Expert Systems with Applications 36 (2009) 9592–9598

Contents lists available at ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

CRM to improve the avoidance tendency in science and engineering college in Korea

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ARTICLE INFO

Keywords:
Structural equation model
Recruiting
Science and engineering students

ABSTRACT

For the continuous development in science and engineering, strategic manpower planning is essential. Korea, like many other countries, has been experiencing difficulty in recruiting and retaining a good quality of manpower in the fields of science and engineering. Success in recruiting science and engineering students can be related to multiple factors such as governmental policy, social culture, educational environment, and financial incentives. In this paper, we use a structural equation model (SEM) to analyze the effects of these factors on increasing the science and engineering population. The proposed SEM is fitted based on a partial least square (PLS) estimation. Also, we assess the satisfaction index with respect to gender, age, and major of scientists and engineers. Our study indicated that exemption from compulsory military service may not work but support for a better financial environment for science and engineering students appears to be the best long-term goal.

1. Introduction

Korea has been experiencing difficulty in recruiting high quality college students in the science and engineering fields because of a recent avoidance trend in these areas. This is a significant problem which hinders the improvement of Korea's national competitiveness. According to the Korean Association of Science and Technology, the number of applicants to the university entrance examination decreased from 350,000 in 1996 to 200,000 in 2002 (Lee, 2002). The competition rate of science and engineering college has been significantly decreased as well. According to the survey statistics from 688 high schools in Korea, only half of the students who selected a science major in high school actually went to science or engineering college. Of the remaining students, 33% went to medical–pharmaceutical colleges and 13% chose law or business administration as their college major. Moreover, it was reported in 2003 that 36% of science and engineering students in the top three universities in Korea regret their choice of science and engineering as their major. They all represent serious phenomena of avoiding science and engineering careers in Korea.

In the 1960s and 1970s, the Korean government offered many preferential treatments to people in the fields of science and engineering to boost the development of Korean industry. Examples include exemption from the compulsory military service, which is replaced by working in industry and offering a highly paid research position to those who have well established experience abroad. However, such preferential policies are no longer employed. There are several other factors that can be influential on the population size of science and engineering students such as social culture, educational environment, and financial incentives.

Much research has been conducted to improve the college engineering education system after realizing this avoidance tendency and the low satisfaction related to college engineering education in Korea (Lee, Yoon, Kim, & Sohn, 2007). However, the structural relations among influential factors have not been considered.

The main objective of this study is to examine the causal relationship among strategic policies in order to bring excellent students back to the science and engineering colleges. For this purpose, we used a structural equation model (SEM) to analyze the structural relationship between the satisfaction index of science and engineering students, and various influential factors such as government policy, social culture, educational environment, and financial incentives. The proposed SEM was applied to assess the satisfaction index of scientists and engineers with respect to their gender, age, and major field (Fornell, 1992; Sohn & Chang, 2005), where the satisfaction index is scaled from 0 to 100.

This paper is organized as follows: In Section 2, the proposed SEM is introduced along with our research hypotheses. In Section 3, we analyze the data and derive the results. Section 4 summarizes our study results and suggests some feedback information.

2. Structural equation model

The SEM has become one of the most widely used multivariate statistical tools in various areas, such as psychology, educational studies, and behavioral science (Bentler, 1983; Joreskog, 1978). SEM is basically formulated by two types of equations, measurement

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doi:10.1016/j.eswa.2008.07.074

and construct. While the measurement equations can be used to study the relationship between observed variables and latent factors, the construct equations can be used to assess the hypothesized relationship among latent factors.

Since Fornell (1992) developed an SEM to estimate the American Customer Satisfaction Index (ACSI), the use of an SEM has become popular for customer satisfaction in various areas (Choi, 2002; Joo & Sohn, 2008; Kim et al., 2007; Lin, 2007; Sohn & Moon, 2003).

In this paper, we use an SEM in an effort to understand the structural relationship among various factors on the avoidance trend to science and engineering areas.

When such relationship is examined, one can identify the priority on efficient policies. However, no research has attempted to explore a causal relationship between various factors which have a hierarchical structure and avoidance tendency to science and engineering fields in Korea.

Therefore, we apply SEM to evaluate both the direct and indirect effects of multiple causal relationships.

The related literature that has dealt with governmental policy, socio-cultural, educational, and financial factors separately are summarized below.

Park (2004) indicated the importance of government policy for universities and industry to solve the shortage of manpower in technical fields. Kim (2002) indicated that the difficulties of recruiting are caused by the following factors: decreasing benefit for science and engineering students, lack of educational infrastructure, and the problem of engineering college entrance examination, which is associated with no restriction or requirement of preliminary science and mathematics education from high school. Han (2002) pointed out that the difficulty of learning fundamental subjects, such as mathematics and science, and the government's education policy that is incongruent to the development of the technology industry cause the avoidance trend. Finally, Leem (2002) and Lee (2002) indicated that the avoidance trend is caused by the trend of belittling scientists and engineers and the early retirement of researchers in science and engineering field due to the short technology life cycle.

Considering these kinds of literature, we divide various factors that would potentially affect the trend of avoiding science and engineering fields into four: (1) governmental policy, (2) socio-cultural, (3) educational and (4) financial factors. The government policy factor is comprised of two sub factors, government regulation and benefit for military service. We also assume that the satisfaction index would represent the degree of avoidance tendency to science and engineering. In addition this degree of one person's satisfaction is influential on the recommendation to others to science and engineering fields. We represent this with loyalty factor. Each latent factor is measured by its respective measurement variables. The latent factors and measurement variables are presented in Table 1.

Our research hypotheses based on these factors are as follows:

H1. Lack of governmental regulation would have a negative effect on socio-cultural, educational and financial factors.This hypothesis reflects the importance of government policy, which would have not only a direct effect, but also indirect effects on the other latent factors.

H2. Governmental policy, socio-cultural, educational, and financial factors would affect the overall satisfaction index based on the literature review results.

H3. The overall satisfaction index is closely connected with loyalty.

H4. Insufficient benefit for military service would have a negative effect on the satisfaction.In Korea, 26 months of military service is compulsory for healthy young men. The compulsory military service of scientists and engineers can be replaced by working at specified companies or research institutes. However, as this kind of benefit decreases, there is concern that it may no longer boost recruitment to science and engineering fields.

H5. The avoidance trend of science and engineering is different by gender, age and major.

Table 1
Latent as well as measurement variables for SEM

Latent variable		Measurement variable
Governmental Policy Factor	Government regulation factor	– Decreasing benefit for science and engineering students – Insufficient support for industry – Insufficient support for science and engineering education – Lack of preferential system for the employment of public servants
	Benefit for military service factor	– Insufficient benefit for the replacement of compulsory military service – Unsatisfactory work environment for the replacement of compulsory military service
Socio-cultural factor		– Trend of underestimating scientists and engineers – Limitation on becoming a social leader – Absence of a culture of science and technology – Relatively lower employment rate – Avoidance of difficult work
Educational factor		– Compulsory and unspecialized primary education – Difficulty in math and science – Not requiring science subjects for engineering college entrance system – Poor research facilities in college – Low ratio of professors to students – Superficial college education – Gap between college education and industry practice – Insufficient collaborative research between academia and industry
Financial factor		– Low salary – Expensive tuition fee – Poor working condition – Lack of job stability (difficulty of job turnover) – Early retirement due to rapid technology change
Satisfactory index factor		– Satisfaction of policy environment – Satisfaction of social & cultural environment – Satisfaction of educational environment – Satisfaction of financial environment
Loyalty factor		– Degree of recommendation for science and engineering fields

To test these hypotheses, we constructed a SEM as shown in Fig. 1.

We assume that the overall satisfaction index is measured in terms of the satisfaction levels of governmental regulation, socio-cultural, educational, and financial factors, and that loyalty is measured by the degree of recommendation for science and engineering fields.

In the following section, we apply the partial least square (PLS) procedure to fit the model given in Fig. 1. The best-known causal model estimation is LISREL (Gunilla, Gunnar, & Toni, 2005; Hagedoorn & Schakenraad, 1994). However, LISREL is poorly suited