



RESEARCH VISION 2020: RECOMMENDATIONS OF  
THE 2011-12 TASK FORCE ON  
RESEARCH CAPACITY

April 3, 2012

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## I. EXECUTIVE SUMMARY

A 22 member Research Capacity Task Force, including resource personnel, was constituted in Fall 2011 to study Missouri S&T's "current state" research capacity and recommend short- and medium-term actions that need to be taken to improve the research performance of and increase the research capacity at S&T. Also, the Task Force was charged to recommend areas/disciplines in which we must invest, including hiring new faculty and research personnel and recruiting high quality graduate students to enhance the research mission of S&T. After several rounds of discussions, face-to-face interviews with a cross section of faculty, and constructive dialogs, the Research Capacity Task Force has made **seven recommendations**, which are described with related information in this report.

## **II. RECOMMENDATIONS**

1. S&T leadership should communicate campus priority for excellence in research and scholarship, regularly affirm this priority, and publicly recognize those achieving it.
2. S&T should immediately and aggressively increase the number of tenured/tenure track (T/TT) faculty commensurate with student credit hours and achieve student-to-faculty ratio comparable to its peers.
3. S&T should offer competitive compensation to recruit and retain faculty with a record of excellence in research and scholarship.
4. S&T should make it a priority to increase its competitiveness to recruit and retain high quality graduate students.
5. S&T should invest in the necessary human capital to support faculty and student needs in research computing and library resources and services.
6. S&T should aggressively seek and establish new endowments to fund new faculty positions, post-doctoral fellows, graduate fellowships and professional development, infrastructure development and maintenance, faculty startup packages and development.
7. All academic departments should develop goals and broadly communicate expectations for research and scholarship, and take necessary actions to achieve them.

## **III. TASK FORCE CHARGE AND BACKGROUND**

In response to Action Item 3.1.2 in the FY2011 Tactical Plan to "Evaluate the University's Research Capacity," detailed data were collected for the period FY01 – FY10 and a "current state" S&T research capacity report was prepared.<sup>1</sup> This report provided useful insights and highlighted general concerns that must be proactively addressed to continue to build on the momentum generated during the past few years and strive to achieve the goals in S&T's Strategic Plan.

Recognizing the significant role of the research mission, Interim Chancellor Warren Kent Wray appointed a Task Force to be co-chaired by Drs. Venkat Allada and K. Krishnamurthy to study Missouri S&T's "current state" research capacity report and develop a "future state" recommendations report to expand and elevate S&T's research performance and reputation. Specifically, the charge to the Task Force was:

1. Review the "current state" research capacity report and collect other pertinent data as deemed appropriate.
2. Recommend short- and medium-term actions that can be taken to improve the research performance of and increase the research capacity at S&T.
3. Recommend areas/disciplines in which we must invest, including hiring new faculty and research personnel and recruiting high quality graduate students to enhance the research mission of S&T.

The Task Force adopted a broader view of research by expanding the scope of the previous research capacity study to include both externally sponsored expenditures and scholarship.

#### **IV. TASK FORCE MEMBERS**

Dr. Venkat Allada, VP Graduate Studies, Professor of Engineering Management & Systems Engineering (Co-Chair)  
Dr. S. N. Balakrishnan, Curators' Professor of Aerospace Engineering  
Dr. Al Crosbie, Curators' Professor of Mechanical Engineering  
Dr. Mariesa Crow, ERDC Director and Finley Professor of Electrical Engineering  
Dr. Wayne Huebner, Department Chair and Professor of Ceramic Engineering  
Dr. Ali Hurson, Department Chair and Professor of Computer Science  
Dr. Kamal Khayat, CIES and NUTC Director and Vernon Maralee Jones Professor of Civil Engineering  
Dr. K. Krishnamurthy, VP Research, Professor of Mechanical Engineering (Co-Chair)  
Dr. Ming Leu, ISC Director and Keith and Pat Bailey Distinguished Professor of Mechanical Engineering  
Dr. Suzanna Long, Assistant Professor of Engineering Management & Systems Engineering  
Dr. Yinfa Ma, Curators' Teaching Professor of Chemistry  
Dr. John Myers, Associate Professor of Civil Engineering  
Dr. Runar Nygaard, Assistant Professor of Geological Sciences & Engineering  
Dr. Matt O'Keefe, MRC Director and Professor of Metallurgical Engineering  
Dr. Paul Parris, Professor of Physics  
Dr. Nancy Stone, Department Chair and Professor of Psychological Science  
Dr. Hai Xiao, Associate Professor of Electrical & Computer Engineering

#### **Resource People:**

Mr. Andy Careaga, Director of Communications  
Ms. Margaret Cline, Chief Information Officer  
Dr. Thulasi Kumar, Director of Institutional Research & Assessment  
Ms. Joan Nesbitt, Vice Chancellor for University Advancement  
Mr. Andy Stewart, Director of Library & Learning Resources

#### **V. MODEL FOR ASSESSING RESEARCH CAPACITY AND PROCESS FOLLOWED**

Research capacity is a complex term involving a myriad number of issues. Birdsell et al.<sup>2</sup> identified 23 dimensions and proposed two models, Box Model and Circle Model, to assess the organizational capacity of an institution. Their "Box Model" has been adopted here and attention focused on the following three actionable categories.

1. Structure
  - Official Documents Identifying Research Mandate, Including Mission, Vision and Strategic Plan
  - Physical Resources (space, laboratory facilities, computing hardware and software, library facilities)
  - Financial Resources (internal investments, infrastructure development and maintenance, startup funds, graduate fellowships)
  - Support Mechanisms (research centers)

- Incentives (raises, promotion, awards)
  - Disincentives (teaching load)
2. People
- Faculty (including NTT)
  - Students (including Postdoctoral Fellows)
  - Technical and Administrative Staff
  - Academic and Administrative Units (e.g., Department Chairs)
3. Culture
- Supportive Culture (commitment to and valuing research; role models and formal mentorship)
  - Sharing of Knowledge (scholarly publications, meetings, workshops, sabbaticals)
  - Valuing Risk Taking and Innovation (establishing stretch goals)

The Task Force held the kickoff meeting on November 7, 2011 to review the charge and outcomes, and discuss scheduling of future meetings and organizing into subcommittees. At the second Task Force meeting on December 5, 2011, Dr. Allada presented information on graduate student placement and Stipend X in response to follow-up questions at the first meeting. Further, the Task Force was divided into three sub-committees: Structure, People and Culture, chaired by Drs. Myers, Leu and Huebner, respectively.

The People and Structure subcommittees met separately three times to summarize the strengths and weaknesses, and to make short- and medium-term recommendations to improve research performance and increase research capacity. The Culture subcommittee, on the other hand, used face-to-face interviews with a cross section of faculty using a specific set of questions (see Appendix A) to assess the campus culture of scholarship. The subcommittee members met with 17 faculty from 15 different academic departments, including three assistant professors (one female / two male), six associate professors (four female / two male), five professors (one female / four male), and three chairpersons (one female / two male). The survey questions were provided to the interviewee a week before the face-to-face meetings were held with two committee members for each interviewee. The Culture subcommittee met six times as a group to accomplish their task.

The Task Force reconvened three more times (February 20, 2012, March 5, 2012 and March 19, 2012) to review the subcommittee findings and recommendations, review and discuss the first draft of findings and recommendations, and final review of findings and recommendations.

The following metrics were used to study the University's research capacity and make recommendations.

- Externally sponsored program performance: proposals submitted and awarded, and expenditures
- Human resource capacity: number of tenured/tenure-track faculty, post-doctoral fellows, graduate research assistants
- Physical resource capacity: research space
- Financial resource capacity: research center budgets, UM Research Board awards, startup funds and endowments
- Scholarship performance: journals and citations per T/TT faculty

## VI. FINDINGS AND OBSERVATIONS

The subcommittee discussions resulted in articulating the strengths and weaknesses at S&T, and over 100 recommendations, many of which were similar, were made to build on the strengths and address the weaknesses. The following seven recommendations are strongly being made as those that would be most impactful. They are actionable in the short- and medium-term and would comprise a bold plan to advance S&T.

**1. S&T leadership should communicate campus priority for excellence in research and scholarship, regularly affirm this priority, and publicly recognize those achieving it.**

Excellence in research and scholarship is vital to enhance S&T's stature as a technological research university. This should be communicated as a top campus priority and regularly affirmed to ensure all planning and actions taken across campus are aligned with this priority. Research and scholarly accomplishments should be publicly recognized similar to other aspects of S&T mission.

Further, S&T must be strategic in investing its resources to build on existing strengths and add niche areas of future potential growth. Based on the 2010 Blue Sky Task Force Report<sup>3</sup> and reports from government agencies,<sup>4,5</sup> S&T should be forward looking and invest resources, both new and through reallocation, to enhance its mission in the following areas.

- Infrastructure  
Protecting and ensuring the continuity of operation of critical infrastructure assets require new tools, materials and techniques to sense their safety, security and integrity, make informed decisions in a timely manner, and repair or retrofit infrastructure elements. Some critical infrastructure sectors include information technology, telecommunications, civil infrastructure, energy systems, drinking water and water treatment systems, and dams.
- Manufacturing  
Advanced manufacturing focused on product and process design, including effective use of large quantities of manufacturing data, sophisticated design knowledge, multi-scale modeling and simulation, and networked control systems. Some emerging applications include additive manufacturing, bio-manufacturing, composite structure manufacturing, and manufacturing for clean energy technologies.
- Materials  
Integrated computational materials engineering to create new materials with specific parameters, and seamlessly integrate mathematical models and computational simulations of material behavior into product design tools. Some examples of the most pressing challenges are in developing materials for clean energy, human health and welfare, and national security problems.
- Humanics  
Humanics can provide a strong link to research on the human side of technological issues. The interaction of social and technical factors is critically important to take a holistic approach and solve problems in the above mentioned areas, and they stand to benefit substantially with the inclusion of humanics.

**2. S&T should immediately and aggressively increase the number of T/TT faculty commensurate with student credit hours and achieve student-to-faculty ratio comparable to its peers.**

During the past decade, externally sponsored program expenditures have doubled from \$22.2M in FY01 to \$45.9M in FY11, in nominal dollars, as shown in Table B-1. During the same time, student credit hours (SCH) and the number of tenured/tenure-track (T/TT) faculty increased by 50% and 11%, respectively. The increase in tuition revenue from higher enrollment has been critically important to offset declining state appropriations and add to the campus general revenue. However, the number of T/TT faculty (see Table B-2) has not kept pace with the increase in enrollment, as a result of which, the student-to-faculty ratio is dangerously high in a number of departments (see Table B-3), and the teaching load as measured by SCH per T/TT faculty has increased by 35%. S&T's student-to-faculty ratio is 15th, second from the bottom, among its technological research university peers in 2010 (see Table B-4).

The impact of increased teaching load can already be seen in the lower number of proposals being submitted and awarded, and number of faculty having research expenditures (see Figure B-1). There is also anecdotal evidence that the quality of teaching and learning is being compromised. Using the State of South Carolina's model for a public research university, the Missouri S&T 2010 Task Force on Student Educational Capacity<sup>6</sup> had concluded that Missouri S&T was 63 FTE faculty short to support its current student enrollment.

A multi-year plan must be developed and implemented immediately to systematically grow the number of T/TT faculty in areas listed under Recommendation #1. It is critically important to reverse the negative trends so S&T can regain its momentum and vigorously maintain its position as Missouri's technological "research" university and increase its stature nationally and internationally.

**3. S&T should offer competitive compensation to recruit and retain faculty with a record of excellence in research and scholarship.**

Decreasing state appropriations over the past decade has precluded S&T from providing competitive salaries. Anecdotal evidence suggests that S&T has lost a number of research intensive faculty to other universities in the recent past. Soft dollar raises approved in FY2008 has been a good mechanism to recognize and reward faculty who are able to attract externally sponsored grants and contracts. The only other incentive available to faculty is to return of a small portion (5%) of the indirect costs recovered.

A plan must be developed to recruit and retain productive research intensive faculty. For example, some universities have successfully implemented a plan to allow faculty to be on 8-month general revenue funded appointments. Such an approach if implemented at S&T will provide an immediate 12.5% increase in salary without any additional burden to S&T's general operating budget.

**4. S&T should make it a priority to increase its competitiveness to recruit and retain high quality graduate students.**

Table B-5 shows the headcount and full-time equivalent (FTE) of graduate research assistants (GRAs) and post-doctoral fellows. While the total number of graduate students has increased by 64% over the last decade, the number of graduate research assistants has increased by only 18%.



An extensive study of the graduate Stipend X was conducted by the 2009 Task Force X Committee<sup>7</sup> that included several short-term and medium-term recommendations to address competitive student funding at S&T. The Council of Graduate Students discussion report and the study conducted by the Office of Graduate Studies on graduate student financial aid comparison between S&T and its peer institutions was completed in 2011.<sup>8,9</sup> These studies concluded that the S&T graduate student total benefits package needs to be improved (see Figure B-2). The following actions are needed to improve S&T competitiveness to recruit and retain high quality graduate students.

- Increase the number and amount of graduate assistantships and fellowships awarded each year.
- Revisit the current Stipend X model and restructure it to be more flexible and competitive.
- Study the potential to implement and support full tuition waivers for PhD students which would improve the quality of PhD student recruitment.
- Establish collaborative relationships with select US and international institutions to develop a pipeline of high quality doctoral students.
- Invite and pay for campus visits to select group of qualified graduate applicants who are interested in S&T PhD programs.

**5. S&T should invest in the necessary human capital to support student and faculty needs in research computing and library resources and services.**

Support being provided by a small group within IT has improved the research computing environment during the past few years. However, this support should be increased significantly to improve the research competitiveness of faculty; it will also be important to recruit and retain students and faculty. Research, by definition, will require the use of different hardware and approaches that are not part of the standard S&T IT practices. Therefore, technical support should be provided for research projects, which may require use of non-standard S&T hardware and software.

With present staffing, the Library is able to cover basic services and responsibilities, but unable to enhance services and look for new outreach and partnership opportunities. Additional librarians are necessary to fully support the research and scholarship needs of the campus. S&T is 13th among its peers in terms of librarians and other professional staff per 1,000 FTE students (see Figure B-3).

**6. S&T should aggressively seek and establish new endowments to fund new faculty positions, post-doctoral fellows, graduate fellowships and professional development, infrastructure development and maintenance, and faculty startup packages and professional development.**

Decreasing state appropriations over the past decade has also been a significant constraint on S&T to accomplish its mission and grow in stature. Further, only limited support is available for (see Tables B-5 - B-7):

- Graduate fellowships and assistantships through the Office of Graduate Studies;
- Graduate student professional development;
- Infrastructure development and maintenance through departments and research centers;
- Faculty startup packages through departments (generated typically by keeping faculty positions open for a year or two) and Office of Sponsored Programs from research support funds; and

- Assigning office space for research-oriented graduate students and a common place for meaningful graduate student engagement (e.g., Graduate Resource Center).

Regrettably, the decreasing trend of appropriations from the State of Missouri is not likely to change in the foreseeable future. Other sources of revenue must be sought to support S&T's research mission. S&T should leverage its connections with alumni and corporations to establish endowments, which will provide a steady and permanent source of revenue to invest in the building blocks of S&T's research enterprise.

**7. All academic departments should develop goals and broadly communicate expectations for research and scholarship, and take necessary actions to achieve them.**

Numerous concerns were raised regarding varying departmental workload policies and the promotion and tenure (P/T) process, the need to emphasize quality versus quantity and connecting scholarly activities to the education and training of students. To address these challenging issues, all academic departments should have a discussion of what constitutes excellence in research and scholarship within their disciplines, culminating in a published set of affiliated P/T criteria and productivity metrics that are communicated and made available to all faculty. To a certain extent, there is a campus-wide lack of appreciation for the differences between disciplines (and campus departments). In some cases, there appears to be little linkage between the campus' stated goals and the departmental plans and activities. Further, actions should be taken to achieve well-defined departmental goals, including mentoring assistant and associate professors, following S&T workload policies, making P/T decisions, and employing reward structure.

## REFERENCES

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8. S&T Council of Graduate Students, Report: Open forum discussion on graduate stipend, fee waiver & health insurance, November 9, 2011.
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APPENDIX A

**Culture Subcommittee Survey Questions**

<b>1</b>	How do YOU define scholarly activity ?
<b>2</b>	What do you consider to be the top two or three measures related to your definition? Do you feel your definition is shared by members of your department? By the campus?
<b>3</b>	To what extent do you enjoy the scholarly activity process? [ Answers on a 0 (not at all) - 5 (love it!) scale] • Has this changed during your time at Missouri S&T? • What inspires / discourages YOU to pursue further scholarly activity?
<b>4</b>	How does your department support scholarly activity? The campus?
<b>5</b>	What are the three factors that limit /enhance your own scholarly productivity?
<b>6</b>	What would you recommend your department do to inspire scholarly activity? The campus?
<b>7</b>	How well do you feel the campus promotes successes in scholarly activity? Suggestions for improvement?

## APPENDIX B

Table B-1: Externally Sponsored Program Related Metrics

Table B-2: Tenured and Tenure-Track Faculty Headcount by Department (Fall Semester)

Table B-3: Student-to-Faculty Ratio (Fall Semester)

Table B-4: Student-to-Faculty Ratio of Technological Research Universities

Table B-5: Headcount/FTE of Graduate Research Assistants and Post-Doctoral Fellows

Table B-6: Endowed Chairs and Professorships

Table B-7: Endowments Supporting Research Mission

Table B-8: Start-Up Funds

Table B-9: Peer Faculty Scholarly Faculty Productivity

Figure B-1. Frequency Distribution of Number of Faculty with Expenditures

Figure B-2. Graduate Student Total Costs vs. Benefits: Value Graph for Peer Institutions

Figure B-3. Comparative Library Staffing Levels at Technological Research Universities

**Table B-1: Externally Sponsored Program Related Metrics**

		FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11
Proposals Submitted	(\$)	75,241,071	91,097,749	128,990,825	132,446,684	133,613,067	116,219,437	110,119,290	151,142,704	180,092,427	259,065,849	149,504,049
	No.	411	388	476	512	527	485	400	549	567	528	496
Proposals Awarded	(\$)	25,793,776	24,994,584	30,121,009	35,897,004	28,371,230	32,030,392	37,229,626	38,358,948	42,573,151	52,320,124	43,205,657
	No.	300	260	336	370	333	326	348	369	364	327	291
Total Expend	(\$)	22,189,876	26,532,589	28,897,188	34,810,971	34,754,313	36,260,228	32,271,339	37,703,045	38,075,483	44,693,711	45,876,136
No of Faculty with Expenditures		n/a	n/a	n/a	231	251	254	256	250	235	233	217
No of T/TT Faculty		251	263	270	268	279	281	279	274	293	288	279
Total SCH (Fall)		59,733	61,092	65,373	67,016	66,582	69,598	72,387	77,324	79,309	84,979	89,330

Source: Office of Sponsored Programs and Institutional Research and Assessment

**Table B-2: Tenured and Tenure-Track Faculty Headcount by Department (Fall Semester)**

<b>DEPARTMENT</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>Change</b>
Arts, Languages & Philosophy	7	7	4	5	6	7	10	10	10	8	9	2
Biological Sciences	7	8	8	9	10	10	10	10	10	9	10	3
Business & Information Technology	0	0	5	5	7	10	12	13	13	14	16	16
Chemical & Biological Engineering	11	10	8	11	11	12	12	11	12	9	10	-1
Chemistry	16	17	14	16	18	18	17	18	17	17	17	1
Civil, Arch & Environmental Engineering	22	21	22	24	23	20	21	22	23	22	23	1
Computer Science	12	13	13	14	12	10	10	14	14	14	14	2
Economics	5	5	7	7	7	7	6	5	5	4	5	0
Electrical & Computer Engineering	28	31	32	32	31	31	30	32	31	30	31	3
Engineering Mgmt & Systems Eng	16	15	15	16	15	13	9	15	15	14	13	-3
English & Technical Communication	8	8	6	7	8	7	8	9	8	8	9	1
Geological Sciences & Engineering	17	16	17	16	15	17	18	18	18	18	19	2
History & Political Science	9	8	8	9	9	9	10	10	10	9	10	1
Interdisciplinary Engineering	8	8	6	6	6	6	6	7	-	-	-	-8
Materials Science & Engineering	15	18	18	18	17	17	16	16	16	16	14	-1
Mathematics & Statistics	16	16	17	14	17	17	17	17	16	18	19	3
Mechanical & Aerospace Engineering	33	33	33	33	33	31	29	30	33	31	30	-3
Mining & Nuclear Engineering	12	12	10	12	11	12	10	12	13	13	15	3
Physics	16	18	18	18	18	18	17	17	18	18	18	2
Psychology	5	6	7	7	7	7	6	7	6	7	5	0
<b>Total</b>	<b>263</b>	<b>270</b>	<b>268</b>	<b>279</b>	<b>281</b>	<b>279</b>	<b>274</b>	<b>293</b>	<b>288</b>	<b>279</b>	<b>287</b>	<b>24</b>

Source: Institutional Research and Assessment

**Table B-3: Student-to-Faculty Ratio (Fall Semester)**

<b>DEPARTMENT</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Arts, Languages & Philosophy	0.2	0.1	0.3	0.3	0.2
Biological Sciences	12.0	12.1	15.2	16.7	17.8
Business & Information Technology	15.9	14.5	16.8	17.1	15.9
Chemical & Biological Engineering	15.1	17.8	17.4	22.2	26.1
Chemistry	4.3	3.8	5.0	4.9	6.5
Civil, Arch & Environmental Engineering	17.1	16.9	17.2	17.6	17.9
Computer Science	21.3	15.3	18.4	18.9	22.5
Economics	1.6	1.8	2.1	2.2	2.1
Electrical & Computer Engineering	13.6	12.5	12.9	12.6	13.1
Engineering Management & Systems Engineering	15.3	12.9	14.4	13.3	15.4
English & Technical Communication	2.5	1.9	2.7	2.1	2.9
Geological Sciences & Engineering	9.4	10.5	13.4	16.9	18.8
History & Political Science	5.1	6.2	5.1	4.0	4.3
Interdisciplinary Engineering	2.3	2.2	-	-	-
Materials Science & Engineering	6.5	7.3	6.8	7.0	7.5
Mathematics & Statistics	2.6	2.4	3.6	3.7	3.8
Mechanical & Aerospace Engineering	22.4	23.6	25.8	23.4	24.3
Mining & Nuclear Engineering	16.3	15.0	15.8	17.7	18.2
Physics	4.1	4.0	3.9	4.1	3.7
Psychological Science	11.0	9.3	8.0	10.2	13.4

Source: Institutional Research and Assessment

\*Includes all faculty, but excludes deans and above. Also excluded are graduate assistants and post-doctoral fellows.

\*Student-to-Faculty Ratio is based on Common Data Set definitions (Full-Time + 1/3 Part-Time).

\*Freshmen Engineering students are excluded.

\*Includes all Certificate students



**Table B-4: Student-to-Faculty Ratio of Technological Research Universities**

<b>INSTITUTION</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
California Institute of Technology	3	3	6	3	3
Massachusetts Institute of Technology	7	6	8	8	8
New Mexico Institution of Mining and Technology	12	11	10	11	12
Michigan Technological University	12	11	15	15	13
South Dakota School of Mines and Technology	*	12	14	14	14
Stevens Institute of Technology	*	14	13	14	14
Worcester Polytechnic Institute	*	13	14	14	14
Clarkson University	*	13	16	16	15
Illinois Institute of Technology	8	8	13	15	15
New Jersey Institute of Technology	12	14	15	15	15
Colorado School of Mines	14	14	15	17	16
Florida Institute of Technology	13	13	15	13	16
Rensselaer Polytechnic Institute	15	14	15	16	16
University of Alabama at Huntsville	*	#	16	17	16
<b>Missouri University of Science and Technology</b>	<b>14</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>17</b>
Georgia Institute of Technology	14	14	18	18	19

Source: IPEDS (2008-2010) & Institutional Common Data Set (2006,2007)

\*Data not available

**Table B-5: Headcount/FTE of Graduate Research Assistants and Post-Doctoral Fellows**

	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	% Increase
<b>Headcount</b>												
Graduate Students	1127	1391	1370	1287	1289	1343	1414	1459	1610	1702	1850	64%
Doctoral Students	305	338	346	377	369	350	344	364	424	466	528	73%
PhD Degrees Awarded	42	45	51	61	66	74	63	63	50	51	65	55%
Graduate Research Assistants	347	395	419	387	395	373	326	341	394	394	409	18%
Post-Doctoral Fellow	22	24	29	34	35	30	26	20	22	27	31	41%
<b>Full-Time Equivalent</b>												
Graduate Research Assistants	143.7	155.4	168.1	163.9	164.7	154.8	136.7	144.7	164	164.1	169.9	18%
Post-Doctoral Fellow	21.1	22.2	26.5	31.4	31.4	28	23.6	18.1	18.8	22.7	26.1	24%

Source: Institutional Research and Assessment

**Table B-6: Endowed Chairs and Professorships**

	<b>Endowed Professor/Chair</b>	<b>Comments</b>
1	Cynthia Tang MO Professorship in Computer Engineering	Search pending
2	Daniel St Clair Endowed Chair in Computer Science	
3	Donald L. Castleman/FCR MO Endowed Professorship of Discovery in Chemistry	
4	F. Kenneth Iverson Chair of Steelmaking Technologies (Nucor)	
5	Fred Finley Distinguished Professorship in Electrical Engineering	
6	Gulf Oil Foundation Professorship (Geo Eng, Mining, PetE, Geology, Geophysics)	
7	John & Susan Mathes MO Chair in Civil Engineering	
8	Karl F. Hasselmann MO Endowed Chair in Geological & Petroleum Engineering	
9	Keith & Pat Bailey MO Professorship (MAE)	
10	Lester R. Birbeck Endowed Chair in the School of Mines & Metallurgy	
11	Mary K. "Jimmie" Finley Missouri Professorship in Computer Engineering	
12	Missouri Soybean Research Professorship (CEST)	
13	Richard K. Vitek/FCR Endowed Chair in Biochemistry	
14	Robert H. Quenon Chair of Mining Engineering	
15	Robert V. Wolf Professorship in Metallurgical Engineering	
16	Roy A. Wilkens MO Telecommunications Prof for Electrical & Computer Engineering	
17	Schlumberger Endowed Professorship in Electrical Engineering	
18	Union Pacific Foundation/Rocky Mountain Energy Co Professorship (Mining Eng)	
19	Vernon & Maralee Jones Missouri Chair in Civil Engineering	
20	William A. Rutledge-Emerson Electric Co. Distinguished Professorship in Electrical Engineering	
21	Maxwell C. Weiner MO Distinguished Professorship for the Humanities	
22	Wayne and Gayle Laufer Chair in Energy	
23	Bernard R. Sarchet Endowed Professorship in Engineering Mgmt	Pending until \$1M balance is reached
24	Missouri Asphalt Pavement Association Endowed Professorship	Pending until balance is reached
25	Robert W. Abbett Distinguished Chair in Civil Engineering	Search pending
26	Micheel & Barbara Hurst/McCarthy Building Companies Professorship in Construction	Search pending

As of March 2012, chair/professor endowments have a total corpus balance of \$28.2M.

**Table B-7: Endowments Supporting S&T's Research Mission**

<b>Fund Name</b>	<b>Department</b>	<b>Comments</b>
Fellowship/Scholarship		
Heagler, John B. Civil Engineering Scholarship	CArE	Students in Civil
Kerr, Frances W. Memorial for Civil Engineering	CArE	CE Scholarships
Missouri Asphalt Pavement Association Endowed Fellowship	CArE	Selection by Civil Scholarship Committee & MAPA Sch. Comm.
Schmidt, Norbert O. Civil Engineering Fellowship	CArE	Grad student majoring in Geotechnical area of CE
SCI Engineering, Inc. Fellowship in Civil and Environmental Engineering	CArE	First preference to be given to graduate students studying geotechnical engineering
Yu, Wei-Wen Civil Engineering Fellowship	CArE	Grad student in CE w/ emphasis in cold formed steel structures with minimum GPA of 3.75
Hurst, Michael D. Endowed Fellowship	CArE	To establish a fellowship with a priority for a grad student in CE with a construction preference or focus.
Stueck, Cornelius FP Endowed Scholarship in Civil Engineering	CArE	To be used for scholarships or fellowships for students majoring or pursuing an undergrad or advanced degree in CArE.
Academy of Chemical Engineers Endowed Fund	ChE	To enhance the department's ability to maintain excellence including program support, undergraduate and graduate student support.
Academy of Chemical Engineers Quasi-Endowed Fund	ChE	The annual distribution of this fund will be used at the discretion of the Board members of the Academy of Chemical Engineers to enhance the Department's ability to maintain excellence including program support, undergrad and grad student support.
Chemical Engineering Graduate Fellowship Fund	ChE	Graduate Fellowship in Chem E
Rao, Yalamanchili Babu Endowed Scholarship	ChE	1st preference to undergrads majoring in ChemE, junior or higher with excellent academic performance. 2nd preference to ChemE grad students who demonstrate excellent academic performance.
Thompson, Dudley Fellowship Fund	ChE	Support for Graduate students in Chem E

Davies Family Endowed Scholarship/Fellowship Fund	Chemistry	Recipients shall be chemistry students enrolled at Missouri S&T
FCR Endowed Graduate Research Fellowship in Chemistry	Chemistry	Grad students in Chemistry
FCR Endowed Undergraduate Research Fellowship in Chemistry	Chemistry	Grad students in Chemistry
Vitek, Marilyn & Richard K. Graduate Fellowship in Analytical Chemistry	Chemistry	Grad students in the field of Analytical Chemistry
Adams, Neil L. Memorial Endowment	ECE	Annual funds available should be split equally for scholarships & lab equipment.
Finley, Fred W. Fellowship in Communications	ECE	Grad students in Electrical/Communications
McPherson, George Jr. Endowed Fellowship	ECE	Grad Students in ECE need considered
Nolte, Roger E. Endowed Fellowship	ECE	Fellowships for graduate students in Electrical
Koch, Richard E. & Mary Dotson Endowed Scholarship Fund	EMgt	Graduate Study in Environmental Construction or Manufacturing Eng
Alumna and Woman Student of the Year Awards	ERDC	Alumna or women undergraduate or graduate enrolled full time at Missouri S&T.
Cesare, Joseph A. Endowed Fellowship	GeoE & CArE	Preference to students studying Geological Engineering or Civil Engineering w/emphasis on geotech.
Clair, Joseph R. Fellowship	Geology	Fellowship for grad student in Geology
Eckelkamp, Ron Memorial Fellowship	Geotech Eng	For grad students studying geotechnical engineering with a preference for those who have received an undergraduate degree from a college in MO, IL or KS.
Shannon & Wilson, Inc. -Richard Frueh Memorial Scholarship in Geotechnical Engineering	Geotech Eng	Matching Funds Program-Preference to grad students in Geotechnical Engineering
Lee, Tsen-Lu and Yuen-Ray Scholars and Fellows	MAE	MAEEM majors
Mathews, Donald J. and Awilda P. Mathews Endowed Scholarship & Fellowship-A	MAE	To fund undergraduate scholarships and graduate fellowships in MAE. There are 4 separate funds.
Mathews, Donald J. and Awilda P. Mathews Endowed Scholarship & Fellowship-B	MAE	To fund undergraduate scholarships and graduate fellowships in MAE. There are 4 separate funds.
Mathews, Donald J. and Awilda P. Mathews Endowed Scholarship & Fellowship-C	MAE	To fund undergraduate scholarships and graduate fellowships in MAE. There are 4 separate funds.
Mathews, Donald J. and Awilda P. Mathews Endowed Scholarship & Fellowship-D	MAE	To fund undergraduate scholarships and graduate fellowships in MAE. There are 4 separate funds.

Mechanical Engineering Endowment Fund	MAE	Scholarships, Curriculum, lab, fellowships & faculty development
Kaiser Aluminum Scholarship Fund	MAE, MEP	Kaiser Aluminum Scholars or Fellows S&T selects
Eloe, Paul W. Graduate Fellowship Fund	Math	Summer research stipend for grad student in Math & Statistics Dept.
Chao, Richard Y. & June T. Scholarship/Fellowship Fund	MetE	Students in Met E, Pref. Chinese decent
Chubb, Walston Fellowship for Materials Behavior @ High Temperatures	MetE	Grad Students for study of materials behavior at high temperatures
Fick, Armin F & Marian M. Endowment for Mines & Met at Missouri S&T	Mines & Met.	Scholarships/faculty Asst/Equipment
Scott, James J. Memorial Endowed Fellowship in Mining Engineering	Mines & Met.	Students enrolled in Mining Engineering with preference to US citizens studying Rock Mechanics
Forsee Family Engineering Scholarship/Fellowship	S&T	Freshman, transfer, or grad students in Engineering renewable
Sickafus, Edward & Mary Sue Endowed Scholarship/Fellowship Fund	Physics	Scholarships/Fellowships for students in Physics
<b>Equipment and Maintenance</b>		
Academy of Civil Engineers Endowed Equipment Fund	CArE	Quasi Endowment
Civil Engineering Endowed Equipment Fund	CArE	Fund to purchase equipment for department
Barnett, E.H. Endowment in Chemical Engineering	ChE	Maintenance and computer upgrades
Chemical Engineering Endowed Equipment Fund	ChE	Fund to purchase equipment for department
Chemical Engineering Flexible Endowment Fund	ChE	Provide equipment and scholarships
FCR Endowed Equipment Fund for Chemistry	Chemistry	Income used for maintenance and repair replacement
Electrical Engineering Missouri S&T Endowed Equipment Fund	ECE	Distribution income to buy equipment
Electromagnetic Compatibility Laboratory Endowment	ECE	Distribution income to buy equipment
Gund, Russell A. Quasi Endowment for Laboratory Equipment	ECE	Income used to upgrade equipment
Howard, William and Sue Memorial Endowment Fund	ECE	To fund acquisition of instructional or research equipment for ECE. Shall be controlled by the Department Chair.

Nelson, Effie Emerson Electric Co. Hall Equipment Fund	ECE	Used for acquisition, maintenance, or upgrade of equip. in ECE
Deutch, Morton Endowed Equipment Fund in Metallurgical Engineering	MetE	Equipment Fund in Met E
Moeller Brothers Endowment for Metallurgical Engineering	MetE	Used for acquisition, maintenance, or upgrade of equip. in Met E
School of Mines & Met Equipment Endowed Fund	Mines & Met.	Expenditures for equipment of labs, classrooms & offices
<b>Research Support</b>		
Biological Sciences Research Endowment	Bio Sci	To support research activities in the department of biological sciences.
Biological Sciences Research Quasi-Endowment	Bio Sci	Expended from the distribution account at the discretion of the chair.
Civil Engineering Alumni Assistantship	CArE	Stipends for laboratory assistants
Matthews Endowed Fund for Cancer Research	Chemistry	Distribution used for cancer research in the Chemistry Dept.
Grayson, J. Paul Internet Computing Graduate Research Fund	CSci	'Support for research & research assts. In internet computing
Lovitt, John Internet Computing Graduate Research Fund	CSci	Used to support research and research assistants in the area of internet computing.
Power Engineering Fund	ECE	Grad Power Engineering Program Support
Beveridge, Dr. Thomas Graduate Teaching Assistant and Geology Field Camp Awards	Geology	Recipients of the awards shall be 1) a deserving Graduate Teaching Assistant majoring in Geology & Geophysics 2) and undergraduate full time Geology & Geophysics student who is preparing to attend geology field camp.
Horst, William & Margaret Ann Endowed Faculty Development Fund	MetE	Assist junior faculty in establishing their research programs
Claypool, John W. Fund for Medical Research	OSP	Medical research campus wide
Schearer, Laird D. Fund	Physics	Provide prizes for grad students in Physics for outstanding research
Olson, G. Suzanne Undergraduate Research Award	Psych	Undergrad students in their junior or senior year with a psychology major. Preference to students who present their research
Hasselmann Research Endowment	S&T	Marjory Hasselmann funds

Stoecker, Wilbert Stoecker Undergraduate Research Fund	S&T	Distribution to be used at discretion of Vice Provost of Undergraduate Studies to support undergraduate research
<b>Faculty Excellence</b>		
Finley, Fred W. & Mary K. Endowed Faculty Enhancement Program	ECE	Income for annual faculty awards in EE
Brown, Constance R. Endowed Fund in History & Political Science	History & Political Science	\$1,000 annually for the purposes of faculty excellence awards; given in the amount of \$2,000 biennially to tenured faculty who demonstrate excellence. The remainder to be used to provide scholarships for worthy students in History & Political Science.
Brown, John Stafford Faculty Excellence Fund	S&T	Provide 2 Faculty excellence awards
Class of '37 Faculty Excellence Endowment Fund	S&T	Use to be determined by the Chancellor to enhance the quality of Missouri S&T
Forsee Family Engineering Faculty Excellence Fund	S&T	Outstanding faculty in School of Engineering
Keiser, Robert Endowed Faculty Award for Teaching Research & Service	S&T	Faculty award for teaching, research & service

As of March 2012, endowment corpus balances are as follows:

- Scholarship/Fellowship: \$5.1M
- Equipment and Maintenance: \$3.1M
- Research Support: \$6.9M
- Faculty Excellence: \$0.8M



**Table B-8: Start-Up Funds**

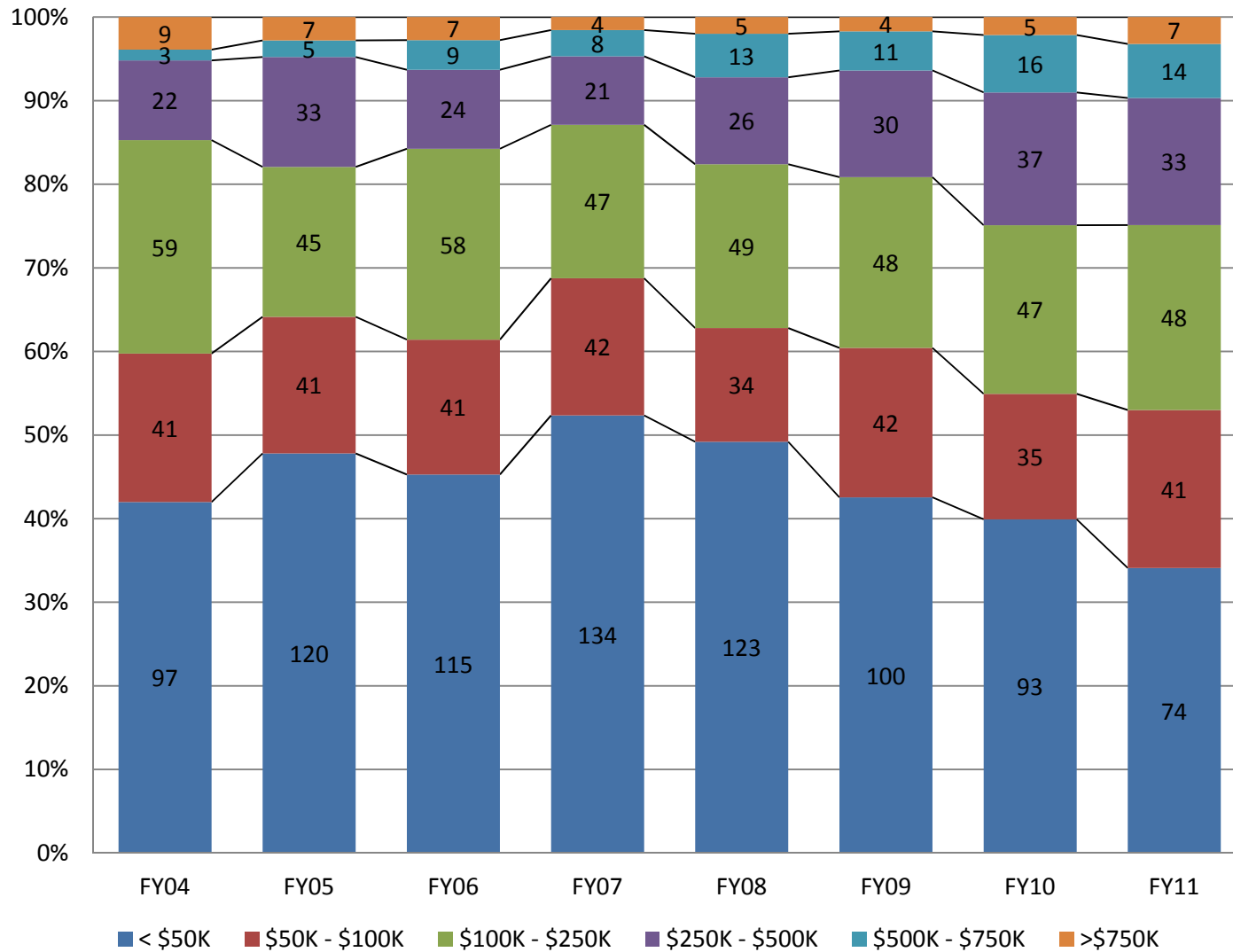
<b>Starting Year</b>	<b>Number of Startup Packages</b>	<b>Total Amount</b>
FY08	16	\$1,818,014
FY09	23	\$2,193,157
FY10	4	\$755,000
FY11	14	\$2,250,715

**Table B-9: Peer Faculty Scholarly Productivity**

<b>Institution</b>	<b>Publications per T/TT Faculty</b>			<b>Citations per T/TT Faculty</b>		
	<b>2007-08</b>	<b>2008-09</b>	<b>2009-10</b>	<b>2007-08</b>	<b>2008-09</b>	<b>2009-10</b>
California Institute of Technology	12.7	16.6	17.5	156.2	195.8	188.3
Colorado School of Mines	3.9	5.4	6.1	13.5	20.2	21.9
Florida Institute of Technology	4.4	5.3	5.2	11.0	13.5	12.5
Georgia Institute of Technology	10.4	11.5	13.3	55.3	65.6	67.0
Illinois Institute of Technology	5.9	6.9	7.3	17.0	21.7	21.9
Massachusetts Institute of Technology	10.7	10.9	12.1	106.0	100.9	104.3
Michigan Technological University	3.1	4.2	4.4	9.0	12.7	13.1
<b>Missouri University of Science and Technology</b>	<b>5.2</b>	<b>5.7</b>	<b>5.9</b>	<b>14.9</b>	<b>15.4</b>	<b>14.4</b>
New Jersey Institute of Technology	4.4	6.0	7.5	15.5	22.7	30.9
New Mexico Institute of Mining and Technology	3.7	4.3	4.8	18.2	25.6	29.7
Rensselaer Polytechnic Institute	7.4	10.5	11.2	34.9	49.2	50.9
South Dakota School of Mines & Technology	1.4	2.3	3.5	2.0	2.9	3.8
Stevens Institute of Technology	5.1	7.1	8.6	14.9	19.6	18.8
The University of Alabama in Huntsville	4.0	4.0	4.6	9.9	12.2	11.4
Worcester Polytechnic Institute	3.6	4.6	5.3	12.1	12.8	14.4

Source: Academic Analytics

Comments: Publications include peer-reviewed journal articles and conference proceedings. Information about publications and citations was collected from Scopus.



**Figure B-1. Frequency Distribution of Number of Faculty with Expenditures (Source: Office of Sponsored Programs)**

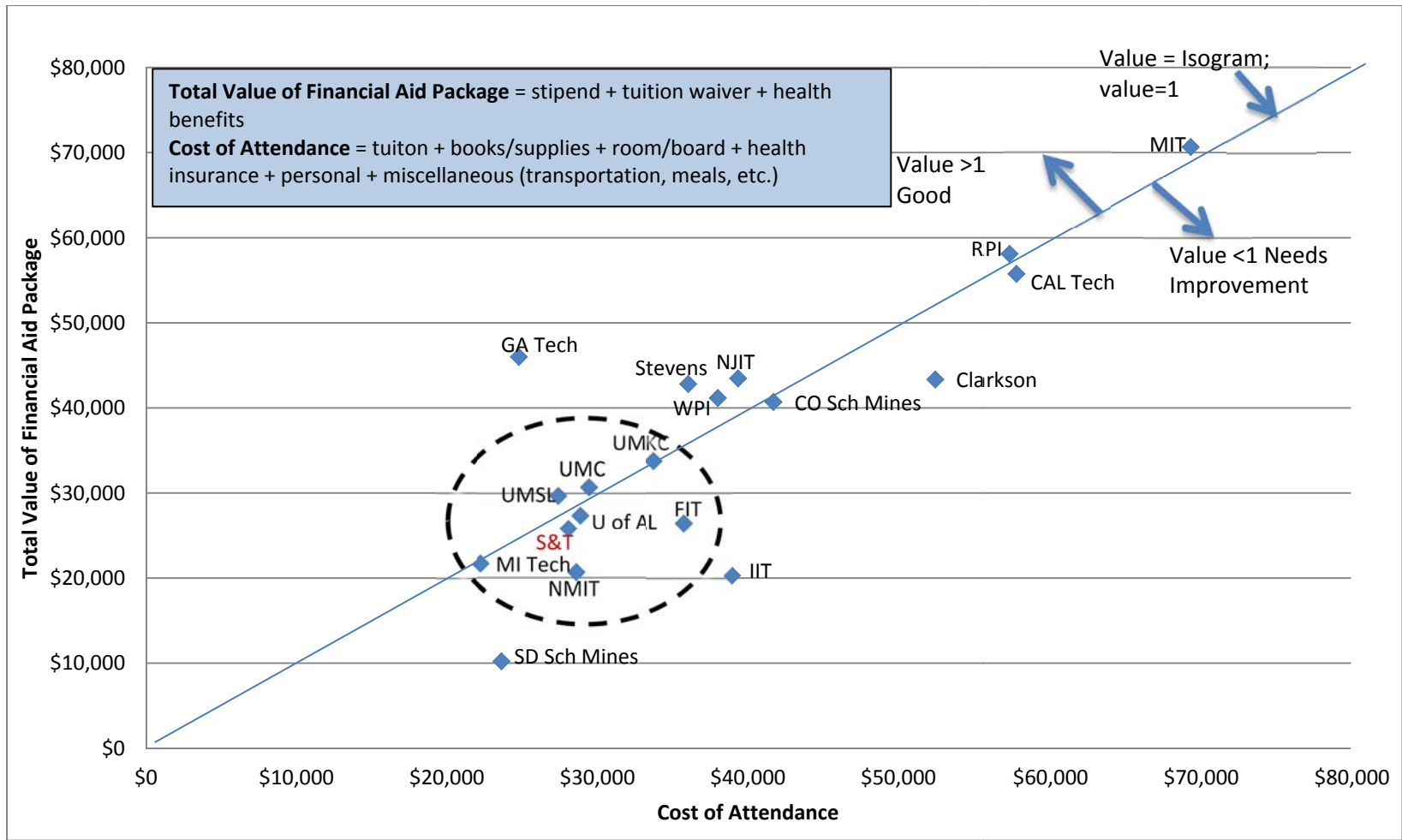
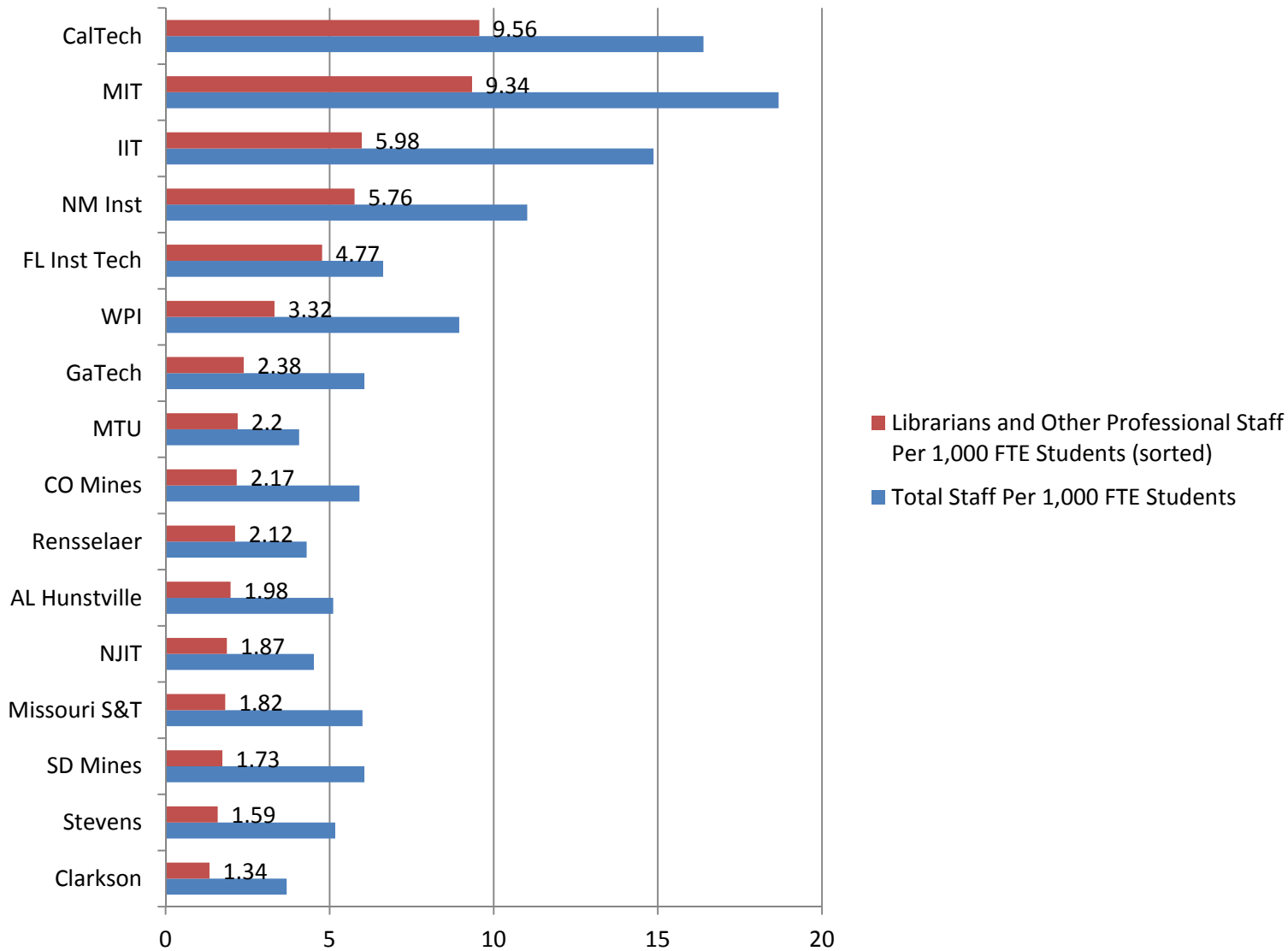


Figure B-2. Graduate Student Total Costs vs. Benefits: Value Graph for Peer Institutions (Source: Office of Graduate Studies, 2011)



**Figure B-3. Comparative Library Staffing Levels at Technological Research Universities (Source: National Center for Education Statistics, 2010)**