

A Study of the Supply and Demand for Construction Education Graduates in the United States

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Abstract

In 1997 the Department of Construction Science at Texas A&M University conducted a survey of accredited construction programs and construction companies that consistently hired from these programs to identify if the demands of the industry were being met by the supply of construction graduates. A time series regression analysis was used to predict the demand for construction graduates from accredited construction programs. The model showed that there was an increase in demand for construction graduates of approximately 593 students per annum. The supply of students however was reported as remaining static for the next five years indicating the prospect of gap between supply and demand. The results of this research were presented at the annual conference of the Associated Schools of Construction in 2000. In 2005 the study was repeated to see if there had been any change in the supply and demand for construction education graduates. In the 2005 study, 64 accredited construction education programs were surveyed to quantify the number of "construction graduates" who were produced by accredited construction programs. The study surveyed 551 construction companies across the United States, who hired construction graduates to quantify the demand for construction graduates. The study then compared the supply and demand figures. In 2005, findings from the accredited universities indicated a production level of approximately 3596 construction graduates. The industry survey indicated a demand in 2005 for approximately 7877 construction graduates. The intent of the study is to provide a representation of the current production level of, and the demand for construction graduates, for the purpose of comparing supply and demand. Actual demand figures are given for the years 2000 through 2005. Demand projections are given for the years 2006, 2007, 2008, 2009, 2010. Supply figures are based upon the average production of construction graduates, from each identified university, during the years 2000 through 2005. The results of the survey data indicate an increasing demand for construction education graduates of approximately 754 students per annum. Additionally, the survey data reveals the supply of construction graduates is increasing by only 160 students annually is not currently meeting the demands of the construction industry, nor will it be meeting the industry demands in the future.

Keywords: Demand, Education, Labour Markets, United States of America, Workforce.

Introduction

The construction industry has, for several years, been one of the largest industries in the USA. Over the course of the last few years, the construction industry has continued to grow steadily. According to the U.S. Department of Labor and Statistics (2006), current employment statistics estimates show total annual average construction employment rising from 5,274,000 in 1995 to a high of 6,964,000 in 2004, surpassing the previous high achieved in 2001. Due to this continued growth, and construction processes becoming increasingly complex the industry has placed a growing importance upon accredited construction education programs to supply bright and motivated individuals (U.S. Department of Labor, Bureau of Labor Statistics, 2006). As the importance of the supply from construction education programs increases, so does the necessity to measure and evaluate industry needs (the demand for construction graduates) and the educational program production (the supply of construction education graduates). However, the research that has been done to quantify the supply and demand for construction graduates in recent years is very limited. To address this problem, the Department of Construction Science at Texas A&M University has been actively involved in research to develop credible information on both the supply and demand for construction graduates. In 1997 a study was conducted by Bilbo, Feters, Burt and Avant (2000) to attempt to quantify the supply and demand of construction graduates. It involved the survey of 54 accredited construction programs in the United States. and over 700 companies which consistently hire graduates from the surveyed construction education programs. The results suggested a widening gap in the supply and demand of construction graduates for the near and long-term future, given the continuation of current market growth and production levels of accredited construction programs. The results of this research were presented at the annual conference of the Associated Schools of Construction in 2000; this is the annual conference of construction educators in the USA. In 2005 the study was replicated to identify what changes if any had occurred to the supply and demand of construction graduates since the original study and to validate the original 1997 study. The results of the 2005 study were presented at the 2007 annual conference of the Associated Schools of Construction (Bilbo, Collins, Mohamad & Burt, 2007). This paper brings together and compares the results of the two studies.

Methodology

The purpose of conducting the research for the two studies was to analyze the supply and demand for construction education graduates from 1995 – 2005 and 2000-2010 respectively. In order to analyze and collect this data, surveys were sent and collected from the supply (universities) and demand (construction companies) sources.

University Survey

In order to analyze the supply for construction graduates, accredited construction education programs throughout the United States were surveyed. To facilitate the gathering of data for the construction education supply, mail-out surveys were sent to all American Council for Construction Education (ACCE) accredited construction education programs, selected Accreditation Board for Engineering and Technology (ABET) programs, and selected National Association of Industrial Technology (NAIT) programs. The ABET and NAIT programs that were selected to be surveyed had to meet certain standards. In order to ensure the selected ABET programs were producing a “construction graduate,” that was the close equivalent to a construction graduate of an ACCE program, the selection criteria was as follows: the identified ABET programs were those in the engineering field that best matched the ACCE programs by preparing and educating students for a career in the construction industry, rather than engineering. In the 1997 study, department heads were asked to reveal their average number of graduates per year for the three years prior to the study. The number of graduates from each program were then summed in order to calculate the current number of construction graduates produced by universities across the nation. In addition the 2005 study asked if the supply of construction graduates was meeting demand and what plans they had to increase the supply of construction graduates. For both studies the department heads were also asked to provide a list of companies that recruit their students upon graduation. Responses from this question were used to compile a list which would represent the population of employers who hire new construction graduates. When the original study was conducted in 1997, 48 universities were surveyed. The 2005 study surveyed 64 universities, as the number of accredited construction education programs has increased in the past seven years.

Employer Survey

For the 1997 study an attempt was made to survey every company on the list of employers established in the university survey. The survey targeted the past, present, and future number of new construction graduate hires within each company. Each employer was asked directly if the supply of graduates was sufficient to meet the needs of the company. If a company indicated there were not enough graduates available for hire, the employer was asked how many graduates would have met the needs of the company. This allowed a calculation of past and present demand for the construction graduate. To assess future estimates in construction graduate demand, several questions asked the employer to predict their hiring needs from 1998 to the year 2000. The employer was asked to make these predictions based on the current trend of steady economic growth.

In the 2005 study data collected from the employer survey was a two-part process. Initial contacts were made to survey the companies on the list of employers from the original study conducted in 1997. The original list of companies was surveyed first, and was part one of data collection for the demand element of this research. Data was collected from chief executive officers and/or presidents of construction companies. The heads of human relations were also recipients of the survey, depending upon the departmental structure of the company or directions of the company president.

In addition to obtain a list of companies that currently regularly recruit from universities, each accredited university was asked to identify these companies. In the survey, it was made clear that construction companies of all size and volume were relevant, as long as they recruited from the construction program on a regular basis. Once companies were identified by the universities, each company was subsequently surveyed.

Data Analysis and Results

University Survey Findings

In the 1997 survey a total of 54 universities with construction programs accredited by ACCE, ABET, and in some instances both, were surveyed. Results from the survey indicate 2350 construction graduates, as defined by this study, are produced each year. Of these graduates, 2179 students receive a bachelor's degree, and 171 students receive a master's degree.

For the 2005 survey a total of 64 universities with construction education programs accredited by either ABET, ACCE, NAIT, and in some cases two of the three, were surveyed. Of the 64 universities surveyed, 57 responded. Out of the 57 universities that participated in this research study, 46 (81%) reported that their supply of new construction graduates was not meeting the demands of the recruiting companies. Of these universities, almost all of them revealed in the survey that they could place, in most cases, two to three times more students were they available. Only 11 of the universities (19%) stated they were meeting the demands of the construction companies. Although, as revealed by 81% of the universities, their supply of construction graduates are not meeting the demands of the recruiting companies, even more significant is that only 58% (33 out of 57) of the universities have plans to increase the size of their programs. Most common reasons that were given for not increasing the program included: money and budget issues (lack of available funds), fierce competition amongst programs within the university (for example, business, architecture, engineering) and lack of faculty to teach.

Data analyzed from the 2005 survey indicated that approximately 3596 construction graduates, as defined by this study, were produced in 2005. Of these students, 3272 (91%) received a bachelors degree and 324 (9%) received a master's degree. However, the reader must keep in mind that of the 64 universities that were surveyed, 57 actually responded, making the response rate 89% for the university surveys. Therefore, taking this response rate into account, the annual supply totals were multiplied by 1.12 (1/0.89), which gives us an

approximation for the final supply number for construction graduates of 3596. Table 1, lists these numbers. The years from 2006 to 2010, under the heading “Survey Data,” are the short-term predictions (reported by the programs) of the supply of construction graduates.

Table 1: Supply & Demand of Construction Graduates 2000-2010

Year	Survey Data - Supply	Survey Data - Demand
2000	2843	3949
2001	2935	4796
2002	3008	5727
2003	3359	6129
2004	3436	6715
2005	3596	7877
2006	3493	9087
2007	3624	10570
2008	3736	10020
2009	3911	10457
2010	4062	11182

When the original study was conducted in 1997, it was reported that 2350 construction graduates were produced each year. Of these 2179 students (93% of) received a bachelor's degree and 171 students (7%) received a master's degree. This represents an increase in the supply of construction graduates of 1,246 (53%) from the 1997 study to the 2005 study. In 2000, 93 students out of 100 earned a bachelor's degree, while only 7 out of 100 earned a master's degree. In 2005, 91 students out of 100 earned a bachelor's degree, while only 9 out of 100 earned a master's degree.

Employer Survey Findings

For the 1997 survey each university was asked to list the companies that recruit construction graduates. The company names were aggregated into a list containing 773 employers. For the 1997 study, this list was considered the population of companies who recruit construction graduates. Of these 773 companies, 295 responses were received to the employer survey. In summary, the projections within this study were based on responses from 38% of the total population of companies under investigation. The demand for construction graduates was calculated in two ways. For the years 1995-1997 the annual demand was measured by summing the total number of graduates hired by responding companies and the total number of additional graduates companies would have hired had they been available. For the years 1998-2000 annual demands were based on the number of graduates responding companies predicted they would hire. Of all the companies issued with a questionnaire, only 38% of them completed the questionnaire. Taking this response rate into account, the annual demand totals were multiplied by 2.63 (1/0.38). The annual demand totals are set out in Table 2 they show both the reported hiring figures and the predicted hiring figures.

Table 2: Demand of Construction Graduates 1995-2000

Year	Survey Data
1995	2302
1996	2708
1997	3396
1998	4525
1999	4800
2000	4972

Respondents to the 2005 employer survey reported the actual number of construction graduates they hired and the total number of additional graduates they would have hired had they been available in the years 2000 through 2005. They were then asked to predict how many construction graduates they would hire in 2006 through 2010. Of the 551 companies that were surveyed, 203 actually responded, making the response rate 37% for the employer surveys. Therefore, taking this response rate into account, the annual demand totals were multiplied by 2.7 (1/0.37), which gives us the final demand numbers for construction graduates. The annual demand totals are set out in Table 1 they show both the reported hiring figures and the predicted hiring figures.

Predicting demand for construction graduates (1997 study)

For this study, the historical hiring quantities and the short-term predictions through the year 2000 were used to formulate a simple regression model in order to extrapolate the data through the year 2005. It should be noted at this point, however, that straight-line extrapolations from the past are acceptable only during times of steady growth which was assumed for purposes of this study. The following section summarizes the model used for the data extrapolation and the resulting data.

For this analysis, the dependent variable was the measure of the demand for construction graduates of ACCE accredited construction education programs and selected ABET programs. The independent variable was the number of years from the first year surveyed. The first year surveyed is calendar year 1995, which was designated year 0 for purposes of the study. The final year surveyed (2000) was labeled year 5.

A simple linear regression model was used to predict the demand for the number of construction graduates based on the calendar year. The regression model was defined as:

$$\text{Number of Construction Graduates} = \beta_0 + \beta_1\text{Year} + e$$

Results of the General Linear Model procedure are displayed in Table 4. The R-square value (coefficient of determination), which measures the proportion of variability in the dependent variable explained by the independent variable (Ott, 1993) show that approximately 95% of the change in the number of construction graduates is caused by change in time. This indicates that this regression model would appear to be a good predictor of the demand for construction graduates, if the steady growth of the industry remains constant.

Table 4: Results of general linear model procedure for demand of graduates (1997 Study)

<i>Regression Statistics</i>					
Multiple R		0.97			
R Sq.		0.95			
Adjusted R Sq.		0.93			
Standard Error		293.03			
Observations		6			
<i>ANOVA</i>					
	<i>DF</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Sig. F</i>
Regression	1	6150893	6150893	72	0.00107
Residual	4	343469	85867		
Total	5	6494362			
	<i>Coefficients</i>	<i>Std Err.</i>	<i>t Stat</i>	<i>P-value</i>	
β_0 Intercept	2302	212.08	10.85	0.000408	
β_1 Year	593	70.05	8.46	0.001068	9

Table 4 shows that the demand for construction graduates is increasing annually by approximately 593 students. Using the parameter estimates of the linear regression model, the predicted demand for years 2001-2005 was calculated. Table 5 shows the demand for construction graduates for 2001-2005 based on the regression model.

Table 5: Demand Predictions for years 2001-2005

Year	Predicted	Prediction Intervals	
		Lower 95%	Upper 95%
2001	5859	4747	6971
2002	6452	5212	7692
2003	7045	5660	8429
2004	7638	6098	9177
2005	8230	6528	9933

The results from this regression analysis are compared graphically in Figure 1 with the demand totals from the 2005 study (Table 3). They show that the 1997 study predictions fell below the lower 95% prediction limits until 2003 and then start to fit comfortably between the upper and lower 95% prediction limits.

Predicting supply for construction graduates (2005 study)

For the 2005 study, the data for the supply was predicted into the future. By taking the factored numbers given by the universities a statistical analysis using linear regression was conducted. A simple linear regression equation was used to predict the supply of construction graduates (based on the calendar year). The regression model was defined as follows:

$$\text{Number of Construction Graduates} = \beta_0 + \beta_1 \text{Year} + \varepsilon$$

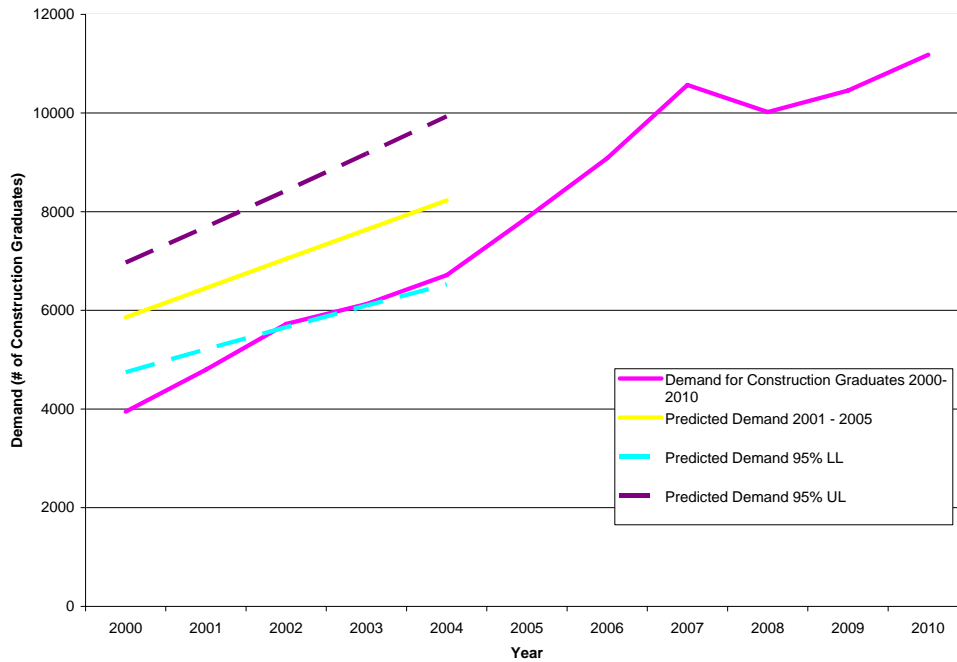


Figure 1: Comparison of predicted demand from 1997 study with the actual & predicted demand from the 2005 study

The dependent variable was the number of construction graduates. The independent variable (β_1) was the number of years from the first year surveyed (the first year surveyed was calendar year 2000). The results of the General Linear Model procedure for supply of graduates are shown in Table 6 below. The r-square value (the coefficient of determinant), was 0.96. This means that approximately 96% of the change in the number of construction graduates is explained by change in time. Essentially, this r-square value indicates that the regression model is a good predictor of the supply of construction graduates, withstanding the steady growth of the industry remaining constant. Table 6 shows that the supply of construction graduates is increasing annually by approximately 160 students

Table 6: Results of general linear model procedure for supply of construction graduates (2005 Study)

<i>Regression Statistics</i>	
Multiple R	0.98
R Sq.	0.96
Adjusted R Sq.	0.94
Standard Error	72.80
Observations	6

<i>ANOVA</i>					
	<i>DF</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Sig. F</i>
Regression	1	451045	451045	85	0.000767
Residual	4	21198	5299		
Total	5	472243			

	<i>Coefficients</i>	<i>Std Err.</i>	<i>t Stat</i>	<i>P-value</i>
β_0 Intercept	2794.81	52.69	53.05	<0.0001
β_1 Year	160.54	17.40	9.23	0.000767

Table 7, lists the actual number of construction graduates as reported by the accredited construction programs. The years from 2006 to 2010, under the heading "Survey Data," are the short-term predictions (reported by the programs) of the supply of construction graduates. The numbers under the headings "Predicted (In Regression)" and "Prediction Intervals" were generated by taking the actual numbers given by the universities and performing statistical analysis using the SPSS program.

Table 7: Supply of Construction Graduates 2000-2010

Year	Survey Data	Predicted (In Regression)	Prediction Intervals	
			Lower 95%	Upper 95%
2000	2843	2874	2634	3115
2001	2935	2991	2757	3224
2002	3008	3107	2880	3334
2003	3359	3223	3000	3445
2004	3436	3339	3119	3559
2005	3596	3455	3236	3674
2006	3493	3571	3351	3791
2007	3624	3687	3464	3910
2008	3736	3803	3576	4030
2009	3911	3919	3687	4152
2010	4062	4035	3795	4276

This projected supply trend is a linear regression model based only on actual university estimates from the years 2000-2010.

Predicting demand for construction graduates (2005 study)

Respondents to the 2005 study reported the actual number of construction graduates they hired, and if there were not enough graduates available for hire, how many graduates would have met the needs of the company in the years 2000 through 2005. They were then asked

to predict how many construction graduates they would hire in 2006 through 2010. Of the 551 companies that were surveyed, 203 actually responded, making the response rate 37% for the employer surveys. Therefore, taking this response rate into account, the annual demand totals were multiplied by 2.7 (1/0.37), which gives us the final demand numbers for construction graduates. These numbers represent the predicted number of future hires, the respondents from the employer list predict, and are considered short-term predictions. The results of the General Linear Model procedure for demand regression are shown in Table 8 below. The r-square value was 0.96. Again, this r-square value indicates that the regression model is a good predictor of the demand for construction graduates, withstanding the steady growth of the industry remaining constant.

Table 8: Results of general linear model procedure for demand of construction graduates (2005 Study)

<i>Regression Statistics</i>					
Multiple R		0.98			
R Sq		0.96			
Adjusted R Sq		0.96			
Standard Err		505.16			
Observations		11			
<i>ANOVA</i>					
	<i>DF</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Sig. F</i>
Regression	1	62539776	62539776	245	<0.0001
Residual	9	2296709	255190		
Total	10	64836485			
	<i>Coefficients</i>	<i>Std Err</i>	<i>t Stat</i>	<i>P-value</i>	
β_0 Intercept	4094.36	284.95	14.37	<0.0001	
β_1 Year	754.02	48.17	15.65	<0.0001	

Table 8 shows that the demand for construction graduates is increasing annually by approximately 754 students compared to 593 students in the 1997 study. Table 9, below, shows the actual numbers of the demand for construction graduates and, Figure 2 below, graphically depicts those numbers. Although the “Survey Data” results have produced the actual demand for construction graduates from 2000-2005, the respondents were only able to predict the future demand from 2006-2010.

Table 9: Demand of Construction Graduates 2000-2010

Year	Predicted (In Regression)	Survey Data	Prediction Intervals	
			Lower 95%	Upper 95%
2000	4094	3949	2784	5404
2001	4848	4796	3580	6117
2002	5602	5727	4367	6838
2003	6356	6129	5145	7568
2004	7110	6715	5914	8307
2005	7864	7877	6672	9056
2006	8618	9087	7421	9815
2007	9372	10570	8161	10584
2008	10126	10020	8890	11362
2009	10880	10457	9611	12149
2010	11634	11182	10324	12944

The results from this regression analysis are compared graphically in Figure 2 with the demand totals from the 1997 study (Table 5). They show that both the survey and the predicted data from the 2005 study fit comfortably between the upper and lower 95% prediction limits established in the 1997 study.

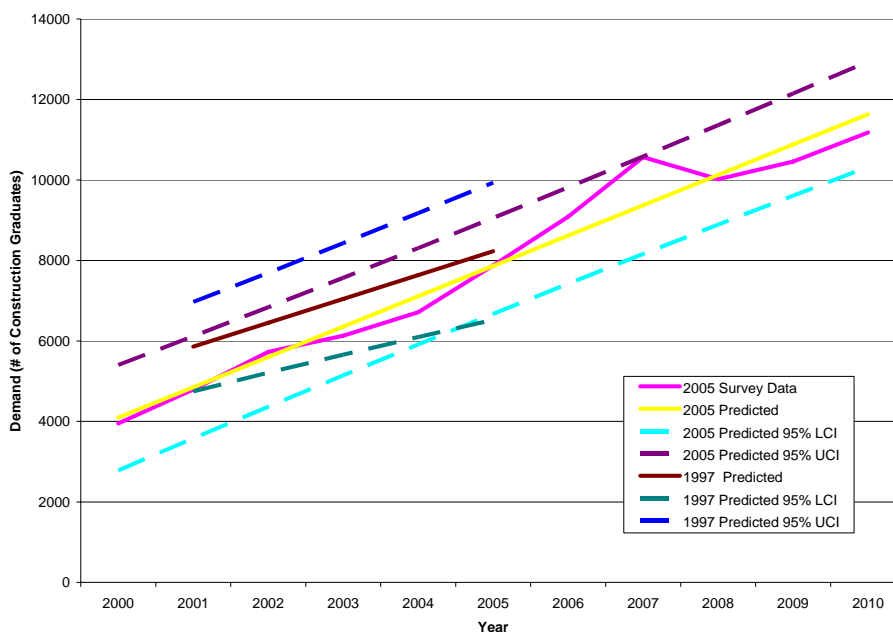


Figure 2: Comparison of predicted demand from 1997 study with the actual & predicted demand from the 2005 study

Comparing Supply and Demand (2005 Study)

The results from the two regression models were compared to identify the gap between the predicted supply and demand. The results of the general linear model procedure for the supply of construction graduates (Table 6) identified the annual increase in the supply of construction graduates of 160; yet the results of the general linear model procedure for the demand of construction graduates (Table 8) shows an increase of 754 graduates annually. This ever widening supply/demand gap can be clearly seen in Figure 3.

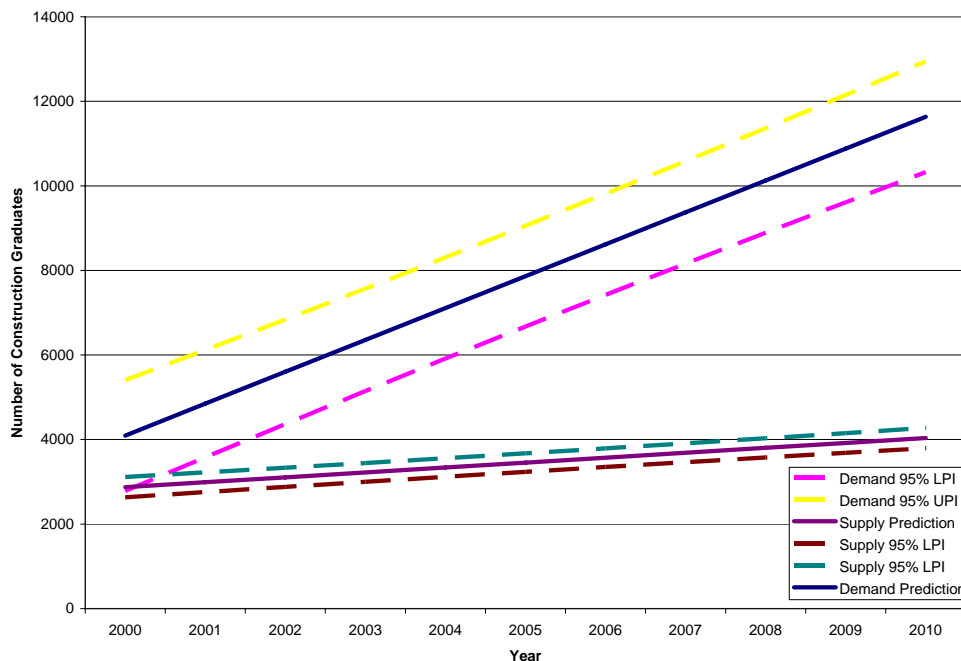


Figure 3: Upper and Lower Predictions-Supply and Demand for Construction Graduates 2000-2010

CONCLUSIONS

Both the 1997 and 2005 studies show an increase in the annual demand for graduates of accredited construction programs of 593 and 754 respectively; yet the increase in the supply of construction graduates from the 2005 study show an annual growth of 160 students. A clear gap between the supply and demand of construction graduates currently exists and all indications are that this gap will continue to widen, provided the current level of economic growth continues. How can this gap be closed? If the current growth in the economy continues it is highly unlikely the demand for construction graduates will reduce. The Bureau of Labor Statistics *Occupational Outlook Handbook* (2007) paints a rosy picture for the future demand of construction managers:

Excellent employment opportunities for construction managers are expected through 2014 because the number of job openings will exceed the number of qualified individuals seeking to enter the occupation. This situation is expected to continue even as college construction management programs expand to meet the current high demand for graduates. The

construction industry often does not attract sufficient numbers of qualified job seekers because it is often seen as having poor working conditions.

The question now becomes how do you increase supply? Increasing the number of construction graduates is not easy. Education of construction students needs resources such as space, faculty and money. All of which are in short supply in publicly funded universities. If there is a solution to the problem it will require increased investment in construction programs.

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