Location-based management system for construction: principles and underlying logics

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Production efficiency has been elusive in the construction industry and it has been difficult to implement the new production methodologies which have been so successful in manufacturing industry. This paper argues that this is because of the emphasis on activity-based planning systems and poorly integrated documentation and cost systems which do not have production efficiency as their focus.

An new methodology is proposed based on the Location as the unit of analysis and the Task as the unit of control. The paper presents the planning components of this methodology, which is part of the location-based management system (LBMS). The basic structure is introduced and a method provided for integrating linear scheduling techniques with CPM methods using Layered Logic.

Keywords: Flowline, Scheduling, Location-based Management, CPM, Layered logic.

1. Rethinking the way we plan and manage construction

It is time to rethink the way we plan, manage and control construction.

The construction industry has developed a suite of ad-hoc systems which either cannot integrate. The basic mechanisms by which we develop our cost models, measure our buildings and schedule our work, provide little help to manage the issues which are at the forefront of industry concerns these days - efficiency, speed and productivity.

This paper proposes an alternative methodology based on a shift in the unit of measurement and the method of control. The unit of measurement should be the location. The method of control should be the work flowing through locations. Combined, these form a location-based methodology from which arises the Location-Based Management System. The focus is on improving the production system.

2. Location-Based management

The location-based management system (LBMS) is planned to be an integrated system of management system components from design through to completion. Unlike previous systems, it is not focused on documentation exchange, although that is important, it is focused on data modeling to support production efficiency.

At the heart of location-based management is the location as the unit of analysis. Concentrating on the location for data modeling allows work continuity to be planned for tasks. Tasks consist of the related work packages which flow through the locations sequentially.

In the LBMS, locations in a project are defined by a Location Breakdown Structure (LBS). It is possible for the project to be broken down in many different ways, however, locations must be hierarchical so that a higher level location logically includes all the lower level locations.

Properties may be added to the BOQ items, such as standard production rates, cost data, (and anything that can be described in IFCs). The LBS provides the structure and the Location provides the container for all project data.

The Task is the method of control in the LBMS planning system. The location-based planning system differentiates between activities and tasks, where the definition of a task is that it contains work or activities which can be done by a single crew, or split among multiple crews. Location-based planning then uses CPM external logic to define the logic or connection between different activities within locations wherever they occur. However, unlike CPM, the planning system also considers a task’s own internal logic, by allowing the planner to plan the location sequence and production rate to achieve continuous production. Thus CPM-logic applies between tasks within locations and flow-logic applies within tasks between locations. A location-based task contains multiple CPM activities, which correspond with physical locations.
Emphasis on the task enables a focus on production efficiency, as it is recognised that performance in a given location is not discrete and is highly likely to affect activities later in the task. If the crews are slow, they are likely to continue so. Furthermore, efficient use of resources requires that concentration is placed on minimising waste. This means reducing non-productive activities such as delays, waiting, mobilisation and demobilisation, double handling, stockpiling, moving and rework and defects. This is achieved by maximising the flow properties of the work (a Lean concept) and this in turn requires the task to be the unit of control, where continuity can be planned and preserved through control.

Properties may be added to the Task, such as resources, learning attributes, risks, actual progress, etc.

A task should default to continuous production in order to maximise productivity.

The new theory of location-based scheduling involves far more than linking like activities in chains to derive resource optimisation. Rather, it involves several layers of interactive CPM logic which combine to form a powerful location-based logic, Layered Logic.

CPM is a tried and tested method for calculating schedules based on durations and precedence relationships.

Standard CPM has a single layer of logic, as it treats all activities independently and is unaware of location. This is an overly simplistic model for construction, as the assumption of independence through location does not hold true. A more powerful set of logical layers is required to correctly model the typical construction process.

There are five logical relationships that arise when tasks are the unit of control rather than activities. These are:

1) External logical relationships between activities within locations

2) External higher-level logical relationships between activities driven by different levels of accuracy

3) Internal logic between activities within tasks

4) Phased hybrid logic between tasks in related locations

5) Standard CPM links between any tasks and different locations

This is a new system which will challenge our thinking about the planning, scheduling and control of construction work.