

Simulation-based Training Model to Develop Project Management Competencies

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Abstract – This paper aims to review the simulation-based training (SBT) model to develop project management competencies for industrial employees. Microsoft Project was used as simulation media to support training. We suggest that SBT gives many advantages as a method for developing project management competency. Descriptive-survey study was conducted with 100 trainees. The findings that around 61.5% project management knowledge has improved, 89% project management knowledge has improved, and 98% personal competency has improved.

Keywords – SBT, Microsoft Project, Project Management Competencies

I. INTRODUCTION

Simulations are recognized as an efficient and effective ways of teaching and learning complex and dynamic systems for engineering education (i.e. project management). According to Reference [1], the main uses of simulation as: (i) training and education, (ii) assessment of proficiency, and (iii) development of operational research. Simulations have been widely used in training and education, known as SBT.

Simulation-based training encompasses a continuum of technology intended for training purposes. Simulation-based training can be conceptualized as any synthetic practice environment that is created in order to impart competencies (i.e. attitudes, concepts, knowledge, rules, or skills) that will improve a trainee's performance [2]. Use of simulations in training have been purported as beneficial for a number of reasons [3]: (i) simulations typically include several multi-media features which can optimize learner's ability to make sense of material, (ii) prompt psychological processes relevant to performance in real-world setting, (iii) enable emotional arousal, (iv) knowledge integration, (v) enhance feeling of presence and engagement, (vi) safe practice environment, and ect.

Nowadays, the use of simulation-based training model, especially in project management, is now well established. The using of simulation aims to develop a project management competency, so they are capable to manage projects professionally. For the sake of understanding and clarity, the continuum of extant simulation-based training can be loosely group into three primary categories: role-playing simulations, physically based simulation, and computer-based simulation [4]

This paper aims to review simulation-based training methods, especially computer-based simulation, and project management competencies and to provide

examples of how the author has developed such training for industrial employee.

II. SIMULATION-BASED TRAINING

Training is the systematic acquisition of attitudes, concepts, knowledge, rules, or skill that should result in improved performance. Training is planned and systematic effort to modify or develop knowledge, skill, and attitude through learning experience, to achieve effective performance in an activity or range of activities. Its purpose, in the work situation, is to enable an individual to acquire abilities in order that he or she can perform adequately a given task or job and realize their potential [5]. Simulations are recognized as an efficient and effective way of teaching and learning complex and dynamic system engineering education [6]. Simulation is a method of training or research that attempt to create a realistic experience in a controlled environment. As a consequence, simulation-based training can be defined as any synthetic practice environment that is created in order to impart competencies (i.e. attitudes, concepts, knowledge, rules, or skills) that will improve a trainee's performance.

There are some well known benefits of using simulations as training tools. For example, Reference [3] summarize the distributed learning features of simulation-based training and their associated instructional benefits as shown in Table 1. In addition to benefit of simulation-based training, Reference [2] present some advantages of simulation-based training: (i) simulation-based training is superior to other training strategies for imparting complex applied competencies, (ii) simulation-based training can lead to learning in a reduce time frame, (iii) simulation-based training provides a more complex and realistic learning environment than other training strategies, (iv) simulation-based training more readily allows for reality to be simplified and manageable, (v) simulation-based training provides a (relatively) risk-free environment for learning and experimentation, (vi) simulation-based training is an ideal method for training infrequently engaged but critical skills, (vii) simulation-based training can be quite affordable, (viii) simulation-based training is (usually) simple to learn and operate, (ix) simulation-based training is a form of learner-controlled training, and (x) simulation-based training is inherently more engaging than other training method

TABLE 1. BENEFITS OF SIMULATION-BASED TRAINING

Information Richness	Distributed Learning System Features	Benefits of Simulation-Based Training	Relevant Technologies
Low ↑ ↓ High	Content: Text Still images/graphics Images in motion Sound: video, music, special effects	<ul style="list-style-type: none"> ▪ Simulations typically include several multi-media features which can optimize learner's ability to make sense of material 	<ul style="list-style-type: none"> ▪ Video-game quality graphics ▪ Supplementary training materials online or in CDROM (e.g. case studies)
Low ↑ ↓ High	Immersion: Psychological fidelity Constructive forces Stimulus space or scope Fidelity of contexts Motion and action Real time Adaptive to trainees	<ul style="list-style-type: none"> ▪ Prompt psychological processes relevant to performance in real-world setting ▪ Enable emotional arousal ▪ Knowledge integration ▪ Enhance feeling of presence and engagement ▪ Safe practice environment 	<ul style="list-style-type: none"> ▪ Real-time interactions ▪ Motion and action ▪ Realism of environment
Low ↑ ↓ High	Interactivity: Single participants Individual oriented Multiple participants Team oriented	<ul style="list-style-type: none"> ▪ Simulations have potential to offer high degree of interactivity with other users or the systems ▪ Use of characters or agents to stimulate competitors, colleagues, or customers 	<ul style="list-style-type: none"> ▪ Decision trees ▪ Virtual agents ▪ Pre-programmed ▪ Artificial intelligence
Low ↑ ↓ High	Communication: One-way communications Two-way communications Asynchronous Synchronous Audio only Audio & video	<ul style="list-style-type: none"> ▪ At high bandwidth trainees can interact in real-time ▪ Communication with the system 	<ul style="list-style-type: none"> ▪ Natural language processing ▪ Voice recognition technology

(Source: Reference [3])

In accordance with computer-based training (CBT), its have been used extensively in the development of technical skills for relatively well-defined tasks such as surgery, share trading and responding to crisis, project management, ect. CBT, as the name implies, involve some level of computer technology. This category includes a wide variety of simulation technologies to full motion simulations [2]. Computer-based training on project management (i.e. Microsoft Project Simulation) could enrich the learning process to introduce project management techniques.

III. PROJECT MANAGEMENT COMPETENCIES

Competency can be defined as integration of knowledge, skill, and attitude to perform the job professionally. Reference [7] defined competence as knowledge + experience + personal attitude. Knowledge and experience relate to function and attitude relates to behavior. Meanwhile, Reference [8] defines competency as an underlying characteristic of a person in that it may be a motive, trait, skill, aspect of one's self-image or social role or a body knowledge which he or she uses.

Project management competencies are the capability to manage projects professionally, by applying best

practices regarding the design of the project management process, and the application of project management methods [9]. Project management competencies require knowledge, skill, and attitude in the subject, which enables the project meet its time, cost, quality, scope, and resource availability.

According to Reference [10], project management competencies divided into three separate dimensions:

- a. What individual project managers bring to a project or project-related activity through their knowledge and understanding of project management? This dimension is called Project Management Knowledge (i.e., what they know about project management)
- b. What individual project managers are able to demonstrate in their ability to successfully manage the project or complete project-related activities? This dimension is called Project Management Performance (i.e., what they are able to do or accomplish while applying their project management knowledge).
- c. The core personality characteristics underlying a person's capability to do a project or project activity. This dimension is called Personal Competency (i.e., how individuals behave when performing the project or activity; their attitudes and core personality traits).

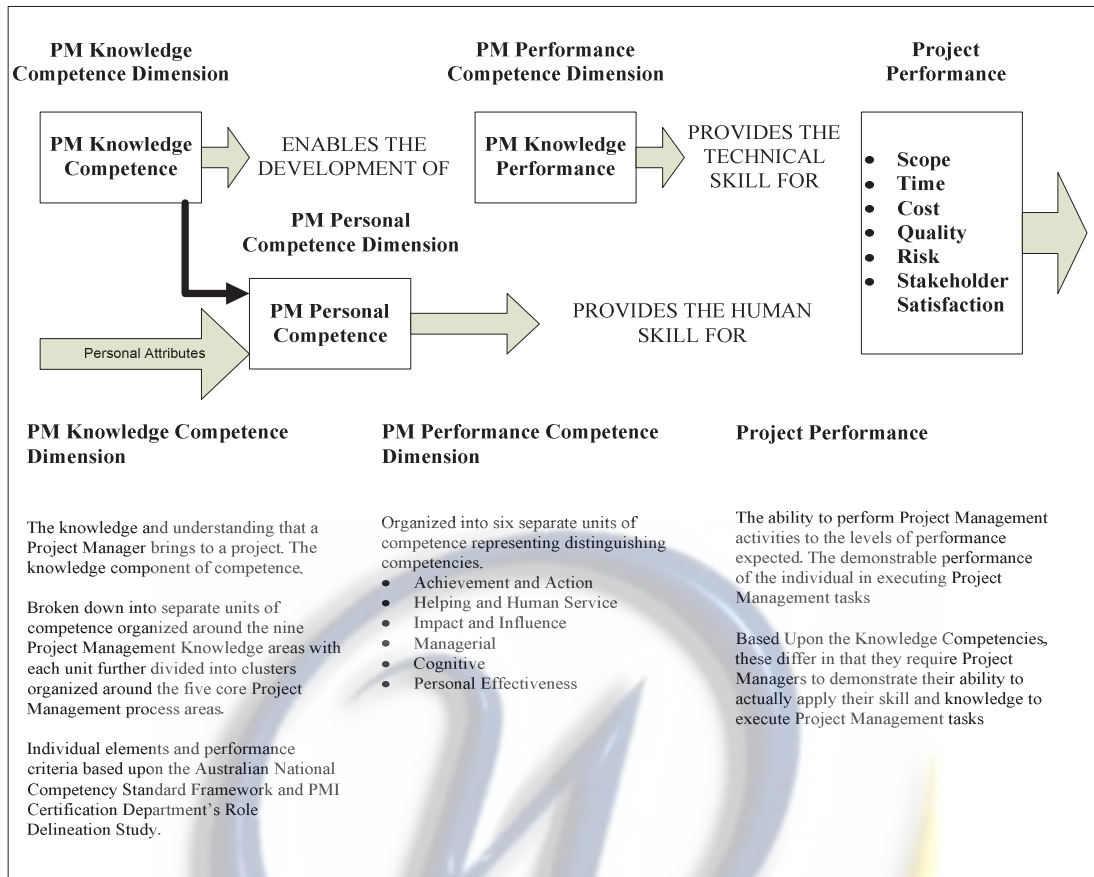


FIG. 1. DIMENSIONS OF COMPETENCY (Source: Reference [11])

It is generally accepted that, to be recognized as fully competent, an individual would need to be evaluated successfully against each of these dimensions. It would be impossible for project managers to be judged competent if they did not possess the “right” combination of knowledge, performance, and personal competence. Project management competencies are achieved by the combination of education and the knowledge acquired during training, the skills developed through experience, and application of such acquired knowledge and experience.

Project success requires project management competencies, as well as organizational project management maturity and capability-organizational performance cannot be ignored. Figure 1 show project management competency and organizational maturity are required to consistently obtained project success, and how both of these can be influenced by various contingency or moderating variables.

IV. SBT DEVELOP PROJECT MANAGEMENT COMPETENCIES

SBT was provided for industrial employees (i.e. project planner, project engineering, and project cost

estimator, ect.). In the following SBT, project management competencies of the employees were measured by formative test for project management knowledge and self-assessment for project management performance and personal competency. The content of project management knowledge and performance are project integration management, project scope management, project time management, project cost management, project quality management, project human resource management, project communication management, project risk management, and project procurement management, meanwhile the content of personal competency are achievement and action, helping and human service, impact and influence, managerial, cognitive, and personal effectiveness. The competencies were measured before SBT through pretest and after SBT through posttest. The result is shown in Table 1.

SBT with Microsoft Project offers some benefits in developing a project competency such as: (i) develop network and schedule, (ii) determine critical path analysis, (iii) determine project owner estimate, (iv) set a baseline, (v) update the project, (vi) control the project, and (vii) develop project report. Beside that, according to Reference [12] SBT programs are expected to provide: (i) effective dissemination of new ideas, principles, and

concepts, (ii) an opportunity to apply content in an experiential environment, and (iii) feedback.

Overall SBT using Microsoft Project in Project Management Training Program was a useful to transfer knowledge and to develop skill and attitudes the trainees. 100 trainees were involved in the SBT and were measured on project management competencies. For project management knowledge, the values of pretest was 53,6 and posttest was 86,8, so there was improvement of this

competency around 61%. For project management performance, the value of pretest was 92,03 and posttest was 173,87, so there was improvement of this competency around 89%. For personal competency, the value of pretest was 89,47 and posttest was 177,4, so there was improvement of this competency around 98%. The result of measurement is depicted in Fig. 2 as follow.

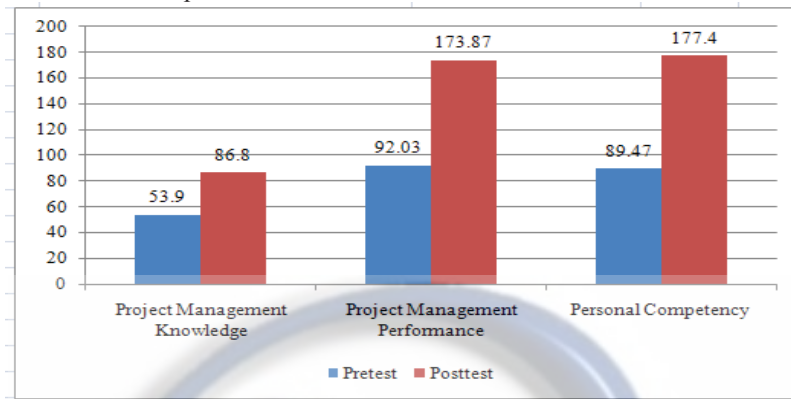


FIG. 2. MEASUREMENT OF PROJECT MANAGEMENT COMPETENCIES

Beside that, the trainees were also asked to give their opinion on a number of Microsoft Project characteristics, their satisfaction and effectiveness of using Microsoft

Project. Using semantic differential scales of 1 to 5, their views are shown in Table 2 and 3 as follow. The questions are adopted from [12]

TABLE 2. SATISFACTION OF USING MICROSOFT PROJECT

	Very satisfied	Fairly satisfied	Neither satisfied nor dissatisfied	Fairly dissatisfied	Very dissatisfied
Quality of graphics	65	30	5		
Variety of tasks	80	20			
Structure of program	15	90	5		

TABLE 3. EFFECTIVENESS OF USING MICROSOFT PROJECT

	Very effective	Fairly effective	Neither effective nor ineffective	Fairly ineffective	Very ineffective
Explaining new ideas	60	40			
Giving adequate feedback	20	80			
Using realistic examples		60	20	20	
Using your experiences		35	65		

V. LEARNING STYLE

According to Reference [13], there are two models for learning namely pedagogy and andragogy. Pedagogy is defined as the process of teaching children, meanwhile andragogy is the process for teaching adults. The distinction between the two models is shown in Table 4 below. Training using SBT method for industrial employees should carry out andragogy model because they are andragogical learners and have specific

assumptions about their learning expectations. For this matter, there are several models and concepts when designing teaching methods for andragogical learners. Reference [14] explained a concept known as experiential learning, where it is believed that experience plays a central role in the learning process. Fig. 3 below show that learning process consist of four-stage cycle. The model relies on here-and-now concrete experience to validate concepts, where immediate personal experience is the focal point for the learning process.

TABLE 2. DISTINCTION BETWEEN PEDAGOGY AND ANDRAGOGY MODELS

About	Assumptions	
	Pedagogy	Andragogy
The learner	Dependent personality	Increasingly self-reliant
Role of learner’s experience	To be built on	Resource for learning
Readiness to learn	Determined by age	Developed from life tasks
Orientation	Subject-oriented	Task or problem-centered
Motivation	By external rewards	Internal incentives/curiosity

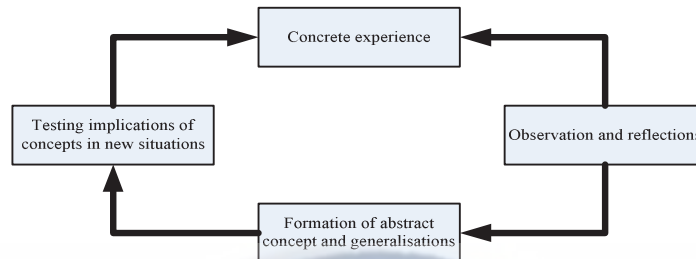


FIGURE 3. THE EXPERIENTIAL LEARNING MODEL

VI. CONCLUSION

The overall SBT are recognized as an efficient and effective way of teaching and learning project management. It can create a realistic experience in a controlled environment, where one of SBT media or software often used in project management training is Microsoft Project.

Microsoft Project was very thorough and well designed for training on project management field. It often used in training because it is prohibitively expensive or simply too risky to allow trainees to learn in the real world. It also allows trainees to explore, make mistakes and learn valuable lesson in virtual environment (Wood, 2009).

The trainees competency were positively improved after SBT (i.e. project management knowledge, project management performance, and personal competency). Overall, we agreed that SBT was a useful to transfer knowledge and to develop skill and attitudes the trainees.

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