M7 STEM WHITE PAPER: FINAL REPORT

REGIONAL TASKFORCE ON STEM EDUCATION (M7)

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ABOUT THE MILWAUKEE 7

The Milwaukee 7 (M7), launched in September, 2005, is a regional conglomerate that was created to establish a cooperative, economic development platform for the seven counties of southeastern Wisconsin: Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha. Its overarching mission is to attract, retain, and grow diverse businesses and talent. The M7 has embarked upon a comprehensive economic positioning strategy in efforts to broaden the region's economic range of industry choices and opportunities as well as to attract more highly skilled workers.

While solidifying its strategic plans, the regional conglomerate has identified industry hiring of science, technology, engineering, and mathematics (STEM) graduates and professionals as a priority. Specifically, the M7 seeks to increase the number of students and graduates within STEM pipelines and to recruit as well as retain STEM professionals within the region. Marquette University and the Milwaukee Area Workforce Investment Board have assembled the Regional Taskforce on STEM Education to study these matters in-depth and to make recommendations to M7.

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PART I: INTRODUCTION AND STATE OF THE STEM WORLD

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BACKGROUND

As a nation, the United States is at a crossroad where our global technological competitive advantage is threatened. Dr. Shirley Ann Jackson (2004) says it best, "The engine of our national economy, upon which our safety and security, our wellbeing, our quality of life, and our global competitiveness, indeed, our national preeminence depends, is powered by the technological and scientific discoveries and innovations made by scientists and engineers." Furthermore, a 20-member panel of the National Academy of Science, reporting at the request of a bipartisan group in Congress, said that without such an effort the United States "could soon lose its privileged position." It cited many examples of emerging scientific and industrial power abroad and listed 20 steps the United States should take to maintain its global lead. In a report called *Rising Above the Gathering Storm*, the panel stated "Decisive action is needed now" the report warned, adding that the nation's old advantages "are eroding at a time when many other nations are gathering strength." The health of the U. S. economy is directly tied to our science and technology industries, and the United States is a world leader in scientific and technological innovation.

Since 1995, for example, the United States has generated the largest share of high-technology manufacturing output of any country in the world. However, concerns have been raised about the nation's ability to maintain its technological competitive advantage, especially in light of other nations' investments in their own research infrastructures, the aging and changing U. S. workforce, and the fiscal challenges facing the nation. From 1990 to 2003, research and development expenditures outside the United States have more than

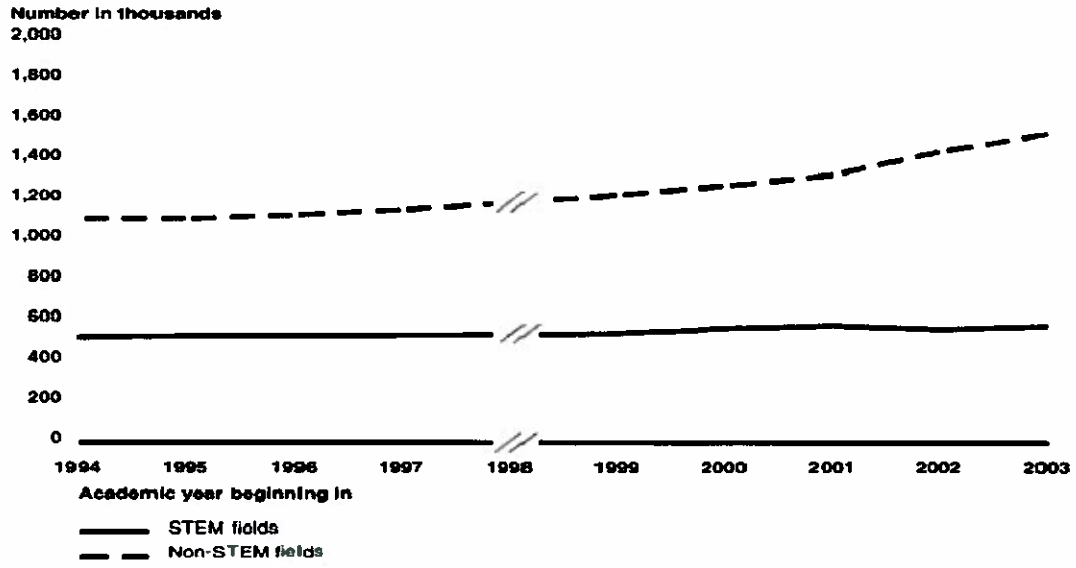
doubled, from about $225 billion to over $500 billion. According to the Census Bureau, the median age of the U. S. population in 2004 was the highest it had ever been, and the growth of the labor force is expected to slow considerably, becoming negligible by 2050. Further, as the United States becomes a more diverse society, minorities, in addition to women, will continue to represent a continuously increasing share of the workforce, yet women and minorities have tended to be underrepresented in STEM education programs and career fields" (GAO, 2006, p. 1).

In this first section, data are presented that supports these claims to the extent that action must be taken nationally and regionally regarding STEM. The Milwaukee 7, has an opportunity to be a leader in STEM to make a difference for a nation in need.

THE STEM CLIMATE

While postsecondary enrollment has increased over the past decade, the proportion of students obtaining degrees in STEM fields has fallen. Approximately 519,000 students obtained STEM degrees in academic year 1994–1995, which represented 32% of all degrees awarded at that time. In academic year 2003–2004, approximately 578,000 students obtained STEM degrees, which represented 27% of all degrees awarded (see Figure 1). When college and university officials were asked why STEM numbers are falling, they cited sub par teacher quality and poor high school preparation as factors that discouraged the pursuit of STEM degrees. In follow up studies, recommendations to encourage more enrollments in STEM fields by increasing outreach and mentoring were provided. In an effort to combat this issue of STEM enrollments and our global competitive advantage, Congress in addition to establishing new grants to encourage students from low-income families to enroll in STEM fields, established an Academic Competitiveness Council to identify, evaluate, coordinate, and improve federal STEM programs (GAO, 2006). However, the benefits of these funds have not resulted in significant changes.

Figure 1: Number of Graduates in STEM and Non-STEM Fields, 1994–1995 through 2003–2004 Academic Years



Source: GAO calculations based upon Integrated Postsecondary Education Data System (IPEDS) data.
Note: Information for academic year 1998–1999 was not reported by IPEDS.

STEM Issues: Global and Local

From 1990 to 2003, research and development expenditures outside the United States have more than doubled, from about $225 billion to over $500 billion. The term "outsourcing" has become part of the unpopular vocabulary in STEM fields. These figures clearly demonstrate how domestic companies are sending funds overseas. This is a direct threat, or at least, a perceived threat to our competitiveness. High school kids are being told by their counselors not to major in STEM because your job will be outsourced. Outsourcing and the perception of outsourcing are direct threats to the national STEM workforce.

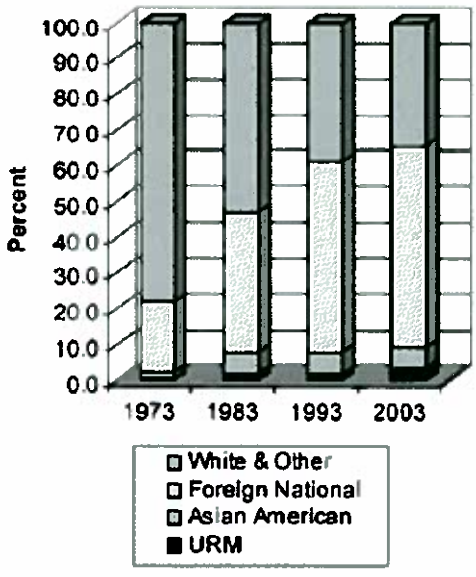
Furthermore, the minority population is increasing 10 times faster than non-Hispanic White population. The proportion of other minorities enrolled in the nation's public schools, particularly Hispanics, has almost doubled since 1972. As of 2002, American Indians, Asians, African Americans, Hispanics, and Pacific Islanders constituted 29 percent of all college students. Traditionally, White males and Asians have dominated STEM fields. Given the fact that the minority population is growing so fast, it is clear that we must broaden participation in STEM beyond White males and Asians in order to keep our competitive advantage. While the estimated number of women employed in STEM fields increased from 1994 to 2003, there was not a significant change in the percentage they comprised. Also, while the number of African Americans and Hispanic Americans employed in STEM fields increased from 1994 to 2003, minorities remained underrepresented relative to their numbers in the civilian labor force.

If the U. S wants to maintain its global technology competitive advantage, these groups must participate in STEM in great numbers. We can no longer depend on White males and Asians to sustain

our STEM workforce. Although foreign workers have filled more than 100,000 positions annually (many in STEM fields) through the H–1B visa program, employment levels declined in 2002 and 2003 after several years of increases. One key factor in this decline was more opportunities abroad for foreign employees. Additionally, after September 11, 2002 (9-11), new security measures were put in place that made it more difficult for foreign workers and students to come to the U. S. This is a major blow to our STEM workforce and competitive advantage, which is our nation's true innovation.

The U. S. has benefited greatly from innovative research in our academic research labs. The federal government funds research within our nation's institutions of higher education. As a result of this funding, innovative research ideas are generated that lead to new businesses. Hence, the U. S. gets the first look at these new innovations that eventually go global. If you take a close look at our nation's academic research labs, the graduate students are the work horses within these labs. White males and Asians traditionally are the people in these labs. Figure 2 shows the distribution of doctorates in engineering by race/ethnicity from 1973 – 2003.

Figure 2: Distribution of Engineering Doctorates



After 9-11 and recent developments in Asia, our workforce is dwindling. Table 1 demonstrates the shocking decline in international applications, admissions, and enrollments to our graduate programs. Although international graduate applications increased in academic year 2005–2006 for the first time in 3 years, it is too early to tell if this marks the end of declines in international graduate student enrollment. However, it is not in the U. S.'s best interest to rely on foreign students to populate our STEM workforce. In terms of employment, despite some gains the percentage of women in the STEM workforce has not changed significantly. Minority employees remain underrepresented relative to their employment in the civilian labor force, and many graduates with degrees in STEM fields are not employed in STEM occupations. These numbers demonstrate a potentially bad future for STEM. The obvious question that comes to mind is: "What is the federal government doing about this problem?"

Table 1: Change in Applications, Admissions and Enrollment of International Graduate Students 2003-2005

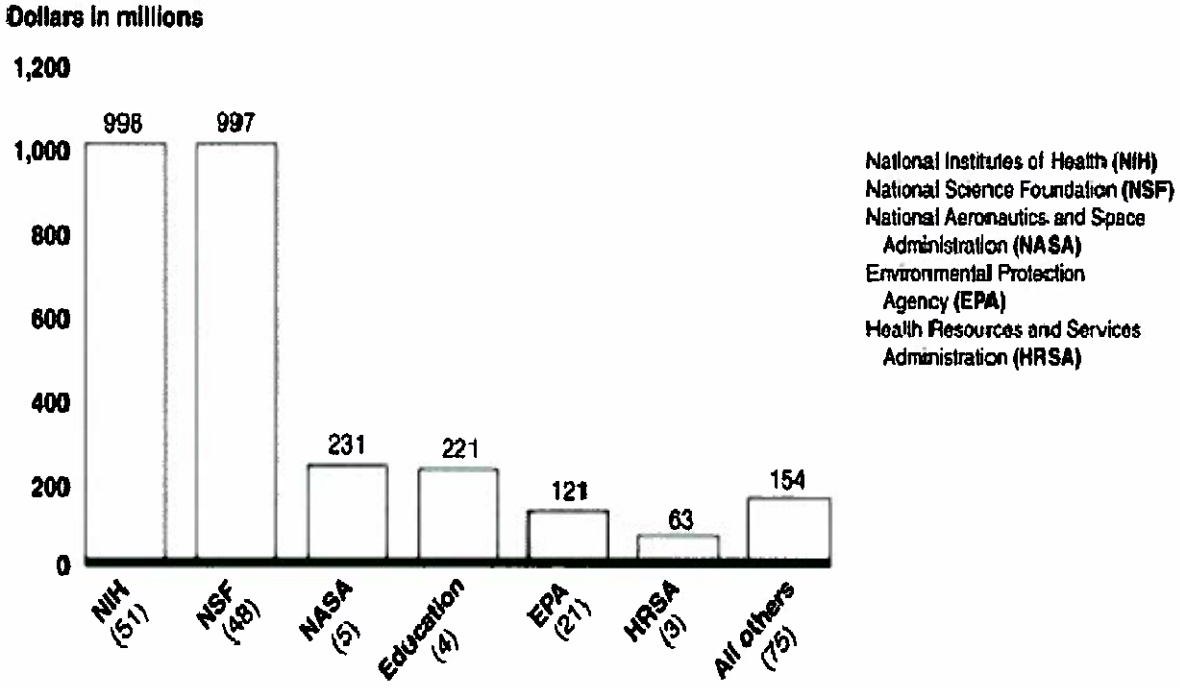
	Total	Engineering	Life Sciences	Physical Sciences
Applications	−28% (−5%)	−36% (−7%)	−24% (−1%)	−26% (−3%)
Admissions	−18%	−24%	−19%	−17%
Enrollment	−6%	−8%	−10%	−6%

There have been large declines in applications and admissions and a more moderate decrease in enrollment. Data for the 2005 academic year are shown in parentheses.

SOURCES: Heath Brown and Maria Doulis. 2005. *Findings from the 2005 CGS International Graduate Survey I.* Washington DC: Council of Graduate Schools. Heath Brown. 2004. *Council of Graduate Schools Finds Decline in New International Graduate Student Enrollment for the Third Consecutive Year.* Washington, DC: Council of Graduate Schools (November 4)

The federal government is very much aware of this problem- to the extent that the federal government has spent approximately $2.8 billion in fiscal year 2004 to fund over 200 programs designed to increase the numbers of students in STEM fields and employees in STEM occupations, and to improve related educational programs. Figure 3 breaks down these funds by program. The National Institutes of Health and the National Science Foundations account for nearly 50% of all programs. On a positive note, women now outnumber men in college enrollment, and minority students are enrolling in record numbers at the postsecondary level as well. To the extent that these populations have been historically underrepresented in STEM fields, they provide a yet untapped source of STEM participation in the future. Therefore, the Milwaukee region can benefit from tapping into this untapped source and building a strong STEM workforce within the region.

Figure 3: Federal STEM Education Programs and Funding by Agency, Fiscal Year 2004



Source: GAO survey responses from 13 federal agencies.

PART II: THE SOUTHEAST WISCONSIN CONTEXT: OVERVIEW INVENTORY

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INTRODUCTION

The STEM educational program inventory compiled for this section was developed by gathering information on colleges and universities, professional associations and foundations, and public and private organizations. To most accurately report the STEM educational efforts in the region the following criteria guided the data collection:

1. **Programs must be offered within the seven counties of Southeastern Wisconsin.**
   Although students within the seven counties of Southeastern Wisconsin may participate in other programs offered in Wisconsin (e.g., University of Wisconsin-Madison) or other states (e.g., Space Camp in Alabama), the focus of this inventory is STEM development initiatives provided within the seven-county area. This demarcation keeps the focus of this section on the type and scope of activities provided by organizations within the seven-county region in order to develop baseline data and operational knowledge of the STEM capacity within the region.

2. **Programs must consist of an in-person learning experience.**
   While self-study programs and tutorials may be valuable learning experiences, it can be argued that they reveal more about how students themselves learn than how organizations support the STEM pipeline. Online STEM educational offerings, which are limited for PK-12 and postsecondary students, are almost exclusively offered by organizations outside the seven-county area and therefore are excluded from this section.

3. **Contests and events that require participants to form adult-led teams are included.**

   Several STEM-related contests (e.g., the Rube Goldberg Contest) are held as culminating events for adult-led educational experiences (often school-based activities). While the contests themselves are not "learning experiences," in order to be eligible to participate, students must engage in STEM educational activities led by an adult to prepare for their participation in the contest.

4. **Curriculum enhancements provided to requesting teachers to augment students' regular classroom experiences are included.**

   Curriculum enhancement is one mechanism by which organizations attempt to affect STEM education. Materials and support to augment regular classroom instruction, such as the SAE Foundation's A World in Motion, are provided to teachers to give students access to STEM education not otherwise offered by their schools.

5. **Only programs specifically targeting STEM educational activities are included.**

   A host of programs exist that generally support student advancement (e.g., programs that facilitate high school to college transition and programs that give high school students access to college courses), but students may or may not participate in programs that focus to advance the STEM pipeline.

6. **Student organizations are not included.**

   Though STEM-related student organizations may support students' STEM development, student organizations are not instructor-led STEM educational programs and are not included in the inventory.

The current STEM Overview Inventory is comprised of several data points: program name, provider, area of STEM addressed by the program, level of education (e.g., elementary, high school, and graduate school), contact phone number, website address, city, county, ages served, number of participants per year, program length, capacity, program budget, effectiveness measures, type or sector, degree or certification, and target group served. With no clearinghouse of STEM educational programs in Wisconsin in general, and the M7 region in particular, extensive data collection was conducted to develop a list of programs meeting the above criteria. All available information according to the criteria listed above was used in compiling the current program list.

STEM OVERVIEW INVENTORY

The 1,062 programs listed in the STEM Educational Program Inventory are divided into two sections: (1) education programs for adults and (2) education programs for children.

Table 1: Number of Programs by Level Grouped

Level	Number of Programs
Adult Programming	783
Programming for Children	279

This was a natural division given that the needs and resources for adults and children are significantly different. Where there may be significant variation in the academic achievement of PK-12 students, which may relate to the potential STEM pursuits of those students, an analysis of PK-12 education is an undertaking separate from this compilation of STEM programs provided for students within the M7 region. Given that grades 1-12 education is compulsory in Wisconsin, it is not listed as a STEM education program because it is provided to all children within the region.

Rather, the programs listed for children on the STEM Educational Program Inventory are limited to curricular enhancements and extracurricular programs, more appropriately reflecting efforts related to STEM education that may differ geographically and by program. Alternatively, as all adult participation in STEM education programs is voluntary, with the variety of program types and locations likely related to who is accessing them, all STEM-related programs for adults found in the M7 region are included in the STEM Educational Program Inventory.

STEM Education Programs for Adults

The STEM education programs for adults found in the M7 region are almost exclusively formal educational offerings at institutions of higher education. Of the 783 programs for adults found in the M7 region, all but five are higher education programs offered by colleges and universities in the region - there are likely several reasons for this finding. First, colleges and universities are specifically tasked with providing postsecondary STEM education. The expectation, both within the M7 region and nationally, that colleges and universities are responsible for STEM education is so great that employers either expect employees to be responsible for seeking additional education outside of their work duties, or employers will provide tuition remission for employees seeking additional education. With the resources and infrastructure to provide both general overview courses and specific topical courses, it is both practical and preferable that colleges and universities provide the bulk of STEM education programs for adults.

Second, most adult education programs (i.e., educational offerings for adults who have not graduated from high school) are geared for English as a Second Language instruction, for literacy, for GED instruction, or other remedial programming, rather than for developing high-level knowledge and skills. Third, colleges and universities provide students credentials that are portable from job to job, making it preferable to company-provided programming that may increase participants' knowledge and skills, but leave them without the credentialing required for positions with other employers. Finally, information about STEM programs at colleges and universities is provided to the public making it more easily accessible during data collection than programming provided within a company for its employees.

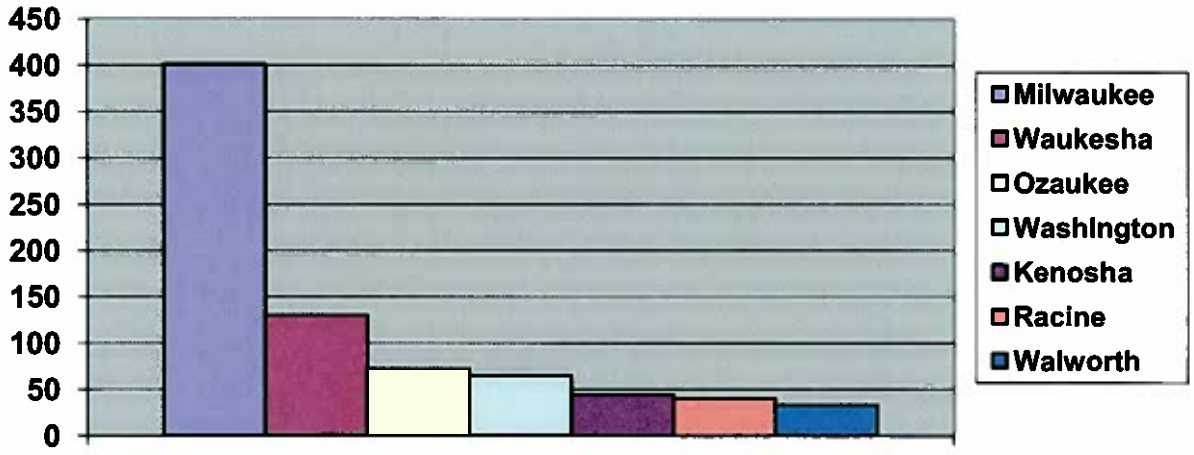
Distribution of Programs for Adults within the Region

Of the 783 programs for adults found in the M7 region, more than half (401) were offered within Milwaukee County, with Waukesha County a distant second providing 130 STEM programs for adults. The number of STEM programs for adults offered within the remaining counties of the M7 region is significantly lower than Milwaukee County, with Kenosha, Racine, and Walworth each offering less than 50 STEM programs for adults. The breakdown by county can be found in Table 2 and Figure 1.

Table 2: Number of Programs by County

County	Number Of Programs
Milwaukee	401
Waukesha	130
Ozaukee	72
Washington	65
Kenosha	44
Racine	40
Walworth	33

Figure 1: Number of Programs by County



As expected, Milwaukee County housed the majority of the STEM programs for adults, but the sharp drop in number of programs per county outside Milwaukee is startling, especially given the distribution of institutions of higher education throughout the region (see Table 3). Waukesha, Kenosha, and Ozaukee counties each have several colleges and universities, yet they fair only marginally better than Racine, Walworth, and Washington counties (which have fewer higher education institutions) in the number of STEM adult education programs they provide. The differences from county to county are even more striking when the specific STEM areas are disaggregated.

In particular, M7 counties outside Milwaukee barely exceed 10 programs in engineering and math programs, except Ozaukee County's 28 math programs. Similarly, the counties vary considerably in the number of science programs offered, with Washington and Waukesha counties noticeably outpacing Racine, Ozaukee, and Kenosha counties, but nowhere near Milwaukee County's 183 science programs. Geographic differences are also startling when focusing on technology programs as none of the counties outside Milwaukee offers more than 28 programs, as compared to Milwaukee County's 155 technology programs for adults.

Table 3: Number of Programs by STEM area by County

	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha
Science	19	183	29	3	4	47	76
Technology	17	155	11	28	19	6	28
Engineering	1	42	1	7	6	1	14
Math	7	48	28	4	7	11	20

The concentration of programs offered by particular institutions is notable, with Milwaukee Area Technical College providing significantly more STEM education programs for adults than any other educational institution in the region (see Table 4). It is interesting that the top two STEM education providers in the region are technical colleges, perhaps leading to additional questions about the relationship between the educational programs offered in the region and the job market.

Table 4: Number of Programs for Adults by Provider

Provider	Number of Programs
Milwaukee Area Technical College	224
Gateway Technical College	86
UW Waukesha	80
Marquette University	58
UW Washington County	57
UW Milwaukee	54
DeVry University	27
Milwaukee School of Engineering	24
Carroll College	21
UW Whitewater	19
WCTC	18
Cardinal Stritch University	16
Concordia University	14
UW Parkside	11
Mount Mary College	10
ITT Technical Institute	10
Alverno College	9
Carthage College	8
Moraine Park Technical College	8
Wisconsin Lutheran College	8
Milwaukee Career College	4
Upper Iowa University	3
Ottowa University	3
Medical College of Wisconsin	3
Project Lead the Way	2
University of Phoenix	2
Lakeland College	2
Goodwill Industries	2
Hands on Technology Transfer, INC.	1

STEM Educational Programs for Adults by Level

Graduate Programs

Within the M7 region, 78 educational programs for adults lead to graduate credentials (see Table 5). These credentials include doctorates, master's degrees, professional degrees, and graduate certificates. Of the 18 STEM doctorates offered within the M7 region, 13 are science-related and 10 of those are in the health sciences. Three doctorates are technology-related. Three are in engineering and one is in math. Overlap in program focus, such as with the Mathematics, Statistics, and Computer Science program at Marquette University (related to both math and science education), accounts for the discrepancy between the overall number of doctorates and the sum of the program-specific designations.

Table 5: Number of Programs for Adults by Level

Level	Number of Programs
Graduate	78
Undergraduate	515
Postsecondary	188
Adult Education	3

There are 46 STEM-related master's programs offered within the M7 region. Twenty-three of those master's degrees are offered in the sciences, with 15 of those in health services. Twelve master's degrees are in technology fields, including two that are in the multidisciplinary area of bioinformatics, which combines mathematics, computer sciences, engineering, and the biological sciences. The ten master's programs in engineering span across the specialties within the field, and the 11 master's programs in mathematics-related fields provide degrees for those specializing in economics, finance, accounting, and statistics.

Eight of the 13 graduate certificates offered in the M7 region are in technology, three are in the health sciences, and there is only one each in engineering and mathematics. Graduate certificates allow those with earned bachelor's to pursue additional credentialing, and specific knowledge and skills beyond the undergraduate level, without having to commit to a full, traditional graduate program.

Only ten of the 78 STEM-related graduate programs in the M7 region are offered outside Milwaukee County. Five graduate programs are offered in Waukesha County, three in Ozaukee County, and two in Kenosha. As one might expect, Marquette University and the University of Wisconsin-Milwaukee, are responsible for the bulk of the graduate programs in Milwaukee County specifically, and the M7 region generally- offering 31 and 19 programs respectively. Perhaps more surprisingly, Devry University, with a reputation for providing working adults a path to bachelor's degrees, offers ten graduate programs, exclusively in technology- and math-related areas. Milwaukee School of Engineering offers seven graduate programs heavily focused on engineering-related disciplines. The few remaining programs are offered by Cardinal Stritch University, Carroll College, the University of Wisconsin-Whitewater, and the University of Wisconsin-Parkside.

Undergraduate Programs

Undergraduate education represents the bulk of STEM-related higher education programs. Of the 515 undergraduate programs offered in the M7 region, 325 are for those pursuing associate degrees. The remaining 190 are bachelor's degree programs. Undergraduate education is more widely dispersed in the M7 region, but Milwaukee County still offers almost half (234) of the 515 undergraduate

programs offered in the region. Waukesha is responsible for 117 of the undergraduate programs offered in the region, with the University of Wisconsin-Waukesha, contributing significantly to that number. Washington County offers 59 undergraduate programs, with the University of Wisconsin-Washington County responsible for the vast majority of those offerings. Milwaukee Area Technical College, Concordia University, and the University of Wisconsin-Whitewater offer the 53 programs found in Ozaukee County. Carthage College, Gateway Technical College, and the University of Wisconsin-Parkside offer the 26 programs found in Kenosha, and Gateway Technical College is responsible for the 17 programs offered in Racine County and the 9 programs offered in Walworth County.

A significant number (269) of the undergraduate programs in the M7 area are in the sciences, with an overwhelming percentage of them in the health sciences. This is not surprising given the standard credentialing for many health science jobs is an associates or bachelor's degree. A notable number (132) of undergraduate offerings are in technology-related areas. While the 52 engineering programs offered in the M7 region span a host of specialties in the field, most of the 75 math undergraduate programs offered in the M7 region are in accounting, finance, and economics.

Postsecondary Programs

Postsecondary programs are those providing education and credentialing to high school graduates outside degree programs. The 188 postsecondary programs provided within the M7 area provide certificates and diplomas to those seeking the additional knowledge and skills for career advancement without requiring students to commit to a full degree program. Technical colleges offer the vast majority of the postsecondary programs in the M7 region, with

Milwaukee Area Technical College responsible for 99 postsecondary programs, and Gateway Technical College offering 49 postsecondary programs. Marquette University, the University of Wisconsin-Milwaukee, the Milwaukee School of Engineering, and the University of Wisconsin- Parkside, join Waukesha County Technical College and Moraine Park Technical College in offering the remaining programs.

Some technical colleges have several campus locations, a few with campuses both within and outside the M7 region. To most accurately represent the geographic spread of programs offered by these institutions, programs were recorded by campus, and were limited to those campuses within the M7 region. For instance, two of Moraine Park Technical College's three campuses are outside the M7 region, so programs offered at those locations are excluded from the STEM Educational Program Inventory. Gateway Technical College, as a further example, has several campuses within the M7 region. The Network Security certificate program is offered at Gateway's Kenosha, Racine, and Elkhorn campuses and each campus receives its own listing within the STEM Educational Program Inventory to appropriately reflect the geographic spread of the program.

Even with this sensitivity built in to the STEM Educational Program Inventory, there is a concentration of 94 of the 185 postsecondary programs in Milwaukee, largely because of the offerings of Milwaukee Area Technical College. Where the University of Wisconsin- Washington County and the University of Wisconsin-Waukesha provided for a greater dispersal of undergraduate programs, their limited certificate offerings keep them from providing for similar geographic dispersal of postsecondary offerings. Instead it is Gateway Technical College, Moraine Park Technical College, Cardinal Stritch University, the University of Wisconsin- Parkside, and Waukesha

County Technical College that offer the 93 postsecondary programs provided outside Milwaukee County, with 25 offered in Ozaukee County, 24 in Racine County, 16 in Kenosha County, 14 in Walworth County, 8 in Waukesha County, and 5 in Washington County.

Understandably, given that certificates may be necessary credentials for employment in the field of technology, 125 of the 185 postsecondary programs offered in the M7 region are in technology. Similarly, given the certification necessary in health fields, many of the 49 postsecondary science programs are in the health sciences. All but two of the 13 math-focused postsecondary programs in the M7 region are for those pursuing accounting and financial planning education. Interestingly, there are only two engineering postsecondary programs in the M7 region. While this may represent a significant gap in educational offerings in the area, it may also represent peculiarities in the credentialing of engineers if engineering positions are limited to those who have at least an associates degree, rendering postsecondary certificates of no use for employment or advancement.

STEM Education Programs for Children

The 279 STEM education programs for children included in the STEM Educational Program Inventory represent data collected to date on STEM-related curricular enhancements and extracurricular activities offered within the M7 region. Where as STEM programs for adults are offered almost exclusively by colleges and universities, STEM programs for children are offered by a host of organizations, including colleges and universities, foundations and nonprofit organizations, public parks and museums, professional organizations, private camps, and 4H. In addition to a greater variety in the number of providers of programs for children's programming, information about the providers of these programs is even more decentralized and difficult to collect than information about programs for adults. Consequently, the STEM Overview Inventory section of programs for children is likely even more dynamic than that of programs for adults.

STEM programs for children generally fall within four areas:

Curriculum enhancement programs in which classroom teachers are provided extra materials to bring students STEM educational activities. These materials often not only augment district-established curriculum, but also usually involve interactive, hands-on, project-based lessons intended to make STEM education more exciting for students. Examples of curriculum enhancement programs include Project Lead the Way, A World in Motion, and MATHCOUNTS. A World in Motion, for instance provides teachers the plans and materials for authentic engineering design lessons, they refer to as "challenges." The Society of Automotive Engineers International, which developed and distributes A World in Motion, designed the challenges in alignment with math, science, and technology standards for elementary, middle school, and high school students.

Project Lead the Way is another example of a curriculum enhancement program in which schools are provided the resources and materials for a four-year sequence of courses in engineering to augment the standard curriculum. Project Lead the Way courses are intended to be combined with college preparatory mathematics and science courses, and provide students precollege access to the scope, rigor and discipline of engineering. MATHCOUNTS is a national mathematics curriculum-enhancement and competition program promoting middle school math education. Teachers may choose to only use MATHCOUNTS curricular materials to enhance classroom instruction, or they may choose to have students participate in the MATHCOUNTS competition series.

"Precollege" programs provided by colleges and universities, which provide educational opportunities after school or on Saturdays during the school year, and/or summer programs of varying lengths. Examples of precollege programs include Marquette's College of Engineering summer programs, UW-Milwaukee's Upward Bound Math and Science, the University of Wisconsin-Milwaukee's Health Sciences programs, and apprenticeship programs. Marquette's College of Engineering, for instance, offers several summer courses for elementary, middle school, and high school students, including robotics programs, and programs in physics and chemistry.

The University of Wisconsin-Milwaukee, administers the federally-funded Upward Bound Math and Science program which assists low income and potential first generation college students in pursuing math and science undergraduate and graduate degrees by providing advising, tutoring, financial aid information, college planning, and career exploration. The University of Wisconsin-Milwaukee's Precollege Health Sciences Saturday Academy is a

20-session program that provides disadvantaged students hands-on health science activities.

Contests are administered by both university-affiliated and private organizations, and require students to work with teachers and/or other adults to prepare for a STEM-related competition. Several contests are available to students in the M7 region, including the Rube Goldberg Contest, the First Robotics Competition, Future City Competition, and 4H competitions. The Rube Goldberg Contest provides students of all educational levels the opportunity to participate in engineering everyday materials into innovative machines. The FIRST Robotics Competition is a varsity sport in which students build robots from a common "kit of parts" and enter them in a competition in which the robot they have designed must complete predetermined tasks.

Non-university-affiliated summer camps include programs, such as the Science Adventure Camp, and Discovery World Day Camps. Science Adventure Camps provide students the opportunity to pursue a number of interactive science projects, including building robots, launching rockets, and creating slime. The learn-by-doing curriculum of the Science Adventure Camps is aligned with National Science Standards and designed to fuel science learning. The Discovery World provides elementary, middle, and high school students a host of summer camp experiences in science and engineering, including robotics, biology, astronomy, and environmental science.

STEM students may also participate in the support and resources of non-STEM-specific programs, such as TRIO programs, GEAR UP and Youth Options programs. TRIO programs include a

number of educational opportunity outreach programs for primary, secondary, and postsecondary students including Talent Search identifying and supporting disadvantaged students with academic promise, Upward Bound which helps prepare low income secondary students for college entrance, and McNair programs which helps prepare low income postsecondary students for graduate study. While these programs are notable, since they serve students regardless of field of study, they are not directed specifically toward increasing STEM opportunities or the capacity of the STEM pipeline, and consequently, they are not included in the STEM Educational Program Inventory.

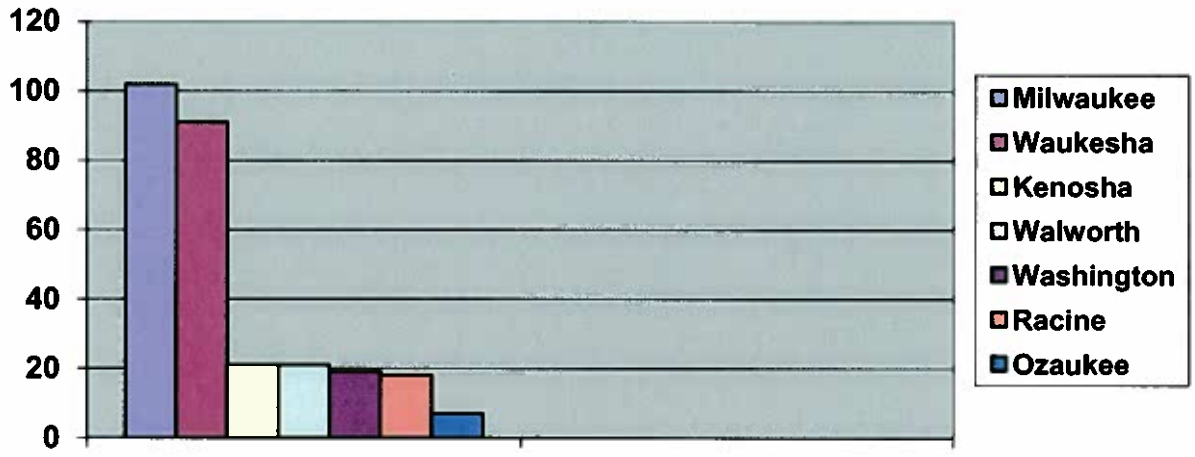
Distribution of Programs for Children within the Region

The distribution of programs for children by county is not much different than that of programs for adults, with Waukesha County only trailing Milwaukee County in number of programs slightly (see Table 6 and Figure 2). The limited number of programs for children in Kenosha, Racine, Walworth, Washington, and Ozaukee counties is notable given that children's mobility is often limited and dependent upon the availability of a parent. The likelihood that children will be even less likely than adults to participate in programs outside their immediate geographic area makes the concentration of programs in Milwaukee and Waukesha counties of particular interest.

Table 6: Number of Programs by County

County	Number Of Programs
Milwaukee	102
Waukesha	91
Kenosha	21
Walworth	21
Washington	19
Racine	18
Ozaukee	7

Figure 2: Number of Programs by County



Geographic proximity may be of even greater importance in Milwaukee County as students in this more urban area may be more likely to come from a single-parent household and have a lower socioeconomic status (see Table 7). An initial inspection of Milwaukee County shows 58 of the 102 programs offered in Milwaukee County is located in the City of Milwaukee. Further examination, though, reveals that of these 58 programs, 34 are provided by the University of Wisconsin-Milwaukee and Marquette University. Considering that these two institutions offer more than half of the programs within the City of Milwaukee shows significant control regarding accessibility of programs offered within the city.

Table 7: Number of Programs by County and Level

	Kenosha	Milwaukee	Ozaukee	Racine	Walworth	Washington	Waukesha
Elementary	3	27	2	3	2	6	31
Middle School	3	28	2	7	5	6	32
High School	15	46	3	7	14	8	28

In examining geographic distribution across educational levels, the numbers are relatively consistent for each county, with moderate increases in the number of high school programs offered in Kenosha, Milwaukee, and Walworth counties. For the most part, the number of STEM programs available to children in each county remains the same regardless of the education level. That is, this spread across educational level is encouraging as it may indicate attention to STEM education at the primary levels. In contrast, in those counties in which STEM education programs are sparse, they are equally limited at both primary and secondary levels.

STEM Educational Programs for Children by Level

Table 8: Number of Programs for Children by Level

Level	Number of Programs
High School	121
Middle School	83
Elementary	74

In the STEM Overview Inventory, programs that are offered to students across more than one educational level are counted toward each educational level they serve. That is, if a program serves both middle and high school students, it is counted separated for each level. Additionally, programs are organized by educational level even when they serve only a portion of the grades in that level. While it is not surprising that high school students have the most STEM-related educational programs, it is notable that the number of programs for middle school and elementary students are a reasonably close.

High School Programs

It should not be surprising that colleges and universities dominate high school STEM providers given the precollege programs offered by the University of Wisconsin system and private universities. Project Lead the Way, 4H, the First Robotics Competition, and A World in Motion also provide numerous high school programs in the M7. As we found with adult programs, science programs top high school STEM offerings, with 81 offered in the region. There are 56 and 57 engineering and math programs, respectively. Interestingly, high school technology programs lag behind with 34 programs offered in the region. There may be several reasons for the relatively small number of high school technology programs.

First, efforts to integrate technology into PK-12 education and adequately equip schools technologically may have reduced the need for extracurricular technology programs. Second, students may have adequate access to technology at home providing opportunities to explore technology they would otherwise seek from educational programs. Finally, high school students, as part of the "Net Gen," may have grown up with technology to such a degree they are less likely to seek out technology education programs. Each of these explanations is called into question when considering that while they are predicated on having a sufficiently high socio-economic status to have home and/or school access to technology, the more affluent Waukesha County has almost twice as many technology programs as Milwaukee County.

Middle School Programs

Curriculum enhancement programs account for all but a handful of middle school STEM programs in the seven-county region. Project Lead the Way, A World in Motion, and MATHCOUNTS

are responsible for the vast majority of the STEM programming to which middle school students have access. Where as in adult STEM education and other levels of STEM programs for children, science programs account for most STEM programming, math programs lead the way for middle school students in the region, with 70 middle school math programs outpacing the 54 science programs found in the area. While 35 engineering programs are available for M7 middle school students, technology programs lag behind with only 22 offered in the region as was found at the high school level.

Elementary Programs

FIRST Lego League, A World in Motion, and private summer camps provide the overwhelming majority of elementary STEM programs, though colleges and universities do provide 10 of the 74 STEM programs offered in the region. Sixty-eight science programs are provided to elementary students in the seven-county area, with 59 math programs offered in the region bringing in a close second. There is a significant gap between the number of math and science programs offered at the elementary level, and the number of technology and engineering programs offered, with 21 and 20 offered respectively.

Marquette University - Milwaukee Area Workforce Investment Board STEM Project Online Overview Inventory Database

Given the enormous amount of data collected for the overview inventory, it would be difficult to organize the programs in paper format such that it can be easily viewed and manipulated. Therefore, the programs were loaded into an online searchable database at (http://www.mupicstemproject.org/). The database allows you to search by Program, Provider, Level, City, County, and by STEM area. Search entries are used to form conjunctive queries. For example, if you were to enter 'A World in Motion' as the Program and select Elementary as the Level, the resulting query would only list programs that have 'A World in Motion' as the Program AND Elementary as the Level. Partial search entries are fully supported as well. In the previous example, you could enter 'world' instead of 'A World in Motion' and get the same results. If no values are entered into any of the search fields, the system will list all the programs in the database. The results of each query are displayed in table format with hyperlinks to web pages are available. At the bottom of the results list is a link that provides a downloadable version of the results for processing in third party packages (e.g., Microsoft Excel).

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PART III: SWOT ANALYSIS ON STEM EDUCATION
A STUDY OF THE M7 REGION

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PREFACE

"I had a desire to participate in a profession that contributes to the public good and provides an interesting variety of job options in a multitude of environments."

According to the National Science Foundation (2006), science and engineering jobs are a growing sector of the United States economy, but the number of people earning science and engineering degrees has lagged behind the growth in science and engineering occupations. In describing Wisconsin's "technology profile," Winters, Strang, and Klus (2000) report that Wisconsin ranked 23rd nationally regarding the number of Ph.D. scientists, and 26th nationally with regard to the number of Ph.D. engineers. Further, Competitive Wisconsin (2006) reports that the number of doctoral degrees awarded in the sciences decreased 11% between 2000 and 2005. The state of Wisconsin is also below the national average for the percentage of residents holding a bachelor's degree. Reports from the 2000 Wisconsin Economic Summit indicate the need for an increase in "brain gain[1]" jobs in Wisconsin.

Increasing the science, technology, engineering, and math (STEM) pipeline in Wisconsin is a vital part of increasing and maintaining its economic stature. This objective is perhaps most important in the seven-county region of southeastern Wisconsin (M7), as it is a vital part of the state's economy and accounts for 34% of the state's workforce according to Workforce Development Secretary, Roberta Gassman. According to the 2000 census, the M7 region is the most racially diverse area of the state (Southeastern Wisconsin Regional Planning Commission, 2004)—making it of particular importance to develop students and professionals of color in the STEM fields. This need mirrors national trends.

1 An opposite situation of brain drain, in which many trained and talented individuals seek entrance into a country or jurisdictions, is called a brain gain; this may create a brain drain in the nations or jurisdictions that the individuals are leaving.

Many major corporations and national organizations have been pointing to the need for improved K-12 and collegiate opportunities for minorities since the early 1970s. They argued that such an infrastructure would be necessary to provide Blacks, Hispanics, American Indians and others with the background to enter the science and engineering workforce in meaningful numbers. Yet, despite decades of such advocacy, the facts on the ground remain daunting. 'Of the 659,000 minority high school graduates in 2003, only 26,000 had the requisite preparation in science and mathematics to qualify for admission to study engineering or technology at the college level,' says Dr. John Brooks Slaughter, the president and CEO of the National Action Council for Minorities in Engineering (NACME) (Roach, 2006, p. 24).

Despite the importance of STEM educational opportunities in the M7 region, information about STEM programs in the region remain decentralized and disjointed, with the state's top math and science education personnel identifying no comprehensive resource for those interested in STEM education programs in Wisconsin. In response to the state of STEM affairs, the Regional Task Force on STEM Education has commissioned this SWOT[2] analysis in efforts to provide an environmental scan of the readiness of the M7 region to be reframed as a STEM Corridor.

The overarching goals of this SWOT analysis are to understand how to: (1) boost student participation in STEM at all educational levels in the M7 region; (2) increase STEM participation in order to bolster industry hiring in the M7; (3) convince more STEM graduates to stay as well as attract STEM professionals[3] to the M7 region; and (4) gain a greater understanding of the activities or initiatives that help cement a cooperative relationship among STEM organizations in the region.

2 Strength, Weaknesses, Opportunities, and Threats

3 In the context of this report, a STEM professional is an individual who holds a degree in a STEM discipline and/or whose professional employment supports a STEM culture or environment.

This section is separated into three components: (1) a description of the demographics for the participant respondents; (2) a documentation of participant respondents' perceptions of STEM educational opportunities in the M7 Region; and (3) a critical analysis of the strengths and weaknesses of STEM programs as well as an evaluation of potential threats to and opportunities for improvement concerning the recruitment and retention of STEM graduates and professionals in the M7 region. This section includes information derived from extensive data collection conducted throughout the M7 region. Specifically, empirical data were collected through an on-line survey distributed to diverse constituencies and key stakeholders within the STEM community (see Appendix for more detail). Targeted participants included STEM professionals residing in and around the M7 region.

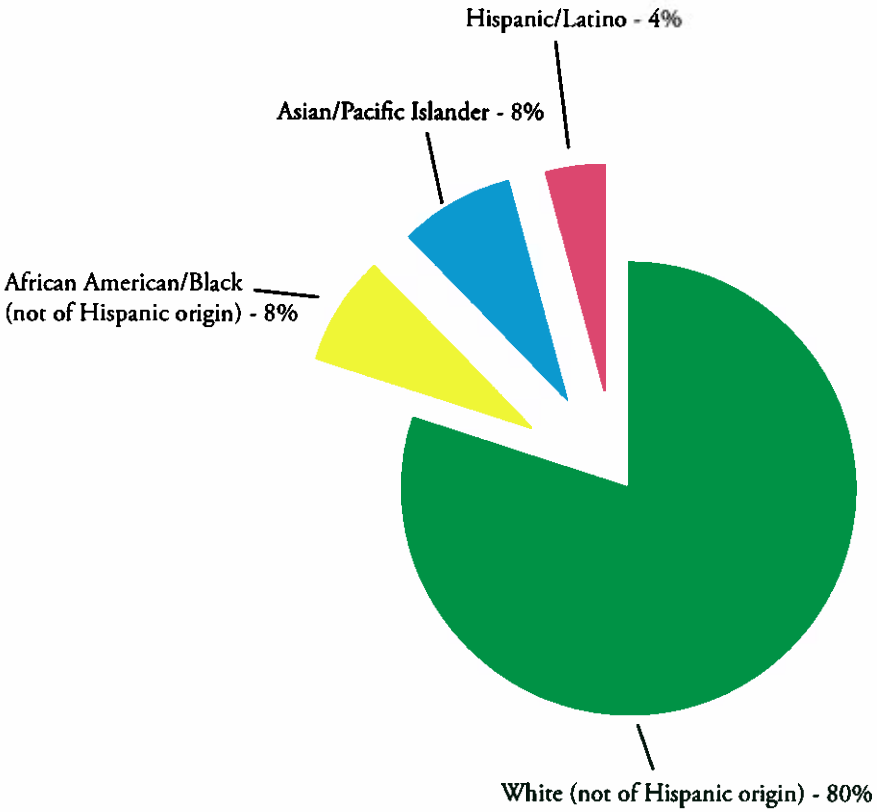
PART I - DEMOGRAPHICS

Race/Ethnicity

Targeted participants included STEM professionals in and around the M7 region. Given the nature of the STEM community within the M7 region and the severe underrepresentation of racial and ethnic minorities, only 20% of the respondents to the survey identified as racial and ethnic minorities (e.g., African American/Black, Asian or Pacific Islander, and Hispanic or Latino). The remaining 80% self-identified as White (i.e., not of Hispanic origin) (see Figure 1).

"I was interested in contributing to the energy, integrity, and advancement of Milwaukee."

FIGURE 1
RACE/ETHNICITY OF RESPONDENTS

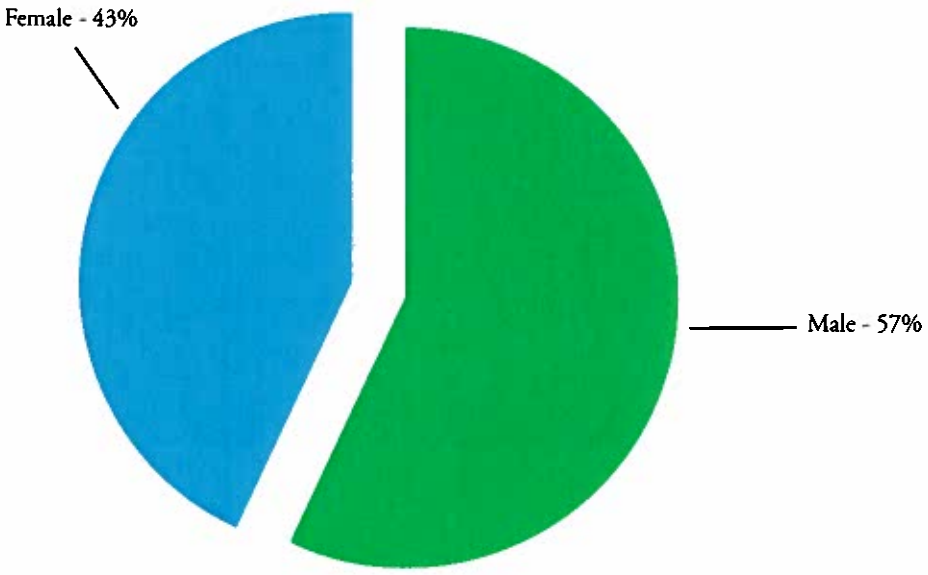


Source: Regional STEM Survey 2007

Gender

When examining gender of the professionals in STEM and STEM related disciplines within the M7 region, 57% of the respondents were male while 43% of the respondents were female (see Figure 2).

FIGURE 2
GENDER OF RESPONDENTS



Source: Regional STEM Survey 2007

Employment Categories

Of the professionals in STEM and STEM related disciplines within the M7 region that participated in the study, respondents to the survey were categorized within nine employment sectors (see Table 1). Table 1 details the employment categories with the corresponding percentages of employment/participation. There were 192 survey respondents, and approximately 80% were categorized within the education sector—which included higher and continuing education, K-12, distance learning, and extension services within local communities. The second largest concentration of categorical

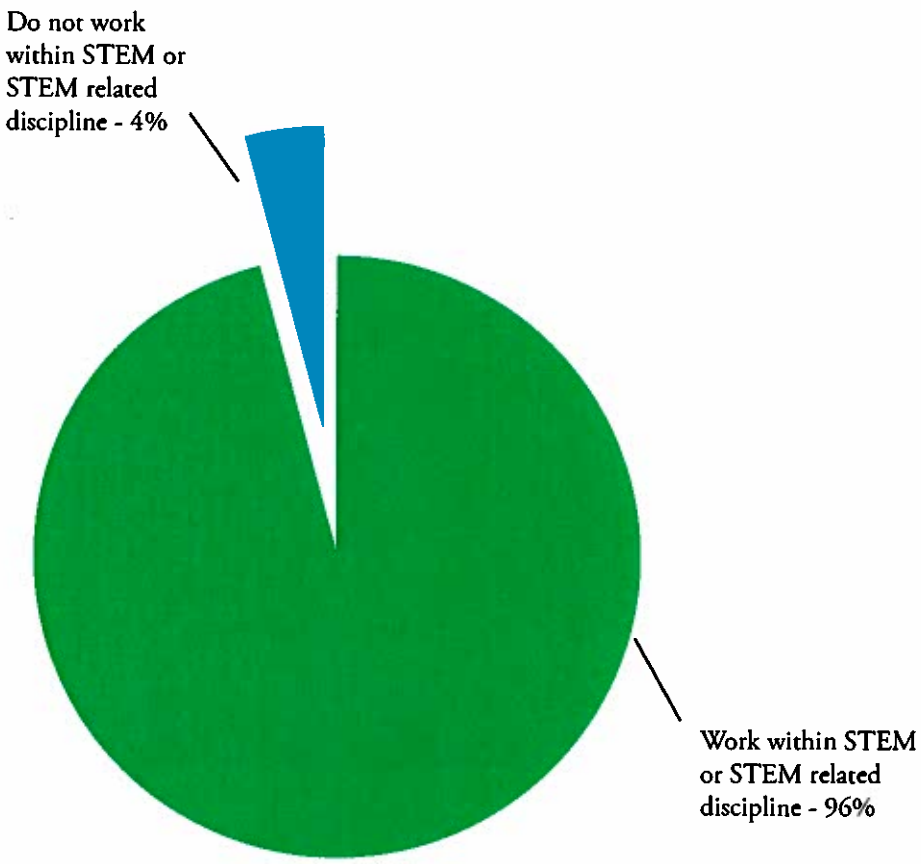
participation was the health sector. An overwhelming majority (i.e., 96%) of the respondents currently work in a STEM or STEM related discipline (see Figure 3). Among these disciplines, those that were the most prominent among respondents were: (1) technology education; (2) engineering; (3) mathematics education; (4) computer science; (5) computer security and systems analysis; (6) nursing; (7) media/ broadcasting; (8) chemistry; (9) biotechnology/biomedical research; and (10) medicine.

TABLE 1
EMPLOYMENT CATEGORIES OF STEM DISCIPLINES FOR RESPONDENTS

Category	Percentage
Chamber of Commerce	1%
Construction	1%
Criminal Justice	1%
Education (Higher, K-12, Distance)	80%
Financial	1%
Government	2%
Health	6%
Information Systems	2%
Legal	2%
Major Corporation/Small Business	1%
Non-Profit	2%
Utilities	1%

Source: Regional STEM Survey 2007

FIGURE 3
EMPLOYMENT OF RESPONDENTS



Source: Regional STEM Survey 2007

"I was attracted to the Milwaukee area in general because of its progressive history, overall quality of life, and educational opportunities."

M7 Counties

The seven counties of southeastern Wisconsin that comprise the M7 region are: Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha. Of the seven counties, the majority (74%) of the survey respondents reside in Milwaukee county (see Table 2). In fact, the remaining six counties only account for 26% of the respondents.

TABLE 2
PERCENT RESPONDENTS BY COUNTY

County	Percentage
Kenosha	2%
Milwuakee	74%
Ozaukee	4%
Racine	6%
Walworth	1%
Washington	2%
Waukesha	7%
Other	4%

Source: Regional STEM Survey 2007

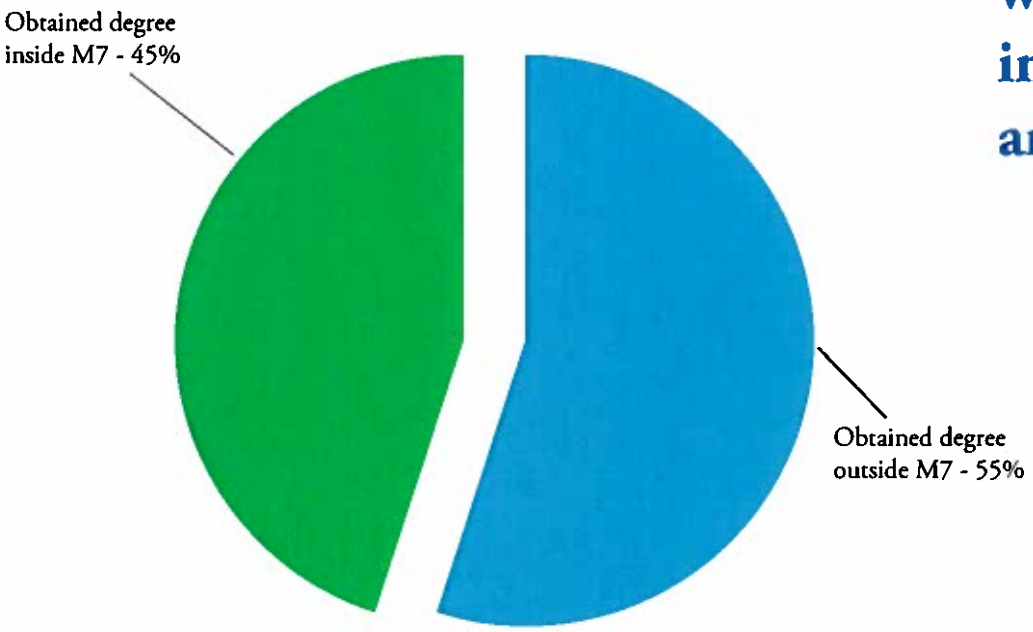
PART II - STEM EDUCATION

Degree Attainment

As indicated in Figure 4, 55% of the respondents obtained their degrees outside of the M7 region, and approximately 74% earned degrees within STEM or STEM related disciplines (see Figure 5). Table 3 provides a list of the STEM and related disciplines in which respondents obtained their degrees. Mathematics, engineering, chemistry, physics, and nursing were among the most frequently reported disciplines.

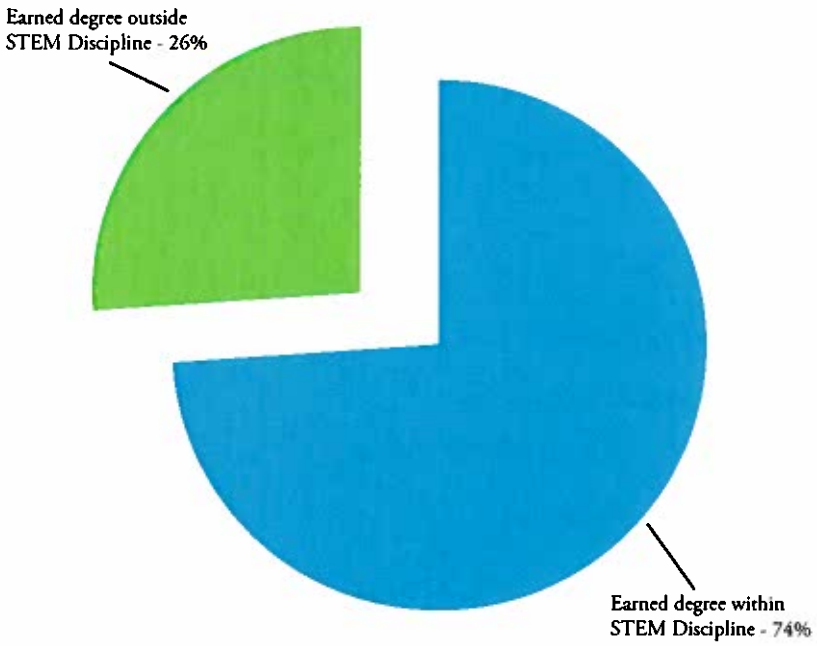
"I think UW-Milwaukee is an excellent university, and my family has made a wonderful home in the Milwaukee area."

FIGURE 4
WHERE RESPONDENTS OBTAINED DEGREE



Source: Regional STEM Survey 2007

FIGURE 5
DISCIPLINE DEGREE OBTAINED



Source: Regional STEM Survey 2007

TABLE 3
DEGREES: STEM AND STEM RELATED DISCIPLINES

Actuarial Science	Manufacturing Engineering
Agricultural Engineering	Marine Biology
Technology	**Mathematics**
Applied Geocehemistry	Mechanical Engineering
Applied Mathematics	Medical Imaging
Biology	Metallurgy
Biochemistry	Microbiology/Immunology
Biomedical Engineering	Molecular, Cell & Developmental
Botany	Biology
Chemistry	Neuroscience and Human
Civil Engineering	Development
Clinical Laboratory Science	Nuclear Physics
Communicative Disorders	**Nursing**
Computer Science	Oceanography
Electrical Engineering	**Physics**
Environmental Science/	Psychology
Engineering	Public Health
Geological Science	Toxicology
Industrial Technology	Zoology
Information Systems	

Source: Regional STEM Survey 2007

Institutions

Respondents earned degrees from a variety of institutions, both within and outside of Wisconsin. Table 4 provides a list of the in-state and out-of-state institutions from which respondents received their STEM degrees.

"There was a potential for research growth with the proximity of world-class research and development firms (i.e., GE, Rockwell, and Eaton)."

TABLE 4
DEGREES

Wisconsin	Other	
Carroll College	Univ. of Iowa	Univ. of British Columbia
Cardinal Stritch Univ.	Northern Illinois Univ.	Univ. of Basel
Medical College of Wisconsin	Saint Louis Univ.	Univ. of Illinois - Urbana
Milwuakee Area Technical College	Univ. of South Florida	Bombay Univ.
Univ. of Wisconsin	Univ. of Oklahoma	Univ. of Missouri
Eau Claire	Oregon State Univ.	Lamar Univ.
LaCrosse	Northern Michigan Univ.	North Carolina State
Madison	Univ. of Arizona	Dartmouth College
Milwuakee	Washington Univ.	Rutgers Univ.
Osh Kosh	Haverford College	UCLA
Parkside	Indiana Univ.	McMaster Univ.
Platteville	Ohio State Univ.	Univ. of Maryland
Stevens Point	Northwestern Univ.	Illinois State Univ.
Stout	Cornell Univ.	Univ. of North Dakota
Gateway Technical College	Johns Hopkins Univ.	Univ. of Alabama
Mount Mary College	Central Michigan Univ.	Univ. of Tennessee
	Brandeis Univ.	Duke Univ.
	Virginia Tech	Texas Tech
	Purdue Univ.	Xavier Univ. - Cincinnati
	Arizona State Univ.	SUNY-Buffalo
	Stanford Univ.	George Washington
	Valparaiso Univ.	Clark Univ.
	Univ. of Pittsburgh	Brown Univ.
	Illinois Institute of Technology	Oxford Univ.
	UC-San Diego	Loras College
	MIT	Rice Univ.
	UC-Berleley	Columbia Univ.
	Univ. of Minnesota	Mt. Holyoke College
	Michigan State Univ.	UC-Santa Barbara
	College of Wooster	Case Western Reserve
	Loyola Univ. - Chicago	Tulane Univ.
	University of Detroit	Univ. of Wyoming
	USC	Univ. of Rochester

Attraction to STEM

Respondents provided many factors that initially attracted them to their respective STEM discipline(s); however, the most salient factors were: (1) a general interest in math and science that was cultivated in junior high and high school; (2) curiosity about how technology works; (3) a vast array of career opportunities; (4) the opportunity to provide a public service and help others; and (5) the ability to engage in problem solving and hands-on activities that provide an immediate sense of gratification.

Regardless of age, gender, or racial/ethnic background, nearly all of the respondents shared a significant interest for STEM or STEM related subjects. Among the most popular subjects were computer science and mathematics. As one respondent shared, "I was interested in STEM from early on. I've always enjoyed computers and mathematics since I was in elementary school." Another respondent shared, "Since the age of nine, I have excelled at science and math. My interest was nurtured by my parents and teachers throughout school, but especially in high school."

Many of the respondents described their interests in problem solving and their deep-rooted desires to understand and make sense of the changing world around them. In fact, the desire to know "how something works" and to problem solve (especially using computers) was the most common theme across all of the comments made by respondents. As stated by one respondent, "I have always had a great interest in how things work and how they are built. As a child, I dismantled my toys and put them back together." This respondent was not alone in terms of his sentiment. Another respondent offered the following: "I like problem solving, and problem solving with computers seemed particularly attractive. That was coupled with my

desire to participate in a profession that contributes to the public good and provides an interesting variety of job options in a multitude of environments."

In addition to their curiosity about "how things work" and their drive to be a socially productive citizen, respondents provided a great deal of commentary on the immediate gratification that results from conducting hands-on work within STEM and related disciplines. For many, their initial attraction to STEM disciplines was triggered by the realization of their abilities to apply math and science to practical issues that affect people in their communities.

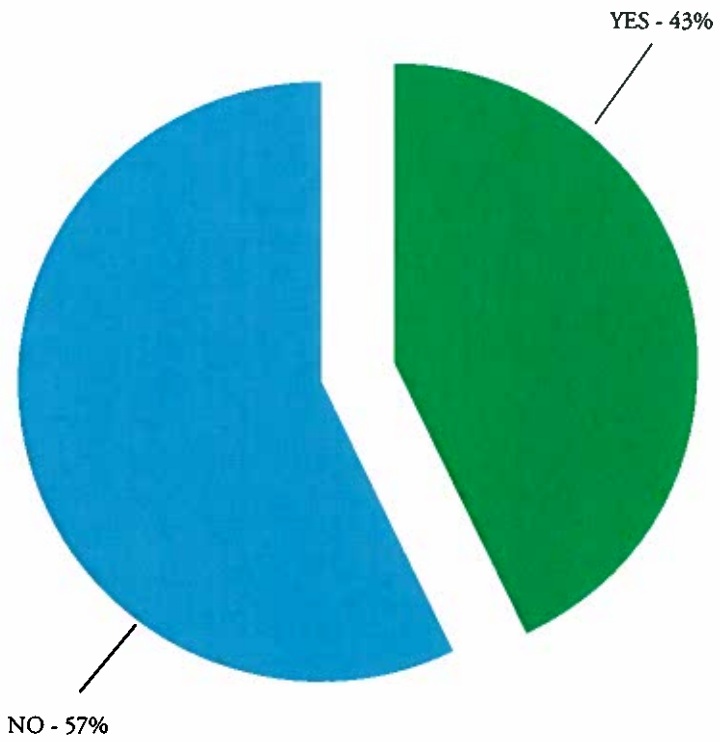
"Professional work was available and provided a diversity of population and quality of life in the community."

PART III - M7 SWOT ANALYSIS

STEM Organizations/Programming: Strengths and Weaknesses

1. When asked to comment on existing relationships among STEM organizations in the M7 region, only 43% of the respondents were knowledgeable about such efforts (see Figure 6).

FIGURE 6
RESPONDENTS' KNOWLEDGE OF EXISITING RELATIONSHIPS AMONG STEM ORGANIZATIONS



Source: Regional STEM Survey 2007

"There are great job opportunities and a strong business sector."

The general consensus among those who were knowledgeable was that the STEM relationships were cooperative and substantive in nature. Specifically, respondents were careful to note the strong nature of established relationships among the Milwaukee Public School (MPS) system, Wisconsin Technical College system and other higher education institutions in the M7 region, and industry affiliates. One respondent shared, "MPS has been developing relationships for quite some time with business and higher education to improve the educational opportunities in STEM for K-12 students. The partnerships are deep and meaningful."

Strength

The M7 region has a commitment to providing educational opportunities in STEM for students throughout the pipeline. A shining example of this commitment, as indicated by many of the respondents, is Project Lead the Way. Other programs that were mentioned are Upward Bound, INROADS/Wisconsin, the Minority Engineering Program at both Marquette University and the University of Wisconsin-Milwaukee, and other articulation agreements between the Wisconsin Technical Colleges and postsecondary institutions located within the M7 region. Programs like Project Lead the Way are successful because they are offered at the middle and high school levels and connect K-12 with higher and continuing education programs within the M7 region.

These programs have and continue to receive support from STEM organizations within the M7 region such as the Society of Hispanic Engineering Professionals, the National Society of Black Engineers, and the Society of Women

in Engineering. With such well established programs, organizations, and STEM partnerships, the M7 region has a strong STEM network/infrastructure upon which it can build and increase educational opportunities for STEM students. The region is rich in STEM resources, support, partnerships, and opportunities for collaboration. It seems that the M7's greatest strength lies in its STEM educational programs and initiatives (e.g., Project Lead the Way).

Weakness

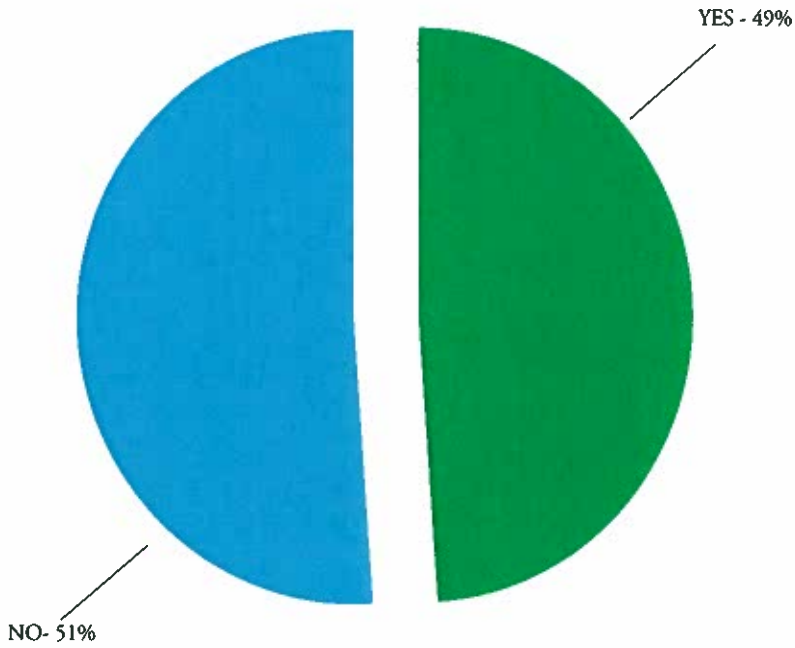
Although the M7 region has a strong STEM network/ infrastructure, there is minimal evidence to show that collaboration among STEM organizations (non-parternership arrangements) are prevalent. Indeed, communication is often non-existent within and among the M7's STEM organizations. As noted by several of the respondents, communication and transparency among different STEM organizations is an integral component of the M7's efforts to reposition itself as a major player within the industry. According to one respondent, "The relationships between the organizations could be better. There needs to be better coordination." Another respondent offered the following: "I believe that there are strong partnerships, but the community has tended to ignore partnerships already in place and prefers to reinvent the wheel."

Such a lack of communication and collaboration among the M7's STEM organizations is a major weakness and may prove to be a fatal flaw in its infrastructure. As one respondent aptly stated, "We must begin to see collaboration, which is the key to truly breaking out of the box to lead in providing an innovative, leadership workforce to enhance the quality of life in the M7 region."

2. As previously mentioned, there are several STEM program initiatives in place to increase the number of STEM students and graduates (e.g., Project Lead the Way, Upward Bound, INROADS, and the Minority Engineering Program). Respondents reported that these initiatives and programs, by and large, have made gains toward increasing the number of students in the STEM pipeline. Of the 49% who were aware of existing STEM programs efforts in the M7 (see Figure 7), approximately 67% of the respondents indicated that these initiatives are efficient in form and capacity (see Figure 8).

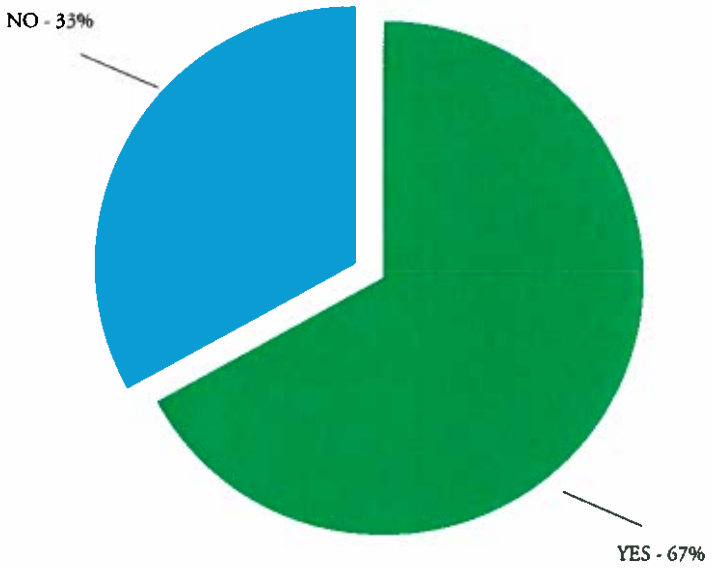
"There are many opportunities to grow professionally, enjoy access to a wide range of services and activities, and a variety of housing and educational options."

FIGURE 7
RESPONDENTS' KNOWLEDGE OF EXSTING STEM EDUCATION PROGRAMS



Source: Regional STEM Survey 2007

FIGURE 8
RESPONSES TO EFFICIENCY OF PROGRAMS GEARED TO INCREASE STUDENT PARTICIPATION



Source: Regional STEM Survey 2007

Strength

It would seem, then, that the M7's STEM programs have proven beneficial. Much like the existing relationships among STEM organizations, there is a small but strong and established contingency of STEM programs already in place.

Weakness

In general, respondents felt that the size and scope of these STEM programs were a major weakness, and therefore needed to be expanded and enhanced. As with any major initiatives, there is always need for progress and improvements. Respondents provided a multitude of suggestions to help sustain and increase the progress that has been made concerning STEM recruitment and retention of students and graduates in the M7 region: (1) expand Project Lead the Way and other engineering education programs; (2) integrate STEM subjects across the curriculum at K-12 levels; (3) incorporate

industry supported work-based programs and youth apprenticeships; (4) offer more competitive graduate school packages to STEM students of color with a built-in incentive package to stay in the M7 upon receipt of a STEM degree; (5) offer tax breaks to STEM and development/research firms; (6) create an incentive package for firms that commit to hiring a specific number of STEM professionals/students of color annually; and (7) develop merit scholarships for top high school students with interests in pursuing a STEM degree at an M7 institution.

"Wisconsin actually wasn't my first choice at the time. I came back and the realization was made then that the area had much more to offer than I previously thought."

Respondents provided recommendations for changes that the M7 region should adopt to improve its STEM recruitment and retention efforts. Although there are a substantial number of STEM programs in place, they are small in scale and scope and are narrowly defined as academic and industry programs. As such, existing programs exclude other potential resources such as parental involvement. As suggested by one respondent, "There needs to be more of a parent component added." In their current state, existing programs like Project Lead the Way do not emphasize parental involvement.

In addition, leadership of the M7's STEM programs is somewhat disjointed, as described by many of the respondents. To improve STEM educational/programming leadership, respondents suggest more opportunities for collaboration and communication among the different educational entities, especially at the K-12 level. One respondent offered the following: "Assign a coordinator who will put together a

collaboration or council of STEM organizations that will work together to ensure that students at all grade levels and pre-college institutions are STEM ready."

Threats and Opportunities for Improvement

1. The M7 region, especially Milwaukee county, has the potential to become a major hub center for cultural arts, advanced STEM research, high quality educational programs through the presence of world-class research institutions/ firms (e.g., GE, Rockwell, and Eaton), and entrepreneurial endeavors.

Opportunity

The M7 region is poised to become a major player in the STEM revolution in large metropolitan areas across the United States. There are excellent housing and educational opportunities as well as job opportunities for STEM professionals. In addition, the M7 region possesses a large public research institution (University of Wisconsin-Milwaukee) and a medium-sized private institution (Marquette University), with great potential to conduct advanced STEM research and attract high profile technology and development firms to the region. With its geographic proximity to other large metropolitan areas (e.g., Chicago) and Lake Michigan, it is a desirable place to live and grow as a STEM professional. By capitalizing on the geographic location, marketing the M7 region as an urban hub for young professionals (especially professionals of color), highlighting key financial opportunities for investment and entrepreneurial growth, and devoting more targeted resources to the cultivation and development of both University of Wisconsin-Milwaukee and Marquette University as world-class research centers, the M7 region can compete

"There were ample educational choices and business opportunities, an increasing emphasis on developing an entreprenurial climate, quick access to two major metro areas, and close proximity to an Interstate highway were all factors in me staying here."

nationally with other large metropolitan areas where STEM professionals elect to work.

Threat

Although the quality of living and geographic location/ proximity to other major hubs makes the M7 region a desirable place, the cost of living affected by high tax rates coupled with STEM salaries that are below the national average, and a lack of diversity regarding STEM jobs makes the M7 region a "death zone" for STEM students and professionals. Respondents were very candid in their comparisons of Milwaukee to other major hub centers along the east and west coast lines in terms of STEM salaries. The M7 region is a non-competitor in this arena. Unless STEM salaries are increased to take into account the high tax rate and STEM jobs are diversified to allow for a greater variety, the M7 region will remain a non-competitor in efforts to attract and retain qualified and talented STEM students and professionals.

2. The M7 region currently does not have a vibrant community of young STEM professionals of color. Emphasis is placed on young professionals, as many of the respondents addressed this issue in their comments and responses. In fact, respondents indicated that there is a severe lack of representation, and that southeastern Wisconsin is continually loosing potential pools of highly qualified, young STEM professionals/students of color to historically Black collegs and universities (HBCU) in the southeastern region of the country. While the latter have reported steady increases among STEM alumni of color whom elect to stay in surrounding areas upon receipt of their STEM degrees, the M7 region has reported steady decreases.

Opportunity

The M7 region is not alone in its endeavors to attract and retain more STEM students and professionals of color. Indeed, it is a national priority, and federal agencies and private entities are all committing millions of dollars in the development of a pool of STEM professionals of color across the country. As such, the M7 region has a unique opportunity to receive earmarked funds that are expressly intended to assist in this endeavor. By creating STEM pipeline programs that tap into Wisconsin's talent pools and students attending HBCUs by way of summer research/intern programs at the Medical College of Wisconsin, University of Wisconsin-Milwaukee, and other institutions, the M7 region can drastically increase the number of STEM professionals and students of color. This, of course, entails a concerted effort to recruit cohorts of students from institutions with a reputation of producing highly qualified STEM students of color (e.g., Tougaloo College in Jackson, MS and Xavier University in New Orleans, LA). It is important to note that there are also non-HBCUs with high concentrations of STEM students of color (e.g., University of Maryland Baltimore County, Meyerhoff Scholars Program) that might provide the M7 region with an increased and steady flow of aspiring STEM professionals of color.

Threat

Diversity is an important component of all healthy living, learning, and working environments, and the M7 region is no exception. Failure to increase the numbers of STEM students and professionals of color in an aggressive manner by actively recruiting and seeking such individuals will result in a gradual reduction of STEM professionals who

currently reside in the M7 region. In addition, the desirability and heterogeneity that is often associated with a major urban hub will decrease in scope and scale regarding the STEM community in the M7 region.

3. Many of the respondents developed an interest and deep desire to explore STEM subjects early in their education (i.e., junior high and high school). Specifically, grades 8-10 seem to be of particular importance, as most of the respondents identified this as the time when they developed definitive plans to study STEM or related disciplines at the postsecondary level. Indeed, their interests in STEM and related disciplines at such an early developmental stage may have in fact influenced their decisions to pursue a postsecondary degree.

Opportunity

What is especially encouraging about this finding is that educators, researchers, and policy makers now know that early exposure is an important activity in order to develop and cultivate interest in STEM disciplines in a student's educational career. By targeting elementary schools in the M7 region (i.e., who are good in math and science and possess a natural curiosity about the world around them) and allowing them opportunities to explore STEM subject(s) within the context of a directed study class, it is highly plausible that the number of young Wisconsinites who pursue a career in STEM or related disciplines will drastically increase over the course of the next 10 years. This will, in turn, create a steady flow of STEM professionals in Wisconsin, but more importantly within the M7 region.

Threat

Failure to develop and cultivate interest in STEM disciplines during the specified time frame (i.e., grades 8-10) may result in further loss of potential pools of STEM talent. In addition, denial of opportunities for exploration along with an incentive package (i.e., directed study for high school or college credit) of STEM disciplines early on might curtail the general interest in STEM among students and, thus, further reduce the number of potential STEM professionals.

4. In addition to encouraging "brain gain," the M7 region must also prevent "brain drain[4]." In recent years, the issue of "brain drain" has become a priority among Wisconsin policy makers and employers. Increasingly, the state's economy is becoming a knowledge-driven economy, and the STEM industry is no exception. In this particular instance, STEM knowledge is a crucial component of helping to revitalize the M7 business community. As such, the M7 region must identify desirable features that make it an attractive and amenable place to live and grow professionally for STEM students and professionals.

"Career opportunities were present as well as the opportunity to grow and enhance my work skills."

Opportunity

One of the M7's greatest assets in the reduction of "brain drain" is its proximity to all that is familiar to Wisconsin STEM students and graduates (i.e., in the way of family relations and friends) as well as the quality of life. When asked why they elected to stay and work in the M7 region, many of the respondents indicated strong family and

4 A brain drain or human capital flight is an emigration of trained and talented individuals ("human capital") to other nations or jurisdictions, due to conflicts, lack of opportunity, health hazards where they are living or other reasons.

social ties within the M7 region and surrounding areas as the primary attraction, and a high quality of life and living as a secondary attraction. One by one, respondents gave riveting accounts of how important their families are to them. As one respondent shared, "My family is here. I stayed here mostly for family reasons. I stayed because of the close proximity, job availability, and the quality of life." This is just one among many comments regarding the sheer importance of family and maintaining geographic proximity, and ties to close friends and loved ones.

The M7 region has a special opportunity that is unique to its geographic location to reinvent itself as "a place to call home" for its new STEM recruits and as a "sustainable and likable" home for current residents. The words sustainable and likable are used intentionally, as the express purpose is to continue to appeal to STEM professionals and students who have experienced and are currently undergoing the "M7 Experience" and are, therefore, very familiar with the living conditions, high quality of life, proximity to family and friends, as well as proximity to other major urban hubs.

Threat

The M7 region must emphasize retention as much as recruitment. "Brain drain" is as much of a concern as "brain gain." Equal emphasis must be placed on both. Should the M7 region fail to appeal and cater to existing STEM professionals and students, they will surely compromise their core efforts to revitalize the region and make it more STEM friendly.

PART IV: CONCLUSION

The findings of this study parallels national trends in the lagging growth of individuals earning STEM related degrees as compared to the growth of the science and engineering sectors within the United States economy. Likewise, a key component in addressing the weaknesses of STEM economic development within the M7 region is directly related to education, or the lack thereof. This echoes other economic studies (e.g., National Science Foundation, Competitive Wisconsin, and Wisconsin Economic Summit) that necessitate interventions starting with the K-12 education systems (particularly grades 8-10), relative to increased exposure and development in the areas of science, technology, engineering, and mathematical applications.

The STEM programs in place in the M7 region are relatively small and are limited in their ability to increase their representation within academic or industry networks due to a lack of participation and communication about existing programs. In this study, only 49% of STEM professionals in the M7 region were knowledgeable about existing STEM educational programs geared toward increasing the number of students and graduates within the STEM pipeline. Furthermore, only 43% of STEM professionals were aware of existing relationships among STEM organizations that focused on increasing the number of students and professionals within STEM related disciplines.

The need for increased participation and diversity within the STEM disciplines is critical if the M7 region is to continue to develop and maintain economic competitiveness with other large metropolitan areas across the country. Communications within the

M7 region about existing programs within the STEM disciplines is a key and heretofore underutilized component in increasing participation within the targeted areas. Because there is a lack of collaboration and communication among STEM organizations within the M7 region, the region will have to be systematic regarding its efforts to be positioned as an industry leader in STEM related fields. Communication and collaboration must be increased if the M7 region is to capitalize on already established programs that increase educational opportunities such as the Project Lead the Way and the Minority Engineering Program.

"There were also opportunities to contribute to a worthy mission, a good working environment, and a good community of support."

The process of responding to the state of STEM affairs within the M7 region is currently in progress. In fact, this study highlights programs that are genuinely committed to providing educational opportunities in STEM for students throughout the educational pipeline. The question is whether these programs will receive enough support to expand and build upon current initiatives, increase representation, and foster retention that will ultimately increase the number of STEM professionals in the M7 region.

The reality is that the M7 region, particularly Milwaukee County, has the propensity to become a major hub center for cultural arts, advanced STEM discipline related-research, and high quality education programs through the presence of world-class research institutions and firms such the University of Wisconsin-Milwaukee, Marquette University, GE, Rockwell, and Eaton. By capitalizing on geographic location, the M7 region can market itself as an urban hub for young professionals and in particular, students of color. In an effort to compete with other metropolitan areas that embrace the STEM disciplines, the M7 region can identify key financial opportunities for investment and entrepreneurial growth, and devote more resources to the cultivation and development of the region as a STEM Corridor.

The M7 region must rid itself of its reputation of being a "death zone" for STEM students and professionals. This can be accomplished by increasing STEM salaries to be nationally competitive in light of the expressed concerns about high tax rates, as well as instituting incentive packages in an effort to recruit students and professionals of color. Failure to do so would be detrimental to the national and regional goal to increase participation and representation in STEM related disciplines. Moreover, M7's efforts to become a key player in the STEM industry will be intensely jeopardized.

In closing, it is important to actively and aggressively cultivate interest in the STEM disciplines from an early age by gaining students' interest. The M7 region must market its strengths, minimize its weaknesses, and take advantage of its opportunities by sparking students' interest while they are still young, cultivating their interest through pre-college, enrichment, internship and cooperative programs, and finally, creating a welcoming environment that would retain and cater to individuals' health, financial, and cultural needs. While the rest of the national economy is moving forward with regard to STEM related initiatives, the challenge that the M7 region will have to overcome is its slow implementation of the necessary components to ensure a successful STEM economy.

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APPENDIX

Methodology

A qualitative inquiry is appropriate for the study of a phenomenon for which researchers have very little previous empirical knowledge (Shank, 2002). Creswell (2002) stated more eloquently that "qualitative research examines a research problem in which the inquirer explores and seeks to understand a central phenomenon" (p. 52). Within this context, an exploration means that little is known in the literature about the phenomenon and the researcher in turn will use data from participants to develop foundational knowledge. In order to achieve this goal, it is often recommended to employ a comprehensive interview protocol using open-ended questions (Brenner, Brown, & Canter, 1985; Flowers & Moore, 2003; Rubin & Rubin, 1995). This study utilized the internet to collect qualitative data.

The internet has become a popular medium for finding, retrieving, and exchanging information for use in research (Crossman, 1997; McFadden, 2000). More recently, researchers (e.g., Flowers & Moore, 2003; Moore & Flowers, 2003) have described the usefulness of the internet for collecting qualitative data. Specifically, Flowers and Moore (2003) found that the benefits of collecting qualitative data on the internet were increased efficiency and accuracy by eliminating the time needed to transcribe audiotapes. This study employed e-mail interviews for data collection. Creswell (2002) states: "E-mail interviews consist of collecting open-ended data through interviews from individuals using computers and Web site or the Internet" (p. 207). This approach is recommended when you need to collect data from a geographically dispersed group of people. Accordingly, e-mail interviews were deemed appropriate for this study.

Data Collection

Research data were collected through the use of e-mail interviews. The e-mail interviews were administered via electronic mail and a web-based data collection site. To develop our pool of participants, we sent e-mails to STEM professionals in the M7 region requesting names of appropriate individuals for this study. Upon receiving the names, each potential participant was sent an e-mail explaining the purpose of the study and assuring confidentiality. The e-mail requested participation in the study and included a direct link to the data collection website. If the individual agreed to participate, the link would take them to the e-mail interview protocol. The e-mail interview protocol typically took approximately 20 minutes to complete. This data collection process yielded 192 completed e-mail interviews.

Data Analysis

Using Conrad's (1982) constant comparison method, emergent themes were analyzed after all data were submitted to the web-based data collection site. Themes of particular interest to the researchers were those associated with elucidating the research questions for this study. These themes were labeled and described independently by the two researchers. These themes and their descriptions were then cross-verified by the researchers together, re-labeled, and defined. Each researcher then re-examined the original transcripts for separate verification of the presence of the emergent themes. Original transcripts from these data were extracted as supportive evidence for the existence of each theme. The researchers together combined findings from the separate analyses to produce a final description of each theme, along with their properties and dimensions.

Participants

Participants were 192 STEM professionals employed within the M7 region. Because there is little research on this group of professionals within this specific region, it is difficult to assess the representativeness of our sample. Participants were treated in accordance with the "Ethical Principles of Psychologists and Code of Conduct" (American Psychological Association, 2002). No participant names or other identifying characteristics were used in reporting the results of this study.

Protocol

The E-mail Interview Protocol for STEM Education in the M7 Region was developed to examine this phenomenon. Items on the e-mail interview protocol were based on a comprehensive review of the literature addressing STEM education and professionals. The aim was to ensure that data were collected on STEM education in the M7 region in order to perform a SWOT analysis. For the most part, the e-mail interview protocol consisted of open-ended questions (except for demographic information) and was arranged in the same manner the researchers would have asked in-person. The e-mail interview protocol is divided into four sections: (a) demographic information; (b) STEM educational opportunities; (c) strengths and weaknesses of STEM education in M7; and (d) opportunities and threats for STEM education in the M7 region. Pilot testing of the e-mail interview protocol was completed using five STEM professionals in the M7 region. Respondents were asked to complete the e-mail interview protocol, give comments on the clarity of statements, and identify other items that should be included. Comments were analyzed, feedback was reviewed, revisions were made, and the e-mail interview protocol was revised.

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PART IV: REGIONAL STEM VISION AND RECOMMENDATIONS

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M7 STEM RECOMMENDATIONS

This section offers eight recommendations for improving the STEM workforce in the M7 region. The recommendations are organized into two categories: (1) Foundational Efforts and (2) Unique Opportunities. Foundational efforts are recommendations that are not likely to be viewed as new contributions regarding STEM discourse in the M7 region; however, they are critical to establishing appropriate baseline efforts in order to move forward on proposed initiatives. Unique opportunities are recommendations that emerged from data collection and analyses that, if implemented, would likely poise the M7 region as a national center for STEM education and workforce development.

FOUNDATIONAL EFFORTS

RECOMMENDATION ONE:

Need to Increase the Number of Underrepresented Groups in the STEM Workforce in the M7.

The region should take specific steps to increase the participation of women and people of color in STEM within the region. This is a national problem and it affects the M7 region as well; however, the M7 region has a large pool of people of color that could be STEM participants if provided the proper incentives to pursue such careers.

By leverage existing strengths in this area, appropriate steps could be taken to remedy this concern. For example, Marquette University is a top producer of female engineers, especially in Biomedical Engineering, according to the October 2007 issue of ASEE

PRISM Magazine (see Appendix). These current and former students could be strong advocates for recruiting underrepresented groups into Engineering. Establishing mentoring and scholarship programs for women and people of color to participate in STEM initiatives at all levels could be a logical extension of current efforts. These efforts should be done in concert with industry to offer internships, shadow and employee days, and other programs to underrepresented populations.

RECOMMENDATION TWO:

M7 needs to Retain more of its STEM Graduates.

A significant portion of the STEM graduates within the M7 leave the region after degree completion. Therefore, it is necessary to retain these graduates in order to avoid brain drain within the region. Offering incentives for graduates of M7 institutions to stay in the region should be a chief consideration. For example, tuition discounts for those that stay in the M7 region after graduation could be very appealing. More specifically, a forgivable loan program could be established whereby graduates could borrow up to a specified amount of money interest free for 4 to 6 years while they are in school. Upon graduation, 20% of the loan is forgiven each year they are employed within the M7 region. If a graduate stays within the region for 5 years, their entire loan would be forgiven. After 5 years of employment within the region, these STEM professionals would likely be established both within their careers and the region. As such, leaving the region at that time would be less likely.

RECOMMENDATION THREE:

Recruitment from Outside the M7 is Needed.

Current dialog seems to only prioritize retaining STEM graduates; however, recruiting from outside the region is a key

component to growing the workforce as well. In order to grow the STEM economy, it is necessary to attract STEM employees from outside the region. For instance, in the November 10, 2007 Milwaukee Journal Sentinel there was an editorial on "Engineering Education." This article states:

> *Job openings requiring expertise in science, technology, engineering and mathematics were expected to increase by 18.3% through 2014 in the state, compared with 11.5% for all other occupations, according to a February report by the Center on Education and Work at UW-Madison. Yet only 21% of the degrees awarded by the UW System and technical colleges focused on the fast-growing science, technology and engineering fields, the report states. And M-7 data shows that the Milwaukee region has a smaller share of engineers, computer technicians and scientists than other faster-growing regions like the Twin Cities and Charlotte, N.C.*

The M7 region should recruit actively outside the region for both STEM professionals and students. This can be accomplished by attending job fairs at institutions outside the region. Additionally, the SWOT analysis suggest that focusing on the recruitment for STEM professionals of color could help to increase the overall size of the STEM workforce. For example, one approach would be to recruit from minority serving institutions in the South and Southeast regions (e.g., Tougaloo College, Spelman College, Florida A & M University, and University of New Mexico). It is essential that these recruitment efforts include people of color to create a familiar climate during the recruitment visit. It is also important that recruiters promote what the M7 region has to offer prospective employees at work and within the community.

RECOMMENDATION FOUR:

STEM Education Needs to Start as Early as Possible: K-1.

STEM education needs to start as early as possible. Young children need to be exposed to and develop STEM skills during their

initial years of formal education. This can be naturally fostered with young children because of their curiosity with "how things work." This should be leveraged in the M7 region to establish a STEM culture for young children. Train non-STEM pre-school and K-6 teachers on how to foster STEM thinking at early ages. For example, Dr. Jeannette Wing talks about computational thinking and the benefits of such thought processing (CACM, 2006). Computational thinking is STEM thinking and these processes can be fostered in children at early stages of their educational training by fostering the innate curiosity about "how things work."

UNIQUE OPPORTUNITIES

RECOMMENDATION ONE:

Need to Strengthen the Relationship between STEM Organizations.

Results from the SWOT analysis shows that the existing STEM organizations and programs in the M7 region work and exist in silos. Essentially, STEM organizations within the M7 region have very limited knowledge of each other's programs and offerings. Likewise, the inventory database shows that there could be better balance between the programs across levels (e.g., education and sector) in order to foster a STEM program pipeline within the region. An eclectic and decentralized set of STEM programs exist from K-16 and beyond; however, no central or single entity has knowledge of the specific activities and initiatives for all the programs and their sponsors. Thus, no evidence of coordinated leadership for STEM programming in the M7 region was found.

Accordingly, it is recommended that the M7 region establish a STEM Federation that provides coordinated leadership for STEM programming. The STEM Federation would serve as a centralized

incubator for both STEM innovation and career/professional guidance. A core activity of the STEM Federation would be an annual conference where all STEM organizations and programs would meet to share information. In turn, the STEM Federation would use this information to document all the programs in the Marquette University - Milwaukee Area Workforce Investment Board STEM Inventory Database located at (http://www.mupicstemproject.org). The STEM Federation should be composed of representatives from industry (e.g., GE and Johnson Controls), education (e.g., Marquette, UW-Milwaukee, and MPS) and existing boards and programs (e.g. Milwaukee Area Workforce Investment Board, A World in Motion). Their mission would be to maintain and facilitate knowledge sharing between STEM organizations and projects within the region.

RECOMMENDATION TWO:

Need to Market STEM programs in M7.

An emergent and key finding from the SWOT analysis was that the M7 region needs to market STEM programs to groups (e.g., women and people of color) that are traditionally underrepresented in STEM professions. It is essential that the STEM programs get proper exposure in order to reach all members of the M7 community.

Using the STEM Federation, and/or industry and philanthropic organizations to establish a STEM marketing campaign is one strategy to achieve this goal. Resources such as public television programming (e.g., "Sports Science" and "How it works") can be used to influence students' perceptions and understanding of STEM. The underlining goal of these programs is to bring back the "coolness" of STEM. Innovations such as "edutainment" can be used inside and outside the classroom to help deliver and reinforce STEM subjects. Some examples of these technologies are the African-American Distributed Multiple Learning Styles System (AADMLSS)

at (http://www.aadmlss.org), Culturally Situated Design Tools (http://www.rpi.edu/~eglash/csdt.html), and MindRap (http://www.mindrap.org). There may need to be multiple campaigns that target different groups (e.g., adults and adolescents). These campaigns should use innovative marketing strategies that lure the targeted audience into STEM programs.

RECOMMENDATION THREE:

STEM Education Needs To Be A Priority.

The nation suffers from a shortage of STEM teachers in K-12. There is a need in the nation at-large and M7 region in particular to address the insufficient number of STEM teachers in K-12. The National Science Foundation has a program called the Graduate Teaching Fellows in K-12 Education (GK-12). The program can be described as follows:

> *This program provides funding to graduate students in NSF-supported science, technology, engineering, and mathematics (STEM) disciplines to acquire additional skills that will broadly prepare them for professional and scientific careers in the 21st century. Through interactions with teachers and students in K-12 schools and with other graduate fellows and faculty from STEM disciplines, graduate students can improve communication, teaching, collaboration, and team building skills while enriching STEM learning and instruction in K-12 schools. Through this experience, graduate students can gain a deeper understanding of their own STEM research. In addition, the GK-12 program provides institutions of higher education with an opportunity to make a permanent change in their graduate programs by incorporating GK-12 like activities in the training of their STEM graduate students. Expected outcomes include improved communication, teaching, collaboration, and team building skills for the fellows; professional development opportunities for K-12 teachers; enriched learning for K-12 students; and strengthened and sustained partnerships in STEM between institutions of higher education and local school districts.*

Therefore, it is recommended that the M7 region create a similar program to fill vacant STEM teacher positions. This can be accomplished by taking small steps progressing towards full implementation.

Some steps that could be taken to achieve this goal include:

1. Apply for a NSF GK-12 grant (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5472)
2. Work with the Center for Mathematics and Science Education Research (CMSER) at UW-Milwaukee (http://www.soe.uwm.edu/pages/welcome/Centers/Center_for_Mathematics___Science_Education_Research)
3. Work with the Milwaukee Mathematics Partnership (http://www.uwm.edu/Org/MMP/)

Proposed elements for the final program could include:

A K-12 STEM teacher's salary is approximately $30-40K per year, plus benefits. It is recommended that these funds are used to create named endowed or distinguished professorships at the universities within the M7 region. The professors would receive an annual bonus and the college/department would receive funds to release the professors from teaching or reduce their teaching loads. In return, the professors and their graduate students would teach STEM courses in area schools. A program of this nature could build a relationship between K-12 and higher education institutions in the M7 region around STEM. An additional benefit of this relationship is that this program will increase the likelihood of K-12 students staying within the region and going to area universities and majoring in STEM related field. This form of K-12 and higher education collaboration works in the NSF GK-12 program and it could work within the M7 region.

RECOMMENDATION FOUR:

Create a Research Institute for the Theory and Practice of STEM Entrepreneurial Wealth Creation.

In an effort to connect the STEM corporate community with the academic community, we are recommending the creation of a Research Institute for the Theory and Practice of STEM Entrepreneurial Wealth Creation. This Institute would be modeled after the IC² Institute at the University of Texas at Austin, (http://www.ic2.utexas.edu), with a few adjustments. The Wisconsin Institute would be housed at Marquette University or the UW-Milwaukee. The Institute would create programs in entrepreneurship with an emphasis on STEM. For example, we recommend a Masters of Science degree in Science and Technology Commercialization. The program could also have incentives for graduates to create businesses within the M7 region. Endowed Faculty Fellows would be created as part of the Institute as well.

The Institute would conduct scholarly research in the areas of STEM entrepreneurship, commercialization, and innovation. Initially, the Institute will need a significant amount of seed money. The hosting Institution will be required to obtain funding from various sources at the State and local levels. The vision and purpose of the Institute is to create more STEM research, practice, and policies within the M7 region. The Institute should connect with the Center for Advanced Technology and Innovation (CATI). "CATI is a new model for technology entrepreneurship, incorporating a technology incubator, a commercial technology transfer office, and an integrated education program that crosses campuses and programs to provide training for a wide range of populations. CATI was formed to promote business development, workforce development, and technology innovation in

southeast Wisconsin. CATI seeks to fulfill these goals by engaging in a three-pronged approach: (1) a technology incubation facility where new and developing firms can more economically develop and market new technology and products and services (2) a technology transfer office to help leverage research and development activities at local and regional educational institutions and businesses and industries in the area, and (3) an education program integrated with local colleges, universities, and school districts to provide project based learning opportunities to students from high schools, colleges, and graduate schools, and entrepreneurship courses to a wide range of audiences, including under– and unemployed individuals." (Arion et. el. 2003) The Institute can build upon the success and infrastructure already established with CATI.

CONCLUSION

The M7 STEM White Paper is the result of an empirical analysis of the region, stakeholders, and programs. This project began with an overview inventory composed of data collected on STEM programs within the region. An outcome of this data collection process was a fully searchable database of STEM programs. To our knowledge, this is the only STEM program database of its kind within the country. After building the STEM program database and analyzing the STEM programs available, we conducted a strengths, weaknesses, opportunities and threats (SWOT) analysis. The SWOT analysis surveyed key stakeholders within the region to determine the STEM climate. Together, the overview inventory and SWOT analysis provided us with the answers to the "what" and "why" regarding the STEM climate and capacity within the region.

These findings led to recommendations based on expert knowledge and existing programs that have been successful. The recommendations are divided into two categories: Foundational Efforts and Unique Opportunities. The Foundational Efforts are activities that are necessary to build STEM capacity and sustainability. The Unique Opportunties are innovations that will eliminate brain drain, create additional STEM infrastructure, unite corporate, community, and educational stakeholders, and establish the region as a STEM corridor within the U. S. If the M7 region adopts these recommendations, it will certainly become an exemplar for the nation and the world on STEM innovation, sustainability, and inclusion.

APPENDIX

REGIONAL TASKFORCE ON STEM EDUCATION (M7)

ASEE PRISM
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The percentage of engineering bachelor's degrees awarded to women declined for the fourth consecutive year in 2005-6. The 19.3 percent of engineering degrees awarded is far below women's general representation of 56 percent in the undergraduate ranks. However, this trend is not uniform for all engineering disciplines. The 10 fields listed here continually draw a higher percentage of women to engineering than the larger fields of mechanical, electrical and computer engineering. Additionally, biomedical is the fastest-growing engineering field, having increased by 187% since 1999.

Data source: American Society for Engineering Education. More data can be found online at www.asee.org/colleges.

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ENGINEERING DISCIPLINES WITH THE HIGHEST PERCENTAGE OF FEMALE GRADUATES

Biomedical	40.7%
Chemical	36.0%
Agricultural	35.6%
Industrial and Manufacturing	33.0%
Engineering Management	28.6%
Metallurgical & Materials	28.3%
Mining	27.5%
Architectural	25.4%
Eng. Science & Eng. Physics	24.8%
Civil & Environmental	23.1%

Data source: American Society for Engineering Education. More data can be found online at www.asee.org/colleges.

SCHOOLS AWARDING THE HIGHEST PERCENTAGE OF BIOMEDICAL ENGINEERING BACHELOR'S DEGREES TO WOMEN**

1. Rensselaer Polytechnic Institute	60.0%
2. Worcester Polytechnic Institute	56.8%
3. Rose-Hulman Institute of Technology	54.5%
4. North Carolina State University	54.3%
5. University of Illinois at Chicago	52.3%
6. Case Western Reserve University	52.1%
7. Michigan Technological University	51.6%
8. University of Iowa	51.0%
9. Brown University	50.0%
9. Marquette University	50.0%
9. Mercer University	50.0%
9. New Jersey Institute of Technology	50.0%
9. University of Southern California	50.0%

9. University of Tennessee, Knoxville	50.0%
9. University of Toledo	50.0%
9. University of Virginia	50.0%
17. Pennsylvania State University	48.1%
18. University of Rochester	47.1%
19. University of Miami	46.5%
20. University of California, Berkeley	45.9%
20. University of Pittsburgh	45.9%

**Minimum of 20 B.S. degrees awarded. 77 schools fit this criterion.

Data source: American Society for Engineering Education. More data can be found online at www.asee.org/colleges.

SCHOOLS AWARDING THE HIGHEST PERCENTAGE OF ENGINEERING BACHELOR'S DEGREES TO WOMEN*

1. Tennessee State University	45.5%
2. Univ. of Puerto Rico, Mayaguez	38.9%
3. Mercer University	36.6%
4. Alabama A&M University	36.1%
5. Tufts University	36.0%
5. Tuskegee University	36.0%
7. University of Miami	35.0%
8. Brown University	34.8%
9. Southern Methodist University	33.3%
10. Saint Louis University	31.2%
11. Massachusetts Inst. of Technology	31.0%
12. Northwestern University	30.6%
13. George Washington University	30.5%
14. Washington University	29.3%
15. Princeton University	29.2%

16. Marquette University	29.1%
16. Stevens Institute of Technology	29.1%
18. William Marsh Rice University	29.0%
19. Vanderbilt University	28.9%
20. Morgan State University	28.4%

*Minimum of 50 B.S. degrees awarded. 261 schools fit this criterion.

Data source: American Society for Engineering Education. More data can be found online at www.asee.org/colleges.

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