Power to the Edge: A Work Tracking System for Construction

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CIFE Seed Proposal 2012-12
The big idea

This research proposes the development of an onsite **Work Tracking System** which leverages BIM, advances in cloud computing, pervasiveness of handheld devices and tablets and scheduling to track task completion and improve on site productivity.
Motivating Engineering Case

• Definition of task completion to support field operations

• Observed problem:
  – Project engineers spend over 30% of their time tracking work progress.
  – Incompatible levels of detail between schedule (to calculate earned value) and operations (to plan work) hinder coordination between subs and cause delays.

Out of date!

Takes a very long time!
Motivating Engineering Case

- Definition of task completion to support field operations

Intuition: Design a Work Tracking System that shows the exact status of each task associated with every element of the BIM in real time to empower decision making (e.g. Work sequencing, resource planning, coordination between subs).

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Motivating Engineering Case

• **Quality checks, punch lists and signoff areas**

• **Observed problem:**
  
  – Long time lag from moment of task completion to quality inspection.
  
  – Quality inspection generally associated with progress payments.
  
  – Long lag results in finger pointing between trades/subs.

![Image by UrbanDigs.com](Image by UrbanDigs.com)
Motivating Engineering Case

• Quality checks, punch lists and signoff areas

Intuition: Work Tracking System alerts field engineer when a task is finished requiring inspection. All the inspection cycle is synchronized with workers and managers through the cloud, increasing the quality of work and reducing rework.
Motivating Engineering Case

• Concurrent work and quality issues
  • Observed problem:
    – Rework and quality issues increase when different subcontractors are working concurrently in the same area.
    – Subcontractors shield each other from responsibility.
Motivating Engineering Case

- Concurrent work and quality issues

Intuition: Setup a Kanban system supported by the Work Tracking System to coordinate operations. A subcontractor is allowed to work in one area only after it has been signed off.
Points of Departure

• Most **construction rework** (over 10% in finishing phase) is caused by minor quality issues detected in punch lists. Emerging platforms allow the creation of punch lists from the field (e.g. Vela Systems)

• **VDC methods** (Kunz and Fischer 2009) can be leveraged to empower workers by bringing BIM to the field and integrating it to support work processes.

• **Power to the Edge** and agile methods (Levitt 2011, Alberts and Hayes 2005) have increased productivity in the software industry.

• **Kanban** (Ohno 1988) reduces waste, increases output and quality.

• **Theory in coordination** (Malone and Crowston 1990, Olson et al 2001) as well as personal experience shows timely communication is critical to success.

• Align level of detail of **scheduling** with construction planning leveraging location-based scheduling methods (Akinci et al. 2000, Koo et al. 2007, Morkos et al. 2012, Dong et al. 2012)
Method

• Research question:

What information do we need to capture and manage to successfully track work status and completion to inform decision making?
Work Tracking System

Analyze information flows to push and publish

Define task completion and convey to stakeholders

Support decision making like:

- Generation of look-ahead schedules and Last Planner
- Construction sequencing
- Coordination between subs

Design cloud based Kanban project delivery for construction
Method

• Research method:

1. Extended literature review
2. Documentation of industry best practices
3. Industry charrettes to streamline system

Develop prototype for Work Tracking System for Construction
Relationship to CIFE goals

• Research addresses ways to improve construction operations through innovative integration of BIM and metadata such as task completion leveraging on mobile devices and cloud computing.

• Reduced decision latency.
Industry involvement

1. Information about best practices regarding information exchange and management.

2. Interdisciplinary charretes to provide input about proposed system and suggest changes.
Research plan and risks

• The following are the major milestones for the project:

Nov 2012

March 2013

April 2013

Sept 2013

- Literature Review + Industry best practices
- Technical revision to push/pull info using BIM as interface
- Industry charretes with inter-disciplinary teams
- Complete project, submit report

• The main risk for the project is a technical risk involved in integrating the different interfaces and completing the project on time.
Conclusion and Next steps

• **Project objective:**
  Develop a prototype for the Work Tracking System for construction.

• **Next steps:**
  Continue to develop a working prototype either through further CIFE founding or partnering with industry.
• Thank you!

• Questions?
Power to the Edge: A Work Tracking System for Construction

Nelly Garcia- Lopez, Advisors: Professor Martin Fischer and Professor Ray Levitt

1. Observed problem:
Project engineers and superintendents spend a lot of time tracking work progress and updating the schedule. By the time they finish updating the schedule, it is already out of date. They are making decisions with outdated information.

2. Intuition:
Develop an onsite Work Tracking System to track task completion and improve on site productivity.

3. Method:
- Work Tracking System
  - Analyze information flows to push and publish
  - Define task completion and convey to stakeholders
  - Support decision making like: Generation of look-ahead schedules and Last Planner
  - Design cloud based Kanban project delivery for construction
  - Construction sequencing
  - Coordination between subs

4. Research plan:
- Nov 2012
  - Literature Review + Industry best practices
- March 2013
  - Technical revision to push/pull info using BIM as interface
- April 2013
  - Industry charretes with inter-disciplinary teams
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  - Complete project, submit report