Construction innovation: theory & practice

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Abstract

The challenges of reducing global output of greenhouse gases and the need for resource efficiency require a step-change in the way we construct buildings. However, the construction industry has a reputation for being conservative and slow to change. This lecture will present a case study of innovation and describe an emergent framework for describing innovation in construction.

Keywords: Construction innovation; Case study; innovation framework; Ferrocement;

1 Introduction

A recent scenario analysis suggested that if the UK construction industry is to meet its greenhouse gas targets, embodied carbon intensity in construction projects may need to fall by up to 67% by 2027 (1). Innovation will be critical to reach this goal. However, the industry's reputation for conservatism suggests that the required change may not occur unprompted. Previous research has shown the importance of capability, opportunity and motivation for delivery of construction innovation on construction projects (2). These aspects are explored in the context of a case study. An emergent framework for assessing interventions to promote innovation will then be presented.

2 Innovation case study

The Stavros Niarchos Foundation Cultural Centre (SNFCC), Athens, Greece was opened in 2016 providing new homes for the Greek National Library and National Opera. While the project is a showcase of innovative engineering, the innovation process for the 10,000m^2 ferrocement solar canopy is the focus of this presentation.

2.1 Motivation – constraints & aspirations

2.1.1 Project contexts, client requirements

The client wanted to deliver a world class cultural centre in Athens, a seismic zone. After an international competition, the Renzo Piano Building Workshop (RPBW) was appointed to deliver the project. The client adopted RPBW's design vision for the scheme. The strength of the client's commitment encouraged the team to work together to overcome the site constraints to deliver the scheme and architectural vision. That vision, in itself, became a constraining factor on project decisions, leading to the development of the ferrocement canopy.

2.1.2 Aspirations: Delivery v deliverable

While the time and cost budgets during delivery were important on this project, the client also wanted to ensure that RPBW's vision was successfully delivered. To achieve this, they were willing to accept the time and cost implications of some limited innovative activity. This aspiration provided a constraint which provided the opportunity to apply innovation to the project.

2.2 Capacity – resources, skills, attitudes

2.2.1 Addressing the Information deficit

The creative process, by its very nature, challenges what has gone before; new uncertainties require exploration and validation. When ferrocement emerged as a potentially/theoretically suitable solution for the canopy, evidence and performance information was sought. While some technical guidance and exemplar projects were available for ferrocement, the context and scale of use here was new – there was an information deficit.

Addressing this information deficit required a significant investment in time and money to undertake calculations, computer modelling, physical modelling, and prototyping ('learning before doing'). It is at this juncture that the importance of the client focus on deliverable over delivery became important. Had time and funding not been made available to address the information deficit, the canopy could not have been developed to its current form.

2.2.2 Skills and attitudes

Prior research has shown the importance of cooperation, commitment and leadership (3) to innovation adoption. These skills and attitudes were all demonstrated during the project. The whole team committed to the vision and worked well together with common purpose to create and deliver the design, demonstrating their own personal commitment to the scheme and innovation. Commitment from the client, project manager and contractors ensured that the innovation was given space to develop, and leadership from Expedition Engineering ensured that the canopy was taken through to completion. Collaboration across the project team was critical.

The delivery team also needed to develop the skills and equipment to deliver the pre-fabricated ferrocement panels. This required an investment of time and money to finance the 'learning by doing' phase of the project which was enabled by the client's investment in innovation.

3 Conclusions

Innovation requires resources to address shortfalls in information and skills. In projects that are tightly coupled and for which delivery is constrained by time or finances, the resources available to make this investment may not be available. This case study supports the proposition that the adoptability of an innovation on a project is dependent upon the coincidence of the motivation and capability. These are described as innovation initiators and enablers (Figure 1).

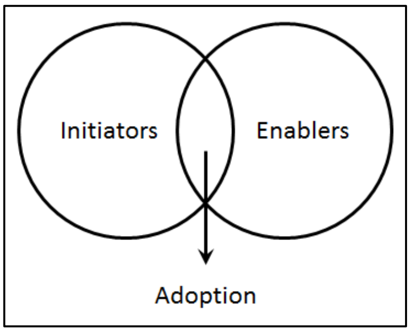

Figure 1. Adoption as confluence of initiators and enablers

In the presence of only one of these factors, the likelihood of an innovation succeeding is limited. This paper points towards a future research agenda exploring how constraining conditions might be exploited to introduce other innovative materials in pursuit of resource efficiency.

4 References

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