KOREAN CONSTRUCTION JOB MARKET FORECAST FOR CIVIL/ARCHITECTURAL ENGINEERS

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ABSTRACT : In the early 90's, we had serious shortage of construction engineers in Korea. The shortage was acute especially in construction quality control and supervision area, which were gaining social attention due to the road bridge and the department store collapse that took the hundreds of lives in the early 90's in Seoul, Korea. In order to meet the high demand of construction engineers, the engineering license regulations were changed in 1995. Engineers who did not pass the written exam but have equivalent working experience are given engineering license to practice engineering legally. Since year 2000, while the severe engineer-shortage has been resolved, the opposite situation has occurred: there is serious over-supply of construction engineers. Policy makers and engineering practitioners are agreed to bring back the old-fashioned written exam engineer licensing system like before 1995, i.e., no more written exam exemption. However, the engineers who obtained license without taking written exam may not want to go back to old policy which would take their license. It is required to provide appropriate grace period before the new policy takes effect to minimize the impact of the changes. This paper forecasts the supply-demand of construction engineers providing the basis for the most appropriate policy changes.

Key words : Professional Engineer, Engineering License, Construction Job Market Forecast

1. INTRODUCTION

This paper discusses the construction engineering license regulations. There are two different types of engineer licenses: engineers who passed the written exam and engineers who didn't take the written exam but with equivalent years of hand-on experience. In this paper engineers who passed the written exam are called "written exam license holders" and engineers without the written exam but with equivalent years of hand-on experience are called "non-written-exam license holders."

In the early 90's, we had serious shortage of construction engineers in Korea. The shortage was acute especially in construction quality control and supervision area, which were gaining social attention due to the road bridge and the department store collapse that took the hundreds of lives in the early 90's in Seoul, Korea.

In order to meet the high demand of construction engineers, the engineering license regulations were changed in 1995. Engineers who did not pass the written exam but have equivalent working experience are given engineering license to practice engineering legally. Since the written exam exemption was adopted in 1995, the number of construction engineering license holders has increased dramatically.

Since year 2000, while the severe engineer-shortage has been resolved, the opposite situation has occurred: there is serious over-supply of construction engineers. There were 480,000 professional engineers reaching in 2004 which is much more than the construction job market needs in Korea. This resulted in unstable employment status of professional engineers and expectations and respects on professional engineers have gone low. Policy makers and engineering practitioners are agreed to bring back the old-fashioned written exam engineer licensing system like before 1995, i.e., no more written exam exemption. However, the engineers who obtained license without taking written exam may not want to go back to old policy which would take their license. It is required to provide appropriate grace period before the new policy takes effect to minimize the impact of the changes.

2. CONSTRUCTION ENGINEER SUPPLY-DEMAND

In the end of the year 2004, there were 484,224 engineers were registered in career management organizations (such as Korean Institute of Registered Architects, The Korean Construction Consulting Engineers Association, Korean Association of Surveying & Mapping, Korean Engineering and Consulting Association, Korea Construction Engineers Association). 395,269 (202,439 written exam licenses and 192,830 non-written-exam licenses) were employed while 88,955 were unemployed due to the over-supply of construction engineers as shown in Table 1.

Table 1. Construction Engineers in 2004 (Source: Korea Construction Engineers Association)

License type	Registered	Employed	Unemployed
written exam	247,433	202,439	
no written exam	236,791	192,830	
Total	484,224	395,269	88,955

2.1 Construction Engineers Supply-Demand Forecast Based on Construction Economy

Although the employment of construction engineers may depend on many uncertain issues such as social, environmental, political, etc., condition of construction industry is the most important factor that determines the number of employed construction engineers. Condition of the construction industry is assessed by the amount of funds invested on construction industry. Therefore, it is concluded that investment on construction industry and employment of construction engineer have direct relationship. The investment on construction industry is expected to increase by 4.6% every year from 2005 until 2010 reaching 116,000 Billion Korean Won (116 Billion US dollars). The construction engineer's employment forecast is made based on this assumption.

During the last 13 years of construction industry, contracts continuously increased until Korean economy crisis in 1997. From 1997 to 2000, construction market was very cold. While the economy was getting over the crisis, construction contracts went back to normal track in 2000. It is important to note that the contract amount and payment received by contractor are not same. Many contracts that had been on-hold during the economy crisis came out all at once since 2000, but construction projects had not followed immediately after (Figure 1). Therefore, it is more reasonable to link construction employment with payment received by contractors rather than link with the amount of construction contracts.

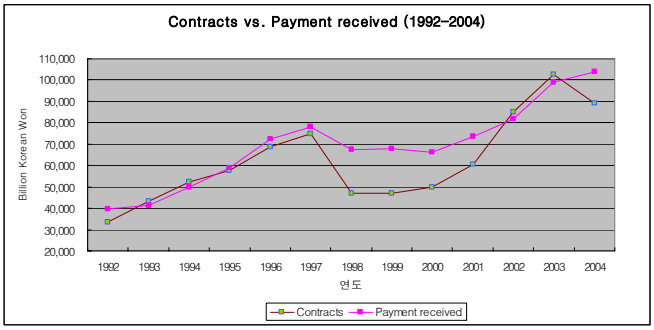

Figure 1. Construction contracts vs. payment received by contractors

3. SUPPLY-DEMAND FORECAST

In this research, construction employment rate changes depending on engineering license regulation changes are studied in three scenarios: (1) Scenario I: No regulation change; (2) Scenario II: Current non-exam engineering license are valid but there will be no written exam exemption except college graduate level of engineers are automatically given entry-level engineering license; and (3) Scenario III: Complete removal of non-exam engineers license to practice engineering.

3.1 Scenario I: No Regulation Change

Three factors are assumed to represent demand for construction engineers and employment rate.

$$D_t = Y_t / P_t \qquad (1)$$

Where, D_t: Engineer demands at time t
P_t: Construction productivity per construction engineer at time t
Y_t: Payment received by contractors at time t

A formula for productivity per person is developed based on past five years data. Logarithm regression model is chosen instead of linear model although the goodness-of-fit (R^2) is low but it does provide more reasonable forecast while the time, t, increases.

$$P_t = 0.0288\,Ln(x) + 0.2044 \qquad (2)$$
$$R^2 = 0.5745$$

Where x= t-1999 for year t. For example, x = 1 for year 2000

The productivity forecast model is shown in Figure 2.

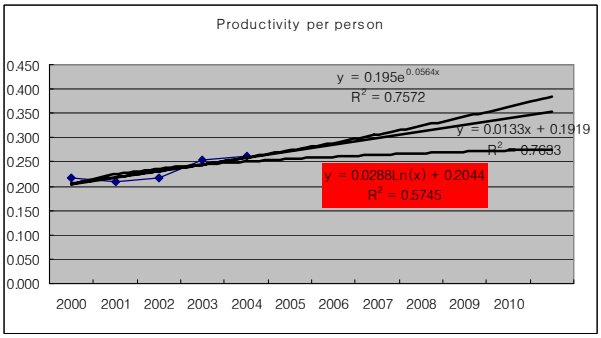

Figure 2. Productivity forecast based on past 5 years trends

This paper uses the data provided by the Construction & Economy Research Institute of Korea (CERIK) to forecast the payment received by contractors in next five years. According to CERIK report, construction industry would grow 4.6% early. Thus, the growth of construction industry and the changes of construction productivity per person can be depicted as shown in Table 2 and the required number of construction engineer can be calculated.

The supply for the construction engineers is calculated based on the number of students graduating with construction related college degree.

$$S_t = S_{t-1} + S_{ut} + S_{net} + S_{ht} \qquad (3)$$

Where, S_{t-1} is registered number of construction engineer

at time t-1;
S_{ut} is students hired by construction industry upon graduation;
S_{net} is newly registered construction engineer with upgraded level of engineering license system;
S_{ht} is high school graduate as construction crew.

Table 2. Demand forecast for construction engineers for next five years (Unit: Billion Korean Won)

Year	Payment received by contractors (Billion Won) (a)	Construction productivity per person (b) = *0.0288 ln (x) + 0.2044*	Demand for construction engineers (a / b)
2005	108,498	0.256	423,816
2006	113,529	0.260	435,907
2007	118,801	0.264	449,515
2008	124,329	0.268	464,467
2009	130,123	0.271	480,665
2010	136,198	0.273	498,055

College graduate construction engineers (S_{ut}) are divided into four categories by the types of colleges such as (1) community college (S_{ut1}), (2) technology institute (S_{ut2}), (3) university (S_{ut3}), and (4) graduate school (S_{ut4}). The forecast model was built for each category.

$$S_{ut} = S_{ut1} + S_{ut2} + S_{ut3} + S_{ut4} \quad (4)$$

$$S_{ut1} = 81.815Ln(x) + 3187.2 \quad (4.1)$$
$$R^2 = 0.1084$$

Where x= t-1999 for year t. For example, x = 1 for year 2000

$$S_{ut2} = 318.33Ln(x) + 872.1, R^2 = 0.9075 \quad (4.2)$$
$$S_{ut3} = 1221.7Ln(x) + 1636.2, R^2 = 0.6672 \quad (4.3)$$
$$S_{ut4} = 241.62Ln(x) + 1364.6, R^2 = 0.6572 \quad (4.4)$$

Number of newly entered construction engineers (mid-level, high-level, expert-level) is forecasted based on past five years historical data.

$$S_{net} = -82.605 Ln (x) + 4606.3, R^2 = 0.5895 \quad (5)$$
where x = t-1999

Number of high school graduate entry-level construction engineers is forecased based on past five years historical data as following equation.

$$S_{ht} = -2389.5 Ln (x) + 7647.9, R^2 = 0.9448 \quad (6)$$
where x = t-1999

As a result, construction engineer supply and demand are calculated as shown in table 3. It is expected to have 77,000 over supply in 2005 and 85,000 over supply in 2010.

$$SD_t = S_t - D_t \quad (7)$$

Table 3. Number of construction engineers for next five years

Year	Supply (a)	Demand (b)	Supply-Demand (a – b)
2005	501,115	423,816	77,299
2006	517,798	435,907	81,891
2007	534,301	449,515	84,786
2008	550,645	464,467	86,178
2009	567,098	480,665	86,433
2010	583,650	498,055	85,595

3.2 Scenario II: Current non-written exam engineering license is valid but no more written exam exemption is allowed except entry-level engineering license.

The demand for the construction engineers is same as in equation 1 in Scenario I and productivity forecast is same as equation 2.

In Scenario II, the supply for construction engineers (S_t) at time t can be calculated by the summarizing S_{ut} (Students hired by construction industry on graduation), S_{pet} (new professional engineers), and S_{ht} (high school graduate as construction crew).

$$S_t = S_{t-1} + S_{ut} + S_{pet} + S_{ht} \quad (8)$$

The supply for Professional Engineers (PE) from 1992 to 2003 are assumed to be 1,134 based on the number of PE registration in career management organizations in Korea.

$$S_{ht} = -2389.5 Ln (x) + 7647.9, R^2 = 0.9448 \quad (9)$$
where x = t-1999

As a result of aforementioned equations, it is expected to have 75,000 of over-supply for construction engineers as shown in Table 4.

Table 4. Number of construction engineers for next five years (Scenario II)

Year	Supply (a)	Demand (b)	Supply-Demand (a – b)
2005	499,123	423,816	75,307
2006	513,941	435,907	78,034
2007	528,689	449,515	79,174
2008	543,376	464,467	78,909
2009	558,259	480,665	77,594
2010	573,319	498,055	75,264

3.3 Scenario III: Complete removal of non-exam engineering license

The demand for the construction engineers is same as in equation 1 in Scenario I and productivity forecast is same as equation 2.

In Scenario III, the supply for construction engineers (S_t) at time t can be calculated by the summarizing S_{aet} (supply

for industrial engineer at time t), S_{et} (supply for licensed Construction Engineer (not PE license) at time t), and S_{pet} (new professional engineers).

$$S_t = S_{t-1} + S_{aet} + S_{pet} + S_{et} \quad (10)$$

The numbers of Industrial Engineering license, Construction Engineering license, and Professional Engineering license registered yearly in career management organization are 9090, 14570, and 1134, respectively between year 1992 and 2003. Thus, the supply for the construction engineers will be short of 151,000 in the year 2005 and 101,000 short in the year 2010 (Table 5).

Table 5. Number of construction engineers for next five years (Scenario III)

Year	Supply (a)	Demand (b)	Supply-Demand (a – b)
2005	272,227	423,816	-151,589
2006	297,021	435,907	-138,886
2007	321,815	449,515	-127,700
2008	346,609	464,467	-117,858
2009	371,403	480,665	-109,262
2010	396,197	498,055	-101,858

4. SUMMARY AND CONCLUSION

Supply and demand forecast was developed in three different scenarios. If the current license law does not change, there will be 88,000 over-supply of construction engineers and about 40,000 over-supply only in expert-level (equivalent to PE license) engineering license holders (as mentioned in Scenario I). Because non-written-exam license holders are about 50% of the licensed engineers, immediate removal of non-written-exam licenses (as Scenario III) would cause sudden shortage of licensed engineers.

In order to meet the supply-demand of construction engineer employment, scenario II is the most reasonable option: Maintain current non-written-exam engineering license but no more written exam exemption is allowed except entry-level engineering license are written exam exempt.

This research work is based only on the numbers of construction engineers disregarding the qualification comparison of experienced non-written-exam engineering license holders and written exam license holders. It is commonly assumed that engineers who passed the written exams are better engineers than who didn't take the written exam. However, it is required to assess the effectiveness of the written exam, and comparison of the expertness of two types of license holders.

Adjusting the supply-demand for engineering licenses means less competition among engineers. However, keeping good quality of expert engineers and providing them reasonable job security and wage would increase the quality of work and produce the competitive edge of Korean construction industry. Government-led construction expert education program is strongly recommended for the future of Korean construction industry.

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