USM Presidential Task Force on STEM Workforce

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FINAL REPORT

Preamble:

As recognized by the U.S. Department of Labor in its 2007 STEM Workforce Challenge report, both the economic growth and global competitiveness of the United States rely heavily on the nation's ability to generate and retain an adequate supply of skilled workers in Science Technology, Engineering, and Mathematics (STEM) fields.

The Base Realignment and Closure (BRAC) process which will transition an estimated 30,000-60,000 new jobs to Maryland, many of which are STEM professions, according to the Governor's BRAC Subcabinet, has brought to the forefront Maryland's urgent STEM need. In order to fulfill the demands for qualified workers in STEM fields, a coordinated and collaborative approach must occur in both the public and private sectors among educational institutions, agencies, businesses, and government.

Institutions of higher education, however, hold a crucial role in enhancing and strengthening the pipeline of students studying and graduating in the STEM fields at every level of education. College and universities have multi-dimensional influence on the makeup of the nation's workforce from the classroom to the boardroom. Colleges and universities train and prepare future educators that go on to motivate or influence the educational and career pathways of their students. At the same time, higher education institutions provide access programs in partnership with local elementary and secondary school students to broaden the academic horizons of students and generate interested in selected topics at an early age.

Once students arrive on campus, institutions must create and deliver additional academic opportunities for STEM majors and ensure they graduate. Furthermore, they must also create educational opportunities for those who seek career advancement or a career change.

This multi-faceted approach to address the need for STEM professionals is vital to supplying the high demand for highly skilled workers in these fields and institutions of higher learning provide the gateway to this much-needed supply.

As part of its mission the University System of Maryland, a public system of higher education comprised of 13 institutions, aims to provide knowledge-based programs and services that are responsive to the needs of the citizens of the State of Maryland and the nation. Several years ago the USM identified STEM as an area of concern and through its member institutions has sought to create early interest in STEM fields among K-12 and higher education students as well as provide professional development opportunities for the State's existing workforce. Cooperatively and individually the USM institutions have launched a number of initiatives and programs centered at STEM promotion including, teacher workshops, symposiums, K-12 summer learning academies, program-centered housing, scholarships, internships, expanded program offerings and more.

As a participant in the Governor's Commission on STEM, the USM determined the current landscape for STEM education within the system, where increased capacity can occur, and what the cost and necessary resources are to move forward with increasing the STEM pipeline of students.

Over the past six months, 12 of the 13 USM institutions participated in an extensive review of each institution's efforts to cultivate a continuous stream of STEM students and professionals and an evaluation of Maryland workforce data[1].

[1] USM STEM Workforce: Competitiveness and the USM. *Presentation to the Governor's P-20 Leadership Council Maryland STEM Task force Meeting*, *November 20*, *2008* Office of Administration and Finance, Chief Operating Officer

This report accesses the combined results of each institutions best practices and methods and offers recommendations on areas where additional focus and further support is required to foster STEM growth in the State of Maryland.

Findings:

While many gaps between need and production exist, the largest gaps in the Maryland STEM workforce were determined to be in the following four fields: engineering, information technology, bioscience and STEM teaching.

Recommendations to address these workforce gaps were developed in the following categories:

1) Resources and Financial Incentives
2) Pipeline Creation/Career Awareness
3) Program Availability

Strategies and the costs associated are being developed for each campus to increase STEM production for each field.

To achieve growth in the STEM fields, the group is recommending focusing efforts in the following areas:

1) Increasing STEM graduates
2) Increasing STEM teachers
3) Increasing retention of STEM majors
4) Increasing current knowledge base of STEM educators

Many groups in Maryland have been struggling with the now all too similar problem of how to increase the number of qualified STEM graduates. In an effort to build upon rather than duplicate the work of others, the task force reviewed the recommendations from the MSDE Teacher Shortage Taskforce[2], the GWIB Education Industry Initiative[3], the Rising Above the Gathering Storm Report[4], and the Tapping America's Potential Interim report[5], among others. Many best practices were also discussed such as the University of Texas, UTeach program. The recommendations from the reports reviewed have been consistent and will be reflected in the recommendations.

[2] Maryland State Department of Education. "Maryland Teacher Shortage Task Force Report" 2008. http://www.marylandpublicschools.org/NR/rdonlyres/517D465A-F0B5-40DD-BB4B-E98EA716EC46/18195/MD_TSTF_Report_0608.pdf (2 September 2008)

[3] Governor's Workforce Investment Board. "Maryland's Education Industry: Report and Recommendations for the Governor's Workforce Investment Board-Education Industry Initiative Steering Committee" 2008 http://www.mdworkforce.com/pub/pdf/mdeducind.pdf (2 September 2008)

[4] Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future" 2007. National Academy of Sciences, National Academy of Engineering, Institute of Medicine.

[5] Business Roundtable. "Tapping America's Potential: The Education for Innovation Initiatives, *Gaining Momentum, Losing Ground"* 2008. http://www.tap2015.org/news/tap_2008_progress.pdf (2 September 2008)

Data Review:
Data on USM production of STEM enrollment for undergraduate and graduate programs and for STEM programs at each of the institutions were collected. These data are represented in Tables 1 and 2.

Table 1:

STEM Total Enrollment

USM Schools	2003	2004	2005	2006	2007
Bowie State University	881	758	602	692	667
Coppin State University	342	354	328	307	275
Frostburg State University	532	502	476	437	428
Salisbury University	917	879	828	872	867
Towson University	2,049	2,032	2,040	2,181	2,313
University of Baltimore	207	231	228	245	267
University of Maryland, Baltimore	279	268	283	286	270
University of Maryland, Baltimore County	5,349	5,256	5,073	5,048	5,079
University of Maryland, College Park	10,238	10,052	9,785	9,629	9,972
University of Maryland, Eastern Shore	896	835	946	969	934
University of Maryland, University College	4,395	4,879	4,588	5,192	5,379
TOTAL:	26,085	26,046	25,177	25,858	26,451
4-Year Public & Selected Schools	**2003**	**2004**	**2005**	**2006**	**2007**
College of Notre Dame of Maryland	151	125	109	117	118
Goucher College	74	81	88	88	70
Hood College	257	270	288	283	328
Johns Hopkins University	5,508	5,767	6,052	6,031	6,726
Loyola College	513	541	504	544	578
McDaniel College	230	232	221	221	214
Morgan State University	1,835	1,757	1,518	1,561	1,545
Mount St. Mary's University	209	207	218	227	230
St. Mary's College	158	173	178	263	301
Villa Julie College	512	461	472	511	572
TOTAL:	9,447	9,614	9,648	9,846	10,682

Source: *MHEC Trends in Enrollment by Program*
Prepared by: TU Institutional Research- N.S. 9/16/2008

HEGIS Codes used to define STEM

Engineering	0900-0999	Math	1700-1799
Biology	0400-0499	Computer Science	0700-0799
Physical Science	1900-1999	Science Related Majors	4902 & 4999 & 9099

Table 2:

*USM Schools: STEM Programs	2003	2004	2005	2006	2007
Engineering (0900-0999)	5,898	5,900	5,879	5,765	5,915
Biology (0400-0499)	6,267	6,591	6,896	7,295	7,443
Physical Science (1900-1999)	1,546	1,683	1,777	1,941	1,970
Math (1700-1799)	1,226	1,311	1,254	1,288	1,377
Computer Science (0701)	4,791	4,285	3,725	3,514	3,423
Information Systems (0702)	5,703	5,635	5,091	5,398	5,736
Other- Computer Science (0799)	505	446	374	464	392
Science Related Majors (4902/4999/9099)	149	195	181	193	195
TOTAL:	26,085	26,046	25,177	25,858	26,451
**4-Year Public & Selected Schools: STEM Programs	2003	2004	2005	2006	2007
Engineering (0900-0999)	3,136	3,314	3,408	3,473	3,480
Biology (0400-0499)	2,883	2,988	3,017	3,152	3,821
Physical Science (1900-1999)	817	802	855	907	1,034
Math (1700-1799)	430	473	488	519	559
Computer Science (0700-0799)	1,411	1,330	1,247	1,213	1,175
Information Systems (0702)	742	677	595	544	593
Other- Computer Science (0799)	0	0	0	0	0
Science Related Majors (4902/4999/9099)	28	30	38	38	20
TOTAL:	9,447	9,614	9,648	9,846	10,682

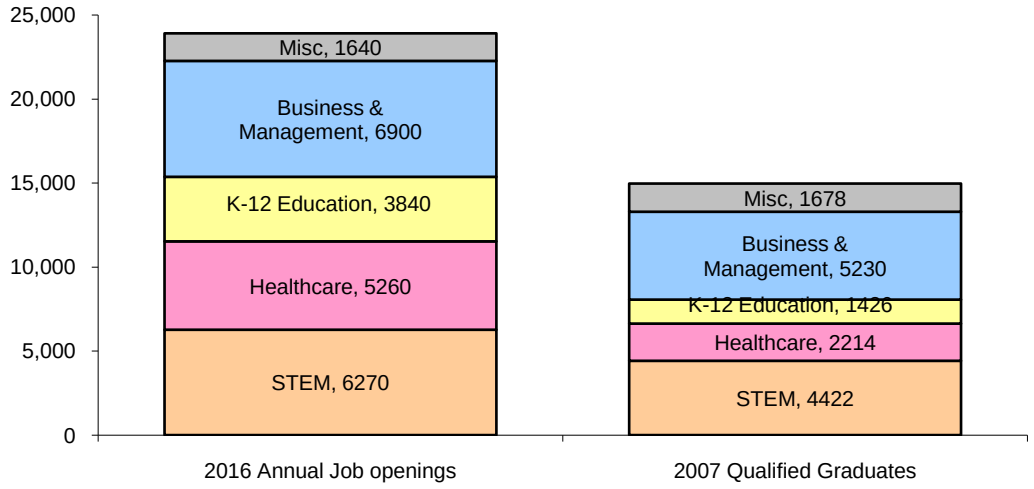
*Note: *USM Schools* include: Bowie State Univ, Coppin State Univ, Frostburg State Univ, Salisbury Univ, Towson Univ, Univ of Baltimore, Univ of MD- Baltimore, Univ of MD- Baltimore County, Univ of MD- College Park, Univ of MD- Eastern Shore, Univ of MD- Univ College.

**Note: *4-Year Public & Selected Schools* include: College of Notre Dame of Maryland, Goucher College, Hood College, Johns Hopkins Univ, Loyola College, McDaniel College, Morgan State Univ, Mount St. Mary's Univ, St. Mary's Collge, Villa Julie/Stevenson

Source: *MHEC Trends in Enrollment by Program*
Prepared by: TU Institutional Research- N.S. 9/16/2008

Workforce Gaps:
STEM graduates were compared by job category to demand and need these data are summarized in Figures 1 and 2 and Table 3.

Figure 1: Workforce Demand in KeySectors
Jobs Requiring College Degree



Gaps in the STEM fields are greatest for the following categories: engineering, information technology, STEM teaching, and biosciences. The recommendations will address these specific fields. A detailed breakdown of the gaps is found in Table 3.

Figure 2: The current USM STEM graduates compared to the 2016 job openings in selected STEM fields.

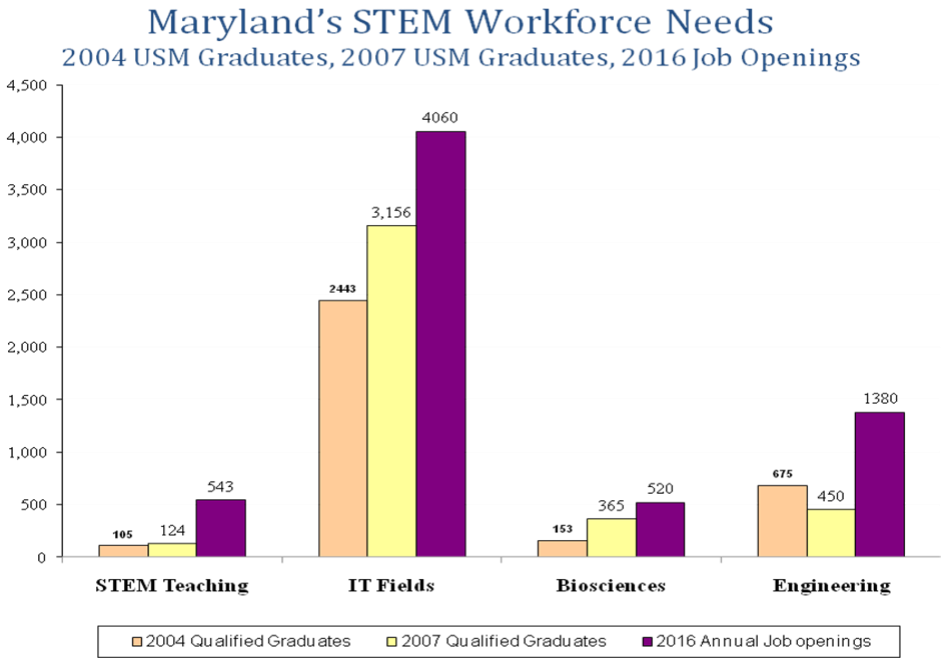


Table 3:

Gap between Need Met by USM Graduates and Total Need in Key Workforce Need Areas

Academic Year 2006-2007

Area	Total Qualified USM Graduates	Total Additional Graduates Needed	USM Goal to meet Demand (70% of need)	Key Areas
Engineering				
Bachelors	352	269	**188**	Civil Engineers, Electrical Engineers, Electronics Engineers
Masters	87	131		Aerospace Engineers, Architects
Information Technology				
Bachelors	3,130	824	**577**	Computer Software Engineers (Applications), Computer Programmers, Computer Hardware Engineers
Masters	300	0		None
STEM Teaching				
All	124	322	**225**	All
Bioscience Professions				
Bachelors	534	935	655	Civil Engineers, Biological Technicians, Electrical Engineers, Environmental Scientists & Specialists, Computer Software Engineers (Applications), Computer Programmers
		111	78	Without Engineering and IT duplicates
Masters	179	41	28	Medical Scientists
		152	**106**	Bachelors & Masters

Using these data the task force members reviewed constraints to increasing STEM production on our campuses in order to fill the observed workforce gaps. The task force considered those areas in which some institutions should be able to make progress with few additional resources and where institutions will need significantly more assistance to move forward. This review led to the following recommendations to increase the production of STEM graduates. Measurement outcomes will be established for these recommendations and for the funds directed to achieve the desired outcomes. The highest priority recommendations listed below include items that fall under the purview of the State, USM, MSDE, MHEC and other educational and business partners. The list of USM focused recommendations are reflected in the attached funding request. Of significant importance are items in which state policy or governing agencies can take the lead in achieving success and consensus for the improvement of STEM education in the State of Maryland.

RECOMMENDATIONS:

USM Focused recommendations:

Resources and Financial Incentives

1) Fund STEM programs on a premium basis (150% of the current funding guideline) with the funds aimed at incentivizing the development of critical need programs and scaling up targeted programs
2) Expand and ensure availability of State supported scholarships, tuition waivers, tuition discounts and loan forgiveness programs
3) Encourage MSDE, local school boards and the MSTA to provide competitive salaries for hard to fill STEM teaching positions

Pipeline Creation/Career Awareness

4) Develop, enhance and provide systemic funding for programs that have proven to be successful, such as weekend and summer academies and State mandated Professional Development Schools (PDS) , in providing teachers with the opportunities to remain timely in their fields , professionally engaged, and also provide the time and help to develop resource and enhancement materials for their classes
5) Partner with industry to sponsor summer science and math academies for students (e.g., ExxonMobil Bernard Harris Science Academy at BSU), internship and mentorships including early field experiences for STEM majors so that they can be exposed to teaching and STEM classrooms
6) Develop programs to build strong partnerships between STEM departments in universities and local secondary schools to provide strong enrichment and professional development activities for both elementary and secondary teachers
7) Develop programs with MSDE to reduce remediation needed by entering college students and to align high school graduation with college entrance requirements for math and the STEM fields
8) Expand professional development programs and pathways to certification and enhance options for career changers into all STEM fields

Program Availability

9) Expand availability of programs through online education
10) Provide enhancement funding to increase retention and graduation rates in the STEM fields for HBCU's per the Commission to Develop the Maryland Model for Funding Higher Education
11) Expand statewide associates degrees and continue to develop seamless articulation and transfer agreements

Recommendations under the State's purview:

The support of a wide range of partners is needed to achieve success in closing the gap between STEM graduates and STEM employment opportunities in Maryland. The following recommendations need the support of the State, Governor's Office, MDSE and MHEC to ensure their success.

1) Ensure professional staff development and overall classroom support occurs at all K-12 schools
2) Ensure open competition in the development of STEM graduate degree programs
3) Engage a marketing firm to clearly define avenues to reach schools and students to expand career awareness
4) Expand public relations efforts to attract second career professionals and retirees into the STEM fields, specifically STEM teaching

Additional Best Practices:

The recommendations above were selected as highest in priority and were deemed most likely to have the greatest impact to achieve the goals of this initiative. In addition, many other recommendations were discussed by the task force and were felt to be important tools in to address the STEM gap in Maryland. There are many regional needs and situations that may be better addressed through the practices listed. The list is provided for consideration by institutions.

1) Work with the local education associations (LEAs) to leverage their Federal enhancement funds for professional development efforts for teachers
2) Expand availability of mobile labs for science teachers in schools
3) Provide additional funds for support services for faculty and lab enhancements
4) Create and fund a system to provide teacher professional development opportunities and course work at no cost to Maryland school systems
5) Create targeted in-service programs for new STEM teachers
6) Revive (or invigorate) math and science clubs in K-12 schools
7) Organize competitions – essays, projects, robotics, science fairs - on annual basis
8) Expand outreach programs for young students such as the Towson University (TU) Hackerman Saturday Science Series and Make Science Fun at Bowie State University (BSU)
9) Reach out to the advisors and counselors at the middle and high school level to expand the awareness of careers in the STEM fields
10) Target "Way-to-Go Maryland" type programs to STEM fields
11) To help with career awareness, create entry level umbrella programs for students and develop a common language to be used by all institutions.
12) Expand bridge program efforts between K-12 , community colleges and universities
13) Expand regional higher education and existing program offerings
14) Facilitate the approval of graduate programs to fill the state's workforce demands
15) Encourage cooperative academic programs (multi-institutional efforts)
16) Create a specific planning focus at the state-level, perhaps through the P-20 Council, to parallel and support institutional level planning
17) Ensure policy decisions do not compete with the programmatic needs to meet the demands of educating a STEM workforce
18) A STEM Institute was developed earlier in Maryland but not funded. This is another recommendation worthy of additional consideration. See appendix 4

19) Several best practices from other states were discussed such as the UTEACH model at the University of Texas. A summary of this program is found in appendix 5

A budget has been developed for the costs associated with each of the recommendations. That budget is found in Tables 4 and 5.

Table 4:			**USM STEM BUDGET**					
High Priority Recommendations:								
	Yr 1	**Yr 2**	**Yr 3**	**Yr 4**	**total**	**70% of total workforce gap/students**	**average cost per student**	**per student/per year cost**
STEM Secondary Education-50% comprehensive avg.	$814,730	$814,730	$814,730	$814,730	$3,258,920	113	$28,840	$7,210
STEM Secondary Education -50% research avg.	$1,259,552	$1,259,552	$1,259,552	$1,259,552	$5,038,208	112	$44,984	$11,246
Computer and Info Science Majors - 50% comprehensive	$2,083,690	$2,083,690	$2,083,690	$2,083,690	$8,334,760	289	$28,840	$7,210
Computer and Info Science Majors -50% Research	$3,238,848	$3,238,848	$3,238,848	$3,238,848	$12,955,392	288	$44,984	$11,246
Bioscience Majors - 50% comprehensive	$382,130	$382,130	$382,130	$382,130	$1,528,520	53	$28,840	$7,210
Bioscience Majors -50% research	$596,038	$596,038	$596,038	$596,038	$2,384,152	53	$44,984	$11,246
Engineering Majors (bachelors) research avg.	$2,114,248	$2,114,248	$2,114,248	$2,114,248	$8,456,992	188	$44,984	$11,246
Fund increased STEM programs on a premium basis (additional 50% of the EFI cost per student)*								
STEM Secondary Education-50% comprehensive avg.	$407,365	$407,365	$407,365	$407,365	$1,629,460	113	$14,420	$3,605
STEM Secondary Education -50% research avg.	$629,776	$629,776	$629,776	$629,776	$2,519,104	112	$22,492	$5,623
Computer and Info Science Majors - 50% comprehensive	$1,041,845	$1,041,845	$1,041,845	$1,041,845	$4,167,380	289	$14,420	$3,605
Computer and Info Science Majors -50% Research	$1,619,424	$1,619,424	$1,619,424	$1,619,424	$6,477,696	288	$22,492	$5,623
Bioscience Majors - 50% comprehensive	$191,065	$191,065	$191,065	$191,065	$764,260	53	$14,420	$3,605
Bioscience Majors -50% research	$298,019	$298,019	$298,019	$298,019	$1,192,076	53	$22,492	$5,623
Engineering Majors (bachelors) research avg.	$1,057,124	$1,057,124	$1,057,124	$1,057,124	$4,228,496	188	$22,492	$5,623
SUBTOTAL	**$15,733,854**	**$15,733,854**	**$15,733,854**	**$15,733,854**	**$62,935,416**			
Weekend/Summer Academies	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$4,000,000	480		$2,083.33
Online resources	$250,000	$250,000	$250,000	$250,000	$1,000,000			
Professional development schools	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$10,000,000			
Enhancement funding for HBCU's**								
Fund the scaling up or creation of targeted programs to meet demand (eg: IT)***								
total	**$19,483,854**	**$19,483,854**	**$19,483,854**	**$19,483,854**	**$77,935,416**			
*The funding per EFT will be 150% of the funding guideline as a minimum								
**HBCU enhancement funding to increase retention and graduation rates will be determined by the Commission to Develop the Maryland Model for Funding Higher Education.								
***The 150% of EFI shall cover the cost of labor when scaling-up programs.								
These funds should be used for additional lab equipment needs, research assistants and teaching assistants and willl be determined on a case-by-case basis.								

Table 5:			**USM STEM BUDGET continued**					
Additional Best Practices Budget:								
	Yr 1	Yr 2	Yr 3	Yr 4	total	70% of total workforce gap/students	average cost per student	per student/per year cost
Expand mobile labs (4-1 per region)	$2,400,000	$1,000,000	$1,000,000	$1,000,000	$5,400,000			
Increase Loaner lab program	$137,000	$137,000	$137,000	$137,000	$548,000	100		$1,370
Marketing/PR efforts for career awareness	$100,000	$450,000	$350,000	$250,000	$1,150,000			
Expand Regional higher education offerings	$600,000	$150,000	$150,000	$150,000	$1,050,000	total of 40-60 fte growth		
total	**$3,237,000**	**$1,737,000**	**$1,637,000**	**$1,537,000**	**$8,148,000**			
*USM STEM Teacher Initiative "STEM-Teach"	See appendix for proposal and budget							

Appendices

Appendix 1: Task Force Charge

Appendix 2: Task Force Members and Support Staff

Appendix 3: List of Meetings

Appendix 4: USM STEM Teacher Initiative “STEM-Teach”

Appendix 5: STEM Institute

Appendix 6: USM Institutions STEM Initiatives