

## Alumni Perspectives on Professional and Ethical Responsibility

Robert J. Gustafson, Edward McCaul, Earl Whitlatch  
The Ohio State University

### Abstract

The goal of the study reported in this paper was to collect data which would give guidance to our programs on ways to reduce the gap in the perceived importance versus preparation of College of Engineering B.S. graduates in the area of “Professional and Ethical Responsibility”. A survey was designed to address four main questions:

- Q1) What ethical issues are occurring most frequently in engineering practice?
- Q2) What is important in determining professional and ethical behavior?
- Q3) What are the most significant barriers that limit professional and ethical behavior?
- Q4) What should be done differently in our undergraduate programs to improve professional and ethical behavior?

Based on a survey completed by 249 alumni, relative to the four questions, the following observations can be made:

Q1) A. “Confidentiality of Information”, “Reviewing the Work of Another Engineer”, and “Engineering Competency” were ranked as the three items with the highest frequency of creating ethical issues in engineering practice.

B. Overall, those with PE or EIT status and females tended to rate frequency of occurrence of ethical issues higher. However, the variation was not uniform across items.

C. No consistent pattern of variation by alumni year was observed, but variation by program was readily apparent.

Q2) A. “Personal Beliefs” are ranked very high while “Undergraduate Education” and “Professional Registration” were both low among items important in determining professional and ethical behavior.

B. Overall, those with PE or EIT status tended to assign higher importance to items determine behavior. However, the variation was not uniform across items.

C. As with Q1, no consistent pattern of variation by alumni year was observed, but variation by program was readily apparent.

Q3) Written responses regarding barriers that limit ethical behavior fell into nine categories:

- Cost and time constraints(n = 37);
- Supervisor/employer attitude, values and behavior (n = 37);
- Personal beliefs and attributes (n = 22);
- Lack of training or knowledge (n = 18);

Money and personal greed (n = 11);  
Career advancement and job security (n = 10);  
Communications (n= 7);  
Laws, regulations and design codes (n = 7);  
Unclassified (n= 11)

Q4) Written responses regarding improving undergraduate programs fell into seven categories:

Specific suggestions for approach (n = 46);  
Specific suggestions for content (n= 41);  
Create a specific class on ethics (n = 33);  
No change suggested or not an issue (n = 13);  
Distribute instruction across the curriculum (n = 10);  
Add to existing course(s) or activities (n = 9);  
Other suggestions (n = 9)

## Background

Based on results of the AY 1998-99 and AY 1999-2000 College of Engineering Alumni Surveys<sup>1</sup> and feedback from other sources, the College Outcomes Assessment Committee has supported a series of targeted studies<sup>2,3</sup>. For this particular study, a Task Group was established to study the nature of the higher perceived importance versus preparation of College of Engineering B.S. graduates in the area of “Professional and Ethical Responsibility”. It is related to ABET EC 2000 Criterion 3. (f) “Engineering programs must demonstrate that their graduate have an understanding of professional and ethical responsibility”. The goal of the study was to collect data which would give guidance to our programs on ways to reduce the gap between importance and preparation.

The Task Group reviewed literature available on engineering ethics, including engineering society codes of ethics, and content of current courses and websites on this topic. Using this information, an alumni survey was developed (See Appendix). The survey was designed to address four main questions:

- Q1) What ethical issues are occurring most frequently in engineering practice?
- Q2) What is important in determining professional and ethical behavior?
- Q3) What are the most significant barriers that limit ethical behavior?
- Q4) What should be done differently in our undergraduate programs to improve professional and ethical behavior?

The first element of the survey asked respondents to indicate in their experience how often 28 different items *create ethical issues in engineering practice*. The items list had been developed by review of engineering society codes of ethics and NSPE case studies<sup>4</sup>. Respondents could add items as well. The second question asked respondents to rate how important each of a list of 13 items is in *determining their professional and ethical behavior*. Again, respondents could add items. The third question was an open-ended question asking for *the most significant barriers*

*that limit the professional and ethical behavior of engineers.* The fourth and final question was also open-ended, asking *what should be done differently in our undergraduate programs.*

The survey was included as an extra two pages with the AY 2001-2002 alumni surveys. Surveys were mailed to engineering alumni of the 2<sup>nd</sup> (1999), 6<sup>th</sup> (1995), and 15<sup>th</sup> (1986) year alumni groups based on addresses maintained by The Ohio State University Alumni Association. Useable surveys were returned from 249 persons, as shown in Table 1.

Table 1. Response Rates for Survey

Alumni Year	No. Mailed	Survey Returned	Percent
2 <sup>nd</sup> (1999)	522	85	16.3
6 <sup>th</sup> (1995)	614	99	16.1
15 <sup>th</sup> (1986)	720	65	9.0
Total	1856	249	13.4

## Results

Table 2 gives a summary of the demographic data collected for all 249 respondents. It should be noted that, unfortunately, gender, ethnicity, employment status and registration status were not included in the 15<sup>th</sup> year alumni survey. Therefore any comparison by gender or registration status will only include 2<sup>nd</sup> and 6<sup>th</sup> year alumni.

Table 2. Demographics of Respondents

Total Number Returned		249
Gender *	Male	147
	Female	37
	Unknown	65
Ethnic*	African-American	1
	Asian-American	8
	Caucasian	162
	Native-American	1
	Hispanic-American	1
	Foreign	9
	Other/Unknown	1/1
	Employment Status*	Full time
Part time		3
Military		3
Caring for family		0
Unemployed, seeking employment		3
Unemployed, not seeking employment		0
Other		4
Currently employed as an Engineer/Surveyor *		157

\*This demographic not collected for 15<sup>th</sup> Year Alumni

Year since Graduation	2 <sup>nd</sup> (1999)	99
	6 <sup>th</sup> (1995)	85
	15 <sup>th</sup> (1986)	65
Program	Aero	12
	Aviation	0
	Ceramic	2
	Chemical	27
	Civil	34
	Civil/environmental	5
	CSE	31
	ECE-elec	37
	ECE-comp	5
	Physics	3
	FABE	6
	Geomatics	0
	ISE	13
	MSE	4
	ME	57
Metallurgical	6	
Surveying	0	
Welding	7	
Professional Engineer*	PE	19
	EIT	59

*Question 1 – What ethical issues are occurring most frequently in engineering practice?*

Table 3 summarizes the data for how often respondents felt various topics create ethical issues in engineering practice. The table orders the issues by mean of “How Often” from most frequent to least frequent using the one to five scale indicated in the table.

Table 3. Ranked Frequency of Creating Ethical Issues in Engineering Practice

	n	Mean	Not Often (1)	Some-what Often (2)	Often (3)	Very Often (4)	Extremely Often (5)
Confidentiality of Information	241	2.59	65	64	47	36	29
Reviewing the Work of Another Engineer	238	2.34	75	66	53	30	14
Engineering Competency	243	2.22	86	67	51	28	11
Use of Employer's Facilities	239	2.16	95	61	46	23	14
Competitive Bidding	237	2.13	108	51	37	21	20
Criticism of Another Engineer	240	2.12	82	88	38	24	8
Conflict with Client	241	2.11	96	66	43	28	8
Conflict with Employer	245	2.11	82	92	43	19	9
Obligation to Public Health/Safety	242	2.10	108	53	41	29	11
Conflict of Interest	240	2.05	96	72	44	19	9
Expense or Time Account Padding	238	2.01	113	58	34	18	15
Obligation to Environment/Sustainable Development	242	1.96	125	46	36	25	10
Assignment of Liability	234	1.91	119	48	43	17	7
Receiving Gifts	240	1.90	125	49	39	18	9
Patents and Copyrights	237	1.90	131	44	32	14	16
Resume or Qualifications Padding	238	1.89	123	57	32	14	12
Giving Gifts	240	1.77	142	43	31	16	8
Personal Behavior Outside of Work	241	1.74	135	60	27	11	8
Discrimination based on Race, Age or Gender	238	1.74	146	42	31	4	15

Duty to Report Violations (whistleblowing)	243	1.66	142	60	26	11	4
Support for Professional Development/Registration	236	1.59	153	50	17	8	8
Political Donations/Influence	239	1.50	177	27	20	8	7
Public Comment by an Engineer	230	1.43	164	42	18	3	3
Moonlighting	237	1.39	183	28	17	6	3
Practice in a Foreign Country	232	1.35	188	19	16	5	4
Professional Advertising	236	1.33	185	34	9	6	2
Service on Advisory Boards	231	1.32	182	30	15	2	2
Misuse of PE Seal (plan stamping)	225	1.25	196	15	5	4	5

Seven (7) additional suggested topics were written in by respondents. The following is a list of those topics, and the indicated ranking:

- Boss asks you to deviate from accepted practices causing problems for others (Often, 3)
- Compensation (Often, 3)
- Conflict between business decisions and technical/engineering decisions (Often, 3)
- Conflict with legal requirements (Often, 3)
- Delivery on word (Extremely Often, 5)
- Dramatically inflating/padding project costs (Extremely Often, 5)
- Misuse of project funds (Very Often, 4).

Observations regarding variation by demographic factors (gender, P.E. status, year group, and program - data available from 1<sup>st</sup> author) include:

- Those with PE or EIT status tended to rate frequency of occurrence of events higher than non-PE/EIT respondents (Overall Mean of 1.90 compared to 1.78). Table 4 shows the eleven items with the largest difference (greater than  $\pm 0.25$ ). In nine cases the PE/EIT group indicated higher frequency and in two cases lower frequency.

Table 4. Frequency of Ethical Issues – Differences by PE/EIT Status

	Mean of PE/EIT (n = 77)	Mean of Non PE/EIT (n = 107)	Diff
Competitive Bidding	2.39	1.85	0.54
Support for Professional Development/Registration	1.88	1.40	0.48
Obligation to Public Health/Safety	2.34	1.93	0.41
Political Donations/Influence	1.69	1.31	0.38
Obligation to Environment/Sustainable Development	2.14	1.77	0.37
Giving Gifts	1.97	1.62	0.35
Reviewing the Work of Another Engineer	2.52	2.21	0.31
Public Comment by an Engineer	1.60	1.34	0.26
Misuse of PE Seal (plan stamping)	1.38	1.13	0.25
Patents and Copyrights	1.76	2.03	-0.27
Confidentiality of Information	2.41	2.72	-0.31

- Overall, female respondents tended to rate frequency of occurrence of the issues higher than males (Overall mean 1.95 compared to 1.80). Table 5 shows the eight items with the largest difference (greater than  $\pm 0.25$ ). In seven cases the female group indicated higher frequency and in one case lower frequency.

Table 5. Frequency of Ethical Issues – Differences by Gender

	Mean of Female (37)	Mean of Male (147)	Diff.
Discrimination based on Race, Age or Gender	2.43	1.53	0.90
Confidentiality of Information	3.00	2.48	0.52
Practice in a Foreign Country	1.81	1.30	0.51
Use of Employer's Facilities	2.51	2.07	0.44
Personal Behavior Outside of Work	1.97	1.67	0.30
Conflict with Employer	2.27	1.98	0.29
Patents and Copyrights	2.15	1.86	0.29
Assignment of Liability	1.68	1.97	-0.29

- No consistent pattern of variation by alumni year was observed. Some variation by individual question can be observed in a few cases. Such as, 15<sup>th</sup> year alumni appeared to

rate “Resume and Qualification Padding” as a more frequently occurring issue than the 2<sup>nd</sup> and 6<sup>th</sup> year alumni groups.

- Variation by program is apparent in the data. Table 6 shows the sequence for the ten most frequent issues within the five programs with the largest number of responses. The first number indicates the sequence across all programs. Overall Means across all questions for each program varied from a low of 1.56 to a high of 2.06 on the five point scale.

Table 6. Frequency of Ethical Issues by Program

Chemical (n = 27)	Civil & Civil/env (n = 39)	CSE (n = 31)	EE-comp & ECE- elec ( n = 42)	ME (n = 57)
1- Confidentiality of Information (2.88)	2- Reviewing the Work of Another Engineer (2.51)	1- Confidentiality of Information (2.63)	1- Confidentiality of Information (2.71)	1- Confidentiality of Information (2.91)
9- Obligation to Public Health/Safety (2.73)	5- Competitive Bidding (2.49)	4- Use of Employer's Facilities (2.43)	2- Reviewing the Work of Another Engineer (2.34)	2- Reviewing the Work of Another Engineer (2.33)
12- Obligation to Environ/Sustainable Development (2.58)	9- Obligation to Public Health/Safety (2.44)	7- Conflict with Client (2.37)	6- Criticism of Another Engineer (2.27)	3- Engineering Competency (2.33)
2- Reviewing the Work of Another Engineer (2.40)	3- Engineering Competency (2.38)	2- Reviewing the Work of Another Engineer (2.34)	7- Conflict with Client (2.24)	8- Conflict with Employer (2.30)
5- Competitive Bidding (2.24)	12- Obligation to Environ/Sustainable Development (2.33)	11- Expense or Time Account Padding (2.33)	3- Engineering Competency (2.22)	6- Criticism of Another Engineer (2.23)
7- Conflict with Employer (2.23)	8- Conflict with Employer (2.21)	16- Resume or Qualifications Padding (2.30)	15- Patents and Copyrights (2.20)	5- Competitive Bidding (2.22)
19- Discrimination based on Race, Age or Gender (2.20)	10- Conflict of Interest (2.21)	13- Assignment of Liability (2.10)	11- Expense or Time Account Padding (2.15)	4- Use of Employer's Facilities (2.20)
6- Criticism of Another Engineer (2.16)	7- Conflict with Client (2.18)	3- Engineering Competency (2.03)	10- Conflict of Interest (2.12)	7- Conflict with Client (2.15)
4- Use of Employer's Facilities (2.13)	17- Giving Gifts (2.18)	5- Competitive Bidding (2.00)	4- Use of Employer's Facilities (2.10)	9- Obligation to Public Health/Safety (2.15)
3- Engineering Competency (2.12)	1 - Confidentiality of Information (2.16)	10- Conflict of Interest (2.00)	5- Competitive Bidding (2.20)	15- Patents and Copyrights (2.07)
Mean of Means (1.90)	Mean of Means (1.92)	Mean of Means (1.80)	Mean of Means (1.79)	Mean of Means (1.92)



*Question 2 – What is important in determining professional and ethical behavior ?*

Table 7 summarizes the means across all respondents for how important respondents felt various items in determining their professional and ethical behavior. The table orders the items by mean of “How Important” from most important to least important using the one to five scale indicated in the Table.

Table 7. Importance in Determining Professional and Ethical Behavior

	n	Mean	Not Imp (1)	Some what Imp (2)	Imp (3)	Very Imp (4)	Extremely Imp (5)
Personal Beliefs	213	4.23	9	10	23	52	119
Supervisors	213	3.62	16	13	57	78	49
Public Laws	210	3.43	22	23	64	44	57
Customers/Clients	209	3.39	20	30	53	60	46
Peers	213	3.38	16	24	76	56	41
Company Policies	213	3.30	13	36	72	59	33
Profession	213	3.17	25	30	67	66	25
Design Codes	207	3.14	31	30	59	53	34
Employees	209	3.14	28	28	73	47	33
Public	212	2.70	40	56	62	36	18
Prof. Society Code of Ethics	206	2.62	47	59	44	37	19
Undergraduate Education	213	2.40	47	74	60	23	9
Prof. Registration	200	2.36	74	46	35	24	21

Five (5) additional suggested items were written in by respondents. The following is a list of the items and the importance indicated:

- Being able to sleep at night with clear conscience (Extremely Important, 5)
- Peace of mind (Extremely Important, 5)
- Personal integrity (Extremely Important, 5)
- Personal faith, religion (Not Important, 1)
- Religious beliefs-morality (Extremely Important, 5)

Observations regarding variation by demographic factors (gender, P.E. status, year group, and program - data available from 1<sup>st</sup> author) include:

- Those with PE or EIT status tended to rate importance of the items higher than non-PE/EIT respondents (Overall Mean of 3.38 compared to 2.98). Table 8 shows the eight items with the largest difference (greater than  $\pm 0.25$ ). In all eight cases the PE/EIT group indicated higher importance.

Table 8. Importance of Items – Differences by PE/EIT Status

	Mean of PE/EIT (77)	Mean of Non PE/EIT (107)	Diff.
Prof. Registration	3.07	1.90	1.17
Design Codes	3.54	2.85	0.69
Prof. Society Code of Ethics	3.02	2.43	0.59
Public	2.97	2.51	0.46
Customers/Clients	3.67	3.28	0.39
Undergraduate Education	2.64	2.28	0.36
Profession	3.31	3.02	0.29
Personal Beliefs	4.28	4.03	0.25

- Overall, there is no significant difference between males and females in rating of importance of items (Overall means: males = 3.14, females = 3.17). However, Table 9 shows the four items with the greatest difference (greater than  $\pm 0.25$ ). In two cases the female respondents indicated higher and in two cases lower importance.

Table 9. Importance of Items – Differences by Gender

	Mean of Female (37)	Mean of Male (147)	Diff.
Company Policies	3.58	3.17	0.41
Profession	3.45	3.06	0.39
Undergraduate Education	2.16	2.49	-0.33
Prof. Registration	2.07	2.47	-0.40

- No consistent pattern of variation by alumni year was observed. Some variation by individual question can be observed in a few cases. Such as, 15<sup>th</sup> year alumni appeared to rate “Personal Beliefs” as more important, and “Supervisors”, “Customers/Clients” and “Professional Society Codes of Ethics” as less important than the 2<sup>nd</sup> and 6<sup>th</sup> year alumni groups.
- Variation by program is apparent in the data. Overall program means across all questions on the five point scale varied from a low of 2.73 to a high of 3.94.

*Question 3 – What are the most significant barriers that limit professional and ethical behavior?*

Written responses were received from 127 persons. These responses were categorized by the report authors into nine categories. Since respondents in some cases made more than one comment, a total of one hundred and sixty-one (161) comments were identified. The nine categories and number of comments by category were:

- I. Cost and time constraints (n = 37)
  - Employer-related (n = 31)*
  - Client expectations and behaviors (n = 6)*

- II. Supervisor/employer attitude, values and behavior (n = 37)
- III. Personal beliefs and attributes (n = 22)
- IV. Lack of training or knowledge (n = 18)
- V. Money and personal greed (n = 11)
- VI. Career advancement and job security (n = 10)
- VII. Communication (n= 7)
- VIII. Laws, regulations and design codes (n = 7)
- IX. Unclassified (n = 11)

Observations:

- 1) Cost and time constraints and supervisor/employer attitudes, values and behavior were most frequently noted as barriers to professional and ethical behavior.
- 2) Within Personal Beliefs and Attributes, the most frequent multiple responses were received around the barriers of:
  - a) money and personal greed,
  - b) career advancement and job security concerns, and
  - c) personal beliefs and principles.
- 3) The topics of conflict of interest and gifts/bribes, which are frequently covered in ethics classes, were mentioned only two times each.
- 4) Comments concerning law and regulations indicated difficulty in dealing with a perceived conflict between the two.

*Question 4 - What should be done differently in our undergraduate programs to improve professional and ethical behavior?*

Written responses were received from 126 persons. These responses were categorized by the report authors into seven categories. Since respondents in some cases made more than one comment, a total of one hundred and fifty-nine (159) comments were identified. The seven (7) categories and number of comments by category were:

- I. Specific Suggestions for Approach (n = 46)
  - Guest, Alumni, Industry Speakers (n = 8)*
  - Case Studies and Real Life Examples (n = 27)*
  - Team and Group Work (n = 5)*
  - Role Models at University (n = 6)*
- II. Specific Suggestions for Content (n= 41)
  - Codes, Laws and Professional Responsibilities (n = 13)*
  - Teaching Methods (n = 7)*
  - Other Specific Content Suggestions (n = 21)*
- III. Create a Specific Class on Ethics (n = 33)
- IV. No Change Suggested or Not an Issue for Undergraduate Curriculum (n = 13)
- V. Distribute Instruction Across the Curriculum (n = 10)
- VI. Add to Existing Specific Course(s) or Activities (n = 9)
- VII. Other Suggestions (n = 9)

#### Observations:

- 1) Specific suggestions strongly supported instruction with case studies and “real world” examples.
- 2) Use of guest speakers from alumni or industry was a common response.
- 3) Although not mutually exclusive, the suggestion of having an ethics course received significant support, as judged by the number of observations, and as compared to distribution of instruction across the curriculum or adding to existing course(s).
- 4) Practice in team and group work was cited as important to the development of ethical and professional behavior.

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**Robert J. Gustafson, P.E.** is a Professor of Food, Agricultural and Biological Engineering and Associate Dean for Academic Affairs and Student Services for the College of Engineering of The Ohio State University. He received B.S. and M.S. degrees in Agricultural Engineering from the University of Illinois and a Ph.D. in Agricultural Engineering from Michigan State University.

**Edward McCaul, P.E.** is the Program Director for Academic Affairs for the College of Engineering of The Ohio State University. He received a B.S. degree from the United States Military Academy and a M.S. degree from Duke University. He is a registered professional engineer.

**Earl Whitlatch** is an Associate Professor in the Department of Civil and Environmental Engineering and Geodetic Science of The Ohio State University. He received B.S. in Engineering from Geneva College, B.S. Civil Engineering from Carnegie Mellon University, M.S. Environmental Engineering Science and PhD in Environmental and Water Resource Systems from Johns Hopkins University.

**Appendix – Survey Form**

TO: OSU College of Engineering Alumni

1 February 2002

FR: Robert J. Gustafson, Associate Dean for Academic Affairs and Student Services

SUBJECT: Survey on Professional and Ethical Responsibility

Our recent alumni surveys have shown that one area in which engineering alumni do not feel adequately prepared relative to need is “An understanding of and ability to recognize professional and ethical responsibility.” We are seeking your input to help us understand this gap so that we may improve our programs. Please return the following survey with the other portions of the alumni survey. Thank you in advance for your input.

I. Please rate the following topics based upon your experience of how often they create **ethical issues** in engineering practice by marking the appropriate box.

	Not Often	Somewhat Often	Often	Very Often	Extremely Often
Conflict with Client					
Conflict with Employer					
Obligation to Public Health/Safety					
Obligation to Environment/Sustainable Development					
Duty to Report Violations (whistleblowing)					
Engineering Competency					
Misuse of PE Seal (plan stamping)					
Public Comment by an Engineer					
Criticism of Another Engineer					
Reviewing the Work of Another Engineer					
Assignment of Liability					
Conflict of Interest					
Service on Advisory Boards					
Giving Gifts					
Political Donations/Influence					
Receiving Gifts					
Confidentiality of Information					
Patents and Copyrights					
Moonlighting					
Use of Employer's Facilities					
Competitive Bidding					
Expense or Time Account Padding					
Resume or Qualifications Padding					
Professional Advertising					
Personal Behavior Outside of Work					
Support for Professional Development/Registration					
Practice in a Foreign Country					
Discrimination based on Race, Age or Gender					
Please write in topics that you feel should be included and rate them.					

II. For the following items, please rate how important each is in **determining your professional and ethical behavior** by marking the appropriate box.

	Not Important	Somewhat Important	Important	Very Important	Extremely Important
Employees					
Peers					
Customers/Clients					
Supervisors					
Company Policies					
Profession					
Public					
Personal Beliefs					
Undergraduate Education					
Design Codes					
Public Laws					
Prof. Society Code of Ethics					
Prof. Registration					
Please add any items that you feel should be included and rate them.					

III. What do you feel are the most **significant barriers** that limit the professional and ethical behavior of engineers?

IV. What should be **done differently in our undergraduate programs** to help new engineers deal more effectively with issues in professional ethics and practice that you have faced?