

Using Critical Thinking to Improve Engineering Student Retention



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Abstract

Improving the graduation rate of engineering students at any engineering college is a challenge. A new critical thinking tool that is gaining widespread use in lean manufacturing may be used by engineering colleges to guide their efforts in improving the graduation rate of their engineering students. This tool is known as the strategic X-matrix. An example using the strategic X-matrix will be presented.

Research Question

Using critical thinking, how does an engineering college improve its student retention?

Methodology

The ideas of lean six sigma were used to enhance critical thinking for the objective of improving engineering student retention.

Using six sigma DMAIC, first the overall objectives must be defined and the success indicators must be proposed and measured. The Strategic X-Matrix enhances critical thinking for this definition. Analyze-Improve-Control can then be used to Improve student retention. The X-Matrix enables an improved thought process for developing the improvement priorities and success indicators for higher graduation rates.

DMAIC

Define Measure Analyze Improve Control

An Example of a Strategic X-Matrix

•	•			•		4.1b Develop/Execute effective Web-site in which to grow research in energy innovation				•					•		•			•
•				•		4.1a Identify Opportunities for Research in Energy Innovation				•					•	•	•			
	•				•	3.1a Develop Feedback Loops to Alumni and perspective companies and Review student, faculty and stakeholder input/data				•				•		•				•
	•	•	•	•	•	2.2a Develop Mentoring Program for all new faculty							•			•	-	•		TT
			•	•	•	2.1a Develop Recruitment Strategy to Increase the Number of Minority and Female Faculty					•	•					-	•		TT
				•	•	1.2b Develop a 4-year careers in engineering support program	•	•		•						•	-	•	•	T
				•	•	1.2a Review and Implement the Curriculum Plan	•			•								•		
	•				•	1.1g Determine web-content for advising students on admissions, career opportunities, support for courses and engineering activities	•			•								•	•	•
					•	1.1f Evaluate and Develop a Study Abroad Program for engineering students	•			•						•		•	•	
				•	•	1.2e Evaluate Student Need for more Financial Support	•		•	•						•		•		11
	•				•	1.1d Develop Engineering Survey Course on Engineering Careers	•	•								•		•		
					•	1.1c Develop a Program to Increase Confidence in Math Skills and Scientific Reasoning	•									•		•		
	•				•	1.1b Manage the Student Success Programs for high freshman retention	•	•	•							•		•	•	
					•	1.1a Review the Admission Requirements	•									•		•	•	1
4.1 Follow through on key plans and objectives for increasing	3.1 Develop Fee Review the inpu	2.2 Develop Mentoring Program for all new faculty	2.1 Develop Recruitment Strategy to Increase Number of Minority	1.2 Develop Upper Class Strategy to Improve Graduation Rate	1.1 Increase Freshman Retention from 75% to 90%	3. 2nd Level Tactical Improvement Priorities Engineering College at a Large Research University VISION: Priorities Provide an excellent education for all its students 1. 4. Year Strategic Objectives	Freshman Retention Rate	Percent o	Percent of students with unmet	4th year students retention rate (graduate or return)	Percent of new faculty who are minority	Percent of new faculty who are female	Percent of new faculty with a faculty mentor Has annual progress report been	generated?	Research in Energy Innovation Number of hits on website for	Dean of Undergraduate Engineerin	F	Dean of Freshman Engineerin	Director, Stud	Director, Admission Director, Computer Suppo
•	•	•	•	•	•	1. Improve the Graduation Rate from 60% to 75%	•	•	•							P	rıma	y Kes	spons	SIDIIITY
		•	•	•	•	2. Continue to Increase the Number of Female and Minority Faculty					•	•	•							
						3. Get feedback so that the Engineering College can improve the education														
	•		•	•	•	and services that are needed								•						
•						4. Increase Research in Energy innovation.														

Example

An hypothetical example for an engineering college is proposed using the X-matrix. Read it by starting at the bottom and reading clockwise.

My recent PhD research at U-M showed that

Freshman retention was influenced by:

- High School Preparation
- Concern about Financial Needs
- Confidence in Math ability
- Interest in Study Abroad Program
- Enrollment in a Survey Course on Engineering Careers

Improving these characteristics were included as Tactical Improvement Priorities

Four Strategic Objectives were Considered:

- Improve the Graduation Rate
- Increase the Minority and Female Faculty
- Obtain Feedback from all stakeholders for education of engineering students
- ❖ Increase Research in Energy Innovation

References

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About the Author

Dr. Veenstra recently graduated from the University of Michigan in IOE. Her Ph.D. research was on "Modeling Freshman Engineering Success". She has started a consulting company, Veenstra and Associates (www.veenstraconsulting.com), that guides colleges in their continuous improvement strategy for raising their student graduation rates. She may be reached at cpveenst@umich.edu.