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A simulation environment for construction project manager competence development in construction management

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Abstract

According to the forthcoming ICB4, project manager's competencies include delivery management encompassing such elements as managing stakeholders, scope, time, cost and risks. Competence development is based on knowledge and experience from applying this knowledge in practice. However, most College/University courses related to construction are by and large confined to traditional class teaching delivery methods. In the past various attempts have been made to integrate different technologies (such as multimedia) to teaching delivery; in this paper we examine simulation modeling in particular as a tool for construction project manager competence development. For this purpose, a simulation system used for productivity analysis of a complex infrastructure project is utilized as a learning vehicle. A class of volunteer students, in addition to attending theoretical classes, has been trained in the use of the system and by using it in the elaboration of particular construction situations. The whole process has then been evaluated using ICB3 taxonomy analogies and Kirkpatrick's hierarchical model (in lack of a comprehensive ICB4 taxonomy). The findings reveal distinct benefits accruing from this approach which relate to better comprehension of knowledge, increased problem-solving abilities, better decision making and achievement of a welcoming by the students learning experience. A different class of seasoned construction managers also reported positively after using the system. This denotes the applicability of the approach to different competency levels and corroborates further ICB4's ideal for lifelong learning.

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1. Introduction

The construction management discipline has been long searching for the correct paradigm in construction education and training that would enable the development of competence for construction management personnel (Bernold, 2005). The challenge in contemporary educational programmes is the achievement of balance between the teaching of theoretical concepts (Schexnayder & Anderson, 2011; Vorster, 2011) and the integration of different technologies to teaching delivery (Geodert et al., 2011; Sampaio et al., 2010). In a similar manner, the same issues apply for the establishment of training programmes that aim at developing professional competences of construction project managers (Zhang et al., 2012). This reality is further enhanced under the prism of the forthcoming ICB4, where the four major competence groups (i.e. strategy management, leadership behavior, organization and environment and delivery management) call for multi-skilled project managers, who are able to efficiently apply the concepts of modern project management (ICB4, 2012). Therefore, it is important to adapt teaching methods and techniques, so as to serve the dynamically changing nature of the project management (PM) discipline (Bredillet et al., 2013). In that sense, it is believed that the application of advanced technology tools for teaching or training construction project managers is an integral part of the competence development process (Soria et al., 2013). As such, this study explores the application of simulation modeling as a tool for construction project manager competence development. More specifically, a recently developed simulation platform named *CaissonSim* (Pantouvakis & Panas, 2013) targeted at analyzing the productivity of complex infrastructure projects has been utilized as the learning vehicle. The aim of the research is the assessment of the system's impact in enhancing competences related specifically to the delivery management group of ICB4, which comprises elements such as managing stakeholders, scope, time cost and risk. The study objective is served by introducing two groups of trainees (i.e. final-year students and experienced construction managers) to the specifics of the simulation platform and, subsequently, evaluating the developed learning thresholds along specific criteria, such as project management success and management of scope and deliverables.

The structure of the paper is as follows: First, background information on pertinent research on construction project management education and training is going to be provided, followed by a concise description of the applications of simulation as a delivery tool for competence development and a review of training programmes evaluation methods. Then, the research methodology is going to be delineated and, subsequently, the case study results will be presented. Finally, the discussion of the results along with the main emerging inferences will conclude the study.

2. Background

This section presents a review of pertinent research related to construction education and training. The first paragraph summarizes the current state of construction management education paradigm, whereas the second provides a brief review on the training approach of construction managers. Finally, a review of the published research in simulation modeling for education and training purposes, as well as a concise description of training evaluation methods concludes this section.

2.1. Construction management education paradigm

The current state of education in construction management is heavily based on traditional class teaching, which is not learning-centered, thus inhibiting the use of educational methods that stimulate student learning (Bernold, 2005). Most educational programmes offer students a balance between exams and coursework in construction technology and management philosophy and practice, with additional input from other disciplines, to provide candidates with the skills and experience needed to successfully negotiate the terrain upon graduation (Russell et al. 2007). However, leading professional engineering institutions, such as the American Society of Civil Engineering have acknowledged that *“a bachelor's degree is becoming inadequate for licensure and practice of civil engineering at the professional level – that a new model for civil engineering education is needed to prepare practitioners for increasing complex work in which they will be engaged in the 21st century”* (ASCE, 2007). Thus,

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