The end of the 2009-10 academic year will mark the beginning of the 2011-20 Strategic Plan for the Mining Engineering Program at Missouri S&T. VISION 2020 states that Missouri S&T will be the global university of choice for mining engineering education, research and graduate employees for industry. This vision is established upon a strong foundation, which provides the capacity for excellence. Over the 2008-09 academic year, the Department worked with its partners and supporters to build this foundation. The periodic review and accreditation of the B.S. degree program by ABET occurred during the 2008-09 academic year. The program was fully accredited by ABET for the next six years, with a revised curriculum to strengthen mining engineering education at Missouri S&T.

Mining Engineering continues to grow in enrollment. The current total enrolment is 220, which includes 155 undergraduates and 65 graduates. The first batch of 15 students from the University of Botswana (UB) began their program of study at Missouri S&T in the Fall 2009. The academic standing of the Mining Engineering students has also grown steadily. From 2006-07 to 2008-09 academic year, the number of academic honors (with a GPA ≥ 3.5/4.0) increased by 85% from 14 to 37. The minimum HS GPA and average ACT score for the 35 freshmen entering mining engineering are respectively 3.37/4.00 and 28. Missouri S&T is examining opportunities to assist Saudi Mining Polytechnic in Saudi Arabia and Central University of Technology in South Africa in mining engineering education.

The Department has renewed its faculty over the last four years, with the hiring of Dr. Kwame Awuah-Offei in August 2007 as Assistant Professor, Dr. Jason Baird in January 2008 as Associate Professor, Dr. Stewart Gillies in September 2008 as the Union Pacific Rocky Mountain Energy Professor, and Dr. Maochen Ge in January 2009 as Associate Professor. The Department is now recruiting its ninth faculty with specialty in mineral-coal processing. The faculty continues to advance research frontiers in clean coal and carbon sequestration, alternate energy, heavy mining machinery health, mine health and safety, DPM, sustainable environments and counter terrorism with funding capacity of $2 million in AY 2008-09.

The biggest challenge is the state and capacity of existing labs for educating students, which were built in the 40s and 50s. A total of $5 million capital plus an annual support of $250K is required to renew and maintain the capacity. Under the leadership of John Eaves, President and COO and Paul Lang, Senior Vice President for Arch Coal, and the Development Board, strategic initiatives are being undertaken to partner with industry to renew our capacity within the next three years. Ted Ruppert, a MinE’52 alum and a member of the Mines & Metallurgy Academy, invested $300,000 in Computer Learning Centers with over 70-seat capacity in 2008. Tom Holmes, a MinE’50 alum and a member of the Board of Trustees, invested $150,000 in scholarships in 2008. The 2009 efforts include: (i) Arch Coal’s $116,000 investment in the Mine Health and Safety Lab; (ii) $100,000 investment by Joy-P&H Mining in the Underground Mining Lab; (iii) $225,000 investment by CAT Global Mining in the Surface Mining Lab; and (iv) $125,000 investment by Barrick in the Mine Surveying Lab; (v) $150,000 investment by Doe Run in the Experimental Mine Buildings. Kennedy Metal Products is donating the complete set of pre-fabricated steel structures for building the new Experimental Mine Building.

The Department greatly appreciates the outstanding leadership by Bill Kennedy, John Eaves, Paul Lang, Ted Ruppert, Tom Holmes and the Board members toward our capacity renewal efforts. The contributions of the following companies and individuals are greatly appreciated: (i) Arch Coal, CAT Global Mining, Joy and P&H Mining, Barrick and Doe Run; (iii) Mines & Metallurgy Academy; (iv) faculty, staff and students; and (v) our industry partners who continue to provide internship and permanent job opportunities for our students. Finally, I salute the efforts by our donors, whose contributions continue to make affordable university education a reality to many students and by our alums, whose hard work and contributions continue to promote the excellence of the program. Let us continue to work together to create world-class environments to educate the next generation of leaders for our cherished industry.

Phonathon 2009

Fall is coming to the Ozarks and that means the annual Mining Engineering Phonathon is coming up. Our students will work the phones from November 1 to 4, 2009. We hope you will take their call and continue your generous donations to the Department. Remember that all Phonathon donations will come to the Department. The Phonathon funds support scholarships, mucking and mine rescue, as well as the four student organizations.
Mining Program Enrollment Reaches New Highs

Our enrollment in the undergraduate mining engineering program is now the highest of undergraduate programs out of the old School of Mines and Metallurgy. End of fourth week fall semester tallies show us with 132 students excluding those in freshman engineering which puts us as 12th out of the 36 current undergraduate programs at Missouri S&T ahead of Chemistry. Our internal count including freshman engineering is 156 students, which should place us as the largest undergraduate mining engineering program in the United States. In addition, the number of on site graduate students has risen to a 20 year high of 17 and our distance graduate students have increased to an active 46 per semester. The official S&T undergraduate numbers (Sophomores through seniors) are below:

<table>
<thead>
<tr>
<th>Program</th>
<th>Total</th>
<th>Year Ago</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining Engineering</td>
<td>132</td>
<td>110</td>
</tr>
<tr>
<td>Petroleum</td>
<td>100</td>
<td>68</td>
</tr>
<tr>
<td>Nuclear</td>
<td>97</td>
<td>95</td>
</tr>
<tr>
<td>Met E</td>
<td>84</td>
<td>85</td>
</tr>
<tr>
<td>Geol &amp; Geophysics</td>
<td>88</td>
<td>79</td>
</tr>
<tr>
<td>Ceramic E</td>
<td>67</td>
<td>77</td>
</tr>
<tr>
<td>Geol E</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>Material E</td>
<td>30</td>
<td>26</td>
</tr>
</tbody>
</table>

The percentage of girls in our program remains a steady 10% (the same as mechanical engineering).

New Arrival in the Department

Dr. Maochen Ge joined us in January 2009. Dr. Ge came from Pennsylvania State University. His area of expertise is rock mechanics. If you are in the area, stop by and meet Dr. Ge.
World-Class Environments for Educating the Next Generation of Mining Engineers

Today, more than any time in its history, the mining industry faces tough technological, environmental, safety and health, workforce readiness and sustainable development challenges. The workforce readiness challenge has become more critical given the erosion of the capacity of global universities to educate mining engineers and other resource engineers and scientists. For example, United Kingdom has reduced its mining engineering programs to only two. United States reduced its 22 accredited mining engineering programs to only 12 with several anemic programs. In 2003, only 84 Mining Engineering graduates were produced by the 12 accredited US universities, which was less than a third of a total US demand of 300. The supply and demand of graduates from the Western Hemisphere also mimic this picture. The workforce readiness challenge is compounded by employees’ age profile. According to a recent survey by SME, 60% of the mining industry workforce is over 50 years and just 4% under 30 years. The problem is further aggravated by a difficulty in replacing the skilled retiring workforce and the non-availability of senior employees to mentor young engineers.

In an effort to help solve the workforce readiness challenge, Missouri University of Science and Technology (Missouri S&T) is working with industry and its alums on strategies to address the challenges in preparing the next generation of leaders. In preparation for the 2008-2009 ABET Accreditation Evaluation of Missouri S&T’s Mining Engineering Program, the faculty undertook a major quality audit of the program. Table 1 illustrates the overall audit results, which showed that the major weakness in the program centers on the teaching laboratories. These laboratories, built in the 40s and 50s, now have obsolete equipment and facilities. This problem is compounded by increasing enrollment, industry collaboration and international programming activities. Table 2 summarizes the state of the existing and new laboratories to renew the capacity for mining engineering education at Missouri S&T. The quality audit results were discussed with the Development Board and the revised report has become a working document for renewing the facilities and infrastructure. Mr. John Eaves, President and COO and Paul Lang, Senior Vice President for Arch Coal, continue to provide outstanding leadership in making the case for investing in these laboratories. Together with the Department Chair, John and Paul led fruitful visits to P&H Mining and Bucyrus International in Milwaukee, WI and Caterpillar Global Mining in Peoria, IL.

<table>
<thead>
<tr>
<th>Table 1 2007-08 Program Quality Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAM PORTFOLIO</td>
</tr>
<tr>
<td>Undergraduate Enrollment</td>
</tr>
<tr>
<td>Graduate Enrollment</td>
</tr>
<tr>
<td>Curriculum Quality Management</td>
</tr>
<tr>
<td>Student Academic Standing</td>
</tr>
<tr>
<td>Number of Years to Graduation</td>
</tr>
<tr>
<td>Faculty Distinction</td>
</tr>
<tr>
<td>Research Capacity</td>
</tr>
<tr>
<td>Number of Faculty</td>
</tr>
<tr>
<td>Staff Distinction</td>
</tr>
<tr>
<td>Student Professional Development</td>
</tr>
<tr>
<td>Student Leadership Development</td>
</tr>
<tr>
<td>Permanent Job Acquisition</td>
</tr>
<tr>
<td>Teaching Laboratories</td>
</tr>
<tr>
<td>Undergraduate Scholarships</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 State of Existing and New Laboratories</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABORATORY</td>
</tr>
<tr>
<td>Computer Learning Center</td>
</tr>
<tr>
<td>Surface Mining</td>
</tr>
<tr>
<td>Mine Survey</td>
</tr>
<tr>
<td>Mine Health &amp; Safety</td>
</tr>
<tr>
<td>Mineral Processing</td>
</tr>
<tr>
<td>Explosives Engineering</td>
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<tr>
<td>Mine Ventilation</td>
</tr>
<tr>
<td>Underground Mining</td>
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<tr>
<td>Materials Handling</td>
</tr>
<tr>
<td>Rock Mechanics</td>
</tr>
<tr>
<td>Experimental Mine</td>
</tr>
<tr>
<td>Mine Power &amp; Drainage</td>
</tr>
</tbody>
</table>

The total investment capital for the capacity renewal effort is $5 million with annual support requirement of $250,000. The capacity renewal and expansion efforts will create unparalleled world-class environments for educating mining engineering students. These world-class environments will place Mining Engineering at Missouri S&T at the top of its global competitors in a class by its own. The environment will provide hands-on experience to advance the education cycle and solve the capacity problems associated with the increasing enrollment.
Missouri S&T and University of Botswana Cooperation in Mining Engineering

In July 2007, Missouri University of Science and Technology (Missouri S&T) and the University of Botswana (UB) signed a Memorandum of Understanding when a delegation led by Professor Frank Youngman, UB’s Deputy Vice Chancellor for Academic Affairs visited Rolla. In February 2008, Dr. Warren K. Wray, Provost and Executive Vice Chancellor for Academic Affairs, visited UB and signed an Implementation Agreement for a 3+2 Program in Mining Engineering Education. Under the agreement, after three years of fundamental science and engineering and selected humanities and social sciences, UB students will transfer to Missouri S&T to complete two years of study leading to the certification of Bachelor of Science in Mining Engineering. The first batch of 15 students was admitted into Missouri S&T in August 2009. Figure 1 illustrates a cross-section of the students who attended the Department Kick-Off Meeting on September 10, 2009. The UB students have begun building networks among students in Mining Engineering and other disciplines at Missouri S&T. Botswana is a growing mining nation. It is a major producer of diamonds and mines substantial deposits of copper, nickel, and coal. Botswana has no mining department and has selected the mining department at S&T to train its mining engineers.

A Cross-Section of University of Botswana Students with Dr. Frimpong
A Successful Mining Engineering Conference!!

Missouri S&T organized its first Mining Engineering Conference at Rolla in September 2009 to further advance the need for renewing the facilities and infrastructure for training and educating graduates in Mining Engineering. This conference brought together top executives from the mining industry, academic and business leaders and professional engineers and scientists to discuss the technological directions of industry and how to prepare today’s students to meet these challenges. An executive forum was also organized to examine how the industry sectors and companies are navigating the global economic downturn. Table 3 shows the keynote and executive forum presentations. Figure 2 shows a cross-section of the conference participants. During the conference, Joy-P&H Mining presented a check for $100,000 towards the capacity renewal effort. The conference was so successful that an overwhelming number of the participants have endorsed a periodic repetition of the conference on an annual or biennial basis.

### Table 3 Keynote and Executive Forum Presentations

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul A. Lang</td>
<td>Conference General Chair; A Call to Investment Challenge to Conference Participants</td>
</tr>
<tr>
<td>Andrew Harding</td>
<td>President and Chief Executive Officer - Kennecott Utah Copper Corporation</td>
</tr>
<tr>
<td></td>
<td>Keynote Speaker; A Challenged Industry: The economic, technological, environmental and social challenges facing the mining industry</td>
</tr>
<tr>
<td>Bruce Neil</td>
<td>President and Chief Executive Officer - Doe Run Company</td>
</tr>
<tr>
<td></td>
<td>Keynote Speaker: The Doe Run Company and the Strategic Initiatives to Deal with Challenges toward Growth and Competitiveness</td>
</tr>
<tr>
<td>Mike McCall</td>
<td>Energy Strategy and Business Development Consultant; Former Chairman and CEO - Luminant Energy</td>
</tr>
<tr>
<td></td>
<td>Keynote Speaker: A Roadmap for the Future of Coal</td>
</tr>
<tr>
<td>Greg Lang</td>
<td>President - Barrick Gold of North America, Inc.</td>
</tr>
<tr>
<td></td>
<td>Keynote Speaker: Barrick’s Approach to Professional Development</td>
</tr>
<tr>
<td>Dianna Tickner</td>
<td>Vice President of Generation &amp; BTU Development – Peabody</td>
</tr>
<tr>
<td></td>
<td>Keynote Speaker: Mining Engineers for the 21st Century; Was inducted into the Mining Hall of Fame for her Leadership and Contributions</td>
</tr>
<tr>
<td>Janpeter Bekkering</td>
<td>North American Regional Manager, Caterpillar Global Mining, Peoria, IL</td>
</tr>
<tr>
<td></td>
<td>Executive Forum Speaker: Caterpillar Global Mining: Weathering the Downturn …. Ready for the Recovery</td>
</tr>
<tr>
<td>John W. Eaves</td>
<td>President and Chief Operating Officer, Arch Coal, Inc. and a member of the Board of Directors</td>
</tr>
<tr>
<td></td>
<td>Executive Forum Speaker: Coal Sector: Strategic Challenges and Initiatives for navigating the Global Economic Downturn</td>
</tr>
</tbody>
</table>
Figure 2 A Cross-Section of the Conference Participants

Do you want to hear about other conferences? Get information from the Department? Want to post an open position or are you looking for a new position? Please send your email address to mining@mst.edu and ask to get added to the Alumni List Server. It is a very fast connection to the Department and we have assisted many alums. So come and join our network.
A Tribute to Our Scholarship Donors

On behalf of the Department, I would like to extend sincere gratitude to our industry and alums who supported our efforts in the 2008-09 academic year. These support initiatives covered several dimensions of programming activities, such as scholarships, phonathon, competitive games and Conferences, equipment and general operating support. Table 1 contains a cross-section of the individuals and companies whose donations supported students’ financial needs. Due to your efforts, a total of $180,000, in scholarship funds, were awarded to students by the Department. These support initiatives are very essential to the Department in meeting the needs of mining engineering students with serious financial problems and obligations.

Table 4 A Cross-Section of 2008-09 Donors for Mining Engineering at Missouri S&T

<table>
<thead>
<tr>
<th>Allen Hale</th>
<th>Barrick Gold</th>
<th>Bill Summers</th>
<th>Caterpillar</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSOL Energy</td>
<td>E. Stillman</td>
<td>Freeport-McMoran</td>
<td>Granite Construction</td>
</tr>
<tr>
<td>Gary Hubbard</td>
<td>Guy Warring</td>
<td>ISEE</td>
<td>J. Allan Spokes</td>
</tr>
<tr>
<td>P&amp;H Mining</td>
<td>Kennedy Metal Products</td>
<td>Lang Family</td>
<td>N. Parsons</td>
</tr>
<tr>
<td>Samuel Krauss</td>
<td>Pat Hell</td>
<td>Pat Witt</td>
<td>Peabody Energy</td>
</tr>
<tr>
<td>Peter Kiewit</td>
<td>Pollard</td>
<td>Rio Tinto</td>
<td>Robert Dye</td>
</tr>
<tr>
<td>SME Coal</td>
<td>Steven Feder</td>
<td>Stone Endowment</td>
<td>Thor Gjelsteen</td>
</tr>
<tr>
<td>Joy Mining</td>
<td>Tom Holmes</td>
<td>USG Corporation</td>
<td>US Steel</td>
</tr>
<tr>
<td>MINING ENG ALUMS</td>
<td>DEVELOPMENT BOARD</td>
<td>MINES &amp; MET ACADEMY</td>
<td></td>
</tr>
</tbody>
</table>

Guy H. Waring Memorial Scholarship Recipients

Allen Hale Memorial Scholarship Recipients and members of the Hale Family

Kiewit Mining Scholarship Recipients

William Summers Memorial Scholarship Recipients
Ted Doheny, President of Joy Mining Machinery, presents $100,000 check to Warren K. Wray, Provost and Executive Vice Chancellor, Missouri S&T. With them are (from L-R) Samuel Frimpong, Professor and Chair of Mining and Nuclear Engineering, Paul A. Lang, Senior Vice President for Arch Coal and Bruce Neil, President & CEO for Doe Run.

**Student Awards April 2009**

**High GPA Freshman**
Robert Zedric
Michael Allen

**High GPA Sophomore**
Justin Higginbotham

**High GPA Junior**
Tristan Worsey

**High GPA Senior**
Neil Rapp

**Old Timers Award**
Allie Letcher

**Outstanding M/NM Graduate**
Bryan Syers
Brett Richter

**Outstanding Coal Graduate**
Nathan Davis

**Professional Leadership Award**
Casey Slaughter

**External Relations Award**
Jessica Austin
Jennifer Winston

**Student Recruiter Award**
Robert Wilkerson

**Student Activity Award**
Bob Copeland
Bobby Austin
Nick Adams

**Chairman’s Award for Good Citizenship**
Ivan Howard
Brian Sandhaus
Student Chapter of International Society for Explosives Engineers  
Tristan Worsey, President

ISEE is the International Society of Explosives Engineers and we represent the S&T student chapter. This Society represents the Explosives Industry and serves as a great chance at getting your feet wet if you are a student. We have many functions during the school year which include firework shows for campus events, fund raisers, float trips, and conference trips.

In January 2009 thirty-three students and Dr. Worsey attended the Annual Conference of the International Society for Explosives Engineers in Denver, Colorado. Twelve of the students were recipients of ISEE scholarships and it was a great opportunity for the students to show their appreciation. In addition to attending technical sessions, the students networked with industry representatives and passed out resumes. The 2010 conference is in Orlando, Florida, and our chapter will be there. Dr. Worsey and Phillip Mulligan will present papers.

Student Chapter of the Society for Mining, Metallurgy and Exploration  
Matt Turner, President

The student chapter of SME is looking forward to a good year in 2009-10. We have already had our annual kickball social and are in the process of recruiting new members in order to keep our title as the student chapter with the most new members. As October is approaching, plans for the Haunted Mine have started, and it appears the mine will be better than ever. In February the Annual Conference will be held in Phoenix, Arizona. SME is hoping to raise enough money to allow everyone wanting to go to attend. In order to do this we are looking for ideas in addition to Haunted Mine to raise money. Other plans for the year include adding more fun student activities, increasing attendance of the St. Louis section meetings, and increasing the activity of the student chapter.
This past spring, four Mucking teams from S&T traveled to Butte, Montana to compete in the 31st Annual International Intercollegiate Mining Competition. After months of practice, the teams got to show off their skills at the mining events. Most of the teams did quite well in spite of frigid temperatures, snow, and a new environment. The Women’s team brought the overall 1st place title back to Rolla, after competing in a tie-breaking jackleg competition against Mackay. The Men’s A and Co-Ed teams were also impressive, placing 2nd in each of their divisions and the Men’s B team tried their best coming in 9th overall in their division. The teams returned with one World Championship and two US Championships.

Tie-breaking Jackleg Drilling

Call to all Mucking Alums

The 2010 International Intercollegiate Mining Competition will be held in Kalgoorlie, Australia, on April 8 - 10, 2010. Our Lady Muckers defended their title in April 2009 in Butte, Montana. The S&T Men’s team and the S&T Co-Ed team placed 2nd in their divisions with 1st places going to Australia. The challenge is out to the American Teams participating in 2010 to “bring back the Gold”. Our teams are already practicing, but we need help. To make this trip a reality we need financial support. We have several companies that support our teams each year, but we want to increase our donor pool. Here is the request to all the mucking alums: Remember how much fun you had shoveling muck into that big ore cart? Talk to your company about a donation to the trip. It would be great to have an alumni team with us on this trip. We are researching air fare, etc. If you are interested, let us know.
NSSGA: Rising from the Ashes
Brianna Drury
In past years the student chapter of the National Stone Sand and Gravel Association has dwindled in number and involvement in the department. New officers were needed to bring the society back to its former glory. The new executives have been chosen: Brianna Drury - President, Chris Searing – Vice President, Xavier Naeger - Treasurer, and Regan Helmer - Secretary. The primary goal of NSSGA this year is to increase membership and interest in the society. Efforts have included co-hosting the semester-opening Kickball Social with the student chapter of SME to promote the society and become more involved with department events. Additionally, a society-sponsored monthly movie night has been established, allowing students to relax with their fellows and take in a movie and some food. To this date membership has increased to 17 - a record number compared to recent years. There is also interest in sending at least two of its board members to the NSSGA national conference next February in Cincinnati, OH.

Mine Rescue Team News
Casey Slaughter, Trainer
“The Missouri Mine Rescue Association recently hosted the 27th annual Missouri Mine Rescue Competition. The Missouri S&T team led by Nathan Rouse and consisting of members: David Lloyd, Cody Rogers, Dan Klimmek, Zach DeGraffenreid, Drew Blair, Alex Warren and Brandon Ash placed 4th overall out of 15 teams competing including a new rival; the recently formed Colorado School of Mines Team. The first aid team of Nathan Rouse, Alex Warren and David Lloyd also placed 5th overall in the First Aid Competition. We also had a “first”: team Trainer Casey Slaughter placed 1st in the Trainer’s written test competition. Way to go guys!”

Above: S&T Team competing in New Mexico Competition
Left" S&T Team competing on Louisiana
Women in Mining Student Chapter
Jessica Austin, President

This year the Student Chapter of WIM at Missouri S&T (formerly UMR), participated and hosted many events, including the Haunted Mine, experimental mine tours, school visits, and the Women in Mining National conference.

In August, Jessica Austin worked on a t-shirt fundraiser – and the project was very successful for the chapter. In addition, the members participated in the Haunted Mine, the biggest fundraiser for the Rolla Chapter. Jessica Austin and Matthew Coy were in charge of it in the 2008-2009 school year, receiving a high record of seven people admitting to peeing their pants while going through the mine. On Halloween night, a line five people wide was wrapped around the classroom at the mine. This fundraiser is not only for the Rolla Women in Mining chapter, but also for the SME, ISEE, and NSSGA Rolla Chapters as well.

During the fall 2008 semester, the Rolla Chapter visited Bentonville, Arkansas, to promote mining engineering and Missouri S&T to the students at the high school. While at the high school, Bobby Austin talked about the mine rescue team, what a mine rescue team would do, and how it would be useful for teams to practice regularly. Matthew Coy showed the kids how to gold pan Patrick McChesney showed the students dummy explosives and told them how the explosives is used. Aimee Larkin has showed the kids hand samples of minerals and what they are used in Jessica Austin helped the kids choose fliers about the Missouri S&T degree programs and talked to them about what they would need to complete each of the degree programs they were interested.

The students also helped with more than fifteen mine tours at the experimental mine in the 2008-2009 school year; many of the elementary, middle school, and high school students who went through the mine tour were in love with the explosives at the end of the tours.

In February 2009, many of the Roll WIM students attended the SME Conference.

In November 2008, the Rolla chapter started preparation for the National Women in Mining Conference sending in registration for the conference by February 1 hosting the conference May 15 through the 19th. Many of the ladies who participated in the national meeting stated they were “treated like princesses” and the students did a “fantastic job” at hosting the event! The meeting included a tour of Doe Run, tour of Missouri S&T Experimental Mine, dinner, and fireworks at Heavener, and dinner at Matt’s Steakhouse.

The Rolla chapter plans to participate in Western Day at the elementary school in Rolla, MO; where they will do many activities with the kids including gold panning and Swede saw.

The 2009-2010 Rolla WIM Officers are:
President - Jessica Austin
Vice President- Patrick McChesney
Treasurer - Bobby Austin
Secretary - Kaleb Kordes
Greetings from the Experimental Mine:

DeWayne and I say hello from the mine. We had a busy summer with three Explosives camps with a total of 61 campers.

DeWayne and I were very involved with the filming of the Detonators for Discovery channel. There were 11 episodes filmed with Dr. Worsley and Dr. Lusk of University of Kentucky. It was tasking at the very least on all that took part.

In Mar I went with the mucking team to Butte MT. it was a very cold adventure (with Barb). From the time we left until we returned the temp did not get over 32 degrees. Dr. Frimpong with two graduate students and I visited Bingham canyon mine Salt Lake UT. It took 45 min. to drive from the bottom of the pit out. On the trip also Barric and Newmont operations very interesting. In May DeWayne went with one of the mine rescue teams to New Iberia LA. where they came in 5th overall in a field of 13 teams. I went with the other team to Ruidoso MN. where they came in 8th overall in a field of 12 teams. This summer we also visited Kennedy Metal Products that tour was great, to see the operation that Mr. Kennedy has and the inventive ways he came up with to cut operation costs.

Here at the mine we are always seeking donations and here are a few: Stopping’s from Kennedy Metal Products, a track drill from Ed’ Drilling, drill head from Brunner and Lay, cap lamps from Energizer, several loads of gravel from Melrose Quarry, drill steels, air hose, scaling bars, couplers for drill steels from Doe Run, explosives from Orica, and explosives from DYNO.

We could still use a track loader and a portable rock crusher if anybody has one that needs a home.

DeWayne’s twins worked at the mine and I could not tell them apart at first. They played a lot of tricks on me. Kevin attends MIZZOU and David attends MSU. We did get them interested in Mining Engineering and explosives; maybe they will decide to go to school here. His youngest son Jamie is in Rolla high school and plans to help with the haunted mine again this year with some of the football team, that is very good this year.

The grand children are coming faster than I thought. Kinzie will be 4 and loves to ride the golf cart I just hope she doesn’t wreck it like Jodon did! Tatum will be 2 on Pearl Harbor day and and she leaves the house like a Tornado hit! Gage is the newest addition to my clan. He was born on (30 Jan 09) my B-day and I really bond with him in the mornings and the evenings or when we are together, even the poopie dippers. My oldest daughter Shannon will be having another baby in May. That is what you have to look forward to when you are a Grandparent that your children keep your life interesting a good thing!

When you are in the Rolla area and want to see the changes in the mine, give me a call, 573-341-6406, or email me jtaylor@mst.edu or DeWayne phelpscd@mst.edu.

2009 Summer Camps

This year’s three explosive camps in June were another outstanding success, even though we had to raise our prices substantially due to the university chancellor dropping all subsidies on this flagship camp. He insisted that it should be able to stand by itself because of the interest it has generated nationally. He was right on the mark and obviously did not become the CEO of S&T by chance. An interesting side effect was that the kids were noticeably better behaved, we have some theories that might explain this, but some of them might be a bit controversial to the liberals out there. This year we expanded our demonstrations and put a CSI type theme on part of the camp. We examined how shaped charges work; including the shrapnel patterns from linear shaped charges using a large diameter steel pipe and recovering the nice blades they generate using a 55 gallon barrel of water. We also demonstrated how to make a mini EFP using a soft drink can and managed to punch a hole in plate steel armor. In addition, we made a conical penetrator using the bottom third of a wine bottle and of course Paul had to impress the students with his sacrifice of having to empty the bottle in an appropriate manner the previous night for them. We concentrated this year far more on hands on explanations and less classroom teaching. One of the returning students from last year commented how much better it was than even the previous year. Special thanks go out again to Dyno, Capital Quarries, Doe Run, and Premier Pyrotechnics for hosting us on field trips. In addition both Dyno and Orica provided scholarships to selected students through essay competitions.
Stewart Gillies named interim Rock Mechanics director
Reprint of News Release issued by Office of Public Relations

Dr. Stewart Gillies, Union Pacific Rocky Mountain Energy Mining Professor at Missouri University of Science and Technology, has been named interim director of the university’s Rock Mechanics and Explosives Research Center. Gillies takes over for Dr. David A. Summers, Curators’ Professor of mining and nuclear engineering at Missouri S&T, who has served in the position for more than 30 years.

Summers will remain on the faculty and serve as a senior research investigator in Rock Mechanics, as well as director of the university’s waterjet laboratory.

Prior to his current position, Gillies was director of Gillies Wu Mining Technology Pty Ltd based in Brisbane, Aus. He has served as a mining consultant for variety of studies on operating sites including mine ventilation network surveys, planning and system review, expert witness support, heat stress investigations, mine fire simulation, ventilation system design, real-time dust and diesel particular matter monitoring, gas and dust explosibility and instrumentation development.

Gillies has also served on the mining engineering faculty at the Universities of New South Wales, Missouri and Queensland. He has been principal researcher on more than 25 industry-funded research grants on mine ventilation and mine economics issues.

Gillies earned Ph.D. and bachelor of engineering degrees in 1980 and 1974, respectively, from the University of New South Wales. He also earned a graduate certificate in tertiary education in 2001 from the University of Queensland.

Gillies has worked closely with international groups, including the National Institute of Occupational Safety and Health in Pittsburgh, Pa., the Polish Academy of Sciences in Krakow, Poland, and the Australian Coal Association Research Program in Brisbane. He has authored or co-authored more than 200 technical publications, reviewed journals, conference proceedings and technical reports and has delivered more than 100 technical presentations to various academic, government and industry audiences and has led presentation of more than 40 short courses to industry participants. Gillies’ current research projects include the utilization of booster fans in underground coal mines and fire simulation for training in self-escape in underground mines.
Missouri S&T, along with industrial and institutional cooperation, is taking part in the Department of Homeland Security’s Awareness and Localization of Explosives-Related Threats (ALERT). The project is geared toward developing potential DHS employees with advanced explosives training. Under the direction of Department of Mining Chair, Dr. Samuel Frimpong and explosives professor Dr. Paul Worsey, graduate students Nathan Rouse and Buck Hawkins are coordinating with Missouri’s community colleges and high schools in an effort to create awareness of the ALERT initiative. Missouri S&T will recruit potential students to participate in the Mining Department’s advanced explosives program and create a conduit in which these recruits may obtain DHS employment. While in its initial phase, the ALERT project is expected to train future explosives professionals in order to mitigate the risk of explosives attacks on the United States.

Charles Zdazinsky is conducting explosives research to better understand rock fracturing effects that explosives have in mining and construction applications, special techniques must be conducted depending on the desired size of the final stone, the preferred intensity of fracturing, and the type of geology prevalent at the blast site. These techniques have been studied, applied and improved by Explosive Engineers, especially in the last several decades. In order to fracture rock in only one preferred direction, such as in a presplit, smooth wall, or dimension stone application, it is best to use small holes closely spaced together, and a smaller explosive charge diameter than one would find in a typical quarry shot. Correct timing and spacing must be utilized within the shot to ensure that the cracks propagate in primarily the preferred split direction.

Nathan Rouse is conducting research on the mitigation effects of blast barrier walls. The barrier tests, which are 1:50 scale, will provide an understanding of how barrier walls affect blast waves and protect the affected area in the wall’s shadow. The blast table used in the research is similar to one designed by the Army Corps of Engineers to conduct similar tests. This research will ideally assist, with regard to Homeland Security, in computer aided simulation of blasts on barrier walls and the future design of those walls.

Phillip Mulligan is trying to make improvised explosive devices more powerful with the idea of eventually making them less deadly. His research is trying to create the best body armor possible. Mulligan’s IEDs are made of PVC, copper and, of course, explosives. When detonated, the copper plate explodes into shrapnel that flies everywhere. The main slug, though, travels at 6,000 feet per second in a predetermined direction. As part of the research, Mulligan is using high-speed cameras to capture the explosions. One of the cameras, which is protected by a panel of special glass, shoots 10,000 frames per second. The images can be used to determine the speed and behavior of projectiles.
Worsey's bunker

Paul has had another very busy year resulting in him having to go on high blood pressure medicine. Items of additional load that have created extra stress were recovering from the tornado (which hit his house in January 2008 on his wife’s birthday), assembling and still pushing through a new Masters in Explosives Engineering and the Detonators series on Discovery which he co-hosted along with his old graduate student Braden Lusk. This was along with being responsible for 8 classes throughout the last academic year and the hassle of ABET. The detonators series was aired in January on Discovery and put head to head with American idol in the same time slot, which was not really the best of logic and probably very dangerous for many married gear heads holding TV remotes. Paul says its obvious Discovery doesn’t have any engineering majors working for them! It is also reputed that he went through directors faster than he goes through dynamite. The series has already been aired internationally and the Brazilians we know were really excited about it and emailed us immediately it was aired. According to them Paul speaks perfect Portuguese and his voice has got substantially deeper and growly and now sounds like Paul Tuttle senior on Orange County Chopper.

The MLPA blasters certification has been replaced with State Blasters licensing through the State fire marshal’s office. The new licensing is along similar lines to the MLPA certification plus an added bureaucratic element but will allow for easier transfer to other states. The bill also standardized licensing in Missouri and provides uniform standards for blasting. Paul was angling last summer for the first license to be issued i.e. number one but Bill Ziers the fire marshal heading up the program got wind of this snagged it for himself. Paul got Missouri State blasting license number two instead. We think Paul actually got a big kick out of this as he keeps claiming he is going to print on the back of his hard hat: “who does #2 work for?”. In addition, to the great amusement of the fire marshal secretaries he rang up recently and said “This is #2. Can I speak to Dr. Evil please?”. We currently estimate that there are 350 licensed blasters in the State of Missouri, as his son Tristan (a mining senior this year) got license number 333 in May, becoming the youngest licensed blaster in the state. Paul say’s that for all the hassle the little devil gave him when he was younger 666 would have been more appropriate.

76 Pyro

Dr. Worsey has been writing articles on explosives and pyrotechnics for the very glossy and impressive ’76 Pyro magazine. His section is called “Dr. Worsey’s Explosives Corner”. His articles vary between 1 and 4 pages including pictures and the most recent (fall ’09) included July 4th shows, the ATF recurrent licensing backlog and explosives camp. Check it out some as the articles are very informative and some quite amusing. The great exposure for S&T is resulting in more enquires to the department by prospective students.
CO₂ Flux Field Delineation for Construction on Reclaimed Mine Land

**OSMRE Applied Science Agreement - S09AC15437**

Kwame Awuah-Offei, PI, kwamea@mst.edu & Alfred Baldassare, co-PI, PA-DEP

**Objectives**

The objectives of the project are to:

1. Develop a carbon dioxide (CO₂) trace gas flux measurement protocol for assessment of reclaimed mine land for construction purposes; and
2. Develop an approach to delineate high (above established threshold) CO₂ flux field on decision making.

**Background**

Anthropogenic CO₂ associated with neutralization of acid mine drainage (AMD) with carbonate materials has been found to cause high CO₂ concentrations in homes built on or near coal mine spoils. Potentially lethal levels of CO₂ (>25%) accompanied by equally low levels of O₂ (<10%) have been observed in basements of such residences in the Appalachian region. AMD is formed through sulfide oxidation as illustrated below:

\[ 2 \text{FeS}_2 (s) + 7 \text{O}_2 (g) + 2 \text{H}_2\text{O}(aq) \rightarrow 2 \text{Fe}^{2+}(aq) + 4\text{SO}_4^{2-}(aq) + 4\text{H}^+(aq) \]

Dissolved carbonaceous materials, occurring naturally in the overburden material and/or added as amendments, neutralize the AMD to produce CO₂:

\[ 2\text{H}^+(aq) + \text{CaCO}_3(s) \rightarrow \text{Ca}^{2+}(aq) + \text{H}_2\text{O}(aq) + \text{CO}_2(g) \]

There is inherent geochemical and hydrological variability in mine wastes with some induced by mining and reclamation techniques. Measuring CO₂ flux over mine spoil and analyzing it using geostatistical techniques will help to predict CO₂ concentration in buildings constructed on or near such lands as well as estimating emission levels into the atmosphere.

**Preliminary Results**

**Flux Quantiles**

- < 4.56
- < 6.06
- < 3.35
- < 14.46 (max)

**LEFT:** Maximum measured fluxes for three days of sampling in June 2009 on a reclaimed coal spoil at Godin mine, Jennerstown, Somerset County, PA. 43 sample points were established with an initial 250’ x 250’ (closer spacing around the house and along the eastern boundary, because of the stream). The fluxes ranged from 2.12 to 14.46 μmol/m²/sec. Mean maximum flux was 7.00 μmol/m²/sec with a standard deviation of 2.99 μmol/m²/sec.

**Current Task**

As at the end of September 2009, the team has procured all equipment and established over 160 sampling points at a reclaimed mine site in Germantown, MO. This site is part of a series of abandoned mine sites the MO-DNR calls Germantown problem area. The site will be used to determine the optimal grid spacing and validate the isotope sampling protocol.

**Future Work**

The team will use the sampling protocol that is developed and validated at Germantown, MO to conduct detailed surveys at two sites with known incidents of high CO₂ accumulation (one each in IN and PA). The results of this exercise will be used to conduct spatial geostatistical analysis to validate the protocol.

Beyond this project, further research will have to be done to account for the temporal variation using spatiotemporal geostatistics.

**Student Researchers**

- Moagabo Mathiba, mining engineering PhD student.
- Biomark Osei, mining engineering MS student.

**Missouri University of Science and Technology**

**LEFT:** LI-8100 Automated CO₂ Flux System taking measurements in the field.
**CENTER:** Collar in the ground with flag. **RIGHT:** Sample CO₂ measurement
Update from Mr. Windy

There have been quite a few things to report over this last year and among them, two stand out.

S&T is successful in receiving a large five-year NIOSH grant to study fire and fire simulation. With $250,000 per year for five years (or a total $1.25 M), this will mainly allow us to carefully study and model mine fires underground, to train future graduate students in ventilation and assist the mining industry with emergency training as well. Dr. Tien will be closely working with Dr. Stewart Gillies (Co-PI) who has had many years practical experience in this area.

Established by Dr. Larry Grayson five years ago, the NIOSH-funded Western U.S. Mining Safety and Health Training and Translation Center here in the department expired the last August. We were successful in obtaining a one-year extension for an amount of over $730,000. Thousands of hours of training in mining health and safety, diesel particulate matters, roof bolting have been conducted through S&T, Colorado of Mines and University of Utah the past five years. Dr. Tien is looking forward to a continuing busy year in mine health and safety training. In addition, NIOSH has agreed to specifically help S&T financially to improve the Experimental Mine to enhance safety training.

Despite economic slowdown that affected everybody, S&T’s online program continues to be active. Registration remained strong (43 students in fall 2009) and new practical courses are added to the selection (for example, Dr. Jason Baird’s graduate level explosives course, Mr. Dick Phelps’ Money Engineering.) We will continue working on new course offerings and improvements to make this unique program serve the industry even better. Please spread the words among your colleagues and friends, or anybody who might be interested.

Dr. Tien is continuingly involved in coal mining projects in China. His latest trip there is a large coal expansion project in Inner Mongolia from current 1-million to 10-million tones. There are also two projects in extracting and utilization of coal bed methane in Shanxi Province (the Wyoming of China, mined over 500 million tons in 2008).
INTRODUCTION
The boom in the mineral sector has created a surge in the demand for mining trucks. This demand surge in mining trucks has further created tire shortages as a result of the limited tire supply sources. The current lead time for new tires is about 2 years, with black market tire prices up to $100,000 per tire. This situation will persist into the future and thus, there is a need to provide long-term solutions to tire shortage problems.

Effective tire stress management is critical for evaluating tire fatigue life. Based on this evaluation, appropriate stress control management could be effected to promote tire longevity by monitoring tire fatigue life.

OBJECTIVES
1. Develop kinematics and dynamic models of truck-haul road interactions
2. Develop a hybrid virtual prototype for visualizing the dynamic behavior of dump truck and haul road
3. Develop tire FE model for capturing dynamic stress
4. Calculate contact loads between tire and haul road
5. Develop spring-damp haul road model for road deformation
6. Analyze dynamic interaction between tire and haul road

THEORY AND EXPERIMENTATION
1. Mechanics of Truck Tire-Ground Interaction
2. Rigid and Flexible Multi-body Dynamics
3. Body Contact Kinematics and Dynamics
4. Soil and Vehicle System Dynamics
5. Finite Element Method
6. Virtual Prototype Simulation
7. Rigid and Flexible Body Simulation

TIRE CONTACT FORCE
\[ F_x = k_1 \frac{\partial \delta}{\partial t} \]
\[ F_y = \mu F_x \frac{1 - e^{-\frac{\epsilon}{\eta}}}{\epsilon} \]
\[ F_z = (\mu - \gamma) F_x \]

FORMATION RESPONSE

SIGNIFICANCE
1. Develop Truck Vision and Dynamic Control
2. Create a Safe Working Environment
3. Increase Truck Haulage Efficiency
4. Minimize Truck Accidents
5. Maximize Truck Reliability and Maintainability
6. Maximize Truck Availability and Utilization
7. Efficient and Economic Shovel Production

AREAS OF APPLICATION
1. Surface Mining Operations
2. Civil Construction Operations
3. Off-Highway Dump Truck Haulage
4. Underground Mine Truck Haulage
SIGNING OF EXCHANGE AGREEMENT WITH WROCŁAW UNIVERSITY, POLAND

Mining Department Faculty Drs Gallacki, Gillies, Summers and Tien visited Poland in September 2009. The purpose of the visit was to sign an exchange agreement between the Wroclaw University and Missouri S&T and to visit and share experiences with the mining and mining mechanical faculty at the Wroclaw and the Krakow universities. Poland has three universities with mining departments namely Wroclaw, Krakow and Gliwice. Mining studies occur in both their mining engineering and associated departments such as mining mechanical supporting equipment and rock cutting studies. These departments are bigger than the Rolla mining department and are focused to supporting the Polish extensive underground coal and underground copper (room and pillar extraction) industries. During the visit to Poland papers were given by the Rolla faculty at the Sixth International Conference on Mining Techniques organised by the University of Science and Technology, AGH, Krakow in the country’s south east and the First International Copper Ore Mining Congress run by the KGHM Company on their mining lease at Lubin in the south west of Poland, A visit was made underground at one of the KGHM Lubin copper mines.

The Exchange Agreement signed with the Wroclaw University has purposes such as of encouragement

• Exchange of students,
• Exchange of faculty and staff,
• Joint research activities, and
• Publication of results of collaborative research projects.

The agreement was signed by the Rector of the Wroclaw University Professor Tadeusz Wieckowski and Dr Stewart Gillies representing the Missouri S&T Chancellor Dr John Caney III. The intention under the agreement is to initiate joint research in the specific areas of enhanced excavation technology (and particularly use of high pressure water jet applications), thin seam mining, high pressure comminution and mine ventilation issues.
Dr. Frimpong Visits Key Industry Partners

During the 2008-2009 Calendar Year, Dr. Frimpong visited key industry partners including Kennecott Utah Copper Corporation (KUCC) in Salt Lake City, UT, Barrick Gold North America, Elko, NV, Newmont Gold, Elko, NV, Peabody Energy, Terre Haute, IN and Kiewit Mining Group, Denver, CO. The purpose of the trips was to visit with Missouri University of Science and Technology (Missouri S&T) alums and friends in these companies and to tour the mining operations. The trips also provided opportunities to discuss the 2009 Mining Engineering Conference at Rolla, MO with our partners in industry. Jimmie Taylor, Mine Supervisor, and two PhD students, Azeem Raza and Osei Brown joined Dr. Frimpong on the visit to KUCC, Barrick and Newmont. At KUCC, the crew visited the Bingham super pit in Salt Lake City, Utah and spent time with Morgan Costello, the Mine Superintendent at Bingham Mine. The crew visited the main pit operations, waste dump sites, the dispatch and intelligent monitoring stations and the Visitor Center. At Elko, the crew had dinner with alums at Barrick and Newmont and a cross-section of the summer interns from Missouri S&T. Don Dwyer, General Supervisor – Underground and Jami Dwyer, Sr. Engineer at Barrick hosted the dinner in collaboration with Jeff Rosser, Superintendent, Goldstrike Open Pit Mine Maintenance. At Barrick Gold, the crew visited Meikle underground mine and Goldstrike open pit mine. The Barrick underground tour was led by Mike Peck, a Mine Rescue Captain and his Dad, an underground equipment operator and the open pit tour was led by Jerry Johnson, Sr. Mine Planner. At Newmont, the crew visited the Midas Mine, where they toured large sections of the underground operations. The tour was led by Jason Mayne, a Mine Rescue Captain at Newmont.
Dr. Frimpong took over 50 students to visit the strip mining operations at Farmersburg Mine in Terre Haute, IN. This is a Peabody Energy mine, which uses draglines and truck and shovels, with dozer cut operations. This was one of the largest class to be taken on a field trip within the last 10 years, which captures the growing enrollment capacity of the Mining Engineering Program at Missouri S&T. The class also visited the Knight Hawk Mine in Percy, IL on its way to Farmersburg Mine. In August 10 – 11, 2009, Dr. Frimpong was invited by Kiewit to participate in the celebration of Kiewit Mining Group’s summer interns from over 17 universities and colleges at the Omni Resort in Denver, CO. Four students from Missouri S&T, Bobby and Jessica Austin, Tyler Carr and Cody Rogers were among the summer interns. Dr. Frimpong had the opportunity to participate in an 18-hole golf tournament, his first ever on the course. His team members included Paul Conrad from Montana Tech, also a novice and Shashi Kanth from South Dakota School of Mines and Technology. The performance of the trio on the golf course won them a $50 gift certificate each as a consolation for participating and completing the course notwithstanding the severe challenges they faced with learning the skills and competing at same time.
Finally, we want to thank you for all your support during this past year. As you have seen in this newsletter, our students, faculty and staff are very active and new projects or events seem to come out of nowhere. However, all these activities help us to “produce” the best young mining engineer possible - and we see that we are on track by increased numbers of companies looking to us for their mining engineers. The formula we use to mix curriculum, student and professional activities is working and we will keep on track. You can be proud of your “Old School” and the new generation of mining engineers. We always have mining companies coming directly to the Department to interview - but we are overwhelmed by the numbers we had this semester. Close to fifty companies are looking for mining engineers at the Fall 2009 Career Fair. S&T/MSM mining engineers have an excellent reputation in the industry and we are committed to keep the tradition going.

The Faculty and Staff of the Mining Engineering Program