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Simple Analysis Method for Assessment of PEOs
Using Limited Survey Data

Abstract

Alumni and employer surveys are among the assessment tools often used to determine the extent to which a program's graduates are able to successfully pursue the types of careers envisioned in the program educational objectives (PEOs). A major problem with surveys is the very low response rate. However, while the number of responses to the individual surveys in a given year results in limited statistical significance, it is a case whereby the data as a whole, especially interpreted and reinforced by knowledge gained from a variety of other sources, paints a reasonably consistent and coherent picture.

In this paper, a simple analysis method is described that is based on tools often used in market research. Specifically, every question on the alumni survey is considered as an opportunity to measure success or failure of the alumni's perceived obtainment of the PEO. This type of analysis is called "top-box" and "bottom-box" analysis and is often used for reporting customer satisfaction survey data. Finally, the data is accumulated in a manner often done in trying to predict reliability for complex systems when only a limited number of systems are built. Specifically, we utilize a multi-year moving window and aggregate the data.

Introduction and Purpose

To ensure quality in ABET accredited engineering programs, each program must have a set of Program Educational Objective (PEOs).[1] The PEOs broadly define the career and professional accomplishments expected during the first several years following graduation.[2]

Common tools used for assessing PEOs include placement data, input from industrial advisory boards, and alumni and employer surveys.[3] Placement data is a quantitative measure that is often available from a university's career placement department. Placement data is a long-term indicator of employer satisfaction with the program's graduates and provides an overall measure of the attainment of the PEOs. However, evaluation of placement results does not provide specific information that can be systematically used to improve the program. Input and feedback from a program's industrial advisory board is also used to assess a program's PEOs. This assessment tool provides programs with valuable input that is forward looking, specific, and helps to keep programs current. This form of assessment often uses focus groups or data that is collected in an ad hoc manner based on meeting discussions. While of considerable value, it seldom allows for quantifying of any data. Finally, many programs use surveys or questionnaires to assess PEOs. For example, the alumni and alumni employers are surveyed periodically using a standard set of questions. The survey questions are designed to measure the extent to which one or more aspects of the programs objectives and outcomes are met.

In the ABET 2009 Annual Report, the Engineering Accreditation Commission (EAC) provides an analysis of accreditation actions and trends.[4] Specifically, the annual report states

> "*Criterion 2 (Program Educational Objectives) and Criterion 3 (Program Outcomes) continue to be the areas in which there are the most shortcomings (deficiencies, weaknesses, and concerns).*"

The report goes on to list as a common shortcoming

> "*Inadequate evidence demonstrating achievement of objectives (Criterion 2) or outcomes (Criterion 3).*"

One of the key problems associated with the use of survey data for assessment of PEOs is the low response rate.[5] However, while the number of responses to the individual surveys in a given year does not have any statistical significance, it is a case whereby the data as a whole, especially interpreted and reinforced by knowledge gained from a variety of other sources, can paint a reasonably consistent and illuminating picture.

In this paper we introduce a method for analyzing low response rate survey data used to evaluate attainment of PEOs. An example is used to clarify the approach.

Overview of the Analysis Method

Surveys generally consist of a list (all too often much too lengthy) of questions which the alumnus or his/her employer is asked to respond to using a Likert scale. The central problem that must be dealt with is that the number of responses to each individual question or statement is very small. Hence, the following process is followed in order to accumulate data in a coherent manner to amplify that data associated with a common PEO:

1. Survey questions are mapped to each of the PEOs that the questions support.
2. Survey responses are grouped as successes or failures.
3. Data sets spanning multiple years are summed using a sliding window.
4. The results of the aggregated data are evaluated.

Example

We illustrate the method by means of an example. The PEOs for the example program consist of the following three objectives.

1. Graduates will successfully function in engineering positions, demonstrating proficiencies that include problem solving and technical communications skills
2. Graduates will continue to advance their skills through formal and informal activities related to their profession
3. Graduates will exhibit conduct that is ethical and professional, including consideration of the societal and global impact of their professional endeavors

At our university, a common survey is used by all programs to collect data from alumni and employers of alumni. Surveys are sent to all graduates and their employers one year and five years after graduation. Alumni are provided a series of general questions and rate their answer on a five-point Likert scale. The scale consists of strongly agree, agree, neutral, disagree, and strongly disagree. The aggregate results of the survey are provided to each of the programs.

Many of the questions in the survey align and support a program's PEOs, and some of the questions are used to infer the alumni's experience as a whole. The survey questions were relatively consistent in the years spanning 2004 to 2008. Only the questions that map to the program's PEOs are provided in Tables 1 and 2.

Next, we organize the answers into positive and negative responses. This type of analysis is commonly used when analyzing customer satisfaction data.[6] Answers of "strongly agree" and "agree" are counted as positive responses and answers of "disagree" and "strongly disagree" as negative responses. A neutral response is not counted. However, because the total number of responses is provided, the number of neutral responses can be readily determined. The results of this grouping are provided in Tables 1 and 2.

Depending on intent, one has a choice of focusing on either negative or positive responses or both. While showing both responses our primary interest is on the negative responses since Criterion 4 requires continuous improvement of the program. The negative responses provide information on opportunities to improve performance. Unfortunately, as can be seen from the tables, the annual response rate is extremely low and varies from one response to five responses over the five year span. Drawing conclusions by evaluating these results provides little information.

The very small sample size poses a major analysis problem. Therefore, we accumulate the data in a manner often done in trying to predict reliability for complex systems when only a limited number of systems are built. Specifically, we consider every question on the survey as an opportunity for success or failure as it relates to the corresponding objective. Hence, we organized the data in the survey by PEO and sum all responses associated with a specific PEO. The summary results of the numerical data for the alumni surveys are shown in Table 3. Table 4 lists the results as a percentage of total results.

We now have a much larger data set used to evaluate the individual PEOs. For example, the number of samples for the first PEO based on one-year graduate information is 108, because there are 9 questions that align with that PEO and we have 12 responses over the five year time span. It is noted that the five year-out data, in particular, significantly increases the time constant involved in using this data for program improvement.

Table 4 demonstrates that a very distinct pattern emerges that identifies problem areas for the career paths of graduates one-year out. The negative response for PEO 2 is 44.4% for the one-year out alumni. Further examination of the data reveals that the negative responses associated with PEO 2 are clustered around the following related questions.

- I hold a membership in one or more professional organizations
- I have enrolled in a formal graduate program since graduating
- I have taken individual university-level courses since graduating

From the data we see that 28 of the 32 negative responses associated with PEO 2 are for those three questions. There are no problems of significance with PEOs 1 and 3, and the associated negative responses are quite scattered. No comprehensible pattern is formed that needs addressing.

The data and conclusions reached for one-year out alumni are confirmed by a similar analysis of the data for graduates five-years out. In the right hand part of Table 4 we see that 29 out of 34 negative responses were associated with the same three questions. This translates into a 43.6% negative response rate. Again, no issues were identified for PEO 1 and 3.

Clearly, the program graduates in this example do not engage in continuing formal education after graduation to the extent we hope and believe they should. This had also already become a concern based on anecdotal observations. As we started to get sufficient data that allowed the inference that continuing education was not being adequately addressed, our response was an increased emphasis in career advising, specifically within a course required by all juniors. The course is titled Career and Professional Guidance. Aspects of this course were modified to include a session on Graduate studies and guest speakers from industry to provide students with advice on the importance of continued education and professional involvement.

Employer survey responses were also treated in the same manner as the alumni surveys. The summary results are shown in Table 5. Employers did not respond with any negative responses to the issue of life-long learning. However, the small sample size and limited number of questions focusing on this issue does not allow for any firm conclusions. To the extent that employers provided negative response, such responses are limited to the early part of the time range being sampled. Hence, this will be watched carefully while we continue our focus on the essential importance and impact of lifelong learning on career success.

Of consequence, we were able to show that the data from the employer survey readily met the program's goal of less than 15% negative responses.

Conclusion

We have demonstrated an analysis process for low survey response rates, particularly applicable to the analysis of Program Educational Objectives that allows relevant data, which can be acted upon, to be drawn out of data that appears to have no discernable pattern. This process is based on a "top-box" and "bottom-box" analysis and is often used for reporting customer satisfaction survey data.

There is obviously no guarantee that the clarity of other analyses will match that of the example. However, if the data turns out to have a relatively small number of negative responses and they are widely distributed, one may be able to reach the conclusion that there are no outstanding issues revealed by the analysis.

It should be noted that averaging five years worth of data to reach some conclusions has the inherent assumption that no influential changes were made to the program during that time. In practice, changes, however subtle, are implemented at different levels of the program every year. Judgment is required as to when the results are significant enough to impact the conclusions reached.

There is another aspect that makes the usefulness of the assessment of PEOs rather questionable. The issue is the lengthy time interval between implementing a program change and when the impact of that change can be measured in the career paths of the alumni. That time interval realistically would range over 5-8 years, a very long time for fixing any perceived problems.

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Table 1. Alumni survey results, 1 year after graduation.

	Institutional Question Year	2004		2005		2006		2007		2008	
	Number of Responses	2		2		3		3		2	
Related PEO	Survey Question	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
1	My education provided the up-to-date theory necessary for my professional advancement	1	1	2	0	3	0	3	0	2	0
1	My education provided the up-to-date laboratory experience necessary for my professional advancement	0	0	2	0	2	0	2	0	2	0
2	My education influenced my ability to remain current in my professional career	1	0	2	0	3	0	2	0	2	0
1	The technical experiences that I received in my curriculum prepared me for immediate productivity in my chosen profession	1	1	2	0	3	0	2	0	2	0
3	The non-technical education that I received at MSOE prepared me as a well-rounded professional	2	0	2	0	3	0	3	0	1	0
1	My education prepared me for leadership and responsibility in my chosen profession	1	1	2	0	3	0	2	0	2	0
3	gave me a foundation in culture and cultural values	2	0	1	1	0	0	1	1	1	0
3	gave me a foundation in ethics and integrity	2	0	1	1	2	0	3	0	2	0
3	gave me a foundation in social responsibility	2	0	1	1	3	0	1	0	2	0
1	provided a climate that fostered independent thinking	1	0	1	0	3	0	2	0	2	0
1	enhanced my communication skills	1	0	2	0	3	0	2	1	2	0
2	enhanced my skills in information technology	0	1	2	0	1	0	1	0	2	0
1	prepared me well in the natural sciences for the requirements of my career	0	2	1	0	3	0	1	0	2	0
1	prepared me well in mathematics for the requirements of my career	0	1	2	0	3	0	3	0	2	0
1	provided me with a foundation in business and economics	1	0	1	1	1	0	2	0	1	0
2	hold a membership in one or more professional organizations	1	1	0	2	1	2	0	3	2	0
2	I have enrolled in a formal graduate program since graduating	0	2	0	2	0	3	0	3	1	1
2	I have taken individual university-level courses since graduating	1	0	0	2	0	3	0	3	1	1
2	I have attended one or more seminars/workshops since graduating	1	0	1	0	3	0	1	2	1	1

Table 2. Alumni survey results, 5 years after graduation.

Related PEO	Institutional Questions / Survey Question	2004		2005		2006		2007		2008	
	Year / Number of Responses	2		3		5		1		2	
		Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
1	My education provided the up-to-date theory necessary for my professional advancement	2	0	3	0	4	0	1	0	2	0
1	My education provided the up-to-date laboratory experience necessary for my professional advancement	2	0	3	0	4	0	0	0	2	0
2	My education influenced my ability to remain current in my professional career	2	0	2	0	5	0	1	0	2	0
1	The technical experiences that I received in my curriculum prepared me for immediate productivity in my chosen profession	2	0	3	0	3	0	0	0	2	0
3	The non-technical education that I received at MSOE prepared me as a well-rounded professional	1	0	3	0	4	0	1	0	2	0
1	My education prepared me for leadership and responsibility in my chosen profession	2	0	3	0	5	0	0	1	2	0
3	gave me a foundation in culture and cultural values	0	1	2	0	1	0	1	0	1	0
3	gave me a foundation in ethics and integrity	2	0	3	0	5	0	1	0	2	0
3	gave me a foundation in social responsibility	2	0	2	0	2	1	1	0	2	0
1	provided a climate that fostered independent thinking	2	0	3	0	5	0	1	0	2	0
1	enhanced my communication skills	1	0	2	0	5	0	1	0	2	0
2	enhanced my skills in information technology	2	0	3	0	5	0	0	0	2	0
1	prepared me well in the natural sciences for the requirements of my career	1	0	3	0	5	0	1	0	2	0
1	prepared me well in mathematics for the requirements of my career	2	0	3	0	5	0	1	0	2	0
1	provided me with a foundation in business and economics	2	0	3	0	5	0	1	0	1	1
2	I hold a membership in one or more professional organizations	0	2	1	2	0	5	1	0	1	1
2	I have enrolled in a formal graduate program since graduating	0	2	1	2	0	5	0	1	0	1
2	I have taken individual university-level courses since graduating	1	1	2	1	2	3	0	1	0	2
2	I have attended one or more seminars/workshops since graduating	2	0	3	0	2	3	0	1	1	1

Table 3. Summary results of combined data.

Survey Data for 2004-2008		Alum One Year After Graduation			Alum Five Years After Graduation		
	Program Educational Objective	Opportunity Sample Size	Total Positive Ratings	Total Negative Ratings	Opportunity Sample Size	Total Positive Ratings	Total Negative Ratings
1	Graduates will successfully function in applied engineering positions, demonstrating proficiencies that include problem solving and technical communications skills	108	81	8	117	106	2
2	Graduates will continue to advance their skills through formal and informal activities related to their profession	72	30	32	78	41	34
3	Graduates will exhibit conduct that is ethical and professional, including consideration of the societal and global impact of their professional endeavors	48	35	4	52	38	2

Table 4. Summary results as a percentage of total samples.

Survey Data for 2004-2008		Alum One Year After Graduation			Alum Five Years After Graduation		
	Program Educational Objective	Opportunity Sample Size	% Positive Ratings	% Negative Ratings	Opportunity Sample Size	% Positive Ratings	% Negative Ratings
1	Graduates will successfully function in applied engineering positions, demonstrating proficiencies that include problem solving and technical communications skills	108	75%	7.4%	117	90.6%	1.7%
2	Graduates will continue to advance their skills through formal and informal activities related to their profession	72	41.7%	**44.4%**	78	52.6%	**43.6%**
3	Graduates will exhibit conduct that is ethical and professional, including consideration of the societal and global impact of their professional endeavors	48	72.9%	8.3%	52	73.1%	3.8%

Table 5. Summary of employer survey data.

Survey Data for 2004-2008		Employer		
Program Educational Objective		Opportunity Sample Size	Total Positive Ratings	Total Negative Ratings
1	Graduates will successfully function in applied engineering positions, demonstrating proficiencies that include problem solving and technical communications skills	120	103	4
2	Graduates will continue to advance their skills through formal and informal activities related to their	12	10	0
3	Graduates will exhibit conduct that is ethical and professional, including consideration of the societal and global impact of their professional endeavors	48	40	1