AC 2012-5031: A FINANCIAL STUDY OF CIVIL ENGINEERING PROFESSION AND PARAPROFESSIONS

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The authors appreciate the reviewers' comments and suggestions; each was seriously considered and incorporated. Authors feel the quality and organization of the paper is improved as a result of this process. Thank you.

Approved - With Pending Changes

1. The cost of a MS versus 30 credit hours of post-baccalaureate study should be compared?

   Answer: Clearly there are more options than those compared in the article. The author has added the following explanation in the article, "There are many possibilities for a post-baccalaureate education in civil engineering; this research however is in its infancy and at this point only the master's degree in civil engineering has been considered." Research in under way where other options and more refined assumptions are being considered. An article will be written the full analysis is completed.

2. Will the students work while completing the MS or not work (company cover costs)?

   Answer: The authors have added a clarification that no incomes are generated until completing education.

3. The simple cost of courses for medical school and engineering need to be compared.

   Answer: The educational costs are presented in Table 1 and the author has added a clarification that the cost of general graduate school is used for civil engineering.

4. Second paragraph under introduction, not clear that 6 year is the European model.

   Answer: The authors have made the following changes to clarify sentence, "Lyons1 reports that U.S. companies involved in the international engineering market that have hired both U.S. and continental European-trained engineers found that the six-year formal European engineering education system better prepares graduates for the commercial world."

5. Third paragraph under introduction, it is ASCE not ACSE (multiple examples in the paper to include reference section); replace the requiring with the requirement.

   Answer: The term "ASCE" has been changed according.

6. Fourth paragraph under introduction, believe it is Board of Directors versus Executive Committee.

   Answer: The PETC report most of the time used "executive committee." However, there are a couple of instances where "Board of Directors" are used. To eliminate confusion, the authors used "ASCE leaders" instead.

7. Fifth paragraph under introduction, place it before worth.

   Answer: The authors have changed wording for that sentence to "may make the cost of the extra years in school a worthy financial decision".

8. Table 1, need to define NCES somewhere.

   Answer: The authors have added the definition for NCES in the body of text.

9. First paragraph under method of analysis, last sentence, wording is an issue.

   Answer: The authors have changed the wording of the last two sentences as follows, "These assumptions are financially favorable to paraprofessionals, in other words, they are conservative. Thus, if the results of the analyses using these conservative assumptions still show that it makes sense financially for a person to obtain a professional degree, more accurate analyses will clearly support the findings of the research presented herein."

10. Second paragraph under percentage comparison, second to last sentence, need a justification as to why this method was chose (others considered, why works, etc.). It would appear to me that those programs with multiple years beyond one would be unfairly penalized. Perception is a reality and can cause your methodology to lose credibility.

    Answer: The authors have added the following clarification, "Thus, the data were normalized by the number of extra years professionals have spent in school. The normalization simply put the data on 'per additional year' basis rather than on a 'total' basis, which should make comparison between the different professions, a difficult endeavor in itself, more doable. The intention of the normalization is not to penalize programs with multiple years, which one can argue that this is what is being done, but rather to make the comparison possible."

11. Should the section on Age Comparison and Year after School comparison be sub-sets of Break-even comparison?

    Answer: Yes, and the authors have changed the section titles according.

12. Not sure I am following the age and year after numbers for break even. If a student in CE completes the degree in one year, they are normally 23 if timely graduation. Should the break even and age get me to the same point? If it is nine years, then it would be 32 years of age from 23. If I use the other, 6.4 years, then the age should be 29.4 years. Otherwise I do not see how the number could be so different or something is missing in the assumptions. Not able to follow.

    Answer: The authors have corrected the numbers in Table 9 and believe the numbers now will not cause confusion.

13. First paragraph under Summary and Conclusions, Second sentence, replace of with or.

    Answer: The word “of” has been changed to “or”.

14. Be very clear to your audience of your definition of professional and paraprofessional.

    Answer: PETC has defined professional and paraprofessional in their report. The authors have added the following clarification to the text as follow: “The terms professional and paraprofessional used in this article follow the definitions presented and discussed in the PETC4 report, which also presents the professional and paraprofessional categories in each of the profession studied in this research.”

15. Explain how the two sources of salary data defined these two (professional and paraprofessional) categories.

    Answer: The authors have added the following clarification, “The two sources of salary data have similar definitions for the professional and paraprofessional categories as in the PETC report.”

16. Explain the difference between "private not-for-profit" colleges and the "private for-profit" ones.

    Answer: The authors have added the descriptions for each one of them: “private-for-profit (run as business organizations), and private-not-for-profit (run as non-profit organizations).”

17. So many tables and comparisons in this paper. It would be nice to have a summary table at the end that shows in a table what you say in words in the Summary and Conclusions.

    Answer: The authors have added Table 10, Summary of the Different Comparisons, as a way to summarize the most important set of data.

18. Table 4 needs improving. It is very misleading.

    Answer: The authors have adjusted some of the fields’ positions in Table 4 and made some changes in an attempt to improve reading of the table. We believe it is no longer misleading.

A Financial Study of Civil Engineering Professionals and Paraprofessionals

Introduction

Many professions, such as those in law and medicine, require additional education beyond the attaining of a baccalaureate degree. In law for example, there is a paralegal option for those who do not want to or cannot afford three extra years of education to become attorneys.

Lyons[1] reports that U.S. companies involved in the international engineering market that have hired both U.S. and continental European-trained engineers found that the six-year formal European engineering education system better prepares graduates for the commercial world. Walesh's[2] opinion is that a four-year program is simply not enough, and he proposes a six-year civil engineering program, which would include nontechnical skills, internships, cooperative education, etc. to address the issue. Compensation of civil engineers would increase as a result of enhanced graduates' economic values. To strengthen the need of additional education, Walesh[2] suggested that employers hire graduates with master's degrees and cooperative education experience for professional work and hire graduates of technology programs for technician work.

In order to keep pace with new technologies and rapidly changing current practices, the ASCE Vision for Civil Engineering in 2025[3] suggests the requiring of an additional post-baccalaureate education component or a master's degree to all those who want to become licensed civil engineers. Implicitly this means that civil engineering paraprofessionals —persons who do not want, cannot afford, or do not have the intellectual capacity to obtain this additional post-baccalaureate education or a master's degree in civil engineering, will exist. There are many possibilities for a post-baccalaureate education in civil engineering; this research however is in its infancy and at this point only the master's degree in civil engineering has been considered.

Foreseeing this and other issues, ASCE leaders formed a Paraprofessional Exploratory Task Committee (PETC) in March 2008 and charged the committee to define a possible role for civil engineering paraprofessionals. A PETC[4] report was written and submitted to ASCE in September 2008. The terms professional and paraprofessional used in this article follow the definitions presented and discussed in the PETC[4] report, which also presents the professional and paraprofessional categories in each of the profession studied in this research. One key aspect missing in the PETC report is an economic analysis of the possible financial pros and cons that the civil engineering paraprofessional opportunity presents.

In each learned profession, professionals can earn a higher salary than their respective paraprofessionals, which may make the cost of the extra years in school a worthy financial decision. The objective of this article is to report on a preliminary study made to determine if it makes sense financially for someone to obtain a master's degree to become a licensed professional civil engineer. In this research, civil engineering is compared with law, medicine, dentistry, accounting, teaching, and land surveying.

Research Methods: Data Collection – Educational Cost

The data collected and used for determining the cost of education comes from the National Center for Education Statistics[5] (NCES); the median academic year 2008-09 tuition was used. The National Center for Education Statistics publishes data for four types of tuitions: in-state, out-of-state, private-for-profit (run as business organizations), and private-not-for-profit (run as non-profit organizations). Under each type, NCES lists the median cost of tuition for undergraduate (less than two years, two years, and four years) and graduate (general, dentistry, law, medicine, and pharmacy) degrees. This research used the educational cost of general graduate school for civil engineering. Table 1 shows tuition costs for the different professions and types.

To estimate the cost of education, the number of years required in school for each profession is also needed. The PETC[4] report presents the minimum educational requirements to become paraprofessionals and professionals for each of the professions studied, including the number of years in school and what degrees are needed. Table 2 shows years in school required for each profession.

Table 1: Summary of the Median Tuition for Undergraduates and Graduates (NCES[5]).

Type of Education		Median Academic Year Tuition ($1,000), 2008-09			
		In-State	Out-of-State	Private not-for-profit	Private for-profit
Undergraduate	Less than 2-year	4.82	4.82	8.71	12.9
	2-year	2.70	5.70	9.01	12.0
	4-year	5.65	13.9	20.1	14.5
Graduate	General	6.69	14.5	12.2	13.8
First Professional	Dentistry	24.1	45.9	52.1	N/A
	Law (L.L.B. or J.D)	14.7	28.3	35.3	30.1
	Medicine (M.D.)	23.6	42.4	42.7	N/A
	Pharmacy (Pharm. D.)	14.1	28.3	28.1	N/A

Research Methods: Data Collection – Salary

The majority of the salary data was collected from www.salary.com[6] with the exception of salaries for civil engineering paraprofessionals, which were collected from www.allengineeringschools.com[7]. The two sources of salary data have similar definitions for the professional and paraprofessional categories as in the PETC report. The site www.salary.com provides median salary values for different levels of experience for most of the professions that were studied but only one or two values with little regard to experience for a couple of professions. The site www.allengineeringschools.com[7] is the only website that provides information on civil engineering paraprofessional salaries (civil engineering technologist in this case), but instead of just one median value like the www.salary.com site it provides a range of values.

Because the values were obtained from different sources, some assumptions and adjustments were made in an attempt to make the values more comparable. Researchers assumed that (a) the lowest value from www.allengineeringschools.com represents civil engineering technologists who have no related work experience and (b) the highest value

Table 2: Summary of Required Higher Education for Professionals and Paraprofessional (PETC[4]).

Profession	Job Title	Years of Higher Education
Law	Attorneys	7
	Paralegals Pathway 1	4
	Paralegals Pathway 2	2
Medicine	Physicians	8
	Physician Assistants	4
Dentistry	Dentists	8
	Dental Hygienists	2
Accounting	Accountants	4
	Accounting Clerks	0
Teaching	Teachers	4
	Teacher Aides	2
Land Surveying	Professional Land Surveyors	4
	Paraprofessional Land Surveyors	0
Civil Engineering	Professional Engineers	5 (With Master's Degree)
	Paraprofessional Engineers	4

from www.allengineeringschools.com represents civil engineering technologists with eight years of related work experience and is the maximum salary that a civil engineering technologist can attain. In addition, the values collected from www.allengineeringschools.com[7] were adjusted based on the ratios between www.salary.com and www.allengineeringschools.com[7] for civil professional engineers. The ratios were calculated by dividing the minimum and maximum values from www.salary.com[6] by the minimum and maximum values from www.allengineeringschools.com[7], respectively. Then the calculated ratios were applied to civil engineering technologists. Table 3 shows the adjustment on civil engineering technologists' salaries and Table 4 summarizes the salary for each profession that was studied.

Table 3: Adjustment Values Used in Civil Engineering Paraprofessional's Salary.

		Minimum	Maximum
Civil Engineers	Salary from Allengineeringschools.com[7] ($1,000)	50.0	118
	Salary from Salary.com[6] ($1,000)	56.0	107
	Adjustment Ratio	1.13	0.904
Civil Engineering Technologists	Salary from Allengineeringschools.com[7] ($1,000)	28.6	69.4
	Adjusted Salary Based on Salary.com[6] ($1,000)	32.3	62.8

Method of Analysis

The objective of this research is to determine if spending extra years in school to obtain a professional degree makes sense financially. The financial situation was projected to retirement: 65 years of age. The analysis used a timeline from year zero to year 47. Year zero represents the beginning of age 18 (presumably when a person graduates from high school). Year 47 represents the end of a person's 65th year of age, (or the end of a person's career). Three sets of analyses

were performed: 1) simple cash flow; 2) 5% of annual income was invested in some low-risk investment, such as a mutual fund, and yields 12% overall annual return; and 3) 10% of annual income was invested in some low-risk investment, such as a mutual fund, and yields 12% overall annual return . The high rate of return in investment was used for more dramatic results. It is assumed that no incomes are generated until graduation. All values used in the analyses are present values; therefore, time-value-money adjustment was not considered. Extreme cases were used in determining the cost of education. In addition, the most expensive education scenario was used for full professionals and the least expensive education scenario was used for paraprofessional. These assumptions are financially favorable to paraprofessionals, in other words, they are conservative. Thus, if the results of the analyses using these conservative assumptions still show that it makes sense financially for a person to obtain a professional degree, more accurate analyses will clearly support the preliminary findings of the research presented herein.

Table 4: Summary of Median Salary for all Professions with Respect to Working Experience (www.salary.com[6]).

Profession	Job Title						
Law	Attorneys	Year of Experience	0 to 3	2 to 5	5 to 8	8 to 10	10+
		Salary ($1,000)	88.4	114	143	158	177
	Paralegals Pathway 1	Year of Experience			5 to 8	8+	
		Salary ($1,000)			61.8	72.7	
	Paralegals Pathway 2	Year of Experience	0 to 3	2 to 5			
		Salary ($1,000)	47.2	53.4			
Medicine	Physicians - Hospitalists	Year of Experience		2 to 4			
		Salary ($1,000)		178			
	Physicians - Family Practitioners	Year of Experience		2 to 4			
		Salary ($1,000)		173			
	Physicians - Generalists	Year of Experience		2 to 4			
		Salary ($1,000)		165			
	Physician Assistant	Year of Experience					N/A
		Salary ($1,000)					89.4
Dentistry	Dentists	Year of Experience		2 to 4			
		Salary ($1,000)		133			
	Dental Hygienists	Year of Experience		2 to 4			
		Salary ($1,000)		61.8			
Accounting	Accountants	Year of Experience	0 to 2	2 to 4	4 to 6	6 to 8	
		Salary ($1,000)	43.8	52.5	63.2	74.6	
	Accounting Clerks	Year of Experience	0 to 2	2 to 5	5+		
		Salary ($1,000)	31.6	36.6	42.0		

Table 4 Continued.

Profession	Job Title						
Teaching	High School Teachers	Year of Experience					15
		Salary ($1,000)					53.8
	Teacher Aides	Year of Experience					15
		Salary ($1,000)					19.9
Land Surveying	Professional Land Surveyors	Year of Experience		3 to 5			
		Salary ($1,000)		68.2			
	Paraprofessional Land Surveyors	Year of Experience	0 to 2	2 to 4	5+		
		Salary ($1,000)	40.2	46.5	55.1		
Civil Engineering	Professional Civil Engineers	Year of Experience	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10
		Salary ($1,000)	55.9	67.0	78.6	90.8	107
	Structural Engineers	Year of Experience	0 to 2	2 to 4	4 to 6	6 to 8	
		Salary ($1,000)	52.8	67.8	87.5	104	
	Geotechnical Engineers	Year of Experience	0 to 2	2 to 4	4 to 6	6 to 8	
		Salary ($1,000)	53.3	61.0	78.8	100	
	Environmental Engineers	Year of Experience	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10
		Salary ($1,000)	53.4	64.2	78.2	86.1	104
	Transportation Engineers	Year of Experience	0 to 3	3 to 5	5 to 8	8 to 10	
		Salary ($1,000)	48.6	67	85.9	101	
	Paraprofessional Civil Engineers	Year of Experience	0				8
		Salary ($1,000)	32.6				62.8

The salaries for most professions were presented based on a range of experience. To make a salary rise gradually rather than "staircase-like," the salary was assigned to be in the middle of the experience range. Then the unassigned years were linearly extrapolated based on the immediate values before and after each assigned year, the two immediate data values after the unassigned value, or the two immediate data values before, depending on data availability. It was assumed that the salary stayed constant after the end of the last experience range until year 47. There were a few professions that had only one salary value available. Therefore, that salary value was applied to the whole career life span. Salaries of managers were not considered.

In Simple Cash Flow, the cost of education and income through basic salary were considered. Thus, no other forms of income such as bonuses, investments, gambling, saving interests, etc., were considered. The 5% investment scenario took into consideration that some people invest some of their earnings rather than just putting it in the bank or spending it all. The analysis in this section assumed individuals in each of the studied professions would invest 5% of their annual income into some secure, long-term investment, such as a mutual fund. It was assumed that no investments were made until the individuals had completed all the required education and the investments were made at year ending. Therefore, there would not be any

investment growth at the end of the following year. The investment growth is compounded annually. Equation 1 was used to calculate the total capital (equity and earning). For the10% investment scenario the calculation method and all assumptions were the same as those for the 5% investment option.

$$A = (E + I) * (1 + i) \quad \text{(EQ-1)}$$

where A = total (cumulative) assets at the end of current year
E = equity (or retain of earning) from previous year
I = the portion of annual income invested at the end of previous year
i = interest rate

Table 5 shows the cumulative wealth for all professions studied for simple cash flow, 5% investments, and 10% investments. The results show that with the exception of land surveying, professionals can make significantly more money than paraprofessionals. Therefore, it makes sense financially to spend the extra time and efforts for one to become a professional rather than a paraprofessional.

Table 5: Cumulated Wealth for Professional and Paraprofessional at Retirement.

		Financial Situation at Retirement ($1,000)		
Profession	Position	Simple Cash Flow	5% Investments	10% Investments
Legal Services	Attorneys	6000	10800	15500
	Paralegals Pathway 1	2900	5720	8540
	Paralegals Pathway 2	2450	5930	9410
Physician	Hospitalists	6690	12400	18200
	Family Practitioners	6500	12100	17700
	Generalists	6180	11510	16800
	Physician's Assistants	3820	8460	13100
Dentistry	Dentists	4900	9190	13500
	Dental Hygienists	2780	6830	10900
Accounting	Accountants	4870	9280	14800
	Accounting Clerks	1950	5220	8480
Teaching	High School Teachers	2230	5030	7820
	Teacher Aides	890	2200	3500
Land Surveying	Professional Land Surveyors	2850	6390	9930
	Paraprofessional Surveyors	2550	6800	11000
Civil Engineering	Civil Engineers	4150	7980	11800
	Structural Engineers	4090	7810	11500
	Geotechnical Engineers	3910	7420	10900
	Environmental Engineers	4030	7580	11100
	Transportation Engineers	3900	7330	10800
	Paraprofessional Engineers	2560	5250	7940

Preliminary Results

The results show that becoming a professional is significantly better financially for all professions except for land surveying. It can be inferred that it would be worth the effort to obtain a master's degree in civil engineering if ASCE implements such requirement as a mandatory step to become a professional civil engineer. However, this does not mean that it makes sense financially to implement this new requirement. How much more money professional engineers should make than paraprofessional engineers for it to be considered to make sense financially is subjective.

To gain further insight on the issue at hand, three kinds of comparisons between civil engineering earnings to other professions were made: 1) percentage comparison, 2) money comparison, and 3) break-even year comparison. An average was taken for simplicity, if multiple professionals or paraprofessionals were used in the same profession.

Percentage Comparison

Comparisons were made between how much professionals and paraprofessionals make in the different professions. The comparisons were made at year 47. Equation 2 shows how the percentages were calculated.

$$\text{Percentage} - \text{earning} = \frac{Pro - Para}{Para} \times 100\% \qquad \text{(EQ-2)}$$

where Pro = cumulative earnings made by professionals at retirement.
$Para$ = cumulative earnings made by paraprofessionals at retirement.

Direct comparison does not provide a representative conclusion of the situation because the extra effort required to become professionals is not equal in each profession. Physicians, for example, spend four years more than physician's assistants in school, whereas civil engineering professionals spend one year more than their paraprofessional counterparts. Therefore, physicians logically should earn more than civil engineering professionals compared to their paraprofessionals. Thus, the data were normalized by the number of extra years professionals have spent in school. The normalization simply put the data on "per additional year" basis rather than on a "total" basis, which should make comparison between the different professions, a difficult endeavor in itself, more doable. The intention of the normalization is not to penalize programs with multiple years, which one can argue that this is what is being done, but rather to make the comparison possible. Future research should consider other options for normalization of the data.

Table 6 shows that civil engineering professionals would make about 57% (second highest), 45% (second highest), and 41% (second highest) more than paraprofessionals, at retirement, per each extra year spent in school, for simple cash flow, 5% investment, and 10% investment, respectively. The percentage-earning of the civil engineering profession is well above the average of how much more money professionals can expect to make compared to paraprofessionals in all three scenarios. This suggests that it makes sense financially to obtain a master's degree to become a civil engineering professional and that the benefit is much better than most of the other professions studied in this research.

Table 6: Earning Percentage Comparison of Different Professions.

Profession	Extra Year Schooling	Simple Cash Flow	5% Investment	10% Investment
Legal Services	3	42.0	28.3	24.5
Physician	4	17.2	10.5	8.50
Dentistry	6	12.7	57.4	3.96
Accounting	4	37.5	19.5	18.5
Teaching	2	75.4	64.4	61.6
Land Surveying	4	2.96	-1.49	-2.52
average	N/A	31.3	21.1	19.1
Civil Engineering	1	57.1	45.2	41.3

Money Comparison

Comparisons were made between how much professionals and paraprofessionals make in dollar amount for the different professions at year 47. As mentioned before, direct comparisons do not provide representative conclusions because the extra effort required to become professionals is not equal in each profession. Thus, the same adjustments made previously are made here—divide all the earnings at retirement by the number of extra years professionals spent in school.

Table 7 shows that the civil engineering professionals would make about $1.5 million, $2.4 million, and $3.3 million more, per year of extra schooling, than paraprofessionals at retirement for simple cash flow, 5% investment, and 10% investment, respectively. The earnings for the civil engineering profession are well above the average of how much more money professionals can make compared to paraprofessionals in all three scenarios. As a matter of fact, these earnings are the highest among all professions. This suggests that it definitely makes sense financially to obtain a master's degree to become a civil engineering professional, and that the financial benefit is better than most of the other professions in this study.

Table 7: The Money Earned Comparison of Different Professions.

		Differences ($1,000)		
Profession	Extra Year Schooling	Simple Cash Flow	5% Investment	10% Investment
Legal Services	3	1110	1650	2190
Physician	4	659	886	1110
Dentistry	6	354	392	431
Accounting	4	731	1020	1570
Teaching	2	671	1410	2160
Land Surveying	4	75.5	-102	-279
average	N/A	600	876	1200
Civil Engineering	1	1460	2370	3280

Break-Even Comparison

Break-even comparison determines and compares the years that it would take for the cumulated earnings of the professionals to catch up to the paraprofessionals. This will be termed the break-even point: the point at which the professionals' financial situation becomes equal to that of their paraprofessional counterparts. Two types of comparisons were made: 1) break-even age and 2) break-even year after school.

Break-Even Comparison - Age

The break-even age method compares the age when the professionals catch up with their paraprofessional counterparts in total financial gain. Table 8 shows that civil engineering professionals break even with their paraprofessionals at age 28.4 for all three scenarios in this study and is the second fastest profession to break even. It is faster than the average age to break even. Therefore, the professionals in the civil engineering profession have an advantage in "money making" than most other professions.

Table 8: Break-Even Age Comparison of Different Professions.

	Age		
Profession	Simple Cash Flow	5% Investment	10% Investment
Physician	33.7	33.7	34.0
Dentistry	36.0	36.0	37.0
Accounting	31.0	31.0	31.0
Teaching	26.0	26.0	26.0
Land Surveying	42.0	N/A	N/A
Average	33.4	31.7	32.0
Civil Engineering	28.4	28.4	28.4

Break-Even Comparison - Year after School

The break-even year after school method compares how many years it would take the professionals to catch up with their paraprofessional counterparts after finishing school. Table 9 shows that civil engineering professionals break even with their paraprofessionals 9.4 years after finishing school for all three scenarios and is the second fastest for simple cash flow and third fastest for both 5% and 10% investments. This comparison shows that professionals in the civil engineering profession also have an advantage in "money making" compared to the other professions.

Summary and Conclusions

ASCE's The Vision for Civil Engineers in 2025 states that in order to keep pace with new technologies and rapidly changing current practices, there is a need to cooperate and partner in the delivery of baccalaureate, post-baccalaureate, and lifelong learning educational activities. Therefore, ASCE is currently considering requiring all those who would like to become civil engineering professionals to obtain additional post-baccalaureate education or complete a master's degree in civil engineering. ASCE formed the Paraprofessional Exploratory Task Committee (PETC) in March 2008 to better define the role of civil engineering paraprofessionals. However, there have not been any studies seeking to discover whether it makes sense financially for one to spend the extra time, effort, and money to obtain such an

Table 9: Break-Even Year after School Comparison of Different Professions.

	Years after school		
Profession	Simple Cash Flow	5% Investment	10% Investment
Legal Services	7.0	7.0	7.0
Physician	7.7	7.7	8.0
Dentistry	12.0	12.0	13.0
Accounting	9.0	9.0	9.0
Teaching	4.0	4.0	4.0
Land Surveying	20	N/A	N/A
Average	9.9	7.9	8.2
Civil Engineering	5.4	5.4	5.4

education. This research studied the earnings differences between professionals and paraprofessionals in legal services, medicine, dentistry, accounting, teaching, and land surveying and civil engineering with the assumption that a master's degree is mandatory to become a civil engineering professional . This research used three scenarios: 1) earnings from salary only, 2) earnings from salary and return from investing 5% of annual income, and 3) earnings from salary and return from investing 10% of annual income, where the investments were assumed to be some secured long-term investments that can yield about 12% on average. Civil engineering was then compared to the other professions in terms of percentage, dollars amount, and break-even time. Table 10 gives a summary of the results for the civil engineering profession.

Table 10: Summary of the Different Comparisons.

		Salary	5% Investment	10% Investment
Money Professionals Make Compared to Paraprofessionals ($1,000)	Civil Engineers	1460	2370	3280
	Average	600	876	1200
Percentage Professionals Make above Paraprofessionals (%)	Civil Engineers	57.1	45.2	41.3
	Average	31.3	21.1	19.1
Age that Professionals Break Even with Paraprofessionals	Civil Engineers	28.4	28.4	28.4
	Average	33.4	31.7	32
Years after School to Break Even with Paraprofessionals	Civil Engineers	5.4	5.4	5.4
	Average	9.9	7.9	8.2

The results show that civil engineering professionals can earn significantly more than their paraprofessional counterparts. Therefore, it makes sense financially for one to obtain a master's degree to become a civil engineering professional . Civil engineering professionals rank above average (both percentage and dollar amount in all three scenarios studied) per number of extra years spent in school to become professionals. Civil engineering professionals also break even faster than average in both age and years after school in all three scenarios. The results show that spending the extra time, efforts, and money to become civil engineering professionals makes sense financially. The results presented are encouraging but yet preliminary. Future research should consider other options and more refine assumptions.

REFERENCES

1. Lyons, William C. "U.S. and International Engineering Education: a Vision of Engineering's Future." Journal of Professional Issues in Engineering Education and Practice 123.4 (2000): 152-155.
2. Walesh, Stuart G. "Engineering a New Education." Journal of Management in Engineering 16.2 (2000): 35-41.
3. ASCE Steering Committee. The ASCE Vision for Civil Engineering in 2025. Reston, VA: American Society of Civil Engineers, 2007. 15 Jun. 2011 <http://content.asce.org/files/pdf/TheVisionforCivilEngineeringin2025_ASCE.pdf>.
4. Nelson, Jon. D., James R. Lambrechts, Robert D. Stevens, David E. Hornbeck, Leo J. Titus, Joe D. Manous, Jeffrey S. Russell, Thomas A. Lenox, and James J. O'Brien, Jr. Final report to the BOD from the paraprofessional exploratory task committee (PETC) September 19, 2008. Reston, VA: American Society of Civil Engineers, 2008. 4 Jun. 2011 <http://www.asce.org/uploadedFiles/Leadership_Training_-_New/PETC%20Final%20Report.pdf>.
5. Knapp, Laura G., Janice E Kelly-Reid, and Scott A. Ginder. Postsecondary institutions and price of attendance in the United States: fall 2008, degrees and other awards conferred: 2007-08, and 12-month enrollment: 2007-08, first look. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2009. 8 Jun. 2011 <http://nces.ed.gov/pubs2009/2009165.pdf>.
6. Salary.com. Home page. 2011. Kenexa. 2 Jun. 2011 <http://www.salary.com/salary/index.asp>.
7. All Engineering Schools. Engineering Salary. 2011. All Star Directories, Inc. 10 Jun. 2011 <http://www.allengineeringschools.com/engineering-careers/article/engineer-salary>.