Proposed System and Benefits

A Change and Knowledge Management System (CKMS) is proposed by developing a change management module (CMM) within the Knowledge Management System (KMS). The purpose of this module is to serve as a repository of information embedded in the KMS from which potential knowledge can be derived. In this way, it is possible to avoid the loss of potential knowledge during change management processes. A knowledge management system called CAPRILNET has been identified to be used for the project. This is intended for the 'live' capture and reuse of project knowledge and it is planned to extend this through the development of the change management module, which enables project teams both to effectively address any changes that occur on the project and to capture any associated lessons learned from those changes.

The integrated CKM approach is being adopted and demonstrated within the integrated building lifecycle processes in the $129m Energy Efficient Buildings Hub (EEB Hub) project from the Department of Energy (DOE) and the Commonwealth of Pennsylvania.

The following benefits are associated with the proposed change and knowledge management processes:

- Facilitate information flow and exchange between teams involved in change and knowledge management;
- Establish a systematic, methodical and standardized way for the management of changes and knowledge for value creation;
- Seamlessly capture lessons learned during the change management process, and subsequently achieve them in a KMS;
- Help avoid or mitigate against loss of potential knowledge;
- Utilize knowledge for key decision-making during change approval processes;
- Support and equip project teams to be more proactive to CKM issues;
- Support construction lifecycle workflows.

References


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For additional information or questions regarding this research, contact:

Fangxiao Liu, Ph.D. Student
611166@psu.edu

Chimay J. Anumba, Ph.D., D.Sc., P.E.
Professor and Department Head
anumba@engr.psu.edu

Research Background

A construction project is unstable and complex, and involves various participants (Jia, 2010). A large proportion of the problems on construction projects emanate from the lack of appropriate mechanisms to establish and track the dependencies between project elements, which makes it very difficult, and in some cases, impossible to anticipate and manage the changes that occur in the course of a project (Jallow, 2011). This can also have potentially debilitating impacts on a project thus impairing the likelihood of successful project outcomes. Similarly, the inadequacies in systems and approaches to managing knowledge and the lessons learned on projects often result in considerable rework, repeated mistakes, ‘reinventing the wheel’, unnecessary expenses and other inefficiencies. Given that changes on projects often serve as a learning opportunity, there is a need for systems that can simultaneously manage change and knowledge. Project teams are usually aware of the importance and necessity of knowledge generation and utilization, as well as managing changes. However, they generally allocate a lower priority to these activities than to primary project goals.

Research Aim

- Develop an integrated approach to manage changes and knowledge to facilitate efficient and effective energy efficient retrofitting.

Research Objectives

The specific objectives of the project include:

- Review current practice and implementation approaches of knowledge management (KM) and change & dependency management (CM) in construction industry.

- Investigate existing KM and CM frameworks, theories and strategies, as well as their ineffectiveness in energy efficient retrofit projects.

- Develop a systematic approach to (i) capture and reuse knowledge, and (ii) identify and manage potential project changes and their likely impacts in energy efficient retrofit projects.

- Develop a novel approach to integrate change and knowledge management (CKM) processes within the overarching energy efficient retrofit project workflows.

Knowledge Management (KM)

Knowledge management (KM) helps in the planning and organizing companies’ knowledge assets to improve performance and production efficiency (King, 2007). Generally, knowledge management identifies and analyzes necessary available knowledge, therefore generating actions to fulfill organizational/individual goals by developing knowledge assets (Sensky, 2002). It is designed for sharing an organization’s expertise to make knowledge explicit, and managing information with the help of information technologies (Ribino et al., 2009). The high level KM process model is shown in Figure 1.

![KM Process Model](Figure 1: KM Process Model)
Change and Dependency Management

A change refers to "an alteration or a modification to pre-existing conditions, assumptions or requirements" in construction work (Hao et al., 2008, pp.4). Dependency is the interactions among different elements, and a change in one element must coordinate with others to achieve the functionality of a system (Jallow, 2011). Change management (CM), according to Voropajev (1998), is "an integral process related to all project internal and external factors, influencing project changes; to possible change forecast; to identification of already occurred changes; to planning preventive impacts; to coordination of changes across the entire project" (pp.17). Dependency management is aimed to "provide a procedure and associated guidelines to facilitate the management of project dependencies" (COGTA, 2006, pp.1). The high level CM process model is shown in Figure 2.

The Integrated Approach

It is fundamental and extremely relevant that change and knowledge management processes are integrated to support the integrative energy efficient design and development. Multi-scale and multi-discipline interactions occur during design and development with several decisions made. Often, these decisions result in some changes to project variables. As a result of dependencies between project elements, this also creates the phenomenon of change propagation by which a change to a project scope or design element requires additional changes throughout the building. Furthermore, there is also potential for lessons to be learned when performing project activities and during the process of managing and implementing changes. However, knowledge learned from this process is not, if at all, adequately captured and put in the knowledge management system. Consequently, it is important that lessons learned are captured, validated and stored for use in later stages and future projects. This creates a bi-directional relationship between change and knowledge management processes. This means change management processes are application areas of knowledge and within these processes, knowledge is generated through capture and validation processes of lessons learned. The integration of change and knowledge management will significantly contribute to the project variables such as time, budget, value and benefits. This will make provision for the dynamic management of change and knowledge, which are usually static and isolated from the workflows, and propels the ability.

Energy Efficient Retrofit Project

A retrofit project is "the modification or conversion (not a complete replacement) of an existing process, facility or structure. Such modification may involve additions, deletions, rearrangements or not-in-kind replacement of one or more parts of the facility. Changes may alter the kind, quantity, cost or quality of the products or services being produced by the facility." (Sanvido and Riggs, 1993, pp.ii)

The significance of managing changes and dependencies in the context of energy efficient retrofit projects is that if they are poorly or inadequately managed, changes initiated and implemented during the design, construction and operations of buildings could potentially impact negatively on energy efficiency goals. A large number of modeling simulations need to be done in order to get the most optimized design which will meet energy efficiency goals (Heo et al., 2012). Similarly, appropriate knowledge is also needed to determine the most optimized design. Without knowledge, people will make decisions based on assumptions and experience (Heo et al.,

Research Methodology

- Case studies
- Observations
- Interviews
- Prototyping for system development
- Validation and evaluation of the integrated approach and systems

The Need for an Integrated Approach

The Need for an Integrated Approach

Figure 3 shows the integrated change and knowledge management (CKM) approach. When a change occurs, all related lessons learned will be collected and stored in the knowledge repository as new knowledge after validation. On the other hand, knowledge captured during a project can be used to predict potential changes in future projects, thus taking measures in advance. During the change resolution stage, the knowledge management system can act as a resource to help solve problems caused by the changes. Finally, knowledge (including those generated through changes) will be stored properly and shared among different teams.

![Figure 3: Integration of CM and KM](image-url)