

## Strategic Planning Summer Working Group Report Degree Programs of Distinction August 12, 2015

### Section 1: Charge

Define the structures and common themes that ensure quality, currency, and distinctive identity for our BS degrees and suggest strategies to help departments continuously refine and improve their degrees.

Merriam-Webster **distinctive**. Adjective, dis·tinc·tive \di-'stin(k)-tiv\; having a quality or characteristic that makes a person or thing different from others: different in a way that is easy to notice.

### Section 2: Relationship to Strategic Plan

This committee's efforts help advance the following goals of the strategic plan:

Goal 1: Enhance the distinctive identity and reputation of Mines

- 1c Expand active-learning instruction (such as studio and project-based, rather than traditional lecture format) utilizing best-in-class pedagogical and technological practices
- 1d Improve and expand opportunities for participation in professional practice and research throughout the entire undergraduate experience
- 1e Expand and enhance graduate student development of professional attributes through formalized activities and curricular excellence
- 1f Create new and enhance existing large research initiatives focusing on the global challenges related to the earth, energy, and the environment

Goal 2: Build upon a student-centered campus culture of excellence, inclusion, diversity and community.

- 2a Expand residential campus to integrate efforts from academic affairs and student life, for undergraduate and graduate students, to promote student community and to foster collaboration, learning, leadership and citizenship
- 2b Advance academic culture and structure that fosters creativity, intellectual-curiosity, and student success
- 2c Enhance opportunities for students to develop effective communication skills as a complement to strong content expertise
- 2d Build a campus that values employees and students of the institution through a positive, supportive, and inclusive environment
- 2e Increase the diversity and quality of Mines' faculty, student and staff

### Section 3: Membership

Kevin Moore, Chair, Linda Battalora, Rob Braun, Jered Dean, Mark Eberhart, Vaughan Griffiths, Paul Santi, and Sam Spiegel

## Section 4: Summary of Deliberations

### 4.1 Committee Activities

The committee had two face-to-face meetings and one joint brainstorming session with the 1st/2nd Year Experience Committee<sup>1</sup>. Initial discussion focused on a set of six questions, looking first at institutional distinctiveness and then more specifically at degrees and programs:

#### Institutional Level

1. What distinctive theme(s) do you think best describes Mines, if any?
2. Is there another theme that you wish best described Mines (not really the purview of this committee)?
3. What theme(s) do you identify with any schools that you view as our peers or aspirational peers or otherwise "best in class?"

#### Departmental or Program Level

4. What programs at Mines do you think are distinctive (within the state/nation/world)?
5. What makes these programs distinctive (thematically or otherwise)?
6. For programs that you don't see as particularly distinctive, how do you think their distinctiveness could be improved by considering the themes in distinctive programs?

In the joint brainstorming session we considered additionally the following revised questions:

1. What is it about Mines that makes it distinctive?
2. What Mines degrees or programs are truly distinctive and why? Are there common themes in these distinctive degrees or programs?
3. How can Mines programs that are not truly distinctive become so?
4. What does a freshman/sophomore gain by coming to Mines for core education instead of transferring in?
5. What can we do to make the freshman/sophomore year really (or more) distinctive? What elements are essential?
6. How can a truly distinctive freshman/sophomore year enhance our downstream degree programs?

Underlying all these is the question: why come to Mines instead of our peers? And second, why (or why not) come to Mines for the first two years instead of transferring in from a community college or related places? The reason for this second question is that our committee concluded early in our deliberations that much of what is distinctive at Mines builds on the first and second year experiences.

### 4.2 Of Distinction and Narrative:

The two committees' deliberations around the Degree Programs of Distinction committee's charge are summarized below. However, before presenting these summaries, we comment on a particular point-of-view regarding *distinctiveness*: the point-of-view of *narrative*. From [vocabulary.com](http://vocabulary.com) a "... narrative is a story that you write or tell to someone ..."

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<sup>1</sup> First and Second Year Experience Committee: John Berger, Chair, Sam Spiegel, Jessica Keefer, Kay Schneider, Toni Lefton, Vince Kuo, Allison Caster, Deb Carney, Christian Shorey, Leslie Light.

When asking people about what programs at Mines are distinctive and what qualities make these programs distinctive, there is often the common theme that the distinctive programs bring a narrative to mind and people recite this narrative in their discussion. For example, Mines' "historical reputation in...." is often used as an indicator of distinctiveness. A historical reputation is a narrative – a story with a plot and usually a starting point, at least for the storyteller. As another example, our rigorous curriculum was described as a feature that makes our programs distinctive. This too is a narrative. Students love to tell the story of how hard they work. Within the State of Colorado, mention Mines and one often evokes an image of students working late into the night to complete their homework - students who are intelligent, dedicated, and who sacrifice the typical college experience for a rigorous curriculum and academic environment. But what images are brought to mind when considering our less distinctive (though possibly excellent) programs? Very few. Often none. **A distinctive program usually brings a narrative to mind—the more widely known the narrative, the more distinctive is the program.**

The growing importance placed on narratives as a way of communicating and enhancing reputation and distinctiveness has led many governments, governmental organizations, industries, and businesses to supplement their strategic plans with strategic narratives. Quoting from a 5/4/15 article in Forbes, a strategic narrative is:

*A written and spoken story of an imagined future captured in a 'before,' 'now,' and 'to be' sequence. A powerful strategic narrative paints a picture of how an [organization's] past, present, and future fit together in a broader strategy context. Strategic narratives are a form of storytelling, and like all good stories, they need a compelling plot, characters, a climax, and a conclusion. By telling this story, stakeholders will understand their place in the larger narrative and how they can take an active role in shaping the [organization's] future.*

Consider IBM as an example. In the early 2000s IBM began its transformation from a hardware company to a data company by launching its *Building a Smarter Planet* narrative. This narrative capitalized on IBM's long history as a premier producer of computers but now offered something new—a challenge to imagine the future. Quoting from IBM's smarter planet web site,

*With so much technology and networking available at such low cost, what wouldn't you enhance? What wouldn't you connect? What information wouldn't you mine for insight? What service wouldn't you provide a customer, a citizen, a student or a patient?*

Note how this narrative draws the reader into the story. You become part of building a smarter planet. In developing this story, IBM builds on its past, places the defining moment—the availability of technology—in the present, and the future becomes whatever we can imagine. There is a plot, a challenge, and an anticipated climax of a smarter planet. IBM's Smarter Planet commercials website even introduced the IBMers, those building the smarter planet, as characters in their narrative.

**If Mines is to enhance its distinctiveness and reputation we must look critically at our narrative to see whether it meets the requirements needed for a compelling story.**

But, what about name recognition? There is no question that Mines has a famous name, with considerable name recognition and distinctiveness at the School level, though less so at the individual program level. Many of us have experienced telling people we are from “Mines” and get the “oh!” reaction. For the most part, this reaction has its origins in our statewide reputation as a no-nonsense, technological institution with high-quality students pursuing tough degrees. Beyond the State, many Mines’ programs are known and respected nationally and internationally. This respect derives from the expertise and research of many of our faculty and from the perception that Mines has historically provided an excellent education to serious, hardworking students.

Thus, when it comes to telling our narrative, we have an amazing history on which to build. However, can we say that Mines’ narrative has a compelling plot, a clear climax, and outstanding characters? Can we say that we have pursued an advertising strategy (e.g., advertisements at DIA) that tells our story as opposed to promoting name recognition? Though name recognition is good and perception is reality, as a broad statement, we believe Mines has several, narrative themes that can be developed more fully to (quoting from the Charge above): “...ensure quality, currency, and distinctive identity ...” Eliciting department input to expand on these themes and assisting departments in aligning their strategic narratives with those of the School provides the best strategy “...to help departments continuously refine and improve their degrees...” (again quoting from the Charge above). Indeed, while many of our academic department’s Strategic Plans, many of these were developed with little consultation with other departments or reference to the more recent Strategic Plan of the university. As a first step to ensuring our distinctiveness, we can aspire to present a more unified and thematic approach across the campus, derived from the positive parts of Mines’ narrative.

### **4.3 Mines’ Narrative**

So, what is Mines’ narrative? In this subsection we present observations from committee members’ deliberations, organized around the questions presented above and considering the notion of narrative.

- 1. What is it about Mines that makes it distinctive (what are Mines’ narratives)?**
- 2. What Mines degrees or programs are truly distinctive and why?**
- 3. What are the common themes in these distinctive degrees or programs?**

Mines’ has a number of narrative themes that are often told. The committee particularly notes the following:

a) Unique, Niche Focus on Earth, Energy, and Environment (EEE): The EEE moniker is distinctive and can be made the plot of compelling story:

- Several of our best known programs, e.g., Mining Engineering, Petroleum Engineering, Geological Engineering, and Geophysical Engineering, are strongly related to this niche focus.
- Mines is unique in its EEE focus, its strong industrial relevance, and its expertise along the continuum from discovery and recovery of resources to a sustainable global society. Other schools do have a presence in this space, such as CU’s “Earth Energy Sustainability” or Stanford’s “School of Earth, Energy and Environmental

Sciences.” However, the continuum of Mines’ expertise<sup>2</sup> related to the EEE focus continues to receive recognition by industrial sectors and government agencies and our strong ties to the traditional, heavy industry sectors puts Mines in a unique position to bridge the gap between current practices and future technologies.

- Earth Energy and Environment can become Mines’ “Building a Smarter Planet.” We can own this! Mines has a number of programs that are distinctive because they are one of only a few such programs and have as a result developed world-renowned. With a long history in mining and earth resources, Mines has an amazing reputation in this space, which is not populated with a large number of programs world-wide. Programs known worldwide over a long time period include the four noted above as well as Extractive Metallurgy and Mineral Economics. Other quality programs are distinctive because they are rare, such as Underground Construction and Tunneling, Hydrological Science and Engineering, and Humanitarian Engineering. A quick measure of the draw of programs in this category is the number of out-of-state and international students enrolled, especially at the graduate level. These programs are truly destinations of choice.
- Mines also has developing distinction around EEE themes, such as our Water Resources research, electrochemistry research, particularly around fuel cells and battery related technology. The EEE theme provides a compelling framework for developing distinction.

b) Exemplary Undergraduate Education: Many Mines narratives note the strong education that Mines students receive, pointing out many of the following characteristic features of Mines:

- Small “engineering-only” university: Mines is unusually small for a state supported institution. Many people even in Colorado think it is private, which adds to the perception of exclusivity and quality.
- High admission standards: Mines has the highest admission standards of any school in the state and among the highest in the country.
- Rigorous curriculum: Many programs at Mines have some of the highest credit hour requirements for a B.S. degree of any school of the country. And, Mines courses have a reputation as being “hard.” These classes instill passion to achieve goals, enhance students’ sense of responsibility, and require prioritization of tasks and decision-making, thus enabling students to develop good time management and organizational skills.
- Student diversity and quality: Incoming students have very high SAT, ACT, and GPA statistics. Further, the percentage of women at most engineering schools is around 20%, while at Mines the number is in the upper 20%’s, with entering freshmen in the Fall 2015 semester at just over 30% women!
- Some programs known for their pedagogical excellence: The original EPICS program set the bar for early-curriculum design experiences and is still held out as an example in the engineering education community. More recent shifts towards

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<sup>2</sup> Mines is unique in the continuum of our expertise related to the EEE focus. Quoting from the current strategic plan, “... *Mines embraces engineering, the sciences, and associated fields related to the discovery and recovery of the earth’s resources, the conversion of resources to materials and energy, development of advanced processes and products, fundamental knowledge and technologies that support the physical and biological sciences, and the economic, social and environmental systems necessary for a sustainable global society.*”

studio learning in Physics and Biological Engineering have also attracted positive attention and have served our students well. Pedagogical excellence is enhanced by many great faculty educators and well-training TAs (the TA training in Physics and Mathematics is exemplary).

- Multidisciplinary capstone courses: Capstone design courses are a key part of many STEM programs nationwide. Mines is unique in that many of the senior level capstone design courses are strongly multidisciplinary. Examples include EE+ME+CE+EnvE and PE+GE+GP. Completing work with integrated disciplines is an important experience for the engineer of the future.
- Field sessions: Mines is unique in requiring a field session for every program, and this intensive interaction with faculty is a critical step in developing the students' intellectual maturity in their chosen field of study. Field sessions provides students with "hands-on" experiences of their chosen discipline, whether in the laboratory or in the field. In several of these programs, engineering design problems assigned during the sessions challenge the students to integrate the technical, economic, social and environmental systems that are necessary for a sustainable global society. Many of Mines' field sessions are internationally recognized and supported by industry. The quality and depth of the experience varies across departments, but some effective examples include CBE, GE, GP, MN, PE, and CS.
- Unique and Global Impact: Some CSM degrees and programs have acquired a reputation for long standing excellence based on their specific curriculum design. Examples include the Physics Department and "Studio Physics" and PE Department and its strength in multiple areas of hydrocarbon development (e.g., drilling and completion and production) compared with other institutions' PE programs, which have a reputation for excellence in one particular area (e.g., drilling or completion or production).

c) Research Excellence: Mines has a number of areas of existing and growing research excellence, characterized by:

- National and International Renown: Many programs at Mines host well-known researchers and there are pockets of impactful, cutting-edge research excellence, typically collected in centers, consortia, or around thematic areas, including [... dear reader, the committee is not willing to make a list here, but will solicit opinions during the break-outs sessions at the Faculty Conference ...]
- Interdisciplinary Research Partnerships: Often cited is the fact that Mines has numerous internationally-recognized collaborations between departments within colleges and between colleges that adds to the "distinctiveness" of degrees and programs. Selected examples include: Critical Minerals Institute (CASE and CERSE); Earth Resource Institute (CECS & CASE); several Water Centers(CASE and CECS and CERSE); Underground Construction and Tunneling (CECS and CERSE); Unconventional and Conventional Resources/Energy (CASE & CECS); Unconventional Natural Gas and Oil Institute (UNGI).

d) Industrially-Relevant Programs: Mines is known for its real-world relevance:

- Industrially-relevant education: Mines students have the reputation of being able to hit the ground running after graduation and are highly sought after in industry. Mines' starting salaries are among the highest of any state supported school in the country.
- Industrially-relevant research: With nearly half of all extramural funding coming from industry, with a broader and more balanced research portfolio as a result which makes Mines unique among its peers,

- Strategic Enterprise Opportunities: Though a relatively small part of Mines portfolio, the institution has a strong reputation as the go-to place for professional and continuing education, particularly in Mining and Petroleum Engineering, leading to numerous opportunities such as contract research and development - Kuwait/Kuwait Oil Company (KOC), university development – Petroleum Institute and Kazakhstan/Nazarbayev University, industry education/workforce development - Poland, Morocco and Peru.
- e) The Mines Mystique: There is an intangible mystique about Mines that grows from its reputation, traditions, experiences, and the accomplishments of its students and faculty as well as the points noted above. While partly perception, the mystique that Mines makes a “hell-of-an-engineer” is an essential part of the narrative of Mines.
- f) Negative Distinction: While we have focused on positive aspects of Mines, we should note that narratives can also contain myths that need to be understood and demystified, if necessary, in order for organizations to change and grow. Here are some worrisome myths that get in the way of Mines programs becoming truly distinctive:
- Mines education is weak in the liberal arts, producing one-dimensional students (indeed, though we tout high admission standards in terms of GPA and standardized test score, we don't require an essay from admission applicants, giving a message about what is important).
  - Most of our curriculum is set up to reinforce a view that the technical and social dimensions of engineering are separate, with students tending to view humanities and social sciences as “soft” areas of the curriculum that do not need to be taken seriously and instead focusing on calculations and the technical side of engineering.
  - A perception expressed by some that industry is in the driver's seat and that our goal is to align our programs with industrial needs. In fact, part of Mines' current narrative reads, “you will make big money graduating from Mines because you are industry-ready.” When this observation is coupled with the broader perception that the industries we are preparing students for – mining, oil and gas, and chemical refining – are not perceived in the best of lights by the public, we have a problem of negative distinction.

#### 4. How can Mines programs that are not truly distinctive become so?

From our view, the answer is simple – all programs on campus must be aligned in some way with each of the narrative components of Mines:

- Unique EEE niche
- Exemplary undergraduate education
- Research excellence
- Industrial relevance
- Mines' mystique

While every program's narrative might not fully encompass each of these narrative components, every program must be a part of the Mines-wide narrative. Achieving this alignment will involve deliberate action at all levels of the university. Leadership should

- a) Identify themes that will serve as the story elements for their EEE narrative by asking questions such as:

- How might instructors frame classwork around big aspirational EEE problems?
  - How might programs collaborate or build unique multidisciplinary ties to the unique or otherwise distinctive degrees on campus.
  - How might we grow into new niches that build on the historical strength of Mines, yet look towards the future and develop vision and leadership into new areas?
  - How might we equip students to develop skills and ways of thinking about 21<sup>st</sup> Century problems or grand challenges (e.g., Energy-Water-Food-Environment nexus) and coordinate instructors/class activities across the Mines campus around those challenges?
- b) Ensure their programs provide exemplary undergraduate education for their students. Particularly,
- Ensure that every program has an exemplary field session. The most successful field sessions on campus provide industry-relevant hands on technical training and/or contact with industry representatives, allowing Mines graduates to better understand the practical side of their future career.
  - Create engineers who are well-educated thinkers in the EEE theme through innovative curriculum focused on critical thinking and problem solving grounded in the fundamentals of engineering science and design, unique multi-disciplinary courses, and field of study program offerings that
    - Build on Mines historical reputation for innovative educational practices within the academic community in some areas like EPICS and Studio Physics.
    - Expand innovative pedagogy and develop active learning courses utilizing CSM resources such the CITL.
    - Focus on program-level student learning outcomes and are strategic about the distribution of outcomes across the curriculum.
    - Emphasize competency development and problem-solving abilities that are focused on emerging 21<sup>st</sup> Century global problems of energy and the environment.
- c) Align closely with industry by providing industrially-relevant educational experiences, especially within field and design classes (with the caution that there is a distinction between technical training and an education that must be respected and this should be done judiciously and not at the cost of solid education in the fundamentals of engineering science).
- d) As appropriate for their discipline encourage the importance of professional licensure licensed and aim for very high pass-rates in the Fundamentals exam.

## 5. Aspirational areas of distinction

Several areas or themes of aspirational, national distinction were identified by the committee, including producing students who are:

- a) Leaders who understand the social/political/cultural/ethical impacts of their profession and who put this understanding into practice.
- b) Thinkers who tie fundamental science to engineering.



- c) Designers who see the big picture, i.e., “systems thinkers,” and understand social responsibility.
- d) Innovators whose who are comfortable taking risks and who are energized by the belief that engineers help to make the world a better place while improving people’s lives.

**6. What are key resource needs and areas of innovation needed to support Mines distinctiveness into the future?**

Great things are already in the works, such as the CITL (Innovative Pedagogy), training grant programs through the Office of Assessment (Innovative Pedagogy), and the addition of communication specialists to colleges (Mines Mystique). However, several additional resources have been identified as being helpful to fostering degree programs of distinction. Possible areas for improvement include:

- a) Renewed university level branding effort (Mines Mystique). We must turn the positive efforts of Mines Newsroom, college communication specialists, into national recognition.
- b) Strengthened ties between the Alumni Association, Career Center, ORA, and Foundation so that programs can have a clear, strategic approach to industry relations in both undergraduate and research missions. This is similar to integrated sales/support efforts at many companies.
- c) Development of an incentive program for cross-college collaboration.

**Section 5: Recommendations/Observations**

**RECOMMENDATION 1**

**Supplement our strategic plan with a strategic narrative—strengthen our narrative.**

As a strategic narrative, the quality of our story is all-important, and we are fortunate to be sitting at the cusp of one of the most compelling stories in human history, where, for the first time, we are able to see the benefits and consequences of 150 years of unrelenting technological advance. It is a time when engineering is passing from childhood—where we did what we wanted because we could—into adulthood—where we must anticipate and take responsibility for our creations. Could there be a more exciting story? Mines has the opportunity to construct its strategic narrative around this crucial point in history where engineering, particularly, is growing from childhood to maturity. We can expand the positive parts of our narrative, we can Demystify and remove the negative distinctions that may get in the way of a truly holistic education. We can add new story lines to the narrative, such as social responsibility. The institution should actively evolve its strategic plan and the associated narrative.

**RECOMMENDATION 2**

**The School, its departments, programs, students, and faculty should work together to identify the compelling plot of our earth, energy, environment focused narrative.**

Ask a Mines’ student what our Mines tag line, Earth, Energy, Environment, means and the vast majority indicates that these are the specialty areas of the institution. Very few see these words as reflecting the engineer’s existential challenge—that all engineering requires resources derived from the earth, which require energy to fabricate into products and often more energy to use. And, the sheer quantity of our engineering creations guarantees that what we make will impact the environment. Mines students should see their mission, even if they are highly

focused to a specific discipline, as a component part of addressing the broader Earth-Energy-Environment challenge.

### **RECOMMENDATION 3**

**Align at least some portion of the undergraduate curriculum in each department (and particularly in the first and second years) with the EEE challenge and the strategic narrative.**

Our curriculum is not structured in a way that welcomes students into the community of scientists and engineers who will shape the world. (We are not inviting our students to see themselves as actors in the strategic narrative.) We need a set of courses that are as much aspirational as informational. Students should be familiar with the grand challenges of science and engineering and not see science and engineering as a way to approach and solve isolated problems, but as ways to build subsystems to address parts of the larger challenges. Early courses should lay the foundation to develop creative problem-solvers, critical thinkers, entrepreneurs, and future leaders in STEM.

### **RECOMMENDATION 4**

**Incentivize faculty to identify and implement connections between the various courses of the first and second year curriculum and the strategic narrative.**

Presently, the majority of the courses taken during a student's first two years at Mines appear to them to be disconnected—like standalone chapters of a book without connections. Although the original four-course EPICS sequence was an attempt at addressing this shortcoming, the approach to solving this problem has primarily been to “encourage better communication” between the course instructors—whether TT faculty or teaching faculty. After 25 years, the problem persists. Part of the reason, we believe, is that the “encouragement” has not been accompanied by real incentives.

Among the many incentives that the administration might consider is an in-house sabbatical for faculty, teaching and tenure-track. During such a sabbatical, faculty would, at a reduced load, teach or co-teach courses in another department. It is not too much of a stretch to imagine that physics (chemistry, math, EPICS, ME, etc.) instructors might enjoy trying their hand at chemistry, calculus, strengths of materials, etc. Over time, Mines would develop teachers able to see the connections between disciplines and courses. From this expertise we should expect new introductory and interdisciplinary courses to develop that are unique (distinctive) to Mines and aligned with its strategic narrative.

Mines has been hampered in its quest to encourage communication (at least at the curricular level) through its historical reluctance to support joint academic appointments.

### **RECOMMENDATION 5**

**Incentivize the best of our tenured faculty to teach, particularly to large introductory classes.**

The trend toward active learning, with the instructor acting as the “activity director,” is causing some to question the effectiveness of the “chalk and talk” professor at the front of a classroom. While active learning in the hands of skilled instructors is an important component of the

learning environment, so too is the experienced professor relaying his or her personal experiences, views, and insights. The chalk and talk professor fills the role of both teller of, and a character in the narrative. A good storyteller inspires and enthrall. Good characters serve as role models.

Over the last fifteen years the emphasis at Mines has been the use of teaching faculty in our large introductory classes. If we are to maintain and expand our distinctive character, we must find ways to put the best of our entire faculty in front of the large introductory classes, regardless of rank. While a student can get the same (in some cases more personalized) instruction in chemistry, physics, or calculus at Red Rocks as at Mines, they do not have access to the same quality of faculty as we can make available at Mines.

## **Section 6: Next Steps**

We plan the following activities during the fall semester, leading up to a final report

- a) Incorporate the results of discussions and feedback during the faculty conference to develop a crisp set of points about Mines distinctiveness and how it can be enhanced. Faculty input will also be solicited through a survey and focused conversations.
- b) Work with the other committees that have overlapping charges (i.e., First & Second Year Experiences, Active Learning and Technology-enhanced Learning, BSE 2.0 Committee) to develop a coherent vision and set of recommendations for the final report.
- c) Members from the committee will visit each department and the Deans to discuss their view of distinctiveness in their programs.
- d) Members from the committee will visit with President Johnson and the Provost to discuss their view of distinctiveness from their perspectives and to consider policies and practices that can enhance Mine's distinctiveness.
- e) Research different ways in which programs partner with industry on campus and ways other schools successfully partner with industry that ought to be considered to better articulate and define what makes Mines distinct.
- f) Develop a set of questions and recommendation to continue the work and potential impact of the committee's efforts, including an effort to define what should make Mines unique (thinking towards the future, where we want to be).

## **Section 7: Resources/References Consulted**

None specifically, though many committee members have reviewed the slides from last February's budget hearings (<http://inside.mines.edu/F-A-Budget-Update>) and have been generally informed by numerous writings about engineering and engineering education from the NAE and other sources.