OFF-SITE GUARDING: LOOK-AHEAD SUPPLY SCHEDULING FOR RISK INDICATION WITH BIM

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1 Background and Identification of Problem

The Last Planner and Advanced Work Packaging (AWP) have improved the look-ahead construction planning. However, the existing construction planning encounters either insufficient details of resource status and potential risks of delay, or details provided just for one-of-a-kind Construction Supply Chain (CSC) in which information and experience are hard to transfer to other types.

The processes of on-site construction and off-site production are separated. But the risks of delay are shared and they can transfer incrementally along the CSC (e.g. Bullwhip Effect). Currently, the off-site information has not been adequately grasped and processed in BIM (Building Information Modelling) to support on-site construction to avoid potential delay and loss. An efficient look-ahead supply schedule should be developed to provide adequate off-site information for the look-ahead construction planning and indicate the risk along the whole CSC.

2 Aim and Scope

Present BIM systems can provide an informative and interoperable environment for on-site construction and become friendlier to on-site participants and joint participants. For a holistic and look-ahead CSC risk controlling, a proactive off-site guarding mechanism is needed.

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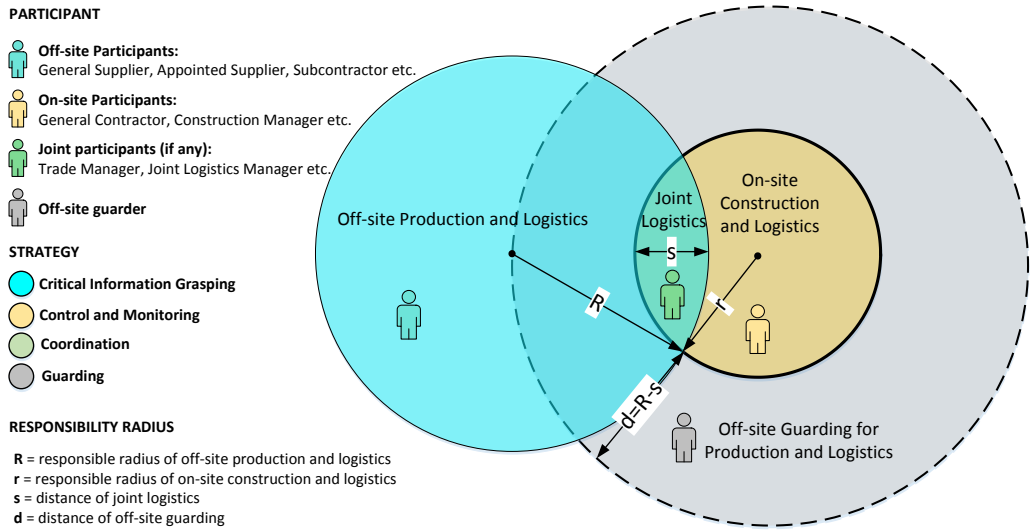

Figure 1: Participants, responsibility radius and strategies of the off-site guarding

As shown in Figure 1, the off-site guarding area can be interpreted as distance and time buffering to correct errors and solve problems, to avoid the interruption of the on-site construction. The off-site guarder refers to a person, group or an information agent (e.g., extended BIM). It aims to grasp key information from the CSC upstream and analyse the risk degree for on-site construction in advance.

3 Methodology: Look-ahead Supply Scheduling

- **Object**: required supply items for on-site construction are the main entity objects of look-ahead supply scheduling, including material, machinery, special building components etc., while the off-site production activities are the main process objects.
- **Process**: off-site production activities need to be expressed as the CODP (Customer Order Decoupling Point)-based processes. This is to create basic process patterns to monitor risks of delay and calculate risk value of each supply object. There are four types of processes with different lead-time from long to short: engineered-to-order (ETO), followed by made-to-order (MTO), assembled-to-order (ATO), finally made-to-stock (MTS).
- **Risk Identification**: the risks of delay need to be identified by checking. The high-frequent checking is aimless and wasteful, so that a state-transition checking is applied. The calculation of risks can be defined as: $R_d = \sum_{i=1}^{n}(s_i * \sum_{j=1}^{m} tf_j)$

  n = number of check points; m = number of the additional events at a certain check point;

  s = occurring probability of additional events; tf = float time of each additional event.
- **Linking for Look-ahead**: the dynamic supply schedule needs to be linked with the construction schedule to indicate the risks, which will transfer into on-site construction activities.
- **BIM View**: the construction manager is quite familiar with on-site construction processes but not good at handling the off-site production, so that the look-ahead risks are design to be visualized in BIM model.

4 Research Findings

Findings are that generating a look-ahead supply schedule does not interrupt the behavioural pattern of the on-site construction manager for the look-ahead planning and weekly meetings, but

BIM enriched with supply information provides more completed and real-time information for decision making.

However, further methods need to be developed and tested to build a robust look-ahead supply linkage. This then will enable users to allocate and control the activities and resources more efficient and ultimately causing lower risk to the project.