Title: A Study of How To Improve the PSU EMP Program Offerings for Individuals from High Technology Companies

Course: EMGT 560/660
Term: Winter
Year: 1998
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Report No: P98008

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A Study of How to Improve the PSU EMP Program Offerings for Individuals from High Technology Companies

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EMP-P9808

TERM PROJECT

March, 1998

A STUDY OF HOW TO IMPROVE THE PSU EMP PROGRAM OFFERINGS FOR INDIVIDUALS FROM HIGH TECHNOLOGY COMPANIES

EMGT 560/660 (Winter, 1998)

Submitted: March 10, 1998

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1.0 EXECUTIVE SUMMARY

We selected the project to look at PSU's Engineering Management Program (EMP) and determine how that program could be improved. We concentrated on three areas:

1. First, we looked at the broad area of TQM as being applied to Universities. Were there any emerging trends or opportunities that appeared to be of possible use to PSU?
2. Second, we looked at the programs of other universities offering EMPs. How did their curriculum compare to that of PSU? Were these universities offering any special courses or tailoring the courses in an special manner that might be applicable to PSU?
3. Finally, we took a look at the PSU environment and surveyed potential and current customers to determine their opinion of the course work and venue of offerings. We also attempted to identify the profile of the typical student and the motivations for pursuing an advanced degree. We looked at the other programs (other than the EMP program) in the Portland area competing for graduate students.

What did we find:

1. Regarding TQM. We found that many universities claim to be applying TQM. Most of the applications found were to the business/services side of university operations. A couple of rather thorough case studies over several years concluded that the applications of TQM have had mixed results. A couple of issues appeared that might be of interest to PSU for further study. First, Malcolm Baldrige criteria for evaluating higher education has be released (released in 1995 for trial and recently revised and re-released). PSU may want to use the criteria to benchmark its current status. Second., some universities indicated they were making a concerted effort to partner with local industries, other universities, and state and local governments. Is this an option for PSU? Third, Purdue University has instituted what is purported to be a highly visible web based suggestion type program. The University president over sees the program, high technology industry representatives are on the board. Projects are tracked and progress is reported on the web. On the surface, the program looks very good. A similar program could be a starting point for PSU's TQM journey.
2. Regarding other EMP programs. We found that PSU has available all courses that are offered as core courses in other universities' EMP Programs—except one. We found that about one half of the programs reviewed offered specialized tracks in their EMP. Would a special track for high technology employed students make sense for PSU? We used a survey to help answer this question.
3. Regarding the survey and associated research. Research revealed that business leaders say engineering graduates lack communication skills, ability to work in teams, and ability to work with people of diverse backgrounds. Survey results revealed similar expressed needs from potential engineering management students and potential engineering management students with a high technology emphasis. The high technology community in the Portland area is asking for higher education's support and accusations have been made that the higher education community is not doing enough to satisfy industries need in both quality and quantity of students receiving advanced degrees.

As a result of the study we offer the following recommendations:

1. PSU should use the Baldrige criteria for higher education to assess the current state of the EMP.
2. PSU should attempt to partner with local major industries. Perhaps implementing a continuous improvement program similar to that at Purdue—with local industry representatives on the board—could serve as a bridge.
3. PSU should consider offering a track tailored to high technology industry. Perhaps starting with only one class and growing as the results demand.

Portland State should focus on promoting the EMP to industry. When compared with EMP programs across the nation Portland States program held its own. Awareness of the program needs to be established throughout the high technology community. Portland State needs to listen to its customer, the high technology industry, in identifying improvements to course content and class offerings.

2.0 INTRODUCTION

Project Purpose

The purpose of this project is to investigate and provide recommendations for improving PSU's Engineering Management Program with particular emphasis of making the program more appealing to those students working in high technology companies.

Engineering education is considered to be successful in providing students with technical skills and knowledge. However, it has been criticized for not providing students with a complementary set of management skills [23]. For engineers, the skill in management is an essential element to move upward on the corporate ladder [23]. Furthermore, many engineers move into supervisory positions between 3 to 7 years after graduation. Most of these engineers are not well prepare to take on management responsibilities. This is especially true if they are working in the high technology industry, where they must also devote considerable effort keeping up with rapidly changing technology and organizations. We are now going into the so-called third wave generation[25], the fast- growing technology period, where technology and information have become essential to human life. Engineers should have the ability to manage their knowledge and keep up with this changing environment.

Some of the responsibilities of engineering managers in the high technology industry are to provide technical, scientific, and consultation services to internal and external customers. They develop new technology to improve products, conduct research, and organize and manage limited resources.

Many engineers, to gain management knowledge, attend business schools and obtain a master of business administration degree. Although this may be a good route to fulfill their managerial needs, they must frequently divorce themselves from the engineering disciplines during the course of obtaining a business degree. Many of these engineers would prefer to pursue a management oriented degree that also incorporates class work to further hone their engineering skills as well as provides a focus on managing engineering organizations. A degree in engineering management will probably fulfill their need more closely because of its emphasizes on the management of technical organizations as well as the general management principals [24].

PSU has a well-established engineering management training program. How does this program compare with other engineering management programs and what could be done to further improve the program?

Project Methodology:

The project focused on three basic areas for sources of recommendations:

1. Structure of other EMP programs. Research was conducted to determine what was being offered in terms of classes and delivery options by other universities' engineering management programs. The findings were contrasted to the offerings from PSU's EMP program.
2. Efforts to increase customer satisfaction at other universities. Research was conducted to determine what actions other universities have taken to improve the quality of their educational offerings using the principles of Total Quality Management. The approaches and attendant results were the source of possible improvement actions for PSU's EMP program.
3. Preferences and recommendations from current and potential students. A survey was used to determine the course preferences, importance of location and course delivery options of current and potential students. The survey was expanded to also include opinions from hiring managers and PSU faculty to permit comparison and contrast.

Recommendations were generated form the three sources and evaluated in terms of cost, strengths, weaknesses, opportunities and threats. As it was not possible to collect all of the information available or to conduct the detail of research desired, opportunities for additional research and study were captured

during the course of this project.

LITERATURE SURVEY

Introduction

A survey of literature was performed to determine Universities that offered a Masters in Engineering Management. This information will be used to compare engineering management courses and programs to those offered by PSU. Understanding that several universities have attempted to apply TQM to improve the services offered to students, research was also conducted to determine if any of the improvement programs spawn by TQM could be of use to PSU in further improving the EMP Program.

Portals, ABI Inform, the Internet and other on-line data bases were used to search for literature that contained the following key words: Total Quality Management. Hundreds of articles were found. The search was narrowed to TQM and Universities and approximately 35 references were found. Research found that 22 were available in the PSU library. These are the articles listed in the bibliography.

Determine Benchmark Schools:

Information was found on 9 universities (in addition to PSU) offering Masters Degrees in Engineering Management. The core courses offered by all nine Universities is presented below: (A comparison of the core courses required at each university is found at Appendix A.)

- Quantitative Decision Making
- Marketing/Technology Marketing
- Quality/TQM
- Project Management
- Finance/Accounting
- Manufacturing
- Planning and Control
- Strategy development
- Organizational Behavior
- Information Systems Management
- Business Ethics/Law
- Systems Engineering
- Operations Research
- Entrepreneurship

The PSU program offered all of these classes either as core or elective classes except for Entrepreneurship. Four of the universities (University of Stockholm, University of Missouri at Rolla, George Washington University and University of Maryland) explicitly offered multiple specialization programs for an MS in Engineering Management. Only one university (University of Kansas) also promoted its "Distance Learning" option for obtaining the MS degree.

Two companies were also found that advertised a Master Degree Program in Engineering Management. Lockheed Martin and Ingersoll-Rand each offer an Engineering Management Program. Each conducted the training "in-house" with company and "acknowledged business leaders". It was not apparent that an accredited university was associated with either program. However, it does point out the need for some large companies to internally develop individuals for engineering management. Both companies' programs mixed class work with rotational work assignments. (It would be of interest to contact the director of these programs to determine why they have not aligned their programs with an accredited university.)

Determine Universities benefiting from TQM

3.1.2.1The need for change.

Not unlike business crisis of the 1980's, universities are now facing a similar crisis of reduced funding, increasing competition for qualified students, and a call for accountability for moneys they do have to spend.

Business leaders state that graduates are not prepared. They feel that a chasm exists between corporate and academic cooperation. Business leaders and alumni feel that higher education is unwilling to change, has a narrow view of fields of study, pays inadequate attention to career preparation and expects support without accountability. The biggest deficiencies of recent graduates are reported to be [16]:

1. Lack of communication skills
2. Lack of ability to work in teams
3. Lack of ability to work with people of diverse backgrounds

The Barriers to TQM in Universities.

It was reported in 1993 that 61% of the college and university presidents were averring involvement in TQM. It was further reported that this involvement was being motivated as much by the desire find a way to work through financial crisis as by the perception of a need to improve [8]. Regardless of the motivation, TQM principles were being applied to universities.

Several barriers were identified [5][22][8][6]:

1. University culture. Individuality is recognized and rewarded. Universities mistake decentralization for participation. Collegiality is thought to be equivalent to participation in decision making. "We are already doing TQM" syndrome crops up.
2. Lack of perceived urgency regarding need for change. Faculty and Administration do not share the same view of what's urgent.
3. Lack of presidential leadership.
4. No shared goal with varying loyalty to institution.
5. Minimum emphasis on staff development.
6. No clear understanding of who the customers are—internal or external. There is also considerable reluctance to recognize the student as a customer. "Giving students what they want does not lead to higher quality education…must give explicit attention to our social contract and the sophisticated judgment required of the faculty members and administration."[0]

If one looks at the barriers presented by university implementation, one sees that they are essentially the same barriers as were conjured up in early implementations of TQM within corporate America.

TQM implementations in Universities.

Research revealed that several universities that embrace TQM and/or claim successful implementations of TQM. These universities are listed in Appendix B.

Those universities reporting progress in implementing TQM generally focus on their process and point to success in the more service related functions such as admissions, plant operations and payroll. Teaching instruction is mentioned, but does not receive much coverage as to benefits.

Two implementations of TQM were well documented in the literature; one by Oregon State University and the other by Delaware County Community College (DCCC). Both schools have defined an orderly process for implementing TQM.

The Oregon State University account initially in 1990 reported that 12 critical areas and 12 teams had been

formed to improve processes [1][2]. However, in 1993, the report indicated ten teams and discussed the results of those ten teams [3]. Conspicuous in their absence from the 1993 list were the "faculty development process" and the "teaching" teams. Did these elements prove to be too controversial or difficult? After three years efforts, the results of the Oregon State University experience were reported [1]:

1. 63% of the members and 72% of the leaders thought the TQM experience was positive. (37% of the members did not!!)
2. 72% of the people surveyed thought employee morale had improved. (Presumably from the opportunity to participate in decision making and improve processes.)
3. 58% of the team and 82% of the leaders did not know whether respective customers were satisfied by the changes. (Customer feedback?)
4. 80% of all team recommendations were accepted. (This number pales besides Toyota Manufacturing of North America that reported in excess of 96% of all suggestions submitted by workers on their production line are accepted.)

The DCCC experience was much like OSU's focusing on service related functions associated with the college. The main difference seems to be in the implementation strategy. DCCC purportedly developed a five-year plan for TQM and worked off that plan. The first year of the plan was devoted to training upper management and conducting trial process improvement projects. After the first year, the training and emphasis expanded to introducing TQM to curriculum and training additional members of DCCC. From the third year on, the TQM process was further expanded to all areas of DCCC. Service improvements are reported in all areas. Team recognition and awards were presented. The president made TQM a regular agenda item on all staff meetings. He reports that "thinking has changed"[7]. However, the results are still assessed as being mixed. Time for TQM activities and the need to start with simple projects were two of the key learning's. TQM is recognized as "representing a revolution in management philosophy, but an evolution in implementation [5].

Seymour related that the concerns of a university parallel closely that of industry as evidenced by a comparison of performance drives at Hewlett-Packard and those promoted by the American Association for Higher Education [19]:

Hewlett-Packard	American Association for Higher Education
Who are my customers?	Who are our students and why do they come here?
What do they need?	What should a graduate be like?
What is my product or service?	How do students change—and why?
Does my product or service exceed their expectations?	How do students talk about their own learning?
What is my process for providing the need?	Is there a better way to organize the curriculum?
What corrective action is needed to improve the process?	How could we do better?

Sherr and Lozier summarize the characteristics needed to implement TQM in a university as follow [20]:

The Person and Organization	The Process	Underlying Values
Honesty	Mission and customer focus	Importance of people
Shared Vision	Systematic approach to operations	Need to use knowledge
Patience	Vigorous Development of human resources	Continuous improvement
Commitment	Long term thinking	
Willingness to learn TQM theory		

The key thrust is for an institution that not only teaches, but also learns.

Changes at Universities.

Davis [4] points out that changes do occur in Universities. He notes that universities changed: as discipline and professional fields emerged-- professional education was added, as more intense focus was needed-- graduate education was established, and finally when methods need to change—education evolved from recitation to lecture and now to participation. Additional changes he thinks will involve are:

1. Emphasis on the ability to analyze, synthesize and apply information
2. Student need for life long study
3. Curriculum co designed between the university and students, and
4. More delivery sites –at work, at home, etc.

An additional trend predicted by Ryan [18] is that of more partnering with various groups:

Type of Partnering	Example
University and Large corporation	1. DuPont added Penn State in applying TQM and constructing classes. Penn State's research used by DuPont and others. 2. Wichita State responding to Boeing needs by establishing TQM related masters program. Boeing supporting and hiring students for the program[10]
Universities with other Universities	Consortia of Amherst, Smith, Mt. Holyoke, New Hampshire and U of Mass at Amherst
University with state government	Ben Franklin Partnership program in Penna. In ten years help to create 20,000 jobs
University with local community	Local branches of the university assisting groups of business by providing training in needed skills
University with small industry	Penn State's assistance to rust belt industries in evolving to high technology
University with secondary schools	No example provided

Ryan warned that these partnerships do not just happen. Formalized outreach structure must be in place in the university.

Benchmarks for Universities.

Our original intent was to use the results of our literature search to identify the key characteristics that seemed to be present in the most progressive and successful university. However, such a criteria has already been developed in the "Malcolm Baldrige National Quality Award: Education Pilot Criteria 1995". The criteria are [13]:

1. Leadership
2. Information and Analysis
3. Strategic and Operational Planning
4. Human Resources Development and Management
5. Educational and Business Process Management
6. School Performance Results
7. Student Focus and Student Stakeholder Satisfaction

Competing Schools/Education Program

Schools targeting local environment

There are three types of competing program's for the potential student in Portland State's Engineering Management program. The first type would be an advanced degree program or continuing education in a technical discipline. This would be the weakest competition in that the customer for an advanced technical degree is looking to further their knowledge or career in a specialized technical area. Portland State, OGI, University of Portland, and OCATE all offer advanced technical degree programs in the Portland area. The next category of competition would come from MBA or similar Master's in Management programs. Portland State, University of Portland, Washington State, OEMBA, George Fox, Marylhurst, Willamette, University of Oregon, and Oregon Joint Professional Schools of Business all offer such program's in the local area. These programs target the general business community attracting students from a large variety

of industries. The most direct competition comes from other graduate programs in engineering management. OGI and Washington State both offer such programs. These programs take into account the technical background of their students and focus on the specific management needs in an engineering environment. (See Appendix C for the competition for a Master's in Engineering Management in the Portland area.

PSU's EMP Program health

The Engineering Management P Program at Portland State University was started in 1987. It offers a M. S. degree in Engineering Management and A Ph.D. in System Science/ Engineering Management. The EMP was design for engineers and scientist moving towards technical management responsibilities while maintaining identity in their technical specialties. It transforms engineers from pure technical experts into engineers capable of dealing with a robust and uncertain environment.

The need for offering a new program for exposing pure engineers to management education in Portland State University was first identified by the high-technology industries around Portland area in the beginning of 1980's. In 1984, the PSU deans decided to offer the new program called Engineering Management. They contacted Dr. Kocaoglu, who was at that time teaching Engineering Management at University of Pittsburgh. Dr Kocaoglu and the deans of Portland State University wrote a proposal to offer the Engineering Management Program..

The PSU Engineering Management Program started in the fall of 1987. At that time, the faculty of the EMP were Dr. Kocaoglu an a part-time secretary. They had a small temporary office in Science Building II. EMP had thirteen students and initially offered three classes, taught by Dr. Kocaoglu. Initially Dr., Kocaoglu taught at both, PSU and University of Pittsburgh. until In winter of 1988 he released his duty in Pittsburgh and became a full time instructor at PSU. Since then the Engineering Management Program has grown rapidly.

In 1989, two additional instructors and one additional secretary were added to the program. In 1993, PSU added a Ph.D. program in System Science or Engineering Management. Currently, EMP has given Ph.D. titles to four graduates, one in 1994, two in 1995, and the last one in 1997.

The program growth accelerated in 1992 after PSU's EMP staff became the editorial headquarters for PICMET, Portland International Conference on Management of Engineering and Technology. Right now, there are three major EMP faculty and five adjunct instructors. The EMP program offers eighteen EMP classes every year as well as a wide range of elective courses.

The total number of students enrolled in the EMP right now is approximately 100 students with 65% registered as part time and 35% as full time. There are currently sixteen Ph.D. students. Every year EMP sends about 300 packets to 30 countries and accepts about 30 to 40 students.

Summary of EMP Competition/Comparisons

As we look at the competition, it appears that PSU's EMP program:

1. PSU was found to have a very comprehensive Engineering Management Program. Of the core courses offered by other universities offering engineering management programs, only Entrepreneurship was found not to be available at PSU. On the balance, PSU appeared to have the most comprehensive set of Engineering Management Courses.
2. Four of the nine universities offered specialties in Engineering Management. The University of Maryland and George Washington both offered six individual specialties—probably tailored to industry and government requirements in the Washington DC area.
3. Only one of the universities stressed "distance learning" as an option.

4. PSU's EMP has several competitors in the Portland area. Program differentiation would seem important to reaching desired students.
5. PSU's engineering management program seems to be growing well. (Information on financial health was not determined)

0 RESEARCH

Characteristics of Target Audience

The Portland area target market for a graduate program in engineering management seemed to fall into two segments:
The descriptions below represent the typical attributes and needs of the two segments .

1. Segment 1. The first segment is characteristically described as a male between the ages of 25 and 30. He works between 50-60 hours a week and have very little free time.. Because of this he believes in getting the best use of his time. He is looking to further his career by moving into management versus becoming more technically specialized. He is looking for growth and a change in the job currently being held. This person wants to stay in the engineering area but with a different set of responsibilities. He is not afraid to work hard if needed and feels it is worth whiled. He may have a family with young children and is possibly foreign born. The most common undergraduate degree held is electrical and computer engineering or software engineering. Factors most important to him in choosing a graduate program are convenience and accessibility of the location, the courses and instructors that respect his time constraints, and quality of instruction. Cost may or may not be a factor - depending upon whether company pays for education. He is ambitious looking for career advancement. Members of this market segment would most likely become part-time students taking one or two classes a term.

This segment would be best reached through ads in local newspapers (business section), local business magazines, and by sending information to human resource departments at local companies Joint company/school programs may also be a vehicle to reach this segment.

2. Segment 2. The second segment is characteristically described as being of either sex, being foreign born and between the ages of 22-25. This perspective student may or may not have a family and their family may not be with them in the states. They are likely to live near or on campus an attend full time. Factors in their decision; program not offered in native country, a graduate degree is required in order to find a job, and cost. Portland State is less expensive even at non-resident graduate tuition than a private school.

This segment would be best reached by building awareness of program at West Coast, Pacific Rim, and East Asian Universities offering undergraduate degrees in engineering. Internet, home page and email, is a good way to communicate and reach the students from other countries.

Survey key parties to determine course and education delivery requirements (Questionnaire)

To create a program focused on high technology, the customer needs should be understood. For this reason, a survey of customers to the program was performed. The customers are categorized as former students, manager/employer of students, current students, perspective students, training managers, and professors. A copy of the questionnaire is attached in Appendix D. A total of 54 responses were received in this survey. Respondents included EMP faculty, students from the University, and employees from different high technology corporations, such as Digital, HP, Intel, RadiSys, and Techtronics.

If the education department is compared to a manufacturing process, the raw material is symbolized as the future students, the work in progress is the current student, and the product is the former students. The end

users are the students, and their managers. Finally the professors are the internal customers that need to satisfy the external customer requirements. The program delivery methods can be considered as class schedule, study method, and attributes like accreditation, location, and tuition the process variables. Available classes and subjects are the product that the university will be offering. Each one of these groups' requirements is an important part of the program and they should be understood.

To understand these criteria and products, we included in the questionnaire questions regarding what class schedule would be preferred, what study method would be preferred. Respondents where asked to rate the importance of the attributes used to choose a graduate program, and the relevance of the courses to their careers. At the end of the questionnaire, we requested information on postgraduate courses, books or training received or read.. The demand for a specialized program of Engineering Management with High Technology Emphasize was also studied.

0 ANALYSIS OF RESULTS

Survey analysis

The survey was analyzed to look for areas of improvement in customer satisfaction. The first area studied was the motivational factors "open question" at the end of the survey. The question asked: "Q11: What would/did motivate you to pursues an advanced degree?" This question provided an unexpected convergence of responses, especially as the surveyors entered their information, rather than choosing from a table. This information is important as a University that focuses its program to motivate its customer will be able to attract and maintain more customers. Understanding motivational factors will give its program an advantage over other programs and other universities. The Pareto of the response can be seen in table 5.1. the total percentage is not equal to 100% because some of the respondents gave more than one answer.

Table 5.1

Response	% Respondents
Career Enhancement	42%
Expand Knowledge	22%
Greater Income	22%
Expand Marketability	9%
Bigger effect on company	5%
Other	28%

The second survey area examined was the demand for an Engineering Management program with a concentration on high technology. The respondents were asked to rate the desirability of several types of advanced degree programs—including an EMP program with a high technology focus. They rated the programs in categories from "1" that represent "would not choose" to "5 " meaning "will choose". For the purpose of this survey we rated responses greater than 3 as "will choose", equal and under 3 as "will not choose". (The response of "3" was included in the "will not choose" category, as it is neutral and indicated a lack motivation to choose.)

Based on this rating we developed the following table (table 5.2) On one axis is listed the percentage of people that will or will not choose the High Technology Emphasize and on the other axis the percentage of persons that will choose or not choose the regular EMP program.

Table 5.2

	EMP Program with High Technology Emphasize	
Regular EMP program	Will choose	Will not choose
Will Choose	48%	15%
Will not Choose	20%	17%

Based on this information, 68% of the respondents would choose an engineering management program with high technology emphasize, but 48% would have registered for the basic EMP program anyway. If an engineering management program with a high technology emphasize is created it will only recruit 20% new students, the rest will come from students that would have chosen the regular EMP program anyway. The next step was to investigate the preferences of the 20% that would choose the high technology EMP and not the regular EMP program. Then we compared the responses to those of the 15% that would choose the regular EMP program but would not choose the EMP program with high technology emphasis. It was interesting to find that the two groups did not show any significant difference in the relevance to the courses.

The degree program preferred was then reviewed. It was surprising to see that 83% of the respondents would pursue or recommend pursuing a masters degree wile only 6% would pursue or recommend to pursuing a doctorate degree. Determining why such a small percentage would advance into a doctorate degree is outside the scope of this project, however it is strongly recommended that further study be performed in this subject so that the university could increase the supply line of good doctorate candidates. (Some universities have chosen to offer a Doctor of Engineering Degree in addition to the Ph.D. The difference is that the Doctor of Engineering is more application focused and requires an internship and practical application of skills instead of the dissertation.)

Compare and contrast course requirements

Key program attributes like degree offering, accreditation, and location were also studied to understand the customer expectations. A clear difference was found in perceptions of the importance of accreditation Students rated accreditation very important with an average rating 4.1 . However, professors rated it as rather unimportant giving it an average rating of .17. Understanding and closing these gaps will allow higher satisfaction of the professors and students. Information regarding the rating of the attributes can be seen on table 5.3.

Table 5.3

Attributes	Average	Professors	Gap
Degree Offering	4.6	5.0	0.4
Quality of Instruction/reputation of instructors	4.3	5.0	0.7
Accreditation	4.1	1.7	2.4
Schedule	4.1	3.7	0.4
Location	3.8	4.3	0.5
School reputation	4.1	4.0	0.1
Ratio of professors to students	3.3	4.3	1.0
Tuition	3.2	2.7	0.5
Service level	2.8	3.0	0.2

The Kano model of customer needs is used to identify the customers' requirements versus what is provided by the current EMP. This model is helpful in understanding what gaps need to be filled in order to motivate more students from the high technology industry to attend PSU's EMP. In this analysis, the average of the relevance assigned by all possible customers is also used. The customers were defined as future students, current students, former students and professors. The ratings were divided into three categories which are: less than or equal to three as "not relevant", between three and four as "relevant" and between four and five as "very relevant". The engineering management offerings were divided into 5 categories; "core classes", Option 1, option 2, electives, and not offered. The results can be seen in table 5.4.

Table 5.4

	Customer Perceived Relevance		
	Not relevant	Relevant	Extremely Relevant
Core		System Anal. & Decision Making Operations Manufacturing Marketing	Project Management
Option 1		Communications	Team Building
Option 2	Computer Aided Manufacturing	Strategic Planning Economic Analysis	
Electives		TQM/ Reengineering Manufacturing process Manufacturing Management Adv. Production Control Technology.	
Not Offered	Simulation—Note: offered through System Sciences Business Law---Note: now offered Environmental Engineering Accounting for Engineers	Design for Manufacturing Organizational Behavior Engineering Optimization Resource Management Statistics Note: offered in other courses Reliability and Risk Assessment Information Systems Supplier Management Reliability and Regulatory Production Planning, logistics, Trasnsp.	

Compare and contrast course delivery requirements

Additional questions were included regarding where and when the courses were preferred. These maybe critical factors to some students. It was very interesting to find that the only favorable class time was in the evening. The options of regular works hours, leave of absence to become a full time student, and weekend classes all received negative feedback from persons surveyed. The university campus was clearly the preferred place for classes. A neutral preference was shown to joint employer--university education and at work site classes. Other options like independent studies, Internet classes, and video classes were perceived as non-preferred.

Provide alternatives for improving PSU EMP program

From the literature search, it appears that PSU's EMP program is a model as far as the courses offered. It also appears that PSU is well organized to reach the candidate students by offering most of the EMP classes on campus and at evening hours. It is questionable whether PSU would benefit from implementing a TQM program like was done at OSU or at DCCC. A strong and determined leadership—in the process for the long term is required. Such a commitment was not evident to any of the members of this team.

However, it did appear that PSU's EMP program might benefit from expanding some of the course coverage to focus on high technology industry. Three possible options were identified:

1) Option 1 - Do nothing, continue to offer the same curriculum.
   a) Economic Analysis: Costs will stay the same and or grow with the present program.
   b) Strengths: Costs are known and curriculum is well developed.
   c) Weakness: May be accused of ignoring the business community and not listening to their needs. High technology industry does not associate keeping the status quo as working for improvement and greater customer satisfaction.
   d) Opportunity: Can focus on improving current classes through student input.
   e) Threat: May miss out on an opportunity to grow the program and lose potential students to other programs in the area.

2) Option 2 - Add two to three electives in areas that are of interest to the high technology community.
   a) Economic Analysis: Assuming one class is taught each term and Portland State is able to recruit an adjunct instructor from the local business community cost for professor and materials would be $1800 to $2400 for a three hour class and $2400 to $3200 for a four hour class. Portland State would need to attract 5 additional students to cover costs

	Cost - Adjunct Instructor	Number of part - time students to break-even
3 hour class	$1800-2400	3.5 -4.6
4 hour class	$2400-3200	3.5 -4.6

   b) Strengths: Would appear to be listening to the high technology community. Risk is minimized in only offering one class per term.
   c) Weakness: Effort may be seen by industry as half-hearted or weak.
   d) Opportunity: Provides an option for the student in the high technology industry to obtain some industry specific education. Portland State can determine demand for additional classes or programs without the risk.
   e) Threat: May lose potential students to other programs in the area that offer a program more closely targeted to the high technology industry.

3) Option 3 - Offer a Master's in Engineering Management with a high technology emphasize.
   a) Economic Analysis: Cost to realign curriculum. Look at core classes and tailor to high technology. Add new classes just for high technology subjects.
   Assuming one regular professor develops the program changes—we estimate that it would take approximately 9 months at an approximate cost of $30,000. The new program would need to attract 15 new students (part-time taking 4 hours a term, paying in-state tuition). These students would have to attend all three terms.
   b) Strengths: Would be actively working to fill a need of the high technology. industry, a major segment of the local economy.
   c) Weakness: The need might not be strong enough to provide the number of students needed to support a targeted program.
   d) Opportunity: Could increase student base of the engineering management program and provide some good publicity to Portland State.
   e) Threat: Could strain resources weakening existing program.

Based on the options presented, we would select Option 2. It is not apparent from survey results that a large need exists for a high technology specific program. The most of the needs expressed on the survey by potential students in the high technology industry can be met with the existing program. Costs that are associated with setting up a new program may weaken and distract from the current program. Effort should be invested in improving existing classes based on feedback from current and former students, the customer. Focus should be placed on publicizing the existing program through local employers and universities. In the development of the two or three elective classes, pains should be taken to insure the material presented is current and the instructor is well versed on up to date industry practices and technology. Based on survey results the preferred delivery option is face to face with classes held in the evening on campus. The university and Engineering Management Program should pursue industry partnerships through a formalized outreach program.

RECOMMENDATIONS:

Based on the results of our study, we offer the following recommendations:

1. PSU should use the Baldrige Criteria for higher education to assess the current state
2. PSU should attempt to partner with local major industries. Perhaps implementing a continuous

improvement program similar to that at Purdue—with local industry representatives on the board—could serve as a bridge.

3. PSU should consider offering a track tailored to high technology industry. Perhaps starting with only one class and growing as the results demand.
4. Portland State should focus on promoting the EMP to industry. When compared with EMP programs across the nation Portland States program held its own. Awareness of the program needs to be established throughout the high technology community. Portland State needs to listen to its customer, the high technology industry, in identifying improvements to course content and class offerings.

AREAS FOR FURTHER STUDY.

Several possible areas for further study were identified:

1. Apply the Malcolm Baldrige criteria to PSU. The Malcolm Baldrige criteria for evaluating universities were issued in 1995 and has recently been reissued. It would be an interesting project to evaluate PSU by that criterion and perhaps determine if the shortcomings would be sufficient to cause the university to begin the journey toward TQM.
2. Evaluate the desirability of mixed venue classes. We did not address the desirability of offering classes in the university environment that were also available on videotape. Given that many of the potential students work near 60 hours per week, a video backup would facilitate study for those times when work precluded the attendance at regular classes.
3. Alter the Ph.D. program content. Investigate the feasibility of offering a Doctorate of Engineering as well as the Ph.D. The Doctorate of Engineering may attract more students that have a desire to enrich their knowledge in Engineering Management principals through application and associated class work, but do not desire to pursue a specific and detailed subject often dictated by a dissertation
4. Investigate why there is such a low percentage who pursues a Ph.D. degree. Does it have to do with limited career advances or the structure of the program?
5. Determine why there is a big gap in the accreditation for professor's perspective and students' perspective.

Appendix A –Core Engineering Management Program Courses.

SCHOOL	Multi Paths	Quant Dec making	Mrktng	Quality	Proj mgmt	Finance/ Actg	Manu-facturing	Planning/ control	Strategy	Org behavior	Info System	Engr Mgmt	Bus Ethics/ law	other
Stockholm	Mech Engr, Elect Engr, Comp Sci		X	X		X	X	X	X		x			Logistics, Cultural studies
Stanford			x	x		X		x	x	x				
UM-Rolla (each path has 8-13 specialized courses)	Mfg Engr, Pack Engr, Indu Engr, Qual Engr Mgmt of technology		X,x		x	x			x	x		x	x	Entrepreneurship
U of Mich			x	x		X,x		x	x	x	x	X,x,x	x	Sys Engr
George Washington (each path has specialized courses)	Const mgmt Env/energy R&D Market of technology Public works Trans mgmt	x				x			x	x	x	x		System Engr. Engr Econ
Northwestern		x	x		x	X,x		x				x		Statistics, Resource mgmt
U of Kansas	Distance learning		x	x	x	X,x				x	x	x		
U of Florida			x			X,x	x			x		x		Ops Res, Probability, process mgmt
U of Maryland (each path has specialized courses)	Core Bio engr Environ Engr Manuf Engr Systems engr Engr mgmt	x			x	x			x	x		x		
PSU-EMP		x	x	E	x	x	E	E	E	x	E	x		Ops Res
OTHERS														
Non Degree														
LSU	TQM Certify Indu Safety Engr mgmt Cost Est.													
Lockheed Martin Engr Mgmt Prog.	Aerospace Civil/Environ Computer Electrical Mechanical telecommunication			X,x	x	x						x		leadership
Ingersoll-Rand	Engr and Mfg Mgmt					x	X,x		x	x				
MIT	Leaders for Mfg Prog													Industry problems

Legend: x---- denotes one class is required
Xx- denotes two classes in subject are required

APPENDIX B– Universities that Embrace TQM

Universities listed in literature as using and or benefiting from application of TQM are listed below:

1. Colorado State University, State University of New York at Stony Brook [22]/
2. Alveeno College [21]
3. Penn State [18]
4. Samford University, Lehigh, University of Pennsylvania, University of Michigan, University of Minnesota, U.S. Naval Academy, Fox Valley Technical College, Delaware County Community College, Arkansas Tech University, Towson State University, Northwest Missouri State University, Belmont University [11]
5. University of Wyoming, University of Wisconsin, University of Tennessee, Oregon State University, University of Columbia [10]
6. Carnegie-Mellon, Chicago University, Colorado State, Columbia, Florida State University, Harvard University, Hawkeye Inst of Technology, Illnois Inst of Technology, Jackson CC, Lamar CC, North Carolina, N D University, Nor Carolina University, Palm Beach CC, Pepperdine University [3]

APPENDIX C. Competition for a Master's in Engineering Management in the Portland Area

School	Programs	Location	Class Times	Delivery
Portland State	MBA, MEM	Downtown; Capital Center	evening	face to face
Oregon Graduate Institute	Computer Science, Master's Science in Management	Capital Center	evening, weekend	face to face and distance learning
University of Portland	MBA, Civil, Electrical, Mechanical	North Portland	evening	face to face
OCATE	Master's Manufacturing Engineering, Computer Science, Electrical Engineering	Capital Center	evening	face to face, TV
Oregon Executive MBA	MBA	Capital Center	Fridays and Saturdays	face to face
Washington State	MBA, MEM	Vancouver	evening	Video(MEM)
George Fox	MBA	Newberg	evening	face to face
Marylhurst	MBA, Master's Management	Lake Oswego	weekend evening	face to face, online
University of Oregon	Applied Information Management	Portland Hillsboro (Capital Center)	evening	face to face
Willamette	Master's in Management	Salem	evening	face to face
Oregon Joint Professional Schools of Business	Masters of International Management	Capital Center	evening	face to face

APPENDIX D. Questionnaire used to assess EMP educational requirements.

Professor / Training Department

Reference Information:

Q1. Industry Association:

_____ High Tech
_____ University/Higher Ed.
_____ Manufacturing
_____ State/Local Government
_____ Financial/Banking
_____ Health Care
_____ Other (specify)_____

Q2. Relationship to Portland State's Engineering Management Program:

_____ Professor/Instructor
_____ Former Student - dropped program
_____ Manager/employer
_____ Perspective Student
_____ Former Student - graduated
_____ Current Student
_____ Training Manager

Q3. Highest degree of education completed by your students

	Degree
_____ Undergraduate	_____
_____ Bachelors	_____
_____ Master	_____
_____ Ph.D.	_____

Q4. Current Position: _____

Educational Preferences:

Q5. What degree of education do you recommend for your students.

_____ Undergraduate
_____ Bachelors
_____ Master
_____ Ph.D.

Q6. Which of the following program will you recommend for your students?

	Not recomend				Will recommend
• Business Administration •	1	2	3	4	5

•

• Engineering Management	1	2	3	4	5
• Engineering Management with High Tech. Emphasize	1	2	3	4	5
• Engineering Technical Discipline	1	2	3	4	5
• Other (Specify)_____	1	2	3	4	5

Q7. What class schedule will be preferred for your student in order to obtain a degree:

	Not Preferred				Preferred
• Regular Work Hours 8:00am-5:00pm	1	2	3	4	5
• Take evening classes	1	2	3	4	5
• Take weekend classes	1	2	3	4	5
• Seek a leave of absence or quit job and attend full time	1	2	3	4	5
• Other (Specify)_____	1	2	3	4	5

Q7. What study method will be preferred:

	Not Preferred				Preferred
• Independent studies	1	2	3	4	5
• Internet	1	2	3	4	5
• Join employer university education	1	2	3	4	5
• On University Campus	1	2	3	4	5
• On Work Site	1	2	3	4	5
• Video Classes	1	2	3	4	5
• Other (Specify) _____	1	2	3	4	5

Q8. Rank the importance of the following attributes you would use in choosing a graduate program.

	Not Important				Very Important
• Accreditation	1	2	3	4	5
• Degree offering	1	2	3	4	5
• Location	1	2	3	4	5
• Quality of instruction/reputation of instructors	1	2	3	4	5
• Ratio of Professors to Student	1	2	3	4	5
• Schedule (Time of Class offering)	1	2	3	4	5
• School reputation	1	2	3	4	5
• Service Level of Services (Registrars, Controllers, ...)	1	2	3	4	5
• Tuition	1	2	3	4	5
• Other (Specify)_____	1	2	3	4	5

Q9. Which classes/subjects have you found or believe you would find to be the most relevant or helpful in order to improve job performance.

Not Relevant Very Relevant

Accounting for Engineers	1	2	3	4	5
Advance Production Control Techniques	1	2	3	4	5
Business Law, (Contract, Patent, Human Resources)	1	2	3	4	5
Computer-Aided Manufacturing	1	2	3	4	5
Communication	1	2	3	4	5
Design for Manufacturability	1	2	3	4	5
Economic Analysis	1	2	3	4	5
Engineering Optimization	1	2	3	4	5
Environmental Engineering Management	1	2	3	4	5
Finance	1	2	3	4	5
Information systems	1	2	3	4	5
Manufacturing Process	1	2	3	4	5
Manufacturing Management	1	2	3	4	5
Marketing	1	2	3	4	5
Operations/manufacturing	1	2	3	4	5
Organizational behavior	1	2	3	4	5
Project Management	1	2	3	4	5
Production Planning, logistics, transportation	1	2	3	4	5
Reliability and Regulatory	1	2	3	4	5
Reliability and Risk Analysis of Engineering Systems	1	2	3	4	5
Resource Management	1	2	3	4	5
Simulation	1	2	3	4	5
Strategic planning	1	2	3	4	5
Statistics	1	2	3	4	5
Supplier Management	1	2	3	4	5
Systems Analysis and Decision Making	1	2	3	4	5
Team building	1	2	3	4	5
TQM/Reengineering	1	2	3	4	5
Other (Specify)_____	1	2	3	4	5
Other (Specify)_____	1	2	3	4	5

Q10. What where the most valuable courses, books, or training have you taken or read after graduation that you will recommend to your students to improve job performance.

_____

_____

_____

_____

Q11. What do you think will motivate people to pursue an advanced degree?

_____

APPENDIX E. Survey Results: Comparison of courses relevance as seen by Education program preferences. (1 = Not Relevant, 3 = Possible Relevance, 4 = Relevant, 5 = Very Relevant) (EMP = Engineering Management Program, HT EMP = Engineering Management Program with High Technologynology empahasis.)

	Will Choose EMP & Will Not Choose HT EMP	Will Not Choose EMP & Will choose HT EMP	Will Choose EMP & Will Choose HT EMP	Total	Diference
Average of · Design for Manufacturability	3.63	4.36	3.77	3.89	0.74
Average of · Project Management	4.50	4.18	4.38	4.36	0.32
Average of · Manufacturing Management	3.25	4.00	3.31	3.47	0.75
Average of · Team building	4.38	3.82	4.04	4.04	0.56
Average of · TQM/Reengineering	4.13	3.82	3.46	3.67	0.66
Average of · Manufacturing Process	3.50	3.82	3.46	3.56	0.36
Average of · Engineering Optimization	3.25	3.64	3.50	3.49	0.39
Average of · Strategic planning	4.13	3.45	3.85	3.80	0.67
Average of · Economic Analysis	3.88	3.45	3.38	3.49	0.49
Average of · Communication	3.75	3.36	4.04	3.82	0.67
Average of · Operations/manufacturing	3.75	3.36	3.27	3.38	0.48
Average of · Resource Management	3.38	3.36	3.46	3.42	0.10
Average of · Reliability and Risk Analysis of Engineering Systems	3.63	3.27	3.42	3.42	0.35
Average of · Advance Production Control Techniques	3.00	3.27	3.54	3.38	0.54
Average of · Systems Analysis and Decision Making	4.00	3.18	4.15	3.89	0.97
Average of · Organizational behavior	3.88	3.18	3.77	3.64	0.69
Average of · Reliability and Regulatory	3.13	3.18	3.15	3.16	0.06
Average of · Statistics	3.38	3.09	3.65	3.47	0.56
Average of · Supplier Management	3.25	3.09	3.35	3.27	0.26
Average of · Information systems	2.88	3.09	3.42	3.24	0.55
Average of · Computer-Aided Manufacturing	2.63	2.91	3.23	3.04	0.61
"Average of · Production Planning, logistics, transportation "	3.50	2.64	3.23	3.13	0.86
Average of · Marketing	3.50	2.55	3.38	3.20	0.95
Average of · Environmental Engineering Management	3.00	2.55	2.92	2.84	0.45
Average of · Finance	2.88	2.55	3.31	3.04	0.76
Average of · Simulation	2.88	2.36	3.12	2.89	0.75
Average of · Accounting for Engineers	3.75	2.27	3.19	3.07	1.48
"Average of · Business Law, (Contract, Patent, Human Resources) "	2.75	2.18	3.12	2.82	0.93

APPENDIX F. Survey Results: Comparison of program preferences as seen by different industries associations. (1 = Not choose, 3 = May choose, 5 = Will choose) (Ave. = Average)

	High Tech	Manufacturing	University/ Higher Education	Other	Student	Finance/Banking	Grand Total
Ave. of· Business Administration	2.8	1.0	3.1	3.0	3.0	1.0	2.8
Ave. of · Engineering Management	3.3	5.0	4.0	5.0	4.0	5.0	3.6
Ave. of · Engineering Management with High Tech. Emphasize	3.8	1.0	3.5	1.0	4.0	1.0	3.6
Ave. of· Engineering Technical Discipline	2.6	1.0	2.3	1.0	2.0	1.0	2.5

APPENDIX G. Survey Results: Comparison of program preferences as seen by different customers categories. (1 = Not preferred, 3 = Indifferent, 5 = Preferred) (Ave. = Average)

	Current Student	Former Student	Manager/Employer	None	Perspective Student	Professor/Instructor	Grand Total
Ave. of· Regular Work Hours 8:00am-5:00pm	2.1	2.0	1.1	1.2	1.8	1.0	1.6
Ave. of · Take evening classes	4.3	5.0	4.6	4.7	4.4	5.0	4.5
Ave. of · Seek a leave of absence or quit job and attend full time	2.4	3.0	2.1	2.3	2.2	2.0	2.3
Ave. of· Take weekend classes	1.3	2.5	3.1	3.3	2.1	3.5	2.4

APPENDIX H. Survey Results: Comparison of program preferences as seen by different customers categories. (1 = Not preferred, 3 = Indifferent, 5 = Preferred) (Ave. = Average)

	Current Student	Former Student	Manager/Employer	None	Perspective Student	Professor/Instructor	Grand Total
Ave. of· Independent studies	2.6	4.0	2.4	2.2	2.6	2.5	2.5
Ave. of · Internet	2.1	3.0	2.0	1.8	2.3	3	2.2
Ave. of · Join employer university education	2.6	5.0	3.0	3.1	3	4.5	3.1
Ave. of · On University Campus	4.5	4.5	4.1	4.0	3.8	4.5	4.1
Ave. of · On Work Site	2.3	3.5	3.3	3.2	3.1	3.5	3.0
Ave. of · Video Classes	2.4	3.0	2.5	2.1	2.9	3.0	2.5

BIBLIOGRAPHY

0. Chickering, Arthur W. and David Potter, "TQM and Quality Education: Fast Food or Fitness Center? *Educational Record*, Vol. 74 No 2, pp 35-36, Spring 1993.

1? Coate, L. Edwin,"An Analysis of Oregon State University's Total Quality Management Pilot Program," *New Directions for Higher Education,* No 83 pp. 42-62, Fall 1993.

2? Coate, L. Edwin, "Implementing Total Quality Management in a University Setting" *New Directions for Institutional Research,* Vol. 18 No3 pp. 27-38, Fall 1991.

3? Coate, L. Edwin, "TQM on Campus: Implementing Total Quality Management in a University Setting,," *Business Officer,* Vol. 24 No 5 pp. 26-35, Nov 1990.

4? Davis, James R., "Reengineering Teaching for the 21st Century Learning," ," *Educational Record*, Vol. 84 No 2, pp 16-22, Fall 1995

5? DeCosmo, Richard D et al,"Total Quality Management Goes to Community College," *New Directions for Institutional Research*, Vol. 18 No. 3, pp. 13-25, Fall 1991.

6? Dooris, Michael J., Teeter, Deborah J., "Total Quality Management Perspective on Assessing Institutional Performance," *New Directions for Institutional Research*, No. 82, pp. 51-62, Summer 1994.

7? Entner, Donald, "DCCC Takes the TQM Plunge...And Tells How," *Educational Record*, Vol. 74 No 2, pp 29-34, Spring 1993.

8? Ewell, Peter T., "Total Quality & Academic Practice: The Idea We've Been Waiting for?," *Change"*, Vol. 25, No 3, pp. 49-55, May-June 1993.

9? Fisher, James L., "TQM: A Warning for Higher Education," *Educational Record*, Vol. 74 No 2, pp 15-19, Spring 1993.

10? Froiland, Paul, "TQM Invades Business Schools," *Training*, Vol. 30, No. 7, pp. 52-56, Jul 1993.

11? Godbey, Galen, "The Agile Institution," *Educational Record*, Vol. 74 No 2, pp. 37-42, Spring 1993.

12? Higgins, Ronald C. et al,"Total Quality Management in the Classroom: Listen to Your Customers, "*Engineering Education*", Vol. 81, No. 1, pp. 12-14, Feb 1991.

13? Karathanos, Demetrius and Patricia Karathanos, "The Baldrige Education Pilot Criteria 1995: A Integrated Approach to Continuous Improvement in Education," *Journal of Education for Business*, Vol. 78, No. 3, pp. 272-275, May/June 1996.

14? Melissaratos, Aris Arendt, Carl,"TQM Can Address Higher Ed's Ills. Westinghouse Executive Offers Advice," *Business Officer*, Vol. 25, No. 10, pp. 32-35, April 1992.

15? Motwani, Jaideep,"Implementing TQM in Education: Current Efforts and Future Research Directions," ," *Journal of Education for Business*, Vol. 79 No 2, pp. 60-63, November/December 1995.

16? "News", *NACUBO Business Officer,* pp. 8-9, March 1997.

17? Presutti, William D., Jr. et al,"Total Quality Management and Cooperative Learning: An Attempt at Synergy," *Journal of Education for Business*, Vol. 70, No. 3, pp. 135-140, Jan-Feb 1995.

18? Ryan, James H., and Arthur A. Heim, "Promoting Economic Development Through University and Industry Partnerships," *New Directions for Institutional Research*, No. 97, pp. 42-51, Spring 1997.

19? Seymour, Daniel, "TQM Focus on Performance, Not Resources," ," *Educational Record*, Vol. 74 No 2, pp. 6-14, Spring 1993

20? Sherr, Lawrence A., Lozier, G Gregory, "Total Quality Management in Higher Education," *New Directions for Institutional Research*, Vol. 18, No. 3, pp. 3-11, Fall 1991.

21? Vazzana, Gary S., et al,"Can TQM Fill a Gap in Higher Education?," *Journal of Education for Business*, Vol. 88 No 2, pp. 313-316, May/June 1997

22? Winter, Robert S., "Overcoming Barriers to Total Quality Management in Colleges and Universities," *New Directions for Institutional Research*, Vol. 18, No. 3, pp. 53-62, Fall 1991

23? B. S. Dhillon. Engineering Management. Technomic Publishing Company, Inc. 1987

24? William A. Cohen High-Tech Management. American Management Association 1986

25. Alvin and Heidi Tofler. Creating a new civilation. Turner Publishing, Inc. 1994