

How to market ETM for prospective students



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Decision Making

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Abstract

This paper proposes a hierarchical decision model to identify the impact of the key decisions that influence a student to choose Engineering and Technology Management at PSU. As part of the overall methodology, criteria for choosing ETM are first identified through a preliminary survey. The criteria and their alternatives are compared to each other using pair-wise comparisons. This paper highlights the importance of the hierarchical decision model using pair-wise comparisons and shows its importance as a decision-making tool. The paper makes recommendations on some of the strategic decisions needed to be taken by Management in areas like enrollment, curriculum, etc for attracting more students to join the ETM Program at PSU.

Executive Summary

The Department of Engineering and Technology Management was established in 1987 and it is home to a diverse range of students with different academic and professional backgrounds. The ETM program also leads global initiatives like the Portland International Conference on Management of Engineering and Technology (PICMET) that help to spread engineering and technology management knowledge throughout the world. Besides the learning experience, Portland offers ETM students various opportunities for professional advancements as well as other recreational opportunities [1]. Though there never used to be a lack of job opportunities for ETM graduates, given the downfall of US Economy since 2007, and if a strong economic recovery is delayed, the demand for graduates will remain low, and this might have serious repercussions on the enrollment of new ETM students. While the ETM Department had not conducted any study to really assess the reasons why students opt for ETM at PSU, our team felt the need to look into the factors that have contributed to this.

1. Introduction

Engineering programs in many countries are experiencing a decline in student enrollments. There have been several reasons cited, such as lack of awareness, lack of role models/mentors etc [2]. It appears seen that many engineering colleges in the world including US are going through a decline in student enrollments. In 2003, the Northern Illinois University, Chicago conducted a case study to assess these problems and recommended successful strategies to increase student enrollment [2]. The trend in student enrollment for ETM at PSU has been somewhat steady with slight occasional declines in enrollment in some quarters, from 1991 to 2008. While this is not a major concern at this time, since enrollment has been more or less on the positive side, yet it is important to explore the reasons why students opt to choose ETM at PSU. This paper helps to identify the criteria that have attracted both current native and international students to opt for ETM, and at the same time makes a preliminary assessment of the strengths and weaknesses of the initiatives currently being taken by the ETM Department as part of the enrollment process. The criteria are compared to each other using the pair-wise comparison method, and the dominating criteria are further assessed to explore alternate strategies which will enable the ETM Department to attract more new students to opt for ETM at PSU.

Project Objectives

- To identify criteria that impact the overall selection process of the ETM Program
- To determine the impact of these criteria.
- To compare and prioritize the relative weights of each criterion.
- To come up with the best possible strategies to successfully market ETM to new students.

The following graph shows the ETM enrollments from the years '91-92' to '07-08'.



Figure1: ETM Total Enrollments for the entire year(Source: ETM Department, PSU)

2. Methodology

The methodology consists of a combination of two proven decision-making models – Delphi [3] Method and Analytic Hierarchy Process (AHP) [4] - for selecting the two optimal criteria out of five that would have the most impact on the overall decision to select the ETM department for future study. An in-depth literature search is carried out to study and develop the underlying concepts behind the relationship and relative importance of change agents, where each criterion consists of three alternatives. A survey of an expert group of Delphi panelists, ETM students (native and foreign) in this case, is carried out with relevant questionnaires. The questionnaires include questions on a wide variety of decision criteria (like academics, department reputation, etc.), which are developed by the team after consulting with Dr. Kocaoglu. Once a student completes the survey by indicating a preference between two alternatives under each criterion, and between two mutually

distinct criteria through pair-wise comparison, AHP and PCM software is used to quantify the experts' judgments and find out the aggregated impact of each of the alternatives on its respective criterion and individual impact of each of the criteria on the overall final decision. A further literature review is carried out to validate the reliabilities and outcomes. Delphi methodology is used because of its structured nature in collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback. By incorporating quantitative and qualitative considerations, the Delphi method facilitates a discussion through writing among anonymous experts to achieve consistency in approaching the topic under debate. The Delphi method is followed in this study by

- a) Identifying and validating the issues that impact the quality of the ETM department through relevant literature documents.
- b) Developing a set of criteria and their alternatives based on the identified issues.
- c) Creating a set of questionnaires to assess the opinion of the experts on the issues.
- d) Selecting an expert panel consisting of students from varied backgrounds.
- e) Keeping the expert panel anonymous to prevent any bias or bandwagon effect.
- f) Testing the quality of the questionnaire through consultation with the Chair of the ETM department.
- g) Analyzing the expert responses thoroughly for any ambiguity or vagueness

Furthermore, AHP is used to prioritize the hierarchy and consistency of judgmental data provided by the group of experts. AHP incorporates the evaluations of all decision makers into a final decision, without having to elicit their utility functions on subjective and objective criteria, by pair-wise comparisons of the alternatives during the survey process. (Saaty, 1990), (Adler and Ziglio, 1996), (Hartman, 1981). AHP is followed in this study by:

- a) Establishing a hierarchical structure through identification and selection of alternatives under each respective change agent.
- b) Establishing a pair-wise [5] comparison matrix and computing relative weights of elements of each hierarchy.
- c) Computing the entire hierarchical weight, ultimately enabling decision makers to select the most appropriate strategy.

2.1 Implementation & Analysis

- 1. In our study, current students (native and foreign) enrolled in the ETM department are considered 'the experts' to take part in the survey process. The expert panel includes students from geographically dispersed regions.
- 2. A series of questionnaires are designed and handed out to each of the experts. The experts are asked to respond to a set of questions directly related to the issues that affect the overall quality of the ETM department. Once all the preferred criteria and their alternatives are marked by the experts using pair-wise comparison, the responses are discussed and compared with other results to derive possible trends.
- 3. Based on aggregated judgment quantification, relative weights of each of the criteria and their alternatives are determined and calculated using PCM software.

4. Hierarchical models, demonstrate the relationship between the criteria and the alternatives and their impacts on overall educational process improvement.

2.2 Recruitment of the Experts

The experts included in this research were current graduate students of the Engineering and Technology Department of Portland State University. Students of the Engineering and Technology Department were interviewed face-to-face in order to find out their predominant reasons for choosing the master's degree in Engineering and Technology Management at the ETM department at PSU. Around twenty five to thirty students representing various nationalities, both part-time and full-time were interviewed face-to-face. These individuals provided the opportunity to offer multiple perspectives on the potential reasons for choosing the ETM department for their higher studies. Base on the face-to-face interview, team members formulated criteria and alternatives through team consensus and their professor's approvals. The selected criteria and alternatives were distributed to thirty nine students representing various countries, who are currently doing their master's degree in the ETM Department, for pair-wise comparisons.

Experts included for pair-wise comparisons were current ETM students from the following geographical areas:



Figure 2: Geographical areas of the experts

Apart from these students, part-time and full-time students were also included for pair-wise comparisons. Thirty six students representing each geographical area were asked to do pair- wise comparisons based on their persuasions and reasons for choosing PSU for their higher degrees. In addition, they were asked for recommendations and improvements to the ETM Department, in order to position it as a better destination for future potential students. The pair wise comparisons were collected from the experts and processed for the analytic hierarchy process to determine the weight of each criterion and its criticality to the ETM department for future students.

2.3 Process flow chart

The paper proposes a hierarchical decision model to identify the impact of the key decisions that influence a student to choose Engineering and Technology Management at PSU. For accurate final results, we combined the data obtained from the experts who included students from different geographic locations and native part-time and full-time students and literature research. A decision hierarchy development process is developed based on the expert interviews and their suggestions, which include different criteria and alternatives. Finally the data obtained from the experts undergoes a judgment quantification process to determine the best possible strategy to successfully market ETM to new students.

Figure 3: Process flow chart of the research project [6]



3. Result and Analysis

3.1 Model development



Figure 4: AHP [4] model for how to market ETM to the new students

The above model explains the criteria that have to be considered in order to market the ETM program for new students. Each criterion has three alternatives that would impact the overall ETM enrollment. This model has been developed according to our survey with the ETM students.

3.2 Identification of the Criteria & its alternatives

Criteria	Description	Alternative
C1: Opportunity	 It is the possibility of the students in the future: To get a scholarship during study. 	 Future Career/Internship Scholarship Research & Capstone
	 To fulfill a good researches or capstones which will be the benefit for future careers? To succeed in future careers or internships applications. 	
C2: Environment	The situations and things that affect the way in which students live and study.	 Cost of living Facility (public transportation) University Location
C3: Information	The facts or details that tell you something about a university, classes, events and networks.	 On-line Video/Website Outreach program ETM network
C4: Academic requirement	The top issues relate to education, especially recruitment and term schedule.	 Curriculum Application requirement Class schedule
C5: Reputation	The overall quality as always mentioned and judged by future students.	 Professor ETM department PICMET Conference

Table 1: Terms and Definitions of the criteria [7-15]

According to our survey of ETM students, American students and international students provided us with five main criteria that can influence ETM educational development process: opportunity, environment, information, academic requirements and reputation. Also, students identified these criteria with three basic alternatives for each criterion as shown in the table below:

Criteria	Alternatives				
Opportuni ty	Future career/intemship	scholarship	Research/capstone		
Environment	Cost of living	Facility (public-transportation)	University location		
Information	On-line video/website	outreach	ETM net work		
Academic	Curriculum	Application requirements	Class schedule		
Reputation	Professor	ETM department	PICMET conference		

Table 2: Criteria and alternatives of how to market ETM to the new students

Another survey was done by distributing several questionnaires_to students. Each questionnaire was based on the pair-wise comparison method to compare the criteria with each other; and to compare the alternatives of each criterion individually. After running the results by a PCM program, we have found that our expectations were almost like the students' assumptions. Most students agreed that opportunity has the most effective influence on the process of ETM educational improvement. Both nationalities weighted opportunity at 0.29. On the other hand, they gave the greatest weight for the future career/internship alternative at 0.49. The weights of other alternatives vary from .41 to .24. The table below shows how much each alternative influences its criterion:

Criteria	Alternatives				
Opportuni ty	Future career/intemship	scholarship	Research/capstone		
opportunity	0.49	0.25	0.26		
Environment	Cost of living	Facility (public-transportation)	University location		
	0.41	0.30	0.29		
Information	On-line video/website	outreach	ETM net work		
momation	0.36	0.27	0.37		
Academic	Curriculum	Application requirements	Class schedule		
	0.40	0.31	0.29		
Reputation	Professor	ETM department	PICMET conference		
	0.38	0.38	0.24		

Table 3: Weight of each alternative from PCM

Results analyses show the break-down of weights that have been given by students for each criterion; and each alternative. The tables below explain these break-downs:

Criteria	Alternatives	Students' weights		Total weights / Criterion		
			international	American	international	
	Future career/internship	0.46	0.50	0.29	0.29	
1	Scholarship	0.29	0.24			
	Research/capstone	0.25	0.26	Tota	10.29	
	Cost of living	0.31	0.47	0.19	0.18	
2	Facility (public transportation)	0.25	0.31	Tot		
	University location	0.44	0.27	Tota	10.19	
	On-line video/website	0.39	0.36	0.11	0.12	
3	Outreach	0.25	0.27			
	ETM network	0.36	0.37	Tota	10.11	
	Curriculum	0.39	0.40	0.22	0.20	
4	Application requirements	0.28	0.32			
	Class schedule	0.33	0.28	Tota	1 0.21	
	Professor	0.36	0.38	0.19	0.22	
5	ETM department	0.40	0.38		0.22	
	PICMT conference	0.24	.24	Tota	10.20	

Table 4: Decision results

4. Conclusions and Recommendations

Master degree is very crucial to students' future careers. Sufficient information improves students' ability to make a decision. Consequently the ETM would have qualified students contributing to higher school ranking and better reputation in the long run. The purpose of this study is to encourage to be engaged in the ETM department. The results of this study as shown in the table below: there are strong relationships between the weights of criteria and alternatives. This table demonstrates the weight of the five criteria and their three alternatives. It is obvious that opportunity has the greatest weight followed by academic, reputation, and environment. The information criterion has the least weight compared to others, but still it has an acceptable degree of consideration. Also, this table shows the weights of the alternatives which have scores more than .30. Our strategies, proposed in this study, are based on the alternatives that have the greatest weights.

Criteria	Weight	Alternative	Weight > 0.30
1. Opp ortunity – Native students(0.29) (0.29)– International students(0.29)	0.29	 Future Career/Internship Native students International students 	0.46 0.46
2. Academic – Native students (0.22) – International students (0.21)	0.21	 Curriculum Native students International students Class schedule Native students International students 	0.39 0.39 0.33 0.33
3. Reputation – Native students (0.19) – International students (0.20)	0.20	 Professor Native students International students ETM Department Native students International students International students 	0.36 0.37 0.40 0.40
4. Environment – Native students (0.19) – International students (0.18)	0.19	 University Location Native students International students Cost of living Native students International students 	0.44 0.30 0.31 0.42
5. Information – Native students (0.11) – International students (0.11)	0.11	 On line Video/Website Native students International students ETM Network Native students International students 	0.39 0.36 0.36 0.35

 Table 5: Summary results of each criterion and alternative

Our study shows that both students gave each criterion the same weight. Although they scored environment almost at .19, they had different point of view about cost of living alternative and university location. Native students see that university location is very important factor for them compared to other alternatives, while international students consider cost of living alternative is the most crucial element for them.

Criteria	Strategies
1. Opp ortunity	 4 Set up an application system for internship program on the ETM website. 4 Approach local businesses to join industrial projects with synthesis, capstones, and research projects of the ETM students. 4 Provide more scholarship opportunities for ETM students who have the excellent academic records. 4 Arrange one or two trips per year to visit well- known companies in engineering and technology management fields.
2. Academic	 4 Periodically review existing courses and their future uses by including students, technologists, business professionals, and professors in the panel. 4 Periodically review and arrange class schedules matching with student requirements. 4 Invite reputed guess speakers in engineering and technology management fields to share knowledge and experience in seminar courses.
3. Reputation	 4 Arrange an awarding event for the students who succeed in publishing academic papers. 4 Post highlights events on the ETM website. 4 Enhance the reputation of the ETM department via PICMET conferences and academic and industrial networks.
4. Environment & Information	 4 Provide information about cost of living, facilities, and security on ETM website. 4 Post video-taped classes on You tube for more coverage. Not only bandwidth/server space will be free, but so will marketing. 4 Embrace online social media – Twitter, face book, LinkedIn, etc.

Table 7: Strate gies for marketing ETM for new students

5. Lessons learned

4 AHP and MOGS A are the effective model that helps the researchers to consolidate their ideas for the projects.



Figure 5: AHP model

4 PCM is a useful software that helps the researchers making decisions about complicated issue.

Paiewise Comparisons Mative Student Criteria NA-A NA-A NA-B NA-C NA-D NA-E Internaltional Student Criteria NI-A NI-B NI-G NI-G NI-G NI-G NI-G South Asia Griteria Africa Griteria Lat Asia
Sauth Asia Griteria Africa Griteria East Asia É= - PgUp PyIn Hone End

Figure 6: PCM program

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Appendix A: Questionnaire

Survey: Decision Criteria why select ETM for graduate program

Objective:

In order to collect the prior information and let our teammates understand the needs of existing ETM students before creating the hierarchy model

Open question:

1. Why did you select ETM for your graduate program?

2. With question number 1, please prioritize the order of your criteria.

Pair-wise Comparison: How to market ETM for prospective student Weighting Criteria for Impact Criteria

Nationality:

Action (Activity)	%	%	Action (Activity)
A1: Opportunity:			A2: Environment
(Future career/ internship,			(Cost of living, Facility (public
Scholarship Research/Capstone)			transportation, University Location)
A1: Opportunity:			A3: Information
(Future career/internship, Scholarship			(On-line video/Website, Outreach,
,Research/Capstone)			ETM Network)
A1: Opportunity:			A4: Academic
(Future career/ internship,			(Curriculum, Application
Scholarship ,Research/Capstone)			Requirements, Class Schedule)
A1: Opportunity:			A5: Reputation
(Future career/ internship,			(Professor, ETM Department,
Scholarship ,Research/Capstone)			PICMET Conference)
A2: Environment			A3: Information
(Cost of living, Facility (public			(On-line video/Website, Outreach,
transportation, University Location)			ETM Network)
A2: Environment			A4: Academic
(Cost of living, Facility (public			(Curriculum, Application
transportation, University Location)			Requirements, Class Schedule)
A2: Environment			A5: Reputation
(Cost of living, Facility (public			(Professor, ETM Department,
transportation, University Location)			PICMET Conference)
A3: Information			A4: Academic
(On-line video/Website, Outreach,			(Curriculum, Application
ETM Network)			Requirements, Class Schedule)
A3: Information			A5: Reputation
(On-line video/Website, Outreach,			(Professor, ETM Department,
ETM Network)			PICMET Conference)
A4: Academic			A5: Reputation
(Curriculum, Application			(Professor, ETM Department,
Requirements, Class Schedule)			PICMET Conference)

1. What would you recommend ETM to improve to the future? (3 recommendations)

2. What are unsatisfied things of ETM department? (3 comments)

Pair-wise Comparison: How to market ETM for prospective student Weighting Criteria for Alternative

Nationality:

Action (Activity)	%	%	Action (Activity)
A1: Future Career/Internship			A2: Scholarship
A1: Future Career/Internship			A3: Research/Capstone
A2: Scholarship			A3: Research/Capstone
B1: Cost of living			B2: Facility (Public Transport)
B1: Cost of living			B3: University Location
B2: Facility (Public Transport)			B3: University Location
C1: Information via On-Line Video/website			C2: Information via Outreach (academic agency, etc.)
C1: Information via On-Line Video			C3: Information via ETM networking (Alumni, professor, etc.)
C2: Information via Outreach (academic agency, etc.)			C3: Information via ETM networking (Alumni, professor, etc.)
D1: Academic Curriculum			D2: Academic Application Requirement
D1: Academic Curriculum			D3: Class Schedule
D2: Academic Application Requirement			D3: Class Schedule
E1: Reputation of professor			E2: Reputation of ETM department
E1: Reputation of professor			E3: Reputation of PICMET Conference
E2: Reputation of ETM department			E3: Reputation of PICMET Conference

Pair wise comparison results:

Relative Weights Project Title: Native Student Criteria					
lisers Person 1 Person 3 Person 4 Person 5 Person 6 Person 9 Person 9 Person 10 Hean Hin Max Std Dev	1 2 3 4 5 Inco 8.23 8.12 8.23 8.33 8.47 8.444 8.27 8.14 8.10 8.28 8.21 8.697 8.42 8.22 8.13 8.15 8.68 0.616 8.27 8.22 8.13 8.15 8.68 0.616 8.27 8.22 8.13 8.15 8.68 0.616 8.27 8.22 8.23 8.15 8.69 0.693 8.17 9.22 8.29 9.20 9.31 0.699 8.22 8.29 8.16 8.21 8.25 8.646 8.24 8.22 8.97 8.24 8.23 8.625 8.63 8.97 8.67 6.16 0.606 8.19 8.24 8.23 0.635 6.29 6.19 6.611 8.29 8.14 8.12 6.22 0.23 0.605 6.29 6.19 6.685 8.63 8.27 8.23 8.33 8.31 6.31 6.34 8.77				
ESC-Exit.	. 🛐-Help. 😰-Nane/Itens. 🛐-Save. 💇-Display. 🔂-Pairs. —————				

Figure 7: Criteria assessment from 10 native student experts

Figure 8: Criteria assessment from 26 international student experts from 4 main regions.

Relative Weights					
	Project litle: Foweign Students				
Users					
Terson 1	0.30 0.10 0.07 0.23 0.17 0.036				
Person A	0.31 0.10 0.14 0.17 0.47 0.01				
Person d	0 19 0 11 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				
Person h	H. 42 H. HY H. HY H. 15 H. 25 H. 164				
Person 6	8.32 8.15 8.12 8.23 8.19 8.053				
Person ?	0.30 0.20 0.11 0.14 0.15 0.004				
Person 8	A.39 A.68 A.12 A.26 A.21 A.017				
Person 9	0.59 0.11 0.09 0.08 0.13 0.024				
Perton 10	0.24 0.29 0.19 0.19 0.25 0.937				
Person 11	8.30 8.34 8.11 8.15 8.20 8.818				
Person 12	8.25 8.25 8.87 8.20 8.21 8.838				
Person 13	9.24 0.12 0.11 0.20 0.21 0.01				
Person 19	H. 32 H. 17 H. 12 N. 12 H. 23 H. 181				
Person 15	0,33 0,31 0,00 0,14 0,13 0,034				
Person 17	0.36 0.14 0.15 0.20 0.15 0.010				
Person 18	8,47 8,68 8,11 8,12 8,21 8,847				
Person 19	8,24 8,32 0.86 0.25 0.11 8.035				
Person 20	8.22 8.14 8.18 8.12 8.23 8.814				
Person 21	0.16 0.34 0.12 0.17 0.21 0.012				
Person 22	0.27 0.23 0.15 0.16 0.17 0.016				
Person 23	H. 20 H. 22 H. 13 H. 27 H. 13 H. 043				
Person 25	6 (1 6 26 6 (1 6 27 6 27 5 6 27				
Berenn 26	a 23 a 19 a 12 a 29 a 18 b age				
Te an	0.29 0.19 0.11 0.19 0.21 0.069				
Man	0.13 0.05 0.06 0.09 0.14				
Ман	0.59 0.34 0.23 0.29 0.39				
Gtd Dov	8.10 8.88 9.83 9.05 9.05				
= E10-Lait.	- Wi-Halp, UE-Hane/Items, UM-Gave, Wi-Display,				

Criteria	Alternative	Weight	In consistency	
1. Opportunity	1.1 Future Career/Internship	0.46		
	1.2 Scholarship	0.29	0.164	
	1.3 Research/Capstone	0.25		
2. Environment	ent 2.1 Cost of living 0.31			
	2.2 Facility (Public Transportation)	0.25	0.086	
	123 University Location	0.44		
3. Information	3.1 On-line video/website 0.39			
	3.2 Outreach	0.24	0.135	
	3.3 ETM Network	0.36		
4. Academic	4.1 Curriculum	0.39		
	4.2 Application requirement	0.28	0.066	
	4.3 Class schedule	0.33		
5. Reputation	5.1 Professor	0.36		
	5.2 ETM department	0.40	0.119	
	5.3 PICMET conference	0.24	1	

Table 8: Alternative assessment from 10 native student experts

Table 9: Alternative assessment from 26 International Student

Criteria	Alternative	Weight	In consistency		
1. Opportunity	1.1 Future Career/Internship	0.46			
	1.2 Scholarship	0.28	0.132		
	1.3 Research/Capstone	0.26			
2. Environment	2.1 Cost of living	0.42			
	2.2 Facility (Public Transportation)	0.28	0.114		
	123 University Location	0.30			
3. Information	3.1 On-line video/website	0.36			
	3.2 Outreach	0.29	0.106		
	3.3 ETM Network	0.35			
4. Academic	4.1 Curriculum	0.39			
	4.2 Application requirement 0.33		0.103		
	4.3 Class schedule	0.28			
5. Reputation	5.1 Professor	0.37			
	5.2 ETM department 0.40		0.107		
	5.3 PICMET conference	0.23	1		

Region	European	Middle East	East Asia	South Asia	Africa
	(3 students)	(6 students)	(7 students)	(6 Students)	(4 Students)
Opportunity	0.33	0.23	0.32	0.31	0.31
Environment	0.18	0.21	0.19	0.14	0.17
Information	0.09	0.13	0.11	0.12	0.12
Academic	0.20	0.23	0.18	0.20	0.16
Reputation	0.20	0.20	0.20	0.23	0.23
Inconsistency	0.089	0.046	0.083	0.058	0.080

Table 10: Comparison	the result of	criteria	assessment	among international	student
groups					