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Case Study

Vancouver, Canada

May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

CHRONOGRAPHIC SPACE PLANNING: A CASE STUDY FOR CONSTRUCTION PROJECTS

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1 Space planning

Most of construction activities for building projects are carried out by subcontractors. Planning and management of these types of projects should tackle the coordination of works and the management of limited spaces, traffic and supplies. Scheduling construction projects without regard for the management of resources and location of the work is inefficient and may lead to misleading schedules. Activities cannot be performed without the resources available and resources cannot be used beyond the capacity of workplaces, even if they are available. Otherwise, workspace congestion will negatively affect the flow of works and materials and may reduce productivity at the construction sites. Despite this fact, most scheduling methods and software apply the critical path logic, which is based on the graph theory. This logic, including the well-known Precedence diagram method, schedule activities as independent discrete events, apply constraints between these discrete events and try to optimize and level the allocated resources. For medium and large projects, the schedule often becomes hard to present, follow and update. Extensive use of activities and constraints make it difficult to read dependence lines, which are often very dense, cutting between themselves and crossing activity lines (Fisk 2003). This scheduling logic therefore overlooks site management constraints, including site space planning and management conflicts, work and material flows and coordination between specialities and subcontractors. Consequently, it becomes unsuited for the planning and management of these types of projects.

Several Lean construction methods have been developed to stabilize work on building sites. We can note, in particular, the standardization of tasks, visual management and takt planning. The takt planning principle is to divide the workspace into zones and define a frequency of rotation of the teams between the zones (Frandson and Tommelein 2014). These methods suit the concept of the Last Planner System (LPS) (Ballard and Howell 1997; Ballard 2000) whose philosophy it is to involve site performers to ensure the presence of all prerequisites before assigning a task to a team. The Last Planner is expected to commit (WILL) to doing what SHOULD be done and only to the extent of what CAN be done.

2 Chronographic scheduling modelling

Chronographic scheduling modelling (Francis 2004, 2013, 2016) belongs to this category and models construction operations as well as their processes, logical constraints, association and organizational models, which help to better illustrate the schedule information using multiple flexible approaches. The objective of the space planning modelling, as proposed by the Chronographic method, is to establish the acceptable ranges of the site occupancy rates for each stage or zone. The space planning model promotes efficient use of the site and ensures optimum rotation of the workforce in the different spaces. The aim is to link the spatial and temporal aspects of a project and associate a space with tasks and

crews to ensure optimized dynamic use of the available space and verify the existence of conflicts between the traditional critical paths and the critical space on the construction site. It is therefore not sufficient to determine the optimum number of workers or speciality in each work area to relax congested work sites or speed up production where workspaces are underutilized.

For this purpose, the model defined three categories of appropriate areas that can represent all types of splitting workspaces, namely: punctual, surface and linear. The method also defined four different layers; each layer of the workspace is divided into different zones according to the evolution of the construction stages: i) space creation (e.g. structure); (Ii) systems (e.g. HVAC); (Iii) closing of space (e.g. partitions); and iv) reduction of space (e.g. floors).

3 Renovation of a five-star hotel: A case study

A case study is performed on the renovation of a five-star hotel to validate the concept. This hotel is undergoing major refurbishment of its interior. Due to the size of the work, it had to be closed for a year. Compliance with the timetable and delivery deadlines is therefore paramount. Any delay will cause significant loss of revenue for the customer. The hotel has 21 floors. The three (3) first floors (the ground floor, 2nd and 3rd floors) are for reception, catering, gymnasium and convention rooms. Their designs are completely reviewed. Floors 4 to 17 are for regular rooms. While the divisions are preserved, all the finishing elements (bathroom, painting, wallpaper, carpet, etc.) are refurbished with a sleek new look. Floors 18 to 21 are for the luxurious rooms, suites and presidential suite. The work on these floors consists in an important refurbishment including the complete replacement of kitchens and vanities. The repetitive nature of the project, mainly for floors 4 to 17, provides an opportunity to explore and validate the developed concept in more detail.

At each stage, the available spaces on a certain floor or zone are distributed among the different specialties whose prerequisites are available. The method thus determines the acceptable ranges of the site occupancy rates considering: i) The type of work performed (punctual, linear or vertical or horizontal areas); ii) the space required for the execution of each specialty (workers, tools, materials and scraps); iii) the interaction between specialties considering the different types of work; and iv) the circulation of materials and necessary storage spaces. Although the developed model ensures balanced production, no model can replace good collaboration between partners on the site. Collaborative Chronographic modelling thus helps to involve partners in order to find better work balance to improve productivity and avoid congestion in work areas. The results demonstrated that the Chronographic modelling helps to simplify the scheduling and monitoring processes while improving site management and the collaborative process.

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