Figure 15: NMT Revenue Budget

**Tuition:** in-state $5,714 / out-of-state $17,073 (2014)

Student: Faculty ratio 13:1 (2014)  
Student: Faculty ratio 12:1 (2013)  
Student: Faculty ratio 11:1 (2012)  
Student: Faculty ratio 11:1 (2011)  
Student: Faculty ratio 11:1 (2010)  
Student: Faculty ratio 11:1 (2009)  
Student: Faculty ratio 11:1 (2008)  
Student: Faculty ratio 12:1 (2007)  
Student: Faculty ratio 11:1 (2006)  
Student: Faculty ratio 12:1 (2005)  
Student: Faculty ratio 12:1 (2004)  
Student: Faculty ratio 11:1 (2003)

Whereas UNM displays a match between tuition and state appropriations, colleges such as Colorado School of Mines (CSM) derive 71% of its revenue from tuition. Michigan Tech a comparably sized STEM institution also draws 71% of its revenue from tuition. Also, Michigan Tech derives three times the state revenue from tuition, while CSM derives a miniscule reaction (less than 3%) from the state of Colorado. **Why does NMT derive less that half as much revenue from tuition as from NM State appropriations?** A Case study of CSM and its challenges with Colorado HED and ultimate success in overcoming the state financial crisis is presented below.
UNM Budget: Revenue

- Tuition/ Fees 30%
- State Appropriation 30%
- Govt. Appropriations 16%
- Grants/ Contracts 24%

Figure 16: UNM Revenue Budget

Student: Faculty ratio 23:1

GA Tech Budget Revenue

- Tuition/ fees 19%
- State Appropriations 16%
- Giving/ operations 26%
- Grants/ Contracts 39%

Figure 17: GA Tech Revenue Budget

Student: Faculty ratio 24:1
**Figure 18: Colorado School of Mines Revenue Budget**

**Tuition:** in-state $16,485 / out-of-state $32,415 (2014)

Student: Faculty ratio 19:1

**Figure 19: NJIT Revenue Budget**

**Tuition:** in-state $15,140 / out-of-state $27,840 (2014)

Student: Faculty ratio 19:1

Student: Faculty ratio 13:1

Case Study 3. Colorado School of Mines and Declining State Appropriations

Subject - Fiscal Year 2011 Operating Budget

“With the national economy beginning to show signs of stress in early 2008, many states quickly began forecasting their own financial pressures. Colorado’s economists reflected Colorado’s first sign of economic stress in December, 2008. As with many states, throughout 2009 and continuing today, Colorado’s economic projections reflect a loss of state revenue, primarily from loss of personal income tax and capital gains tax. With higher education in Colorado being one of only a few unrestricted budgets for the state (in addition to the department of corrections and health care), higher education was and continues to be a source of funds to resolve the state’s budget deficit.

In fiscal year 2009, the state initially funded all higher education institutions in the amount of $706 million. With the looming budget deficit, the higher education budget was reduced in fiscal year 2009 and again in 2010. The state has used, however, federal State Fiscal Stabilization Funds (SFSF) to “keep higher education whole” for those two years. The state’s use of SFSF for higher education will run out in fiscal year 2011 which will leave only state general fund to support higher education. However, the state is required pursuant to the SFSF rules, to keep higher education funded at the fiscal year 2006 level through fiscal year 2011.

With a current projected state budget deficit of over $1.5 billion in fiscal year 2012, the state is anticipating further higher education cuts in fiscal year 2012 by at least $300 million from the fiscal year 2011 level.
The Colorado School of Mines’ portion of the overall budget is approximately 3%. For the fiscal year that we are just ending, fiscal year 2010, we are being funded with both state funds and SFSF at a level of $23.3 million. With SFSF being removed next year, we anticipate to be funded by the state in fiscal year 2011 at $18.8 million. **IF** the state projections remain, likely best case scenario for the School would be a reduction of another $13.2 million in fiscal year 2012 to $5.5 million. Below is a chart that depicts state (and SFSF) funding for Mines over the past ten years and what is predicted over the next few years’

Since 2011, CSM implemented 10% tuition increases on an annual basis. Revenue increases for 2011 alone resulted in $7.8 million, due to the tuition increases and assumes an incoming class of freshman and transfers of 950 students and 58 new graduate students. As a result of this annual increase, CMS finds itself in good financial shape with a growing student body and new faculty hires to accommodate the increased demand in degrees offered.

**The take-away message:** At least in part due to a history of New Mexico cutting state support by an amount equal to any tuition increases exceeding a state specified limit, NMT has feared dramatic tuition increases. The data above shows that we are very low in tuition by various measures and we must consider increasing tuition dramatically to sustain our quality as we grow. Tuition increases worked for CSM, they can work for NMT.

**MOOC Discussion:**

The threat of MOOCs is real. If one considers a generic freshman physics/chemistry or mathematics course, there is little reason not to take such a course as a distance offering from a more prestigious institution than Tech (e.g., Stanford, MIT, Harvard). We again reference the quote by Jim Lerman:

*The most vulnerable, according to Jim Lerman of Kean University in New Jersey, are the “middle-tier institutions, which produce America’s teachers, middle managers and administrators”. They could be replaced in greater part by online courses, he suggests....”*

Please note: the quote above does NOT mention that lab sciences and STEM research are at risk. The threat of MOOCs in higher education is analogous to the threat of off-shoring in industry. If a job can be done as well or better off-shore, American industries cannot compete. However the fix for American industry and the fix for New Mexico Tech are similar. We need to offer something that CANNOT be offered via distance education, and we already do. What Tech offers to all students is meaningful, hands-on, research. To the extent that we can protect and strengthen our research (and advanced laboratory coursework) we can protect ourselves from MOOCs, and we can provide a product that students are willing to pay for. In fact, we can leverage MOOCs and use them to provide pure academic content from other institutions, while our faculty focus on the hands-on course components.
Expected Impact
Effective budget planning affects all institutions and making funding one of our strategic priorities to ensure that we properly raise and allocate funding to carry out our mission and make our vision achievable.

Short Term Initiatives and Initial Progress
The Center for Leadership in Technology Commercialization has already begun to integrate faculty and students in commercialization.

Quality Growth Task Force Materials

Data and Analysis for Priority Setting
The intention of the Quality Growth priority is to address how much the institution should grow, what resources will be needed, and to ensure that growth does not come at the expense of quality. This priority is closely aligned with the other priorities, particularly Transdisciplinary (which is a primary strategy for growth of the Graduate program), Technology and Funding (these contribute largely to solving the resource problem), and Student Success (which includes key objectives for growth and improvement of the Undergraduate program).

Growth in and of itself will be a natural occurrence as we fulfill our vision and mission to advance science, drive innovation, increase transdisciplinary collaborations, expand humanity’s knowledge, and advance economic development. However, growth that is unplanned or under-resourced will be directly contrary to NMT’s vision and mission, as it diminishes the quality of education we provide, shifts resources away from research, and strains our sense of community.

The Quality Growth priority is an institution-wide priority. While the goals focus primarily on the areas of enrollment and research, we recognize that essentially all departments from all divisions will be affected as these two areas grow. This strategic priority seeks to address the subsequent needs and issues that will arise campus-wide from the projected growth.

It is largely accepted that Tech is a premier research and teaching university with a competitive advantage in STEM. Feedback from the initial Town Hall SWOT Analysis indicated a wide-spread concern that Tech’s undergraduate enrollment growth is compromising the quality of education and pulling resources away from our research mission. Since 2010, enrollment has grown from 1,642 degree-seeking students to 1,886 degree-seeking students, and Fall 2014 enrollment is an all-time high of 2,127 students. In 2010, the size of the freshman class shot up by an unexpected 30% and has hovered at that level ever since. Since 2011 NMT’s freshmen retention rate (78.8%) has increased by more than 2 percent per year and is the highest it’s been in 30 years. If this trend continues the retention rate will be 83% in three years.

During this growth budgets have remained mostly flat. In some areas the quality of academic and student services has decreased to the point of being only reasonably acceptable. Specific issues such as large class sizes and insufficient advising support were mentioned in the Town Hall forums. As the SPC sifted through the comments, it became clear that the campus community would support this type of enrollment growth only as long as it did not come at the expense of quality. The human and fiscal
resources to support the growth will be absolutely necessary as we go forward. The strategic priority of Quality Growth was established to capture the institution’s growth goals for the next three to five years while documenting and planning for the resources that will be required at every level to support that growth.

**Expected Impact**
By focusing on growing intentionally, we expect to better balance budget requirements with incoming student population and the need for resources to support their success.

**Short Term Initiatives and Initial Progress**
The Mechanical Engineering Department has been working on their PhD program proposal and the Biology Department has been discussing the requirements for their proposal.

In collaboration with EducationUSA, the Center for Graduate Studies recruited in seven Central American countries (Guatemala, Honduras, El Salvador, Costa Rica, Nicaragua, Panama, Dominican Republic) this fall, where funding is available for students to come and study for graduate degrees. The CGS is in the process of negotiating an MOU with HonduFuturo, the national funding agency for the Hondurans, to be a preferred school for students wanting graduate degrees and qualifying for HonduFuturo funding. After that agreement is completed, the CGS will pursue other such agreements.

Appendix: Student Success Task Force Materials

**Data and Analysis for Priority Setting**
The student success task force considered the impact that recent education-oriented grants have had on student success. In addition, the requirements for ABET and HLC accreditation were considered to set goals and objectives.

**Expected Impact**
This priority will have significant impact on students, which are central to our mission and vision, which makes this essential to our future.

**Short Term Initiatives and Initial Progress**
Some of the initiatives described in this strategic priority are already under way, e.g., updating assessment and evaluation of integration of successful, grant-related developments in our normal operations.

The Office for Student has already provides the following advising services: new/transfer students are supported through their first registration, student in the living learning community program are supported through their first year and beyond, making Banner changes of advisor, minor, and major. The advising support through the living learning community program is currently supporting approximately 125 students.

**Technology Task Force Materials**
Data and Analysis for Priority Setting
The Technology Task Force evaluated the goals as developed by the Strategic Planning Committee as well as other issues brought forth by various constituencies through the SWOT analysis.

Members of the task force evaluated technology issues specific to technology as a strategic priority as well as technology as a catalyst to the efforts of other strategic priorities. This required some members of this task force to be members of the other task forces.

Clearly identified by many constituencies in the SWOT analysis was the need to address technology. Those needs that were strategically centered on the foundational aspects of technology are covered by the Technology Task Force. Those technology needs that arose out of other strategic priorities are included in the scope of other task forces.

The Technology priority has a large institution-wide groundswell of support directed toward consolidation, streamlining and reordering the technology model as practiced. Acted on in an orderly fashion should lead toward the attainment of the technology goals within the five year time horizon of the strategic plan.

The technology priorities are institution-wide both in implementation and ramification and the proper application of technology is instrumental in creating a competitive advantage.

Currently, the application of technology is very decentralized. That approach creates a large number of diffuse initiatives, each of which consumes funding, does not integrate into a unified whole and reduces effectiveness. A more centralized approach, with goals established at the institution level can focus resources and generate the kind of infrastructure that can be utilized by all for a defined institute mission.

However, the strategic application of technology for the advancement of the mission of New Mexico Tech is not a static endeavor. It is important that an institute-wide group oversees the task of bringing technology challenges forward, processing those challenges and producing concrete solutions. The general mission of the group is to provide the appropriate technological planning to a constituency to forward the mission.

Expected Impact
The integration and institute-wide prioritization and funding of technology will reduce costs, while increasing effectiveness and productivity.

Short Term Initiatives and Initial Progress
The CTC has already been initiated.

Transdisciplinary Programs Task Force Materials

Our transdisciplinary program analysis started with the historical interdisciplinary research that has been carried out on campus. From there we analyzed the current and likely future trends for funding and research challenges. This led us to the transdisciplinary focus with the analysis presented here.
Data and Analysis for Priority Setting

Current Situation: Topical Analysis
Based on discussion of the challenges and issues related to developing transdisciplinary education and research programs, the task force recognized the following areas for exploration, data collection, and development. Each of these has been explored and is briefly outlined below.

- Market analysis for transdisciplinary certificates/degrees (ug & grad)
- Grant funding for inter/transdisciplinary research
- Grant support offices
- Existing templates for academic programs

Each of these areas were considered, with data collected as appropriate for each topic.

Program Requirements Analysis
Data and analysis
From Johns Hopkins’ B.S. in Biomedical Engineering, we have adapted the following requirements for transdisciplinary education programs. By completion, students will demonstrate the ability to:

- Apply knowledge of mathematics, science, and engineering.
- Design and conduct experiments, as well as to analyze and interpret data.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Function on multidisciplinary teams.
- Identify, formulate, and solve science and/or engineering problems.
- Display an understanding of professional and ethical responsibility.
- Communicate effectively.
- Acquire the broad education necessary to understand the impact of science and engineering solutions in a global, economic, environmental, and societal context.
- Recognize the need for, and an ability to engage in life-long learning.
- Exhibit knowledge of contemporary issues.
- Use the techniques, skills and modern science and engineering tools necessary for professional practice.

Grant Funding
Many funding opportunities that can support transdisciplinary research and education are available under headings or keywords including interdisciplinary, multidisciplinary, cross-cutting, collaborative, integrative, and synthesis.

Funding opportunities for interdisciplinary research has been growing. The National Science Foundation (NSF) has added numerous opportunities for interdisciplinary research including funding for CAREER awards and Major Research Instrumentation. Indeed, NSF has added Interdisciplinary Research as a high priority with a number of specific solicitations. The National Science Foundation has integrated this support even inside of disciplines. For example, the Division of Physics has a program called “Education
and Interdisciplinary Research” and the Social, Behavioral, and Economic Sciences has a program called “Interdisciplinary Research in Hazards and Disasters.”

In addition, in 2012 NSF added a crosscutting, NSF-wide program called “Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE)”, but it is not clear whether this is being funded in 2014. Finally, NSF’s site on Interdisciplinary Research lists the following mechanisms for funding: solicited interdisciplinary programs, areas of national importance, center competitions, unsolicited interdisciplinary proposals, education and training, and workshops/conferences/symposiums.

The NSF’s self proclaimed flagship interdisciplinary training program is the “Integrative Graduate Education and Research Traineeship” (IGERT). In addition to the many interdisciplinary opportunities, NSF also has many pages of listings that include transdisciplinary in the description, e.g., in the Division of Chemistry the “EPS/NSF Networks for Characterizing Chemical Life Cycle”. Finally, NSF lists one explicitly transdisciplinary funding opportunity in the Division of Integrative Organismal Systems.

The Department of Education also has funding opportunities for transdisciplinary education including the “Predoctoral Interdisciplinary Research Training Program in the Education Science”; indeed our experience with Department of Education has been across multiple disciplines.

The Grants.gov site currently lists 1,984 open funding opportunities with “interdisciplinary” as a keyword from agencies including Bureau of Reclamation, Bureau of Land Management, Fish and Wildlife Sercie, International Narcotics and Law Enforcement Affair, National Institutes of Health, National Insitute of Standards and Technology, Department of the Army - Corps of Engineers on just the first page of opportunities. When we add the restriction to include “graduate” as well, we still have 114 open opportunities. Under “multidisciplinary” we find another 182 opportunities including National Institute of Health, Department of the Army, National Science Foundation, National Park Service. The number that are explicitly “transdisciplinary” is much smaller (9), but there are opportunities from the National Institutes of Health and from the National Institute of Food and Agriculture.

Some private foundations focus on cross-cutting themes. For example, the Morris Family Foundation focuses on innovation in interdisciplinary education, and the James S. McDonnell Foundation supports interdisciplinary science approaches to a select list of topics.

Grant Support
Some institutions provide grant proposal development support, e.g., Michigan Tech’s Sponsored Program Office advertises that they will assist with proposal developmenting to create competitive proposals.

A few practices with specific support that should be considered for advancing the development of grant funding are:

• San Jose State University provides “programs and resources designed to assist them (faculty) in honing their research interests, in finding collaborators and in crafting proposals.”
• The University of Iowa’s Grant and Research Services Center assists with identifying funding sources, provides workshops on grant-related topics, and provides support services for the development, implementation, and utilization of grants.
The University of Arizona Cancer Center’s Research Grant Support and Resources provides support for grant applications, assists with assessment and reporting, assists with setting up customized funding reports, and coordinates best practices for grants.


**Academic Program Models**

**Data and analysis**

There are many academic programs that are either interdisciplinary or transdisciplinary, both in the U.S. and internationally. There are three general approaches for such programs.

- **Transdisciplinary** (or Interdisciplinary) degrees - in these programs the title does not reflect any disciplinary or research area; it is generic, e.g., the Transdisciplinary Program at Claremont Graduate University (http://www.cgu.edu/transdisciplinary). The advantage for this type of program is that NMT would create one program and it could be used to do any transdisciplinary academic program at the same level. The task force is concerned that such degrees are difficult to evaluate for acceptance. Given that we specifically want our degrees to generate outstanding opportunities for students, the task force decided this approach should not be pursued currently.

- **Transdisciplinary** (or Interdisciplinary) Topical degrees - in these programs the title of the degree is specific to a particular topic or research problem; it is specific, e.g., Transdisciplinary Graduate Education in Media Arts and Science Ph.D. at Arizona State University (http://ame.asu.edu/education/degrees/masphd.php). In this case, each topic or research area proposes, creates, and supports a particular transdisciplinary degree with an appropriate name. The advantage here is that the name can provide some disciplinary or topical specificity that may assist with acceptance of the degree. However, it appears that NMT does not have the necessary size and resources to generate a significant number of such degree programs.

- **Add on Transdisciplinary Certificate** - in these programs the student earns a certificate in transdisciplinary research or a transdisciplinary topic, typically while earning a specific discipline degree, e.g., the Graduate Certificate in Engineering Technology (Transdisciplinary Engineering) at University of Southern Queensland (http://www.usq.edu.au/study/degrees/graduate-certificate-in-engineering-technology/transdisciplinary-engineering). This has the advantage that we initiate one certificate program and use that to specifically develop and acknowledge the transdisciplinary capabilities of students across all disciplines. This is the approach that the task force thinks fits NMT best.
**Expected Impact**

This strategic priority will impact primarily students, faculty, and researchers, but will also affect staff as changes to support mechanisms for those engaged in transdisciplinary programs are developed and implemented. This, along with other strategic priorities, will require the entire campus culture to change the way that we value the work that we do so that transdisciplinary work is valued and supported as much as traditional, discipline-focused work. Note, this priority does not disparage discipline-focused work as that work provides an essential foundation for transdisciplinary work.

As is supported by the Data and Analysis Priority Setting section for this priority, more funding and challenging problems are being identified as requiring deep education and research from multiple disciplines. By actively moving NMT to strengthen transdisciplinary education and research programs, we will advance New Mexico Tech’s ability to compete for excellent students and research support and New Mexico Tech’s reputation as a premier institution of both education and research.

**Short Term Initiatives and Initial Progress**

During the strategic planning process, we have made progress on projects that are part of this strategic priority. Briefly, those projects and their current status are as follows.

**Biomedical Sciences Bachelors Degree:** The degree requirements have been fully specified and the program for the Bachelor of Science degree in Biomedical Science have been presented and approved by the Council of Chairs, Faculty Senate, and Board of Regents. This program will officially appear in the 2015-2016 Catalog and students will be allowed to enroll in the program beginning in Spring 2015.

**NRT-DESE: Transdisciplinary Data Science (NRT-TDS):** This National Science Foundation project, for $2.999M, will prepare graduate students for a range of STEM careers and integrate theory, methods, and tools from communication, mathematics, statistics, computer science, and ethics with their training in their respective disciplines.

**S-STEM Transdisciplinary Research:** This National Science Foundation project, for $638K, will prepare graduate students for a range of STEM careers and integrate theory, methods, and tools from multiple disciplines with communication, entrepreneurship, and ethics. Armed with transdisciplinary research skills and knowledge, they will be prepared to advance research in academia, industry, and government service.

**MST Scholarships for NM Teachers:** Working with the New Mexico Public Education Department we secured $50k for scholarships for New Mexico Teachers for the MST program for Spring 2014. We continue to work with NM PED to make this an annual allocation to improve teacher’s ability to prepare our mid and high school teachers.