

## Innovation Management in Construction – Practical Approach

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### **ABSTRACT**

The Construction Industry is required more than at any time previously to be constantly alert and adapt to change. Globalization, changing market conditions and client requirements, together with an era of opportunities created by the development of new technologies fuel a pressure to think out of the box.

Value delivery and client satisfaction are primary objectives of all construction companies. The innovation process in the construction industry is an important source of competitive advantage and value delivery. However it is hard to achieve a sustainable innovative culture, and many critics claim that the construction industry is being very resistance to change.

This paper will discuss a practical approach to obtain a sustainable Innovation Platform.

### **KEYWORDS:**

Innovation, Learning, Construction, Knowledge Management

### **INTRODUCTION**

Creating an Innovation Platform requires an environment that encourages rapid adoption of industrial changes and an innovative mindset that never mistakes activity for progress. Identification of learning gaps is essential; what the organization knows, what it needs to know and what it can learn are vital if the organization is to be prepared for new challenges.

Questions an organization should ask include:

- What is our ability to learn, use our knowledge and Innovate?
- What is the effectiveness and added value of creating an Innovative Platform?

Planning an Innovation Platform starts with a strategy that addresses the culture change requirements and a high-level plan to allocate resources and leadership. Most construction innovations activities are carried out at project level and need cooperation among different parties (Xue, et al., 2017). Enterprise construction companies that have projects in different countries must connect innovation to projects and market the innovation ideas to get real buy-ins and get project teams on board.

This paper will suggest a strategy and a practical approach that succeeded in creating a learning and innovation platform across an enterprise construction organization.

## **DESCRIPTION OF THE CASE**

The Innovation Platform discussed in this study was developed to manage innovation at Consolidated Contractors Company (CCC), a large multinational contracting organization, which has around 150,000 employees distributed all over the world. The organization is headquartered in Athens, Greece and has offices in the five different continents. Teams of senior and junior employees including project managers, mechanical engineers, technicians, etc. perform a variety of civil and mechanical construction projects such as building harbors, airports, tunnels, and gas and oil plants in different contexts. These teams might work onshore or offshore and sometimes in remote areas. The size of these teams may vary depending on the size of projects ranging from 2000 employees in smaller projects up to 30,000 employees in larger projects.

Due to this distributed nature of the organization and the dispersion of project teams, top management started to think about how to leverage and manage the dynamic knowledge and experience of such a vast number of employees to create a culture that supports innovation and knowledge sharing. It is worth mentioning that the company increased its employees from 35,000 in 2003 to 160,000 in 2008. The current number of employees in January 2018 is about 150,000. This explosion in the number of employees further stimulated top management to think about flexible ways for capturing and managing knowledge and experience across CCC projects. Until 2007 CCC mainly used a document management system for storing and organizing its knowledge into structured documents and reports. This system was ineffective in facilitating dynamic collaboration and sharing of knowledge and experiences. Consequently, top management decided to support the establishment of a Knowledge Management (KM) department to develop and manage a shared platform for collaboration and knowledge sharing within CCC. The KM department was therefore officially established in July 2007. The KM department, after eight months of planning, launched a collaboration platform based on a corporate wiki, which is called 'Fanous' which is an Arabic word means "The Lantern" in March 2008 (Mansour, Abusalah, & Askenäs, 2011).

In order to put the wiki into operation, the KM department established a core team of senior employees and top managers. This team represented experienced organizational members who had been working at CCC for a long time. The team aimed at providing a basis for building and cultivating different specialized communities as well as promoting the use of the wiki as a collaboration tool amongst their employees.

The wiki started to operate with five professional Communities of Practice (CoPs). Each community is specialized in a particular Domain and is led by a community manager and a number of community captains. There are also Subject Matter Experts (SMEs) who are expert employees within the domain of the community.

All these members are selected based on their seniority and level of experience with full accessibility to add, edit, comment, and change contributions on the wiki. Other people at the company could access the wiki but with roles limited to reading and commenting on the articles. In due course, as employees became more

mature in using the wiki the membership and authoring rights were extended to any CCC employee who joined the collaboration platform.

Each community has its own space on the wiki that includes community pages where community members collaborate and share knowledge with each other. Members can also contribute to other relevant communities on the wiki. In addition, all CoP members receive weekly newsletters and they also can subscribe to certain topics in order to receive email notifications to keep them updated of any new contributions.

The wiki collaboration platform was extended in 2015 to include Questions and Answers to help project staff ask questions of experts across the organization. Later in 2017 a new Lessons Learned Platform was developed to enable project staff to exchange Lessons Learned with other projects to improve the corporate learning and innovation cycle. In 2017, the wiki included 12 CoPs including the Innovation Community to be discussed later in this paper, with over 2500 active members, and over 3700 contributions in 2017 alone.

## **PLANNING**

Planning an Innovation Platform starts with defining innovation within an organization and creating a road map.

A useful example definition is:

“Innovation is the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change” (Sexton & Barrett, Appropriate innovation in small construction firms, 2003)

(Sexton & Barrett, The role of technology transfer in innovation within small construction firms, 2004) in a definition developed with practitioners, emphasize that the outcome of innovation should enhance overall organizational performance. Based on their work together with (Dickinson, Cooper, McDermott, & Eaton, 2005) and (Freeman, 1989), in this paper we define the Innovation for CCC as:

“The successful exploitation of new ideas and leveraging technologies or business models to add value to the company’s operations”

The road map needs to outline a process through which the following will be identified:

- Where the organization stands (Status Quo);
- Whether the organization reached its learning objectives;
- The means of building an Innovative culture;
- How value will be delivered.

There are three pillars which support our Innovation Platform roadmap (Learning, Innovation, and Value Delivery).

A gap analysis was done to evaluate the learning environment status quo. Then an Innovation strategy was developed based on the following elements:

**Leadership:** “How are we expecting innovation to create value for clients and for our company?” Company's President and Top Management should identify opportunities and challenge the wisdom of the crowd. Market trends and opportunities represent innovations in the market in fields that could benefit the firm such as: Lean Construction, Building Information Modelling (BIM), Sustainability, Work Face Planning etc. Defining who is responsible for the high level planning of development of the Innovation Platform.

**Crowdsourcing vs Experts sourcing:** Rather than relying on a few experts in the company to solve specific innovation problems, you open the process to all employees. (Exploiting large numbers of diverse problem solvers). Crowdsourcing (Henri & Tuomas, 2014) requires fast and efficient ways to test many potential solutions. Crowdsourcing method was selected after years of experience with Experts sourcing, the first innovation platforms attempt was based on about 100 experts nominated by top management. This platform lasted for few months and did not deliver serious innovations. As there is evidence that groups of diverse problem solvers can outperform groups of high-ability problem solvers (Hong & E., 2004) later we decided to open the Innovation Platform for all our employees (to utilize wisdom of the crowd), this strategy succeeded in bringing younger generations who are enthusiastic to share their innovative and new ideas with their colleagues in the organization.

**Change Plan:** The Adoption and Culture Change plan starts with people and operations not technology and tools. We have planned for change by communicating the idea of the urgency of need for a Corporate Learning Platform to establish a culture of learning that leads to innovation. In mega-construction projects (such as construction of pipelines, refineries, airports, power plants, etc.), engineers are located at construction sites and sometimes in remote areas; these work conditions reduce the time engineers spend behind computer screens. We had to consider a communication plan that overcomes such obstacles.

**Branding:** It is highly recommended to brand the Innovation platform or initiative and design a logo that makes a good image; design moves things from an existing condition to a preferred one (Graser, 2000). The name and the logo should be meaningful and represent the vision of the Innovation at the organization; brands are important intangible assets that significantly impact firm performance (Park, Eisingerich, Pol, & Park, 2013).

**Full Picture:** Developing the Learning (Knowledge Management) and Innovation Platform requires resources and budget; many questions come from management and the future users:

- Where will the change will lead us?
- What we will achieve at the end?

The full picture should address the return on investment (ROI), the status quo and the future status. Performance evaluation is an important aspect that should be considered during the planning phase to demonstrate to decision makers' added value and money savings.

The development of the Knowledge Management and Innovation Platform objectives include:

- Utilize latest innovations and technologies
- Reduce employee's effort to learn and Implement
- Recognize best performers
- Prepare Nexperts (future experts)
- Prevent reinventing the Wheel
- Educate Clients on the Importance of Innovations
- Deliver on time
- Spending on R&D

The corporate cross project platform needed to be developed to meet the above objectives. Those objectives were explained through direct communications with decision makers and involved parties. The objectives were communicated with employees in the implementation phase to encourage participation and buy-ins.

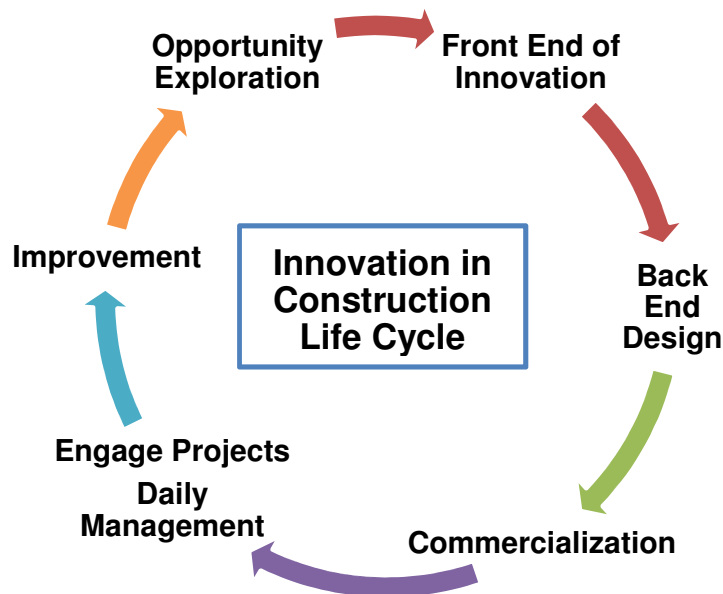
## **INNOVATION IN CONSTRUCTION LIFECYCLE**

Innovation differs in every business sector and it is effected by regulations, cultures and markets. Construction is a very diverse field and there is no standard pattern in which innovation occurs. The meaning of Innovation to a small specialized sub-contractor is certainly different from that in an international enterprise construction contractor (Abbott, Ozorhon, Aouad, & Powell, 2010). Building and construction contractors operations are mainly specialized in one or more of construction, engineering, design, surveying, consulting, or management. Therefore, the organizational context of construction innovations differs significantly from a great portion of manufacturing innovations (Slaughter, 1998).

In the context of the construction industry, (Slaughter, 1998) breaks down the spectrum of innovation into five types: incremental, modular, architectural, system, and radical. Incremental innovation is a small change, based upon current knowledge and experience. Modular innovation entails a significant change in concepts within a component, but leaves the links to other components and systems unchanged. Architectural innovation, on the other hand, involves a small change within a component, but a major change in the links to other components and systems. Radical innovation is an entirely new approach and causes major changes in the nature of the industry itself. Contractors mostly apply incremental and modular innovations due to the risky nature of construction industry.

Innovation in Construction life cycle similar to industrial innovation starts from Opportunity Exploration, where market trends, client insights, technology trends, data analytics, regulatory and competitor information plays an important role to direct the projects or the contractors to investigate new innovations. In Front End of Innovation we study Project Needs, if a new tool, method or technology is identified; we consider whether the new innovation is suitable, usable, and scalable. We also carry user experience tests and whether the project team will be able to sustain using this new innovation.

Figure 1: Innovation in Construction Life Cycle - Contractor Corporate/Project-based Approach



During the Back End Design on the corporate or the project level aspects such as usability, serviceability, robustness, and manufacturability and assembly are considered. In Commercialization culture, change and leadership that are required for continued operational excellence are applied. Daily Management and Project Engagement, training and project team engagement should be highlighted in this phase, reporting and innovation implementation progress monitoring is applied. Final phase is Improvement, lessons learned from applying this new innovation is evaluated and innovation evolution is investigated.

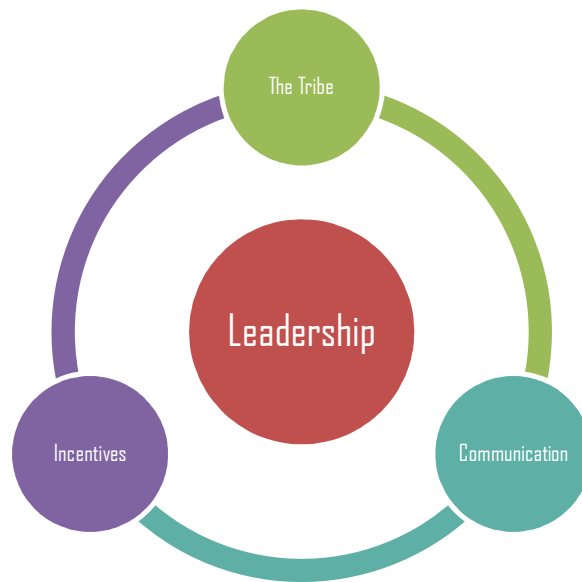
## IMPLEMENTATION

The Innovation Platform was created as a Community part of the KM collaboration platform and uses the wiki for capturing, storing, and reporting new ideas and opportunities. It operates outside the normal scope and boundaries of a single project. This community was formed and directed by the company's top management. As discussed previously the community first had limited access to a group of experts in different areas, but later it was open to all members of the KM to encourage more ideas and participation. The Community has a leader and about 10 – 15 captains. Those captains were (and are) selected by the top management and the Innovation Community leader. Captains may change from one year to another. To integrate innovation with business processes, project team engagement is required. We encouraged projects teams to take part in suggesting new industry innovations, and any employee can suggest an idea openly. On a yearly basis new innovative ideas are evaluated by the Innovation Community captains in order to prepare a business and visibility study for each idea. Then after the study is prepared; those innovations that meets certain criteria are selected to move forward. Development and Implementation plan is then prepared after forming a subcommittee from experts in the field, this committee will communicate with the projects and implement the new innovation. This process follows the rules of the Innovation in Construction life cycle discussed earlier.

Leadership is a key success factor, the company top management had to endorse and take part in the innovation platform and have a budget to support implementation of new innovations. Innovation initiative subcommittees have to report the implementation and findings to the top management, they have to demonstrate the ability to move forward and they discuss difficulties and challenges openly. Top management in turn is tasked to address the challenges and eliminate the problems. For example, if the client does not approve the new technology or work method, top management has more political influence and better relationships with the client so they may be able to open the doors to convince the client to accept the new change.

The Sociotechnical framework was developed because of the interrelatedness of social and technical aspects when implementing innovations in construction projects (Duodu & Rowlinson, 2016).

*Figure 2 Innovation Implementation Success Factors*



A sociotechnical perspective seeks to understand the successful diffusion, or not, of an innovation not just in terms of the technical features of an innovation, or how the innovation process is managed, but in terms of the myriad different social influences that bear upon the innovation process (Lees, 2018). Users and society play an active part in 'socializing' a technology. This can be particularly important for construction companies.

For example, apply new surveying technology using Unmanned Aerial Vehicle (UAV) might have reduced the number of surveyors needed. The potential positive effect (for the company) of applying this new innovation on performance is high as it reduces time and cost; meanwhile this is a highly sensitive issue with surveyors as many of them might lose their jobs, so addressing this consequential issue in a fair and open manner is essential for adoption. During the pilot project of implementing the new Innovation we faced cultural rejection, it was very clear that the Surveying team was not fully cooperating with the implementation team. After discussion with the project

manager we decided to educate and encourage surveyors to use the new technology by training them and demonstrating that the surveying effort required in the office using the new technology will be at least as much as the surveying effort spent on the construction site using traditional methods. Once we gained some supporters we were able to sustain the change.

Another example of sociotechnical perspectives is applying new Safety Radar System to heavy vehicles on construction site. The Radar system detects moving objects and creates a hazard zone, the operator of the vehicle will be aware of any moving objects through a camera and warning alarm. The system improved safety on job site but we noticed that employees became more relaxed when moving as they know the vehicles are equipped with a Radar system. They were in consequence supportive of the innovation. Employee's behaviors and routines have a key role to play in how a technology is used and therefore if it is successful or not.

As we saw in the previous examples we have to create a communication platform by using online collaboration tool to show successful examples on implementation of new ideas and also to connect employees from different projects to share innovations and experiences. Many of those employees will be part of the innovation tribe, they will take part in suggesting new ideas and help in implementation. Incentives is also important. Those employees who endorse innovation and they share their experience and knowledge (and volunteer their time) need to be rewarded and recognized. In most cases staff members belonging to different functional and hierarchic areas take part in the innovation processes, and this highlights those who are particularly creative; or those who make decisions; as well as staff members who have specific professional know-how.

## **SUSTAINING INNOVATION**

Most Innovations happen here because most of the time we are seeking to get better at what we're already doing. We want to improve existing capabilities in existing markets, and we have a pretty clear idea of what problems need to be solved and what skill domains are required to solve them. But we have to say that on an innovation journey not every idea is possible to implement. For example, flying drones in many countries, have strong legislation and regulation to adhere to. There are formal rules which dictate what can and cannot be developed. There are also informal rules. Professions such as engineers, architect and surveyors are taught particular approaches to problem solving, they use a common language and often have a clear idea of what is expected of them professionally. These informal rules shape problem solving approaches, or heuristics, which guide the innovation process as strongly as the formal rules. Groups who share the same heuristics, are referred to as technological regimes. These technological regimes guide and shape the innovation process in a particular direction; giving the regime a momentum which we call a technological trajectory (Lees, 2018).

To overcome the technological regimes we established the sociotechnical framework discussed earlier where a larger group of employees gets involved in the innovation outside the bubble of a single project team.

The sociotechnical framework is important in implementing and sustaining the innovation platform and it is based on traditional methods and change management tools. Traditional methods include setting an innovation road map and including it in



the company's strategic plan, in addition to preparing a yearly R&D budget. Change management tools include: communication and awareness, awards and recognition and training. When applying new method or tool you need to train people on site as they are used to do the job for many years using an older method or tool. Training should be on all levels and results should be evaluated.

## **PERFORMANCE EVALUATION**

Ongoing performance evaluation highlights whether the objects are met and what are the weaknesses. Below are the key performance indicators (KPIs):

- Innovation Growth: Lessons Learned, Collaboration, Questions, and new ideas shared.
- Learning curve: Employees engagement in discussions and membership and performance in Innovation subcommittees.
- Review and evaluate objectives on monthly and yearly bases, what was the effect of the New Work Method/Tool/Procedure?
- Refine the objectives based on the evaluation, for instance if there is an environment which rejects an innovation let us find out how we can convince people to use the new technology.
- Evaluate employee's acceptance and response to the change.

## **CONCLUSIONS**

(Kuczarski, 1996) believed that innovation is not a science, but an art of welcoming risk. When applying new innovations in mega construction projects the risk gets higher so construction contractors become more conservative in applying any new method. This challenge made us think how to connect innovation to projects and how to get buy-ins and project teams on board. This was achieved through an Innovation Platform that connects employees from different projects to share their innovations based on their experience in the project. So our approach was not to tell people what to do, but rather listen to them and understand their desires and needs. People should feel personal achievement in order for them to be part of the Innovation success.

The paper also suggested how to achieve an effective collaboration platform where employees can exchange ideas and how the Innovation can be sustained. Performance evaluation is an important aspect to demonstrate to decision makers' money savings.

Building a culture that encourages Innovation, when people feel the management listens to their suggestions they will endorse any new innovation and will help implementing it successfully. Knowledge Management (Benbya, Passiante, & Belbaly, 2004) collaboration and communication tools are important to connect people across projects, they will exchange experiences and lessons learned. Virtual communities proved vital in achieving a culture of innovation.

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