technologies involved in the mapping of systems include modification of the system via altered components and visualization of the outcomes.

Focus of Research at UMass Boston

- Cell biology: Investigation of response to stimuli at both organism and cellular level in development and morphogenesis; integration of pathways to systems knowledge deciphering morphogenesis and development; response to toxic, abnormal signals. Includes work in drosophilla, yeast, and plants addressing cell signaling, development, morphogenesis, defense genes
- Organism studies
- Bioinformatics
- Imaging technology (potential systems applications)
- Synthetic chemistry of biological compounds (potential systems applications)

UMass Boston Departments Involved

- Biology (molecular, organismic, cellular)
- Computer Science
- Chemistry (potential)
- Physics (potential)

Collaborations—Established and Potential

- Boston University, Harvard University, Mass General Hospital
- Can target significant pharma-biotech-medical device industry complex, and support innovations in health care delivery

Possible Distinctive UMass Boston Approach

- Investigators in organism and cellular biology now using elegant, cost-effective research models that provide information at an organism level conducive to bioinformatics modeling
- Supportive programs in Chemistry and Physics for manipulation and visualization of model systems and moving into more medicinal chemistry applications

Overview

Sustainable technologies use less energy and fewer natural resources, and do not directly or indirectly harm the environment. Examples of the many sustainable technologies are green chemistry, alternative-energy technologies, novel use of renewable materials, and design of “green” buildings and infrastructure. The adoption of sustainable technologies by organizations goes well beyond the technology and requires a systematic approach to thinking about how sustainability can become an organizational mind-set and viable business model with an integration of for-profit and nonprofit sectors. This is at the heart of organizational change and social venturing.

Focus of Research at UMass Boston

- Dynamics of collaborations for sustainability, focusing on governance and multiparty negotiations in climate change, regional climate-change policies, and the regional renewable-energy industry
- Organizational change and innovative management of sustainability and social venturing
- Gas-phase kinetics and photochemistry
- Use of carbon for catalysts and hydrogen storage
- Electrochemical research for renewable energy, sensors, and water treatments
- Algae-derived biofuels, solar cells, novel charge-storage techniques
- Design of synthetic methods for energy efficiency
- Preserving tropical rain forests

UMass Boston Departments Involved

Chemistry, Biology, EEOS (Science and Math), College of Management, Economics, ethnic studies institutes and centers

Collaborations—Established and Potential

- Active work overseas, including India and Colombia
- Linkage with Rocky Mountain Institute
- Strong potential to assist major corporations and community groups seeking to embrace sustainability

Possible Distinctive UMass Boston Approach

- Integration of sustainable-technology development and management of organizations seeking to advance sustainability
- Become the leading center for collaborations with regional industries on sustainability models and organizational approaches; leverage to define requirements for advancing technology solutions
NOTES


2. National data on university research funding is available only through 2005.


5. Ibid.


7. National data on university research funding is available only through 2005.


