

# IS IMPROVISATION COMPATIBLE WITH LOOKAHEAD PLANNING? AN EXPLORATORY STUDY

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## ABSTRACT

Short-term or lookahead planning is critical to the success of construction operations since detailed construction planning is more realistic and objective when performed closer to executing a construction activity. Lookahead planning requires more than simple interpretation of the project schedule, it involves breaking down activities into the level of operations, identifying constraints, assigning responsibilities, and making assignments ready by removing constraints. However, task execution sometimes proceeds without full removal of constraints due to uncertainty, lack of planning, lack of information, or pressure for fast action. In these circumstances, construction specialists revert to some sort of improvisation utilizing available material, information, space etc., and other resources to execute these tasks. The purpose of this paper is to present early results from a study that aims at assessing the performance level of lookahead planning in construction and evaluating how much, where, and when improvisation is utilized. Results from three exploratory case studies are used to identify the performance level of Lookahead planning, and the circumstances for reverting to improvisation. The results will help assess the threshold for planning efforts required before reaching diminishing returns versus the threshold for effective improvisation required to cater for breakdowns in planning efforts and uncertainty. Early results show many gaps in lookahead planning practices and sporadic cases of improvisation.

## KEY WORDS

Production Planning, Improvisation, Making-do, and Lookahead Planning.

## INTRODUCTION

Construction planning is the basis for successful project performance and meeting the project objectives of time, cost, quality, and safety. It involves developing: 1) the engineering and delivery method, 2) the organizational and contractual structure 3) the schedule, 4) the project cost and cash flow, 5) the major equipment plan, 6) site layout and logistics plan, 7) work methods, 8) manpower allocation, and 9) materials allocation (Laufer et al. 1993).

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These general project plans are linked to on-site work activities by short-term construction plans (Laufer et al. 1992). Short-term planning or lookahead planning goes beyond the simple interpretation of the project schedule, to breaking activities down into the level of operations, identifying constraints, assigning responsibilities, and making assignments ready by removing constraints (Ballard 1997, Ballard 2000, and Hamzeh 2009).

### **LOOKAHEAD PLANNING**

The lookahead planning process is an intermediate planning process that follows front end planning and precedes production planning. As a first step in production control, lookahead planning is a vital link between front end planning and weekly work planning. Lookahead planning makes scheduled tasks ready to be performed, shields activities on the weekly work plan from variations by removing constraints, sizes capacity to work flow, produces a backlog of workable activities, and designs how operations are performed (Ballard 2000, Ballard et al. 2003). Lookahead planning accomplishes the above mentioned goals through three main steps (Ballard 1997, Hamzeh 2009):

- Breaking down tasks into the level of processes then to the level of operations
- Identifying and removing constraints to make tasks ready for execution
- Designing operations through first run studies

In identifying and removing constraints, lookahead planning employs activity screening and pulling. Screening subjects scheduled activities to constraint analysis and puts aside those with missing prerequisites (information, material, previous work, manpower, and space). Pulling makes activities ready by removing constraints and ensuring the availability of prerequisites as per actual site demand.

### **MAKING-DO**

While the goal of Lookahead planning is to make activities ready, task execution sometimes proceeds without full removal of constraints due to uncertainty, lack of planning, lack of information, or pressure for fast action. When an activity starts without having all its prerequisites ready (an incomplete kit), a making-do waste is generated. According to Koskela (2004), the consequences of making-do waste are an increase in lead time and a decline in productivity.

One may think that, by planning tasks on a schedule, the predecessor tasks will be automatically completed generating a constraint free environment. However, planning is an evolving process which requires adopting flexible approaches to overcoming unexpected problems (Walker and Shen 2000). Making-do waste can hurt workers' motivation who are aware that they are performing forced work that cannot be completed (Ronen 1992). By losing trust in the system, they will be discouraged to give their opinion and that will negatively impact knowledge creation which is a vital area of competence for effective and innovative organizations (Nonaka and Takeuchi 1995).

To increase agility and quick responses to unexpected problems, it is necessary to shorten the communication time between the site and the decision-making entity. This acceleration can be achieved by delegating more decision-making authority to the lower echelons. Foremen of more productive crews spend almost twice as much time planning work and considerably less time monitoring and inspecting than do foremen of less-productive crews (Shohet and Laufer 1991).

Better planning should lead to a reduction in making-do waste, improvement in productivity, and reduction in overall cost. However, appearances may be misleading since it is often just an illusion that the required planning effort is being made. Since each construction project is unique, it is expected to face some sort of unforeseen problems. It is also very subtle to know when an incomplete kit is considered complete. That is what pressures teams to improvise and find workaround ways to finish tasks that have an incomplete kit.

### **IMPROVISATION**

Improvisation is the use of one's ad hoc cognitive abilities to come up spontaneously with a resolution for an unexpected situation with whatever existing resources. This act of improvising is referred to as bricolage and those terms can be used interchangeably. The need for bricolage is triggered by the necessity to improvise at the spur of the moment without having time to optimize the resources. This deliberate act requires ample of experience and knowledge (Cunha 2004). Improvisation is usually used when: 1) speed is needed to save a deadline and when planned procedures and strategies fail to meet this need, 2) pre-planned strategies or standardized modes fail to assist a sudden action or predicament, and 3) gaps exist because of standardized procedures that fail to catch up with daily ameliorations and development.

Moreover, improvisation is desired in different situations and for different types of alterations; it could be process or product oriented. In the former, it's the need to alter the means (methods or course of action) while in the latter it's the need to modify the end. Likewise, improvisation could be on the behavioral or cognitive level. While behavioral improvisation is the change in the adopted plans, cognitive type of improvisation embarks on the modification of our mental perceptions and interpretations (Cunha et al. 2009).

While Lookahead planning focuses on making tasks ready and using pull to guarantee the availability of inputs; it cannot cater for unanticipated events that require the need for bricolage and eventually verify that improvisation is a complement to planning. Although there are similarities between planning and improvisation in that they both involve creativity, innovation, and learning, there are major differences in the way a bricoleur and a planner thinks. The bricoleur is interested in improvising on resources while the planner's sole concern is to find the fully required resources ahead of time (Cunha 2004).

It is very important to study the extent of short-term planning in construction and find out why, when and how improvisation is utilized. This will help assess the threshold for planning efforts required before reaching diminishing returns versus the threshold for effective improvisation required to cater for breakdowns in planning efforts and uncertainty. It is also significant to look at the type of organizations and cultures that foster improvisation, those that allow the freedom of thinking, sustain one's autonomy in taking action without having to refer every time to the upper managers, promote entrepreneurial thinking that demands bricolage, and take advantage of mistakes as the basis for improvement. Conversely, some cultures or organizations follow the "design-precedes-execution mode" which discourages the use of improvisation.

## RESEARCH METHOD

This research aims at understanding the relationship between short-term/lookahead planning and improvisation in construction. The specific aims identified in this study include:

- Understanding the performance level of short-term/ Lookahead planning in construction operations and the circumstances surrounding planning failures.
- Understanding the why, when, and how improvisation is employed in construction operations.
- Assessing the threshold required for short-term/ Lookahead planning to avoid making-do waste and detrimental project consequences (time, cost, quality, safety)
- Assessing categories of acceptable improvisation that compliments short-term planning and cater for unpredictable and uncertain events versus categories of induced improvisation that result from poor short-term/Lookahead planning.

Data collection for this research combines two methods:

1. Interviews to assess the performance level of short-term/lookahead planning and the use of improvisation in construction. It will address construction projects in Lebanon and the Middle East. For each project, three to five specialists will be surveyed from field and office personnel such as superintendents, general foremen, foremen, field engineers, planning engineers, QA/QC engineers, safety officers, and office managers.
2. Case study analysis; Case study research is the methodology adopted in this study because: (1) it is an appropriate strategy for answering questions pertaining to 'how' and 'why' when no control for behavioral events is required and when research focuses on contemporary affairs, (2) it uses both quantitative and qualitative methods to explain phenomena, (3) it utilizes multiple sources of evidence in a natural setting that encompasses temporal and contextual facets of the variables monitored, (4) it uncovers the dynamics of events explaining the phenomenon under study, (5) it provides qualitative understanding when arriving at conclusions and analyzing results (Meredith 1998, Stuart et al. 2002, Yin 2003).

Three projects are used as case studies to examine the level of short-term planning, making do wastes, the level of improvisation, and the efficacy of the improvisation methods employed.

The research process follows an inductive reasoning scheme adjusted to the specific situation. Accordingly, the research process comprises multiple steps of evaluating and assessing the current practice. In collecting data, several methods will be employed such as: conducting short interviews, attending weekly or monthly meetings, attending planning sessions, direct observation of making-do and improvisation events on site, and analysis of project documents such as master schedule, lookahead schedule, weekly work plan, safety plans, and QA/QC related documents.

A research protocol is prepared to monitor making-do events and improvisation. The protocol will collect data such as: planning failure events, making-do events, causes of failure, presence of improvisation, responsibility for improvisation, and efficacy of the improvised solutions.

This paper reports early results from phase-I of this study. To understand the performance level of short-term planning, categories of improvisation events, the experience level of improvising teams, and the relationship between short term planning and improvisation, we conducted interviews with construction specialists from different functional levels on three projects: two of the projects chosen were educational and one residential. Phase-I interviews addressed specialists responsible for developing and executing operational plans including foremen, superintendents, field engineers, and middle level managers with some direct observations of events happening on site. The first part of the interview included 23 questions addressing short term planning, its efficacy in construction operations, and the circumstances surrounding planning failures. The second part included 16 questions aimed at studying the reasons behind the need for improvisation whether behavioral, managerial, or operational, and any resulting consequences. Upon collecting the qualitative data derived from interviews and direct site observations, and survey answers, we inputted the data into a log sheet to assess and compare the results.

### **CASE STUDY 1**

The first case study is located in Beirut. It is made of two blocks (A&B) used for both residential and commercial aspects. It is spread over an area of 2684 square meters and comprises 17 floors with 6 basements. We had the chance to conduct interviews with the structural engineer from the A/E side, and the project manager (PM), construction manager (CM), a site engineer, and the general foreman from the contractor's side. While the project's team meets every Thursday to update the schedule and assign new tasks, the primavera master schedule is updated on a monthly basis. During weekly meetings the PM, CM, engineers, and some representatives from the subcontractors are present; however the foremen and the superintendent do not attend. We noticed that improvisation was only used on a managerial level; for example when they have to deal with a situation where there is a delay in the imported material. The foremen are only given the part of the schedule they are responsible for executing. This does not give them a chance to understand the interdependence of their activities with others and the effect of their activities on the whole project.

### **CASE STUDY 2**

The second case study is a new Engineering laboratory building located in the campus of the American University of Beirut. The \$10-million project is 6-storey building of around 10,000m<sup>2</sup> above ground with two basements totaling to about 5,000m<sup>2</sup>. The owner has hired a project management firm to manage design and construction. The owner also hired a planning firm that takes the lead in setting and monitoring the schedule and the overall progress of the project. We interviewed the contractor's project manager, the construction manager, and two general foremen. We noticed that having a planning firm on site is quite important but at the same time it induces a certain amount of delay. This project faces many challenges including: complex foundation system, complex logistics due to its presence on a university campus, and tight site space. Moreover, the owner plans to achieve a gold LEED certificate for this project thus adding more complexity to the methods applied during design and construction.

### CASE STUDY 3

The third case study is also an educational building at the American University of Beirut currently in the construction phase and scheduled for completion by June 2013. The building has unconventional design and includes special architectural features. The all-concrete building will look like the head of a Cobra with an S ramp being the tail and the body of the Cobra. The inclined façade has different angles and the building has no 90-degree corners which makes this project challenging to design and construct. Those challenges require a lot of innovation to meet the unconventional design and construction requirements. Additionally, being constructed on a university campus adds to its complexity; the working hours are being interrupted constantly due to noise that distract nearby classes. Moreover, the strict environmental laws to preserve the greenery of campus affect the choice of methods used in construction. All those factors should be taken into consideration and planned ahead of time. Although the contractor maintains a skilled workforce, weekly meetings are conducted with the presence of all parties but without engaging blue collar representatives.

## RESULTS AND ANALYSIS

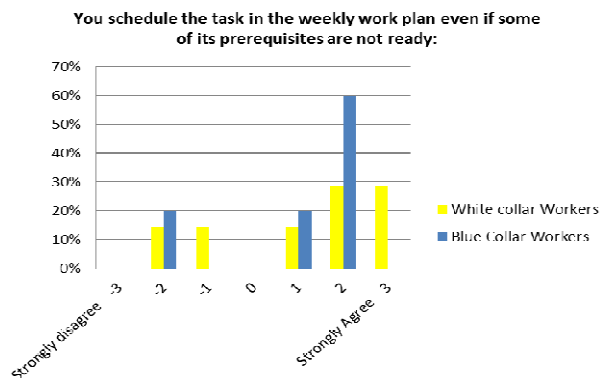
### BLUE COLLAR VS. WHITE COLLAR PERSPECTIVE

Comparing the feedback of blue collar and white collar specialists, we found some differences in their perspective on planning and improvisation. The interview results are presented in a 7-point Likert scale format ranging from -3 to 3 where -3 represents strongly disagree, 3 represents strongly agree, 0 represents neutral.

#### Planning

In general we found that blue collar people tend to be more realistic when planning and commencing tasks. In fact, when asked whether they start or schedule a task even though its predecessor is not completed they answered that they prefer waiting until the current task is finished. This indicates that blue collar people schedule a task based on the possibility of completing it within the assigned period where as white collar people are more focused on finishing tasks on time regardless if this is attainable or not. As figure 1 shows, white-collar specialists are sometimes unaware that the tasks scheduled in the weekly work plan are not completely free of constraints. Even though blue collar specialists tend to be more realistic in planning, white collar are more practical when it comes to reducing task uncertainty before starting it and this is usually done by reviewing the process, its assumptions, and the possible outcomes. This can be directly related to the way managerial people plan tasks because they are interested and in meeting outcomes/due dates and monitor the process from a macroscopic view.

Figure 1: Blue Vs. White collar perspective for planning tasks when prerequisites are not ready



One may think that, by planning tasks on the schedule, the predecessor tasks will be automatically completed generating a constraint free environment. However, planning is an evolving process which requires adopting flexible approaches to overcoming unexpected problems. In case study 2, engineers and workers had to come up with innovative solutions in order to construct the 4 façades of the building which are designed to have different inclination angles.

On all three projects, short-term planning meetings are held without the presence of the blue collar people. Despite that, blue collar people tend to do their own lookahead plan at a smaller scale and when doing this they tend to look for developing practical methods to execute the work. On the contrary, white-collar people focus more on planning, setting dates, and scheduling tasks (figure2).

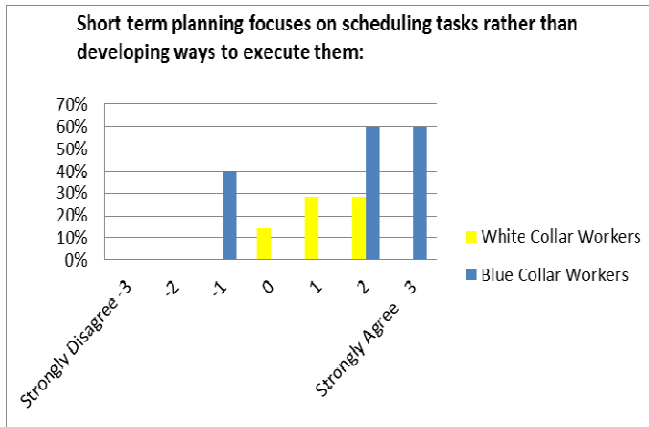


Figure 2: D Short-term planning focuses more on scheduling rather than developing ways to execute tasks

Not involving blue collar people in the weekly meetings reflects on the way white collar people perceive the role of blue collar people. Figure 3 shows that working foremen strongly agree on the fact that

their opinion is taken into consideration when assessing the duration of a specified activities. Ironically, almost 50% of the white collars people disagree with this statement. This might be due the fact that the engineers on site do not value the foreman’s opinion highly. They may discuss with them these matters in order to make them feel “responsible” in case of any delay and give them a sort of incentive to finish the work on time. This mentality forms an obstacle in collaborative planning since, most of the time, only the senior managers, present at the weekly meeting, make the decisions regarding tasks that will be assigned to workers.

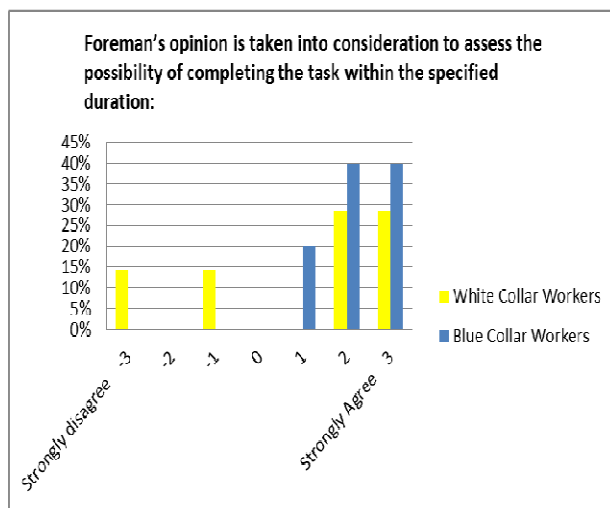


Figure 3: Foreman role in site planning and decision making

**Improvisation**

We realized a sharp distinction between white collar and blue-collar people in terms of attitude, way of thinking, and freedom to be proactive when the need arises. When an activity requires further resources to finish on time, we noticed that both white collar and blue collar people tend to

adjust resources to meet the requirements. Similarly, when errors are detected because of time pressure, risks are cooperatively shared between white and blue collar workers. However, because blue-collar specialists are not involved in weekly work meetings they are not given enough chance to offer alternatives and thus they are not able to see those errors as opportunities for process improvement, unlike white collar people.

Due to the prevalent systems that do not sustain one's autonomy in taking action without having to refer to the upper managers every time, we realized that blue-collar specialists are not given enough chance to break from the conventional means/methods or develop new procedures even if the pre-planned strategies fail to assist a sudden action or predicament. This opposition to exercise a new innovative method or process also exists, in some projects, at the managerial level too because of the built up inertia against anything new.

However, in most cases, the foreman meets with his crew every morning to adjust the daily plan according to current resources and conditions; however this control is restricted and oriented to meet the upper level employees' instructions who believe they can balance the cost of adjustment and its effectiveness.

## **INTER-PROJECT ANALYSIS**

### **Planning**

While analyzing and choosing projects to study, we chose case studies that are different in location, functionality and complexity. And this was done to find out if a relationship exists between the complexity of the project and the level of planning or improvisation adopted.

In terms of planning, the three sites were completely different and unique. Thus where design tends to be more conventional and practical and when the relation among the project stakeholders is good, short-term planning involves a lot of cooperation. Even when problems arise they are solved smoothly and collaboratively. On the other hand, projects with an unconventional design require a lot of studying and understanding to be executed.

Finally, engaging more people in planning will result in plans that are reasonably constructed and executed on time. Keeping in mind that interaction between different entities will be required frequently to assess short-term plans and to adjust them to match the changing conditions.

### **Improvisation**

Knowing that the projects differ in complexity, the method of delivery, time restrictions, rigidity of the companies' systems, design challenges, and project type; those differences impact the peoples' attitude towards improvisation, its efficacy, and ways of improvising. In the project where the design is unconventional and architecturally complicated, behavioral and cognitive improvisation is practiced to change the standard operating procedures. This is justifiable because the traditional methods and procedures are not applicable anymore. Figure 4 shows that specialists in complex projects tend to search more for new operating procedures compared to traditional projects. Moreover, in projects where they are tight on schedule, they tend to study fewer alternatives when making decisions regarding a certain process.



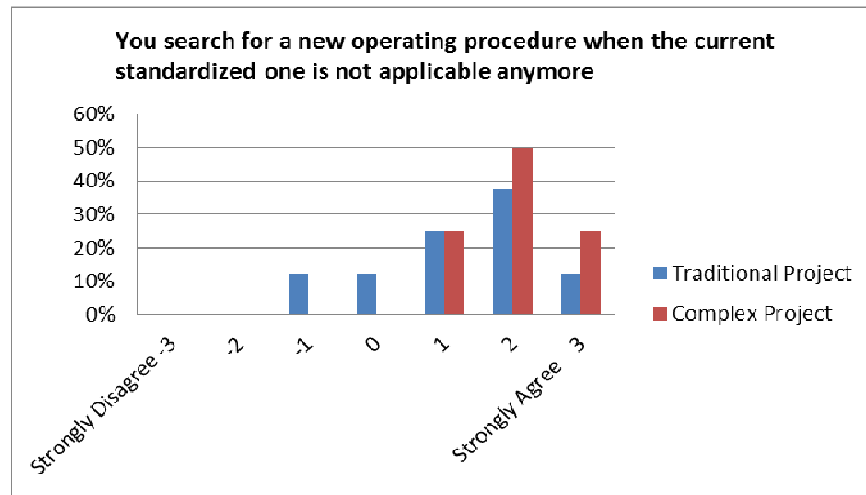


Figure 4: Complex versus traditional projects

### **FUTURE WORK**

Several studies have addressed waste in construction operations and many of these studies have showed that waste represents a large portion of production costs in different forms including: excess use of materials, rework, defects, incomplete products, and non-productive man-hours. Lack of production planning can result in task execution without full removal of constraints and result in planning failures, lower productivity and higher costs. In some circumstances, construction specialists revert to improvisation by utilizing available material, cognitive, affective and social resources to complete these tasks. This study will evaluate the performance level of short-term planning in construction, the circumstances requiring improvisation, and analyze the relationship between the two.

To achieve the above mentioned goals further work is required. The remaining work includes the following:

- Monitoring lookahead plans and track tasks that are not completed weekly.
- Grouping the failed tasks into three categories as shown in figure 5:
  - Failure to complete the planned tasks
  - Failure due to inability to plan the tasks during lookahead planning
  - Failure due to uncertainty
- Monitoring and tracking improvisation events that result due to the above three groups
- Dividing improvisation events into two groups:
  - Induced improvisation
  - Effective improvisation
- Studying the relationship between the three planned failure groups and the two improvisation groups

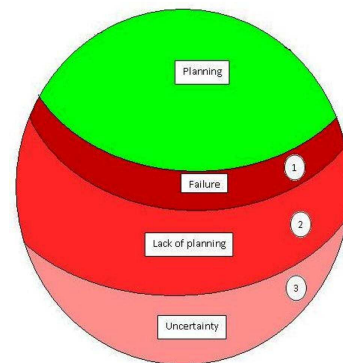


Figure 5: Areas where improvisation can complement short-term planning/lookahead planning

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