

## Engineering Management at UMR – Alumni Voices

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### Abstract

The Department of Engineering Management at the University of Missouri-Rolla is among the oldest of its kind in the United States, and has over 2000 Bachelors level alumni graduates. The Department will undergo ABET accreditation under the new assessment based criteria in the fall of 2002. The new criteria specify that engineering programs should seek to continuously improve their degree offerings through an ongoing assessment process that includes constituent input. Our own department has specified undergraduate alumni as one of the prime or key constituents that will be queried for input into our own processes. For the first time in our history, we sent a detailed survey to all of our undergraduate alumni. We also solicited salary information that could be submitted anonymously. The results from the survey will be presented and discussed.

### Introduction

The Department of Engineering Management at The University of Missouri-Rolla (UMR) has been in existence for over thirty years, and was among the first degrees of its kind in the United States. The Department's founder, Bernie Sarchet, knew that many engineers eventually progressed to management positions during their career. This is still true today. However, most engineers did not have the benefit of studying management or business in the midst of a rigorous engineering curriculum. Graduate school, or trial by fire seemed to be the only options for those engineers. However, Professor Sarchet came to UMR, a campus that at the time did not have a school of business, and proceeded to develop a curriculum that blended the rigors of a traditional engineering and science degree with courses that provided a strong foundation in business and management. Many who have knowledge of Engineering Management at UMR believe that if a business school had been in existence, this unique degree may not have ever existed. Professor Sarchet also had the strong support of campus administrators, enabling him to overcome certain organizational and cultural roadblocks that exist on many engineering campuses. In short, a very unique engineer degree was able to grow and flourish. The Department is now a comprehensive department offering the B.S., M.S., and Ph.D. degrees.

The degree is an engineering degree by virtue of its curriculum, and by virtue of its accreditation. The first two and one half years of the curriculum is virtually identical to any other typical engineering degree. The core set of courses all students must take include

accounting, finance, marketing, general management, strategic management, and operations management. The technical set of courses ranges from more management focused to more systems and manufacturing focused. The Department was the first of its kind to receive ABET accreditation in the nation, and is one of only three such accredited programs in the nation today. However, other similar programs may seek accreditation in the future.

Our own Department will seek accreditation under the new assessment based ABET 2000 criteria in the fall of 2002. The criteria require that departments seek to continuously improve their programs through constituent based assessment processes. This requirement provided the impetus for the development and administration of the first annual Engineering Management Undergraduate Alumni Survey. Our department faculty identified our alumni as one of our key constituents. In our initial survey, we chose to administer the instrument to all of our undergraduate alumni, but subsequent surveys will seek input from smaller populations. However this initial survey truly is, in this author's opinion, our "alumni voices". In the future, we will survey graduates who have been out two years and six years on an annual basis. Because the number of alumni in these two categories will be low, we anticipate having a higher response rate. We will also seek input from all undergraduate alumni every five years. We anticipate subtle modifications to the current survey, but intend to build longitudinal data over time. This paper will broadly present the overall results of the survey, including salary data and job category data, curriculum data, and selected, individual alumni comment.

#### Alumni Survey

The ABET 2000 criteria require engineering departments to develop a mission statement, program educational objectives, and department "learning" outcomes. Our department did this with input from our industrial advisory committee. Our alumni survey was then developed in large part with respect to those requirements. We also were interested in biographical data related to their careers, further education and other areas of interest. Biographical information was solicited in the first section of our survey, but the information requested is not shown here. In the second section (numbers 1 – 24) of the survey we asked our alumni to rate their level of agreement with our mission statement, educational objectives, and general department and program concerns. A five-point scale was used to assess the level of agreement with each statement. Strongly disagree represented the low end of agreement (0), neutral (3) represented the middle of the scale, and strongly agree (5) represented the high end of the scale. Those statements are shown below. The third section (numbers 25 – 36), provided a list of skills and abilities and sought to find out how effective the Department was in giving the students that ability, and how important it was to them in their job or career. A five-point scale was used in each case, with one representing either not effective, or not important. The highest importance or effectiveness was the opposite end of the scale. Those skills and abilities are also shown below. We also asked for any comments that alumni felt would be useful to the department. The basic elements of the survey, excluding biographical queries are shown below.

#### Department Mission Statement:

1. The Engineering Management Department equipped individuals with engineering and management expertise to prepare them to be leaders in the identification and solution of technical and organizational problems that are complex and evolving.

Department Educational Objectives:

2. Developed in students the capabilities to successfully apply engineering expertise to the challenges of the 21<sup>st</sup> century in manufacturing and service enterprises.
3. Developed in students the knowledge and skills that were the foundation for successful management of people, systems, and projects.
4. Developed in students the ability and desire to grow intellectually and personally, in light of an increasingly global and multicultural work environment.
5. The Engineering Management Department at the University of Missouri-Rolla provided an educational environment to support and encourage students to succeed.
6. Provided students with the knowledge of a specific engineering management emphasis area.

Department and Program Concerns:

7. My education prepared me for my current position.
8. My education matched my current interests.
9. My Engineering Management education was of high quality.
10. Department faculty were committed to students and their success.
11. The Department provided modern classrooms and laboratories.
12. The Department provided staff and administrative personnel who supported students.
13. The program had an adequate blend of technical and non-technical content.
14. The program provided adequate written communication experiences.
15. The program provided an adequate integrated design experience.
16. The program equipped us for lifelong learning.
17. The program provided adequate oral communication experiences.
18. The program prepared us for management positions.
19. Faculty members were accessible for consultation on course related matters.
20. The overall quality of the student/faculty relationship in the Department was high.
21. The Department provided adequate opportunities for student activities related to technical societies.
22. The Department provided adequate opportunities for student activities related to social activities.
23. The Department provided adequate background in the following areas as listed:
  - a. Productions/Operation Management.
  - b. Marketing.
  - c. Engineering Economy/Economic Analysis.
  - d. Organizational Management.
  - e. Strategic Management.
  - f. Finance.
  - g. Accounting.
24. My technical preference/emphasis area prepared me adequately for my first job.

## Skills and Abilities:

25. Ability to identify operation and production problems.
26. Ability to carry out tests and experiments.
27. Ability to develop optimal solutions.
28. Ability to implement solutions for improved strategic competitiveness
29. Skills required for effective performance as a member of a work team.
30. Writing, speaking, listening skills required for effective organizational communication.
31. Ability to analyze complex systems and formulate solutions using approximate qualitative and quantitative tools and techniques.
32. Skills for decision making, planning and controlling of the key resources of an organization – money and people.
33. Skills necessary to critically analyze, evaluate, improve, or adapt existing technical and managerial systems.
34. Skills necessary to design and develop new technical and managerial systems.
35. Skills necessary to model, simulate, or otherwise characterize existing and proposed technical and managerial systems.
36. Literacy in the critical management disciplines of finance, marketing, strategy, human resources, operations, and information technology.

## Survey Results

The survey was constructed to fit on one page using both the front and backside, and an additional page was attached for open comment. A postage paid, preaddressed return envelope was provided. The anonymous salary survey was sent in the same packet and also included a postage paid, preaddressed return envelope. Many alumni chose to report their salary information without anonymity. A total of 1976 surveys were mailed in the summer of 2001. A total of 401 of the alumni surveys were returned yielding a 20.29% return rate with no further mailings or phone contacts. We feel that a 20% return rate, while not outstanding, is certainly not low. Given the length of the survey, and the suspicion that many professionals are inundated with survey instruments on a regular basis, we actually are pleased with this return rate. A total of 354 salary surveys were returned yielding a 17.91% return rate. It is perplexing that salary surveys were returned at a lower rate than the general information surveys. Responses were received from the earliest graduates (1968, 1969, 1970, ...) and the latest graduates (2000). The data has been input into an Access database for various analysis and report generation.

For the purposes of this paper, the results have not been statistically analyzed. A colleague within the Department will subject the data to various statistical analyses in the near future. Overall, the results from this survey (raw data and percentage responses), however, seem to indicate that the degree program has been a success. Alumni have reported job titles including president, owner, plant manager, consultant, associate professor, project manager, team leader, maintenance superintendent, manufacturing manager, director contractor services, financial analyst, medical doctor, general counsel, senior process engineer, regional vice-president, and numerous other titles that indicate our graduates have moved into the managerial ranks as well as the executive suite. This would seem to indicate that progression into management is a strong likelihood for our graduates. More recent graduates report titles that are typically held by entry-level engineers.

The salary data also seem to indicate that our alumni will move into higher-level management positions. Graduates from one to five years out report an average salary of \$54,195. Those with six to ten years experience report an average salary of \$67,573. Graduates with eleven to 15 years experience report an average salary of \$76,134. Sixteen to twenty year alumni report an average salary of \$91,978. Alumni with twenty to twenty five years of experience report an average salary of \$111,535. Finally, the most seasoned alumni, those with twenty six to thirty two years experience report an average salary of \$131,922. The salary data also indicate that over one-third of our graduates have reported a salary in excess of \$90,000. Furthermore, if the ranges of salaries in the specified experience brackets were shown, more impressive numbers would be observed. We also did not include stock options or bonuses in the averages implying that monetary rewards are further understated. If our sample is representative for all Engineering Management alumni, then a strong case can be made as to the long-term career success for the degree and program. But, even if it is not representative, it certainly indicates the potential for success that exists for motivated individuals.

The results from the alumni survey that were focused on our curriculum seem to indicate that the Department is doing well in delivering the appropriate curriculum. In items 1 – 24, no particular issue stands out with reference to any level of disagreement. Our mission and educational objectives (Items 1 – 6) have been given strong support as evidenced by over 70% of those who responded either agreeing or strongly agreeing with our statements. Likewise, our stated department and program concerns were given strong support by our alumni. Again, each item had over 70% who agreed or strongly agreed with our statements. Neutral responses far outweighed any level of disagreement.

Our Department appears to be addressing the necessary skills and abilities that alumni require to succeed in Industry. Items 25 – 36 sought to address how important certain skills and abilities were in achieving success, and how effective we were in helping them gain the skills and abilities. In reviewing the responses, no particular item stands out as being less important to their ultimate success, nor does any one item stand out as deficient on our part. If a rating of 3 or higher is indicative of support, then each item has well over 70% support. Raw responses and percentage data are shown in the table at the end of this paper. (Note: Question 19 as shown in this paper did not make it to the final survey document distributed to our alumni. Therefore the tabular data will not show question 19. No one, including our alumni caught the mistake!)

The alumni were also given an opportunity to voice their own opinion about the engineering management program. An estimated one third of the respondents chose to share their comments. In general, the statements provide very powerful evidence of the value and success of this degree. Samples of some of the strongest statements are as follows.

A 1971 graduate says this: “The program prepared me well for a manufacturing career with a major consumer products company. I recently celebrated my 30<sup>th</sup> anniversary with the company. I had a significant advantage over my counterparts with straight engineering degrees. My ability to integrate both people skills and finance understanding gave me an edge. The marketing understanding has also been helpful. The strong engineering foundation has also been valuable because I have found that when it comes to specific technical penetration, I am on equal footing

footing to those with straight ME, ChE, or EE degrees. I have been a plant manager for the past 17 years and have dealt with some of our most complex technologies. I have worked in both Europe and Asia and have been effective in cross cultural organization work. I have had experience in my career in product development, engineering, design, construction, and new plant startups. The engineering management background has provided the optimal base of skills to enable my success across a broad range of opportunities.”

A 1998 graduate, who is a six sigma quality – master black belt say this: “My engineering management studies prepared me for the real world of corporate management better than any other undergrad program could have. When discussing issues with fellow co-workers, I find that even those with MBA’s do not have such a strong cross-functional educational background. I think I have at least a 5 year advantage over my peers with a core engineering degree.” It should be noted that the 1971 graduate is the father and the 1998 graduate is the son!

A 1985 graduate and president of a company says this: “Engineering Management provided a much more useful education and problem solving based program than the ME department. Classes in general were much more interesting and constructive. Most of the engineering classes seemed to struggle with communicating with students how this would help in our work and personal development. Problem solving skills taught at UMR are the number one thing you take away from the school. Engineering Management prepared me for many of the challenges encountered in running, organizing and communicating with hundreds of people.”

A more recent 1999 graduate and whose job title is Industrial Engineer/Lean Team says this: “The Engineering Management Department prepared me thoroughly for my career after graduation. Our Department has a very powerful blend of finance, engineering, and management education, which has allowed me to be able to understand and communicate with all aspects of my company. Communication in this manner will allow me to move forward in my career, and to further promote my department at UMR.”

A 1991 graduate say this: “The overall balanced education offered by my Engineering Management degree gave me a much more diverse skill mix than most of my contemporaries. I was able to adapt into the support side of military aircraft quickly due to my understanding of design, production, and business. The Engineering Management degree also provides a varied enough background to allow for pursuit of advanced degrees in engineering, business, and law.”

Obviously the statements presented are biased on the positive side. However, alumni were not hesitant to point out weaknesses or areas of improvement. Clearly the area cited most often for improvement is written and oral communications. Even though the numerical survey results indicate we are doing reasonably well in this area, more efforts should be focused on the ability to communicate. Another issue that was stated just a few times, but is surprising is in the name of the degree, or in how our department promotes the degree. A few alumni felt the name of the degree hindered their advancement. They indicated their companies or at least their managers felt the degree was a business degree rather than an engineering degree. Perhaps the department should and indeed will work harder in promoting the degree as an engineering degree. Numerical responses with reference to an “integrated design experience” indicate we should pay more attention to this area. Our graduating senior survey reflects this sentiment as well.

Some of the biographical data of interest are as follows. 177 respondents reported advanced degrees to include law, MD, MBA, MA, Ph.D., MS, and other. 32 alumni reported holding the professional engineering (PE) designation, and 32 report to be EIT qualified. Obviously, our department needs to find a way to encourage passing the EIT and pursuing the PE designation. We also asked alumni to report how long after graduation until they hold their first supervisory position. Those results are as follows: Year 1 – 114; Year 2 – 39; Year 3 – 29; Year 4 – 23; Year 5+ - 87; Other – 83.

## Final Comments

The title of this paper reflects the intent to share opinions about Engineering Management at UMR from the undergraduate alumni of the program. The results obtained from the survey are very one-sided, indicating that the program is basically sound and has few, if any areas that are a problem. A pure researcher might well say, and rightfully so, that the results have no meaning. We did not go back and solicit the same information from those who did not respond. Perhaps the respondents represent the best of our alumni. I personally believe the results are at least representative, particularly relative to salary and career potential, of what a motivated individual is capable of achieving. From a curriculum standpoint, the Department is not so naïve as to believe that we need not seek to improve our program. In fact the Department has done so since its inception by developing new courses, new option areas, and continuing to recruit new faculty who believe in the concept of blending hard core engineering with business and management.

Given the statements made to the validity of the results in the previous paragraph, some might question the value of the information provided by this sampling of alumni. However, I believe it has significant value. One of my duties as a faculty of the Department is that of coordinator of undergraduate academic affairs. In that role, I am the first person that potential Engineering Management students see. In effect, the information I provide to these students influences whether or not they choose to enter the Department, stay in a traditional engineering field, or more likely, exit rapidly from the lovely confines of Rolla and UMR. I have found that students are particularly interested in two questions. What can I do with this degree, and what is the career potential for the degree? The first question is easy to answer for traditional engineering fields. For instance, mechanical engineers build things such as machines, cars, thermodynamic systems, etc. Electrical engineers design and build circuits and power systems among other things. Civil engineers build roads, bridges, buildings, etc. In each of these cases, tangible products can be cited. The second question is easily addressed for traditional engineers due to their degrees long history, and by providing examples of companies and industries where typical engineers work. Our Engineering Management program could not cite tangible products and say, “this is Engineering Management”, and, we had limited knowledge of the breadth of companies, industries and actual positions where our alumni worked. We did have salary data and job title data from a previous, more limited survey that we had been using as a recruiting device. That information suggested long term salary potential and the strong possibility to move into executive level positions. We have stated that one-third of our graduates will move into executive level positions, and earn executive level salaries. The results from this survey do in fact support that position. At the very least, we now have a very powerful

story to tell and to use for enticing students to pursue their undergraduate studies in Engineering Management at UMR!

Raw and percentage survey results are shown in the tables below.

Number	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
1	2	5	28	247	112	394
	1%	1%	7%	63%	28%	100%
2	2	9	58	248	78	395
	1%	2%	15%	63%	20%	100%
3	5	5	30	219	135	394
	1%	1%	8%	56%	34%	100%
4	4	13	58	216	103	394
	1%	3%	15%	55%	26%	100%
5	6	3	29	192	165	395
	2%	1%	7%	49%	42%	100%
6	2	14	57	218	104	395
	1%	4%	14%	55%	26%	100%
7	7	21	70	213	84	395
	2%	5%	18%	54%	21%	100%
8	6	29	87	197	75	394
	2%	7%	22%	50%	19%	100%
9	3	3	17	203	169	395
	1%	1%	4%	51%	43%	100%
10	3	7	41	188	155	394
	1%	2%	10%	48%	39%	100%
11	7	36	96	160	96	395
	2%	9%	24%	41%	24%	100%
12	5	8	63	201	118	395
	1%	2%	16%	51%	30%	100%
13	2	8	32	245	94	381
	1%	2%	8%	64%	25%	100%
14	5	43	79	204	51	382
	1%	11%	21%	53%	13%	100%
15	4	48	134	170	25	381
	1%	13%	35%	45%	7%	100%
16	6	24	117	181	54	382
	2%	6%	31%	47%	14%	100%
17	11	57	73	168	73	382
	3%	15%	19%	44%	19%	100%
18	4	16	59	204	99	382
	1%	4%	15%	53%	26%	100%
20	3	5	56	189	128	381
	1%	1%	15%	50%	34%	100%
21	3	17	86	204	70	380
	1%	4%	23%	54%	18%	100%
22	7	14	162	132	30	345
	2%	4%	47%	38%	9%	100%
23a	3	6	50	234	88	381
	1%	2%	13%	61%	23%	100%
23b	5	21	74	221	60	381



	1%	6%	19%	58%	16%	100%
23c	3	11	28	235	104	381
	1%	3%	7%	62%	27%	100%
23d	2	9	63	227	79	380
	1%	2%	17%	60%	21%	100%
23e	5	26	85	203	59	378
	1%	7%	22%	54%	16%	100%
23f	6	22	80	212	60	380
	2%	6%	21%	56%	16%	100%
23g	5	20	75	223	57	380
	1%	5%	20%	59%	15%	100%
24	6	30	77	183	82	378
	2%	8%	20%	48%	22%	100%

**How  
Important  
To You**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Total</b>
25	23	20	46	126	162	377
	6%	5%	12%	33%	43%	100%
26	30	50	116	105	76	377
	8%	13%	31%	28%	20%	100%
27	8	3	37	142	186	376
	2%	1%	10%	38%	49%	100%
28	10	14	57	151	146	378
	3%	4%	15%	40%	39%	100%
29	1	3	30	131	212	377
	0%	1%	8%	35%	56%	100%
30	3	15	46	140	174	378
	1%	4%	12%	37%	46%	100%
31	5	29	65	161	108	368
	1%	8%	18%	44%	29%	100%
32	5	6	33	134	200	378
	1%	2%	9%	35%	53%	100%
33	5	9	60	161	143	378
	1%	2%	16%	43%	38%	100%
34	11	31	106	141	88	377
	3%	8%	28%	37%	23%	100%
35	16	50	123	135	51	375
	4%	13%	33%	36%	14%	100%
36	3	7	47	167	153	377
	1%	2%	12%	44%	41%	100%

**How  
Effective  
Were We**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Total</b>
25	8	23	103	189	53	376
	2%	6%	27%	50%	14%	100%
26	9	30	137	145	54	375
	2%	8%	37%	39%	14%	100%
27	3	11	101	196	65	376
	1%	3%	27%	52%	17%	100%
28	8	26	135	165	42	376
	2%	7%	36%	44%	11%	100%
29	5	20	107	142	101	375
	1%	5%	29%	38%	27%	100%
30	9	29	107	172	60	377
	2%	8%	28%	46%	16%	100%
31	3	17	107	171	69	367
	1%	5%	29%	47%	19%	100%
32	9	25	98	178	66	376
	2%	7%	26%	47%	18%	100%
33	7	20	117	173	60	377
	2%	5%	31%	46%	16%	100%
34	8	32	165	135	37	377
	2%	8%	44%	36%	10%	100%
35	10	38	157	138	33	376
	3%	10%	42%	37%	9%	100%
36	7	22	92	175	80	376
	2%	6%	24%	47%	21%	100%

**Biographical Information**

Stephen A. Raper is an Associate Professor of Engineering Management. He received the B.S., M.S., and Ph.D. degrees in Engineering Management from the University of Missouri-Rolla. His teaching and research interests are in the areas of operations management, packaging systems engineering, and management of technology. He is the coordinator of undergraduate academic affairs for the Department and is leading the effort for ABET accreditation under the new criteria.