A Study on the Improvement of Software Workforce's Working Conditions to Meet Their Increasing Role

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ABSTRACT

At this time, it is very urgent and important that the new high value-added industries with convergence and embedded software technologies are promoted to make the driving force for new growth. Moreover, software is used as an essential part or material of nearly all products. However, the economic and social treatment over the software workforce, which is the core of software development, is very weak. In addition, the discussion or study on the treatment improvement and value awareness of software practitioners is almost non-existent. Therefore, this study suggests some measures for software workforce's improved treatment to meet their increasing role. We examine the present state of software workforce, discuss their status and role, and suggest some measures for the improvement of their working conditions and social treatment.

Key words : software workers/practitioners/workforce, software industry, improvement of working conditions

1. Introduction

It is necessary to foster high value-added industries using software technology so that they may be the driving force of new economic growth. This would enable Korea, a country poor in natural resources, to become a powerhouse of information technology industry. Moreover, software is an integral part of almost all the industrial products including vehicles, vessels, aircraft and electronic devices; products that are used daily[2][3]. Any trouble in the software of a property protection system or a national security system may result in life-threatening consequences for its users as well as endangering the existence of its user organizations. For safety reasons, high quality of software without any critical fault is essential and the human resources necessary for it should be carefully managed.

Even though software workforce are the key players of the software industry, they do not receive the appropriate social treatment and status they deserve[8]. There have been quite a few discussions and studies regarding the promotion of the software industry, reflecting the importance of software. However, the studies for the improvement of the software workforce's working conditions and their status, which

are a crucial factor to the productivity and competitiveness of the software industry, have scarcely been done.

In this paper we examine the current status of Korea's software workforce and discuss the significance of software manpower for the national economy. We then suggest various measures for the improvement of their working conditions.

2. The current status of software workforce and their work environment

This section defines the concept of software workforce and examines their current status and work environment, in addition to investigating the issues for the improvement of their working conditions.

2.1 The concept and status of software workforce

A software practitioner or software worker is a person who works for the software industry. And the software workforce is the total number of software workers in the industry or for a particular business. The software industry includes businesses involved in the development, maintenance and publication of computer software using any business model. The industry also includes software services, such as training, documentation, and consulting.

The number of the domestic software workforce has increased slightly from 112,000 in 2001 to 128,000 in 2006, as shown in <Table 1>.

<Table 1> Number of Domestic Software Workforce
(thousands)

Field	2001	2002	2003	2004	2005	2006
package software	37	44	39	30	29	30
computer- related service	66	67	67	70	82	88
digital contents development · man ufacturing	10	12	11	10	9	9
Total	112	122	117	110	120	128

(source : Korea Association of Information & Telecommunication, 2008)

2.2 Software development conditions
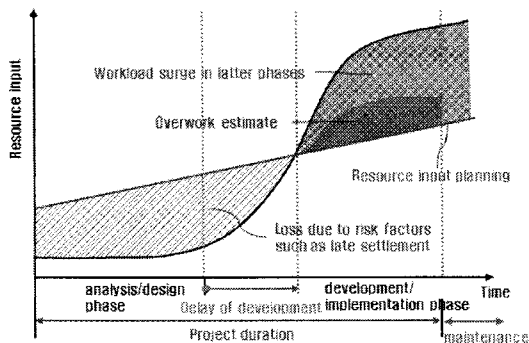
2.2.1 Reality of overtime work

The worst working condition of the software developers is their working hours. According to a KIPA survey, the average of software developers is 55.1 hours per week. This is at the highest level among all the industries, without appropriate payment for the overtime work[9]. Most of the software developers' working hours are distributed from 50 to 60 hours per week and 17.5% of these workers work over 70 hours per week, which includes all-night work or weekend work. The weekly work hours of software developers are almost 12 hours longer than the average for all the workers in 14 industries, which is 43.7 hours according to a survey of the Ministry of Labor.

2.2.2 Problem in the development cycle management

Usually the sequence of events in a software development project involves system analysis and design, coding and testing, implementation, and maintenance. If the user requirements are specified accurately in the analysis stage, the progress of the software development project would be smooth. However, due to the change of user requirements and occurrences of additional new functions, the later phases of project are usually subject to demand overtime work.

Software development projects tend to have more work to do in the latter phases and resource input planning is made accordingly. However, the actual workload in the latter phases often far exceeds its initial estimation because of the risk factors accumulated in the process in which it is carried out. In many cases the late settlement for the scope of development in the analysis and design phase often results in the delay in the starting time of software development

This implies that the analysis for user requirements and detailed definition of system specifications should be made in a timely and accurate manner applying an effective engineering approach[4].

(source : Jaesik Shin, Korea Association of Software Manpower, 2008)

〈Figure 3〉 General Pattern of Project Schedule Delay

2.3 Software quality and profitability

2.3.1 Software quality

It is no exaggeration to say that the success or failure of software depends on its quality. Undue overloads in the development phase may hinder the sufficient testing applying its development methodology and engineering approach, which results in poor quality control in the software development process. Process quality management is done a lower level compared to other fields such as project management and engineering support.

Many projects are received at low price with their low profitability and they make up for it through subcontracting. Their focus is on finishing them within the time limit for delivery, neglecting the quality.

For these reasons the quality control capability of domestic software developer companies is quite low. They cannot compete against their international counterparts due to the low level of quality management capability, resulting in difficulties in expanding their overseas markets. The low quality level and different domestic contract system are obstacles to the export of software development projects, and the outsourcing competitiveness in individual fields is also suffering for the lack of experts[4].

In the past, the United States also experienced project failure which was a result of tight scheduling or time for delivery and budget deficit. They have overcome these problems by upgrading their management level through software engineering approaches.

2.3.2 Project profitability

The earning rates of software development projects are quite low and those of their subcontracts are even worse. This poor profitability leads to low R&D investment and early resignation of software workers from their jobs keeps them from improving the software quality.

They need to cultivate the software industry culture in which the quality of software is regarded as one of critical success factors for a project. The selection of a project should be based on the discriminating evaluation for its technology capability, rather than marketing and bidding price. The project should be carried out with its focus on its quality management as well as its delivery time management for more project contracts. But the opposite prevails bringing about the disbelief for the quality of software products and degrading their values.

Low project payoffs deter the efforts for R&D. To complete the project at the low price, they use cheap low-level workers. Due to the low profitability, they can not afford to invest for the cultivation of high-level workforce and to pay high-grade professionals their high payments. Furthermore early resignation of software workers from their jobs undermines the expansion of high-grade workforce, worsening the quality of software products.

The profitability aggravation due to SI subcontracts leads to the reduction of R&D investment. In this situation software companies may run their projects with interests in getting the labor charges based on the number of input head counts, resulting in early resignation of workers and aggravating the lack of accumulated technologies. These contribute to degrading software values and hindering the enhancement of software quality[4].

2.4 Software manpower

2.4.1 Input workforce

It is not unreasonable to say that the quality of software depends on the skill level of its workers. But

the size of input head counts is used as the basis for calculating the price of a project. In reality, four low-level workers are used instead of one high-level worker. The number of head counts input for a software development task in Korea is four times higher than that for the same task in United States.[1]

Since the price of a project is calculated on the basis of the size of input head counts, cheap software workers with low-level skills are preferred. There is no accumulation of software engineering technologies in the software workforce. The project contract practices are focused on product delivery time neglecting its quality. This results in the low quality of software products and the low productivity of software workforce.

It is a serious issue that there are no sincere efforts for solving the quality problem. For 2003, the project success rate in US was 29%, but the rate in Korea was never established due to obscure user requirements, and the insufficient use of software engineering tools and modeling techniques[4].
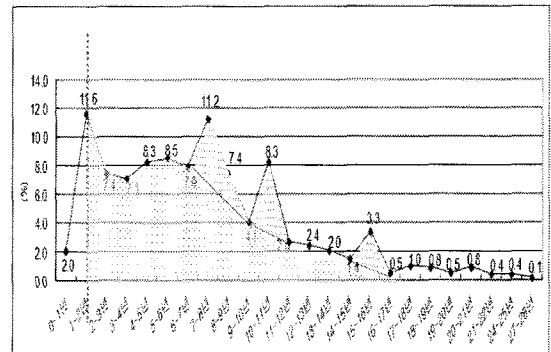
2.4.2 Lack of high-grade workers

The poor working conditions hinder the influx of even low-level workers as well as high-quality workers into the software industries. The inflow rate of new workers into software fields is decreasing, and the outflow rate of skilled workers with seven or eight years is quite high. So we have a shortage of high-grade technical workers.

An early efflux of high-grade technical workers, who are then replaced by low-grade workers, is due to the low payoffs of software projects. Most of the outgoing workers transfer to marketing, and non-professional project management jobs. The work environment is not favorable for the software workers to grow into architects or high-grade project managers.

It is difficult for high-quality workers to have opportunities to advance their careers, due to the lack of high value-added enterprises such as software system consulting firms and specialist enterprises in system

analysis and design or software development. Their difficulties may be attributed to the culture in which people do not properly appreciate the added value of the planning and design tasks done by high-grade workers with their creativity and technical expertise.

〈Table 2〉 Distribution of Software Developers' Career Duration

(source : Jaesik Shin, Korea Association of Software Manpower, 2008)

2.4.3 No vision ahead

The current poor working conditions of software workers and their uncertain vision for future careers have an effect on the decrease of applicants to software-related departments in universities. The tendencies of university students' avoiding majoring in software are illustrated in the following[4].

First, domestic students' avoidance of majoring in computers is significant when compared to other areas in science and technology. Second, in KAIST's case, the number of applicants majoring in computer science has decreased sharply since 2001, while those of other majors almost maintain the status quo. Third, the tendency of avoiding software jobs is prominent against other technical jobs. Fourth, the recent tendency that high-grade engineers with US PhD degrees are reluctant to return to Korea can be interpreted in the same context as the domestic tendency of avoiding jobs in the science and technology areas. Reportedly, 46.3% of Korean professionals with PhD degrees earned in the years of 2000 to 2003 wanted to stay in the US.

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1) source : ISBSG 2006, KIPA 2007

3. Status and role of software workforce as a new growth engine

3.1 Software workforce as a new growth engine

On September 22nd, 2008, the Korean government announced new growth engines which include 22 items in 6 areas. It is planning to create 880,000 jobs with the investment of 99.4 trillion Won in the new growth engine projects for next five years. These initiatives are political projects for the future industrial growth of Korea. We observe that some of the new growth engine projects such as new IT, new convergence industry, and knowledge service should involve software-based applications or convergence with software technologies.

Since the software industry will enable new value-added applications through the convergence of industries and the convergence of services, the coverage of the software industry will be wider in the future. As an example of the convergence of industries, we can consider the case of new telematics industry which has been generated with the convergence of automobile industry and IT industry. Another example of the convergence of services is the case of Seoul u-Transportation card service which has been created from the convergence of transportation service and finance service.

Major advanced enterprises are making the effort to enhance the productivity of current businesses and to create new growth engine businesses with software technologies. GE has overcome its growth stagnation with highly-profitable services such as telematics and wireless telephone service, and has extended the proportion of its service sales up to 15%('80), 45%('90), and 75%('00). Wal-Mart has improved the efficiency of inventory management and reduced the portion of logistics expenses to 6~7% from 10% with the introduction of RFID[5].

In fact there are no need for a factory and any raw materials to produce software. It is possible to do it if professional technicians are available. So the productivity, quality, and competitiveness of software depend on its workers.

Therefore, software workers play an important role to create new growth engine businesses and should be fostered as key human resources for industrial growth.

3.2 Status and role of software workforce

As the status and role of software workers are important for the creation of new growth engine businesses, the treatment for them will be greatly improved[6]. However, at the moment this is not the case.

The realities of treatment for domestic software workers are very poor (except for the technicians working for some large enterprises and high-grade companies). The average monthly salary of domestic software workers is 2.03 million Won, which is very little when compared with 6.53 million Won in US and 5.99 million Won in Japan. In addition, their social treatment and status are at an inferior level compared to their overseas counterparts[1].

Therefore, there is an urgent need of studies on the improvement of software workers' working conditions and political measures for them, based on their opinions.

Korea Association of Software Manpower has conducted a survey for 103 technicians and professionals working for domestic software industry and issued its resulting report, titled 'A Survey on Software Human Power in Korea', which can be summarized as follows[7].

First, for software workers:
• The difficulties that they have are mainly due to the rapid change of technologies (40.8%) and their poor work environment (35.0%).
• The important qualifications for the software workers are technical skill (59.2%) and professional know-how (27.2%).
• Most of them want to remain as software experts in their specialty areas until retirement (44.7%).

Second, for software industry:
• The most serious problem of domestic software industry is the poor accumulation of original software know-how (33.3%).
• They have the prospect that the software workforce's role in new growth industry will become more important (83.5%).

• It is necessary to rationalize the evaluation of software payoffs (35.9%) and to give better social treatment to software workers (35.0%) for the cultivation and expansion of software workforce.

Third, for political measures to improve their working conditions:,

• institutional support to improve poor work environment (39.8%)

• incentive wage system based on skill levels (31.1%)

Fourth, for social and cultural measures to improve their working conditions:

• better treatment to technicians and engineers who work for small and medium enterprises (42.7%),

• cultivation of symbiotic win-win culture for both small and medium enterprises and large enterprises (26.2%),

• the protection of software workforce' rights and interests through Korea Association of Software Manpower (22.3%).

4. Measures to improve software workforce' working conditions

As we discussed above, the work environment and social treatment of software workers are inferior. However, in the paradigm shift into the knowledge-based economy, their role is becoming more important and accordingly, their status should be upgraded with various efforts to improve their work conditions. This study presents political measures for the improvement of their working conditions so that they may play their own increasingly significant role for the creation of new growth engine businesses.

4.1 Efforts for good prospects of software workers

Most of domestic software workers are harassed with low wages and hard work environment. Unclear prospects for their careers are also a cause of concern. This problem should be resolved so that they can continue to work with hopes for the future.

First, the industry infrastructure in which specialized

software businesses can thrive should be build up. It is necessary to foster software enterprises which specialize in software development consulting, system analysis and design, and audit, so that high-grade software practitioners of architect level may grow with them.

Second, with the right management system for software workers' capability, adequate rewards should be given to them for their expertise and job performance.

Third, with right perspective for the importance and value of software, the price system of software projects should be rationalized and accordingly the reward system for software developers should be improved, so that those systems may be favorable for the growth of high-grade software workers[4].

4.2 Promotion of right perspective for software value

The value of software has been greatly increased, but in domestic reality it is not regarded as valuable as it should be. The pan-government efforts are required to rectify this situation [4].

First, there should be the efforts to cease the vicious circle in which the low price for a software project results in the low quality of software and vice versa. Such an ecosystem for software industry should be changed. Second, there should be incentives for software enterprises' activities to improve the quality of software. Third, the price of software project, including subcontracts, should be calculated by applying the function point analysis. Fourth, the investment for software in IT industry should be increased.

4.3 Expansion of training programs and educational support

There is a necessity to diversify the training programs and to strengthen education supports for high-grade software workers.

First, the educational opportunities for reeducation and self development should be given to the software workers in small and medium ventures and freelance workers in the software industry. Political incentives

should be devised for software enterprises which invest positively in their employees' training and education[10][11][12][13]. Second, positive measures should be taken to meet the growing need for education programs which are related to new growth engine projects and the convergence of services or industries.

4.4 Preferential treatment for overseas job activities

The job opportunities should be extended abroad since there is a shortage of domestic jobs. The government should extend support in education training for people who are willing to get their jobs abroad, and various supporting programs for their easy overseas settlement should be established.

4.5 Instillation of the professional spirit and cultivation of the industry culture

High-grade software workers with experiences and skills are indispensible to improve the software development productivity of domestic software industry. Thus, a preferential policy for enterprises with long-term employed technicians should be in operation. And there should be political support to develop software workers' career paths.

4.6 Lifetime privilege to excellent software practitioners

The software practitioners with high-grade skills are indispensible for the growth of software industry. They are the key resources necessary to enhance the quality and productivity of software development. As such, a preferential policy of lifetime privilege to excellent software workers should be established. They may be selected among the prize winners in a vocational training competition or product exhibition of software industry can be useful to foster them.

4.7 Improvement of software manpower productivity

As previously discussed, the productivity of domestic software development is quite low and in urgent need of enhancement. The low productivity is

due to a vicious circle which is resulted from a small scale of the domestic market, fierce competition for receiving software projects, accepting project orders at a price sacrifice, and low-price subcontracting.

The government should support small and medium software enterprises' efforts to increase their productivity by promoting the development and sharing of high-quality components and securing a repository for shared software components. Second, there should be political measures to extend the applications of software engineering approaches and tools in domestic small and medium software enterprises.

4.8 Reformation for contract practices of public IT projects

In the contract practices of a public project, its price is calculated on the basis of the size of input head counts. Consequently, cheap low-grade workers are preferred for more project contracts, sacrificing the quality of software development. This pricing scheme is a serious obstacle to the improvement of software workers' working conditions and their growth into excellent resources. Thus, the government should drive the reformation in management practices of public software projects, establishing an effective system which is favorable for reasonable duration of software development, project management focused on quality, and practical cost considerations for project requirements change.

4.9 Registration system of software workforce, and the rationalization of software workforce management

The registration of software practitioners and the management for them should be linked with the protection of their rights and the promotion of their welfare. Since there can be a conflict of interests between software business employers and their employees, the promotion of software workers' benefits and the prosperity of software businesses should be dealt with separately. In this respect, Korea Association of Software Manpower may be suitable to take exclusive charge of their registration affairs.

5. Conclusion

Software workforce plays an important role for the economy. This paper examined the current status of software workers in Korea and discussed the significance of software workforce for national economy. This paper also presented various schemes for the improvement of their working conditions.

A recent survey for software workforce by Korea Association of Software Manpower shows the following results.

• The difficulties that they have are mainly due to the rapid change of technologies (40.8%) and their poor work environment (35.0%).

• The important qualifications for the software workers are technical skill (59.2%) and professional know-how (27.2%).

• Most of them want to remain as software experts in their specialist areas until retirement (44.7%).

• The most serious problem of domestic software industry is the poor accumulation of original software know-how (33.3%).

• They have the prospect that the software workforce's role in new growth industry will become more important (83.5%).

• It is necessary to rationalize the evaluation of software payoffs (35.9%) and to give better social treatment to software workers (35.0%) for the cultivation and expansion of software workforce.

• Political measures to improve their working conditions are: institutional support to improve poor work environment (39.8%), incentive wage system based on skill levels (31.1%).

• Social and cultural measures to improve their working conditions are: better treatment to technical workers who work for small and medium enterprises (42.7%), cultivation of symbiotic win-win culture for both small and medium enterprises and large enterprises (26.2%), the protection of software workforce's rights and interests through Korea Association of Software Manpower (22.3%).

Based on this survey result for active workers in the industry, the following suggestions have been made for the policy to enhance software workforce's value.
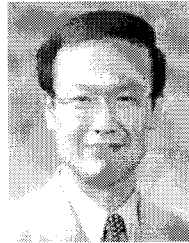
• measures for good prospects of software workers,

• promotion of right perspective for software value,

• more opportunities of training programs for advanced technologies, and increase of educational support,

• preferential treatment for overseas activities of workers with software skills,

• instillation of the professional spirit as a specialist in software industry,

• cultivation of the culture in which software workers get preferential treatment,

• preferential policy for lifetime privilege to prominent software engineers,

• efforts to improve software manpower productivity,

• reformation for contract practices of public IT projects,

• a registration system of software workforce,

• the rationalization of software workforce management

The contribution of this study is to present political measures which can be applied to cultivate software workforce to meet their increasing role. The political suggestions in this study are based on a realistic survey for active workers in the industry. But it has a limitation in showing the causality among software workers' status, software workforce's role, and suggested political measures. The performance evaluation of existing policies which are related to software workforce remains to be made.

Further studies should be done in the issues of; the analysis of some causality between software workforce and political measures for them, and the performance evaluation of policies for software industry and software workforce.

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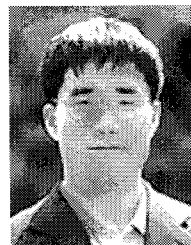
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