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## A cloud-based mobile system to manage lessons-learned in construction projects

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### Abstract

Knowledge and experience are vital assets within the construction industry. Nevertheless, small and medium construction companies still have problems to transfer the knowledge acquired in their projects to the rest of the organization. Lessons-learned are elements of knowledge management that could help companies to improve this process, and therefore, their global performance. This research presents a cloud-based mobile shared workspace to support knowledge management in construction. The article presents the original system and the modifications made to it based on an initial evaluation by construction professionals. The main upgrades were to include a notification system, letting users know when an action is required from them, and to improve the synchronization process for a better offline experience on site. The evaluators considered these were essential features to be able to use the system on site. The 2.0 version of the system was validated with construction experts. The article concludes that one of the most relevant features of the system is its capacity to save information on site without an internet connection for later synchronization. Also, the proposed cloud-based shared workspace is a feasible option to improve knowledge management in small and medium Chilean construction companies, mainly because of mobility, usability and investment-related factors.

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### 1. Introduction

Construction companies are project based organizations characterized by uniqueness, uncertainty and complexity, which makes them different from other business organizations [1]. Thus, it is difficult to manage the knowledge they generate during the progress to deliver a custom-built facility [2]. In fact, many project based organizations constantly fail to learn from their own experience, as shown by their tendency to ‘reinvent the wheel’, repeating mistakes and failing to transfer lessons from one project to another [3]. These difficulties arise due to the unique and discontinuous

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nature of project-based work, which creates intra-firm boundaries that hinder the transfer and use of valuable knowledge gained within particular projects to subsequent projects and/or the organization as a whole [4].

In this regard, efficient Knowledge Management (KM) would allow construction companies to transfer knowledge across their various projects, to create synergies inside the organization, to learn from the mistakes and successes of others, and to receive benefits in terms of productivity and performance [5]. Despite this, construction organizations have historically failed at effectively transferring project information and have not yet developed a learning culture that takes into account both technology and people [6]. This is a complex situation, as transferring learning to future projects allows staff to use existing knowledge to solve problems, instead of having to generate new knowledge which generally requires more time [5]. This also could hinder a companies' performance, as effective KM is believed to be one of the performance enhancers for organizations wanting to remain successful in the construction industry [7].

There are different approaches to conduct KM, such as self-service, communities of practice, transfer of best practices and lessons learned [8]. Lessons learned (LL) are elements of both organizational learning and KM [9] as they capture knowledge from projects, events, or other work to apply in similar situations [8]. Typically, LL from different construction projects are not systematically integrated into a construction firm's memory [5]. In fact, the benefits of learning are still not realized, despite the efforts of some construction companies [10]. There is also the need to maximize opportunities for people to meet and make an efficient use of information technologies (IT) to find information and knowledge [11]. Because of that, this research explores how to use some trending IT, such as mobile cloud computing to the collaborative KM process in medium-sized Chilean construction companies. Specifically, this article presents the first version of a cloud-based mobile system to manage LL in construction companies, developed under the Lean Startup methodology. It also shows the improvements made to the first version, following the feedback received from construction professionals and experts.

## 2. Review of literature

Companies have come to understand knowledge as a resource and a vital asset to carry out their activities. They have implemented various ways of capturing, storing, transferring and reusing it [5]. For example, large companies as Fluor have KM programs including communities of practice, expertise locator system, mentoring, people developments programs, online collaboration, document management spaces, and process improvements methodologies to capture and transfer critical knowledge [8]. Despite these successful experiences, several construction companies still have problems regarding their KM, especially about extracting, distributing and applying knowledge across both cultural and structural boundaries, given its condition of project based industry [12].

An interesting approach to KM is the use of LL. LL are knowledge gained from experience, successful or otherwise, for the purpose of improving future performance [13]. A LL process include mainly three steps: identification (capture), dissemination (transferring) and application (implementation). The last one appears to be the most difficult to operationalize [14]. A survey made to major construction contractors in the UK [10] helps to understand current practices of LL. Its findings include: (1) The most commonly used practices for LL activities include both explicit and tacit methods such as post project reviews (68%), company intranet/extranet (64%), and face-to-face meetings (62%); (2) the most informative practices include communities of practice (56%), brainstorming sessions (54%), and knowledge repositories (53%), followed by post project reviews (52%) and face-to-face meetings (52%) and to a lesser extent technical forums (42%); and (3) face-to-face meeting and post project reviews were commonly used and most informative. Regarding the adoption of corporate LL processes by site teams, Carrillo et al [15] identified some challenges that need to be addressed, such as (1) lack of communication and transparency between site teams and head office teams; (2) strong emphasis on people-to-people dissemination even though they have received tools from the corporate office which they consider useful; (3) a culture of encouraging the collection and dissemination of lessons needs to be addressed; and (4) site teams do not properly recognize the value in collating lessons and therefore excuse themselves by saying they do not have enough time.

It is important to consider that most studies regarding LL in the construction industry have been conducted in developed countries. Thus, these studies have focused on large and/or international construction companies or have assumed that LL are an issue that a large number of companies already have implemented. Therefore, the implementation and adoption of LL systems in small and medium size construction companies, especially in developing countries, have not been adequately studied in the past. This occurs even though construction industry

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