A Case Study of Applying Performance Technology to Diagnose and Improve Skill Education Systems[*]

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This study used the performance technology model of Robinson and Robinson to diagnose and solve the problems of the "N" organization. The performance relationship map of the "N" organization was constructed based on the results of the benchmarking, surveys, interviews, and participatory observations. According to the results of analysis, the research team suggested several interventions in three areas: textbooks, educational methods, and educational environments. The study concluded that performance technology is a very effective way to see performance problems from a holistic viewpoint and solve the problems scientifically based on this case study.

Keywords : Performance technology, teaching skill

Introduction

The advancement of information and communication technology directly expands world-wide interaction and contributes to the global market. To survive in a global society, organizations should be more effective and efficient. A great deal of research has been conducted about effective and efficient organizations. One of the representative areas of studies is the learning organization (Senge, 1990; Marquardt, 1996; Argyris & Schon, 1996). The learning organization means that the organizations actively adapt themselves to social changes by learning like a live organism. Another approach is knowledge management (Nonaka & Kono, 1998; Drucker et al., 1999). Information and knowledge become the driving force to generate new values in an information society. In this point of view, knowledge management is an approach to maintain organizations' competitiveness by obtaining, saving, sharing, and utilizing the organizations' knowledge.

Recently, performance technology has been accepted as a new approach that is more comprehensive and scientific than the two approaches described above in solving organizations' problems. Performance technology is an approach which solves the organization's problems systematically and holistically by considering every aspect of the organization (Lee, 2000; Jung, 2000; Robinson & Robinson, 1996). Problems of an organization are caused by a variety of elements, so performance technology analyzes the problems systematically and solves the basic problems scientifically.

This research is based on a case study that applies the performance technology model to solve problems of "N" organization. The performance problem that was suggested by the organization was ineffectiveness of skill training provided by the organization. "N" organization is a professional training institute with the purpose of cultivating future-oriented nuclear experts under the vision of "Creating a Nuclear Safety Culture with Regard to Fundamentals." It provided about 154 job-related courses for both internal and external employees in 2006.

The study applies performance technology to diagnose and solve the performance problems of the "N" organization systematically and scientifically.

Performance Technology Model

Performance Technology

Before understanding the meaning of performance technology, it is necessity to understand the meaning of performance. Nilson (1999) insist that performance is to use mental, physical, and emotional ability to achieve intended goals. Addison and Haig (2006) explain performance in three aspect: activity, result, and value. According to them, performance is activities to achieve special results and the results should have value.

Therefore we can infer the meaning of performance technology from the meaning of performance. The meaning of performance technology is a little different according to researchers, but many researchers agree on the following three main points. First, performance technology focuses on the improvement of human performance (Harless, 1992; Rosenberg, 1990; Stolovitch & Keeps, 1999). The ultimate purpose of performance technology is to improve efficiency and effectiveness of an organization but its first goal is to improve human performance.

Second, performance technology solves the problems of an organization systematically in the systemic viewpoint (Pershing, 2006; Robinson & Robinson, 1996; Rosenberg, 1990). Performance technology views the problems of an organization in the organic viewpoint by considering every input, supra-system, subsystem, and process of the organization.

Third, performance technology is applied discipline rather than creating a new discipline (Gayeski, 1995; Stolovitch & Keeps, 1999). Performance technology integrates the existing knowledge from the system theory, information technology,

organization theory, and management theory to solve the problems of the field.

Robinson & Robinson Model

This study uses the performance technology model of Robinson and Robinson (1996). They suggest a performance relationship map (Figure 1) to diagnose and solve performance problems. The map shows the relationships among the elements of an organization to easily analyze causes of performance problems.

A specific business need is written at the top of the map. The map then indicates that information is required under box 1 (*SHOULD* operational results). For this box the specific business goals regarding the business need will be noted. For box 2, the map requires information regarding the type of performance that people *SHOULD* demonstrate if the desired operational results are to be realized. For box 3, it identifies the current performance (or the *IS*) of people as compared to the desired performance, or *SHOULD*, as noted in box 2. Box 4 shows the performance that yields the current operational results, or *IS*. Under box 5 it identifies the various
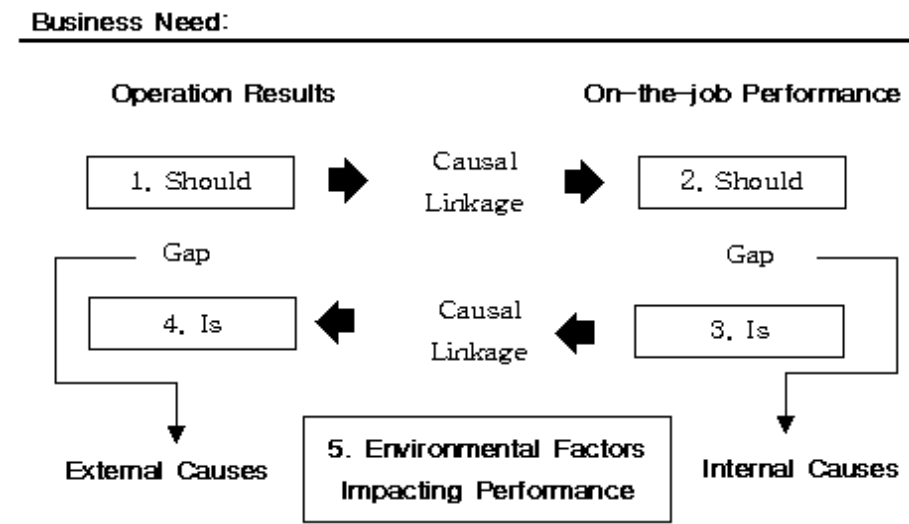

Figure 1. Performance relationship map: adapted from Robinson & Robinson (1996)

factors and forces that impact upon the desired performance. *EXTERNAL CAUSES* are factors that are outside the control of an client team yet affect the achievement of operational results and performance requirements. *INTERNAL CAUSES* are factors that are within the control of the client team and that impact upon achievement of operational and performance goals.

Diagnosis and Interventions for the Performance Problems of the Organization

Diagnosis of Performance Problems of the Organization

The study used benchmarking, surveys, interviews, and participatory observations to gather data and diagnose the performance problems of the organization.

Results of Participatory Observation

The research team observed the instructors' lectures several times and visited the classroom to analyze the classroom environment. The research team also analyzed the eight textbooks that are used in the Nuclear Theory Fundamental Course.

Upon examining the textbooks, we found several problems. The textbooks did not describe the object of the course. Also the textbooks did not observe the principles of textbook writing. The most important problem was the size of the textbook. The amount of the textbook to be covered was too overwhelming to teach and learn for the instructors and trainees.

The results of examining the classroom environment showed the follow problems. The classroom was too crowded and distracting. The front of the classroom was too complex and arranged with too many things. A supplementary whiteboard was arranged at the front of the classroom in spite of there being a main whiteboard because the main whiteboard could not be used due to the overlap problem. The

lighting and air-conditioning systems also were not good.

In educational methods, several problems were found. The one-way lecture was the most important problem. There was no interaction between instructors and trainees. Therefore, trainees' motivation was very low. Almost all of the instructors used Powerpoint for content delivery. However, Powerpoint was not used according to its strengths. The Powerpoint was used for text delivery instead of audio-visual content delivery. The other problem was that the instructors changed too many times between the screen and whiteboard during the one hour lecture. This problem caused losing lecture time so the trainees' attention was distracted.

Benchmarking results

The study executes international and domestic benchmarking. The project team chooses two kinds of organizations. The first are training organizations that provides skill education or nuclear training programs. The second are universities that provide skill education. The chosen organizations are Japan Nuclear Power Training Center, J-POWER(Japan), Samsung Human Resources Development Center(Korea), and Uljin Nuclear Power Training Center(Korea). The chosen universities are Emory University(USA), Florida State University(USA), Tokyo Institute of Technology (Japan), Pohang University of Science and Technology(Korea), and Korea Advanced Institute of Science and Technology.

For the textbook and supplementary materials, we found two suggestions. First, the amount of work from the textbook should be proper for the training period. In the case of the KNPEI, the amount of work from the textbook "Fundamental Courses for the New Employees" is almost twice that of NTC Japan. Second, the textbook should be organized with textbook design principles. The objects should be displayed on the first page of each chapter in the textbook so the focus of the lecture can be maintained. Also textbooks should provide a chapter summary at the end of the chapter. The texts should be concise and clear, and figures should be precise and readable.

For the classroom environment, we found three suggestions. First, the front area of the classroom should be clear enough to avoid distracting the trainees. The benchmarking organization should not arrange any other items except a chalkboard and a screen. They also should arrange the screen at the side of the chalkboard so that they can both be used effectively. Second, they should use classroom space efficiently. For example, they should provide whiteboards or cork boards for writing and sharing among instructors and trainees. Third, the classroom should be conveniently arranged for instructors and trainees. All equipment should be arranged for instructors to control them easily. Above all, the classroom should be comfortable for the trainees.

For the educational method, we could not find a consistent pattern. Every organization had its own approach to the educational method. Instructors had flexibility in deciding educational methods. In the case of Florida State University, an instructional model was suggested in which nine events of instruction, suggested by Gagné (1992) were applied. Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) theory was also suggested to motivate learners.

Results of the survey and interview

Surveys were conducted for 140 trainees and 21 instructors. Interviewees were also conducted for three instructors and four trainees. According to Table 1, there was no

Table 1. Recognition of the skill education

question item	examples	instructor	trainee	χ^2
What is the most difficult thing while you are teaching or being taught?	classroom environment	15.0	23.6	1.68
	textbook	15.0	15.1	
	instructional media	15.0	10.4	
	educational method	30.0	20.8	
	other	25.0	30.2	
	total	100%	100%	

Table 2. Problems with the textbooks

question item	examples	instructor	trainee	χ^2
Which is the biggest problem with the textbook?	content	20.0	14.9	
	figures	10.0	16.5	
	difficulty	45.0	13.2	14.27**
	amount	15.0	44.6	
	other	10.0	10.7	
	total	100%	100%	

significant difference in the recognition of the skill education between the instructors and the trainees. The instructors felt the biggest difficulty was in the educational methods; however, the trainees felt the biggest difficulty was in other factors (lodging, air-conditioning, and long lectures).

According to Table 2, there was a significant difference in the recognition of the problems of textbooks between the instructors and the trainees. The instructors felt that the difficulty of textbook was the biggest problem; however, trainees felt the amount of the textbook covered was the biggest problem. Referring to the interviews, the trainees say that the amount of textbook covered was overwhelming and the speed of lecture was too fast to follow.

According to Table 3, there was a significant difference in the recognition of the problems with the classroom environment between the instructors and the trainees. The instructors felt classroom structure was the biggest problem; however, the trainees felt the chalkboard was the biggest problem. Referring to the interviews, the instructors said that it was difficult to use the chalkboard and screen simultaneously because the chalkboard and the screen overlapped. The trainees also expressed the same problems. The trainees said that they could not see the content on the chalkboard when the chalkboard and the screen were used simultaneously because of the lighting system.

Table 3. Problems with the classroom environment

question item	examples	instructor	trainee	χ^2
Which is the biggest problem with the classroom environment?	lighting	5.3	17.3	
	desks	5.3	15.3	
	chalkboard	36.8	29.6	
	instructional media	10.5	7.1	12.35*
	classroom structure	42.1	14.3	
	other	0.0	16.3	
	total	100%	100%	

According to Table 4, there was no significant difference in the recognition of the problems with the educational methods between the instructors and the trainees. The instructors felt that motivating the trainees was the biggest problem; however, the trainees felt evaluation was the biggest problem. The interview results are almost the same as the survey results in this area. An interesting thing is that the instructors and the trainees both referred to difficulties in individualized instruction. They said that

Table 4. Problems with the educational methods

question item	examples	instructor	trainee	χ^2
Which is the biggest problem with the educational methods?	motivating	40.0	25.2	
	providing instructional goals	5.0	5.0	
	delivering content	25.0	18.5	
	learning activities	15.0	9.2	9.86
	evaluation	0.0	31.9	
	communication	10.0	4.2	
	other	5.0	5.9	
	total	100%	100%	

there were so many levels in the trainees' abilities. However, instruction was provided to all trainees at the same level of difficulty.

Performance Problems of the KNPEI

The performance relationship map of the organization (Figure 2) was constructed based on the results of the benchmarking, surveys, interviews, and participatory observations. The main purposes of the education team at the organization was satisfying the trainees and instructors and enhancing the performance of trainees. To achieve these purposes, the education team should provide a comfortable classroom, strategies for motivating trainees, effective instructional models, an effective textbook,
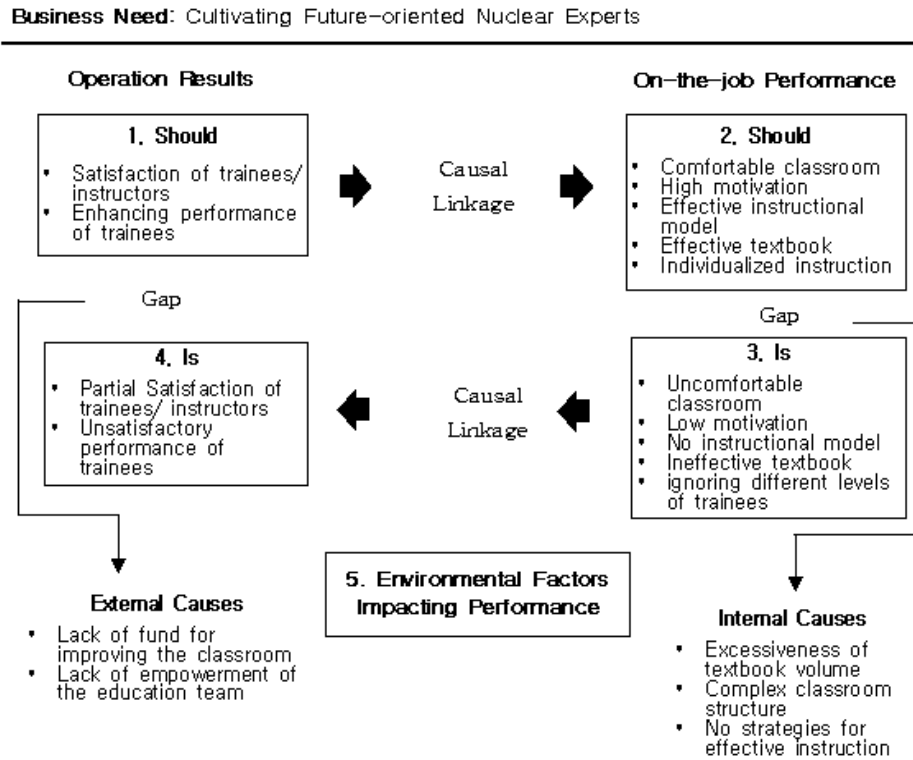

Figure 2. Performance relationship map of the organization

and individualized instruction as on-the-job performance. However, these *SHOULD*s were not achieved in the field. Therefore, the main purposes of the education team came out unsatisfactory. There were gaps between *SHOULD* and *IS* in the operational results and on-the-job performance.

There were many external and internal causes for these kinds of results. The main causes are the following three problems: ineffective textbook design, complex and uncomfortable classroom environment, and no strategies for effective instruction.

Interventions for Solving the Performance Problems of the KNPEI

Interventions for the textbook problem

The textbooks need the following four interventions. The first is to reduce the volume of the textbooks so trainees and instructors can handle them during class time allotted. Second, it is necessary to rewrite the textbooks by observing educational principles. For example, the objective should be described on the first page of each chapter. Also summary should be suggested on the end of each chapter. Third, the textbooks need more accuracy and to be upgraded more frequently. Fourth, the textbooks should be rewritten by textbook writing principles (contrast principle, repeat principle, coherence principle, align principle).

Interventions for the classroom environment

For the classroom environment, three interventions are suggested. The first is to provide trainees and instructors with a comfortable classroom. The classrooms need sufficient space and reform in lighting and air-conditioning. Second, the classrooms need to be a place in which trainees can pay attention only to instructors' lectures. The classrooms need a clean front without anything to distract trainees' attention. Most of all, screens should be arranged at the side of the whiteboard so instructors can use both simultaneously. Also the classroom space should be used more efficiently. The side wall should be used as a supplementary writing place by installing

a small cork board or whiteboard. Third, the classrooms always need to be in an optimal state for more effective management. The classrooms should be inspected periodically by a responsible person.

Interventions for the Educational Methods

For the educational methods, three interventions are suggested. First, the nine events of Gagné are suggested as principles for the skill education. According to Gagné (1992), one hour lessons can be performed in three stages. The first stage is an introduction which takes about five minutes. In the introduction stage, activities to gain trainees' attention, present the objectives, and recall prior knowledge are provided. The second stage is the development stage which takes about forty minutes. In the development stage, activities to present contents, guide trainees' learning, elicit performance, and give feedback are provided. The last stage is a closing stage which takes about five minutes. The activities in the stage are evaluating trainees' outcomes and promoting transfer what they learn from training to their actual job.

Second, customized instruction according to the level of the trainees should be provided. The trainees should be divided to two or three levels and instructors should teach the classes with a different level of difficulty. If possible, instructors should provide individualized instruction.

Third, motivation strategies are needed because of the low motivation of trainees. Keller (1987) suggests ARCS(Attention, Relevance, Confidence, Satisfaction) theory to enhance learners' motivation. According to Keller, attention should be promoted during the first period of instruction and maintained throughout the instruction. Relevance means that the content of the instruction should have some relationship to the trainees' needs and goals. Confidence means that trainees should have trust in their abilities related to the instructional content. Satisfaction means that the trainees should have gratification about the results and processes of the instruction.

The most important thing is that it is necessary to integrate the three strategies above into one instructional model. Therefore, the research team suggests that one

sample of instruction that is constructed by applying these interventions be made and presented as a DVD. The DVD included two sections. The first section included explanations about the contrast between the old textbooks and classrooms and the improved textbooks and classrooms. The first section also included explanations of the new model of instruction. The second section included examples of a one-hour sample instruction. The DVD could be distributed to all inside and outside instructors in the organization and the instructors can use the DVD as a self-study material. They can see well-organized instruction with an improved textbook in an improved classroom. The DVD could be used for the instructors to improve their own teaching skills.

Conclusion

It is very difficult to solve the problems of an organization because almost all problems are related to each other and one solution can be a problem for another thing. Performance technology is a systemic and systematic approach to organizational problems, so it can solve basic diseases as well as symptoms (Robinson & Robinson, 1996).

This study diagnosed the problems of the "N" organization and suggested interventions through the viewpoint of performance technology. The study concluded that performance technology is a very effective way to see performance problems from a holistic viewpoint and solve the problems scientifically based on this case study. The DVD developed as one of the interventions could be used to enhance teaching skills of the instructors in the organization.

However, the study was restricted in solving the internal problems of the organization. To solve the problems of the organization, the external causes, such as the policies for the curriculum and textbook, trainees per instructor and funds, should be solved.

This study will provide organizations or people who have the same problems with an opportunity to reflect on their problems. This study also provides some ideas about how to apply performance technology to solve their organizational problems.

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