

# Human Bias in Construction Industry and Reducing Its Effect Using the Last Planner System Method (Case Study in PT. XYZ)

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## ABSTRACT

Research on decision-making in lean environment has not been studied enough, and that inspired us to run more precise investigation in that area. Nowadays, with the implementation of lean in numerous companies all over the world, it is important to understand not only the truisms of lean, but also what impact does it have on sub processes of activities of the organization.

As it is known, decisions are made by human and that means those decisions are influenced by many human factors. One of those factors is biases and framing effects, that had been closely studied by Noble prize winner Daniel Kahneman and his co-author Amos Tversky. They studied those effects from a point of view of economical psychology, yet not going into details. We took their work as a basis for our study of human biases and decision-making under uncertainty in off-shore construction.

In this research, we try to take a closer look into three theories (lean planning, the last planner system and decision-making under uncertainty). We connect them in order to achieve an understanding of how those aspects of organization's activities are connected and how they influence on each other.

This study was performed with two main goals in mind. The first goal was on one hand to understand and identify the main sources of uncertainty in the engineering process; and on the other hand to identify the main human biases that affect the decisions made in the engineering process. The second goal was to see the theoretical aspects of decision-making through the process of lean planning and lean information flows implementation and to identify ways to reduce the impact of the human bias on the decisions made.

Results of this research are lean knowledge not sufficient, uncertainty can be handled better with lean, and overall improvement not enough. Human biases exist in engineering department are availability bias, representativeness bias, reliability bias and anchoring bias.

To minimize the effect of biases can be done through multi process which involved many parties, such as six thinking hats technique, the premortem technique, checklists and memos. Besides that lean planning and the last planner system in the engineering process make the process having better certainty.

Be on time, adapt to customer demand, inter-department coordination and information flow in general have been improved 25% after applied lean planning.

Future research can be much more focus on evaluation and the way to handle human biases.

**Keyword:** Human Bias, Lean Planning, The Last Planner System, decision making, uncertainty.

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## INTRODUCTION

Human life full of decision making moments which have many problem varieties, from simple and clear to unclear problem, full of risk and uncertain. This kind of problems caused structured decision and unstructured decision.

Rational decision making approachment was developed with *expected utility theory* (Plous, 1993). This theory simply said that human made decision making based on net maximum value of utility which can be attained from a decision making which has been made.

Tversky and Kahneman (1981) developed a model decision making in that kind of situation with different scenario, which is having changes from positive result into negative result:

- Choice A lost Rp1.000.000, fix.
- Choice B lost Rp2.000.000 with probability 50% and profit Rp0, with probability 50%.

Based on expected utility theory, people would be indifferent to that situation. But, Tversky and Kahneman shown us that people would prefer to choose B. At once, this case show that risk factor influences on someone decision making process,

Phenomenon identified by Tversky and Kahneman (1981) they represent one of the birth of approach irrational also recognized with the behavior approach. This approach is then developed and checked as theory in so many discipline, for example in economic recognized

by economical behavior (behavioral economics), in finance recognized as behavioral finance, and in accountancy recognized as behavioral accounting, as well as at discipline of science of psychology and sociology.

In construction industry, various decision perpetrators in value chain make assorted of decision as according to their function each. It is very clear that to increase company profit can be through the waste elimination in the plan and also production process. Intention of applying lean is to lessen the lead-time, and work in process, to get the complete delivery frequency level from supplier in small size measure (small of lot sizes) and for aligning of all activity in the plan, development and construction development. In organization, before designing and implementation a plan or production system, it is important for management to comprehend the information of what have to be known in all value chain, who analyze and take the point and decision mentioned told to succeed. This examination ascertain the availability and quality every decision made.

Uncertainty in offshore construction can be classified under three main categories:

- suppliers' uncertainty,
- production uncertainty
- project-owners' uncertainty

Whereas of each category could be explaining in some points, they are:

1. Suppliers' uncertainty, consist of :
  - Late deliveries
  - Partial deliveries
  - Quality problems
  - Workmanship problems
  - Sourcing issues
  - Training
  - Methods
2. Production uncertainty consist of:
  - Quality problems
  - Material issues
  - Sequencing
  - Coordination
  - Equipement Problem
  - Information
  - Training
3. Project-owners' uncertainty consist of:
  - Variation orders( VO)
  - Rules and regulations
  - Contract issues
  - Financial situation
  - Cooperation

Another important factor affecting the decisions is framing effect. With framing effect, depending on how questions are formulated people attitude toward risk varies. They become risk averse when the problem is put in a positive frame or gain aspect and risk seeking when the

problem is presented in a negative frame or loss aspect (Kahneman and Tversky, 1979). Therefore, asking the incorrect question can affect considerably the outcome (Wallace, 2005). Pieters (2004) who studied framing effect in petroleum industry shows how the errors in probability estimates can be high because the decision-makers are subject to biases and framing effect and use heuristics to make decisions under uncertainty. The error margin can vary between 30% and 98%, which is quasi-complete inaccuracy. To counteract the fact that it is impossible to have all the information required to make a decision; there should be a tailored decision-making process, which allows to reduce as much as possible the impact of the above mentioned systematic errors (ibid)

The aims of this research are:

- The first goal was on one hand to understand and identify the main sources of uncertainty in the engineering process; and on the other hand to identify the main human biases that affect the decisions made in the engineering process.
- The second goal was to see the theoretical aspects of decision-making through the process of lean planning and lean information flows implementation and to identify ways to reduce the impact of the human bias on the decisions made

## METHOD

Our research has been done at PT. XYZ, located in Ds. Bojonegara – Serang, BANTEN.

Our research was done through three questionnaires in cooperation with the management. Questionnaires were addressed to the engineers of the engineering department. These questionnaires addressed different aspect of our study. Questionnaire 1 was related to uncertainty and lean planning. Questionnaire 2 was made to identify the main human biases and reveal the existence of framing effect. The third questionnaire permitted to evaluate professional maladjustment. The results of these questionnaires served as basis for our analysis and we did not have any interview for data collection. During our research period, we stayed most of the time on site and had different meetings with the management to reframe the research and questionnaires. Meetings were arranged with the engineers as well to give them an idea of the purpose of our research. Data obtained from these meetings and questionnaires were direct qualitative data. Most of the indirect data were collected from internet, from articles and books related to decision-making, human bias, lean planning, lean thinking and supply chain.

## RESULT

The result in general give the idea that uncertainty much more because of human being factor, where causing stream process the information which do not go properly, unavailable required document, and others.

Owner and worker leader have the periodic and weekly meeting to discuss the deviation that happened from planning which have been decided and monitor the activity which underway. In the meeting usually expostulated problems that happened by all concern party in the work.

However, wrong assessment or calculation of all possibility which is possible happened, can make entire group take the wrong decision and direction. Further, way of meeting or issue scheduled can form a framing; what in the end will only yield a same decision effect. Often happened individually, an engineer has to prepare the design and the model of 2 dimension or 3 dimension without having all information needed. In this context the use of heuristics can cause the diffraction which induces at decision which they make.

To prevent that matter, various approaches can be used so that lessening effect from human bias in decision making that happened individually and also decided in weekly meeting.

Others, require to be notice that, researcher had not yet seen the applying multi-person process in decision making especially the six thinking hats technique. Following step is proper several things to lessen the effect human deflect in decision making.

## Planning Process

In the matter of planning which is paid attention to that all member of team have to design the last planner system which can fulfill the specification matching with requirement, condition and challenge which possible arise during project take place. To prevent the happening of waste generated because of mistake in decision making, traditional system of push scheduling technique have been replaced by pull scheduling technique and planning team. The matter also is to develop the communications system in two directions. Figure 1 below depicts the sequence in applying of the last planner system in construction industry.

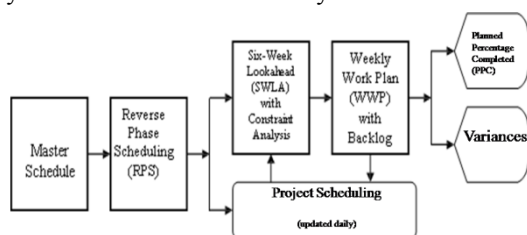


Figure 1: The Sequence of Last Planner Process

The process involved the following steps:

1. A master schedule was developed by the project manager which utilized a push system approach and cumulative experience from similar projects; it included an overall schedule with all phases. The master schedule and drawings with pouring sequences were distributed to all planners and the rebar supplier before the Reverse Phase Scheduling meeting.
2. Before the Reverse Phase Scheduling (RPS) meeting, lean concept and Last Planner procedures were explained to all Last Planners. All Last Planners and the rebar supplier participated in team planning, and developed network of detailed activities for Phase I of RPS. One RPS meeting was conducted at the start of the project. Using a long sheet of paper on the wall and post-its, Phase I was split into activities with the feedback of all Last Planners. First, the planners wrote down activities, with their durations, on the post-its, one activity per sheet, and stuck those sheets on a long sheet of paper that was posted on the wall forming a timeline, from a target completion date backward. Next, all planners identified the logic between these activities and adjusted the sequences if needed by moving the sheets, and they discussed and decided which activities would dominate the critical path. Then, float, used as the schedule contingency, was added to the activities that were on the critical path and contained some uncertainty. The milestone of the master schedule was an important guideline for RPS production. Finally, the final schedule adjustment was taking the place. A detailed schedule was prepared and some constraints appeared. The RT observed the whole process and then produced an electronic RPS file from this new set of detailed schedule.
3. Six-week look-ahead (SWLA) is a six-week rolling schedule with constraints indicated. The project schedule updated daily which was adjusted from the actual project schedule. SWLA was produced by the project manager based on the results of the RPS and the project schedule. RT documented constraints with indication by the project manager, and performed the constraints analysis. SWLA was distributed to all last planners at WWP meetings.
4. The participants in the WWP meeting included all Last Planners and the RT. The meetings were held each Thursday. Each trade submitted its own upcoming week's schedule to the project manager on the day before the Weekly Work Plan (WWP) meeting. The WWP schedule, manpower,

safety, 5S (clean-up and material lay down area issues especially), construction methods, delivery schedules, and any problems from the job site were discussed as part of the planning process during the meeting. Open and two-way communication was the key to the success of this meeting.

- At the end of each week or on the following Monday, the researcher interviewed the project manager and documented the actual schedule for each activity that was performed. They then reproduced an electronically updated WWP schedule and variance control table, and analyzed them. PPC charts and PPC calculations were also prepared by the researcher. The PCC calculation is based on the actual start and finish dates of activities. In addition to the overall Percent Plan Complete (PPC) of the project, individual PPC Charts for each trade were prepared to compare their individual progress. Each planner received both PPC charts during the WWP meeting.

### Mapping Process

The process starts with the master schedule which is used as a basis for delivering the project delivery and meeting milestones. It contains major project milestones including: entitlements, submittal of first design increment, submittal of second design increment, submittal of third design increment, start of demolition, start of construction, and commissioning of hospital operations.

As shown in figure 2 below:

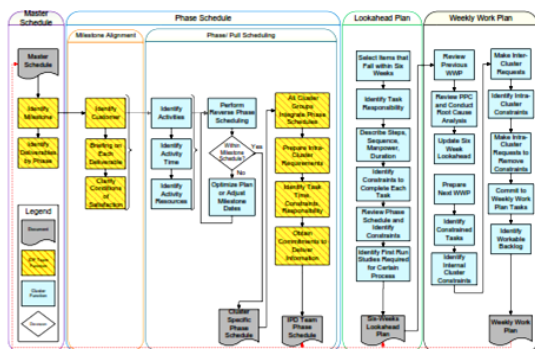


Figure 2: Process Map Depicting the Planning Processes at CHH (Modified from The Last Planner Handbook at CHH, 2009)

The first step is identifying a milestone to map and highlighting the deliverables to release when the milestone is complete. However, it is crucial at this stage to align the perspectives of various project partners for each milestone that needs to be mapped.

### Schedule Development

Next step is making a Schedule Development. Figure 3 below shows a layout of the fourth planning process that formed the last planner system.

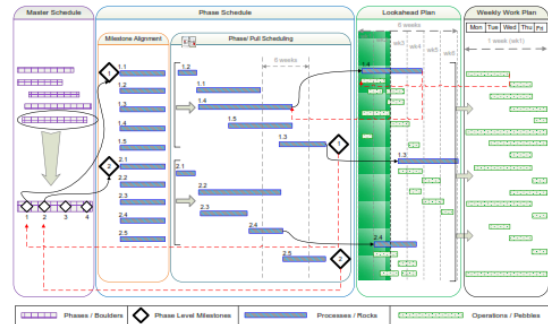


Figure 3: The LPS Scheduling Development Model (Hamzeh 2009)

The first process is master scheduling which incorporates owner's expectations, logistics plans, and work strategies into a master schedule. The master schedule presents milestones and phase level activities. Phases are represented by boulders to characterize coarse level of detail involved.

### Information Flow

In planning, to avoid mistakes in decision making it requires designing transparent pathways for information flow. Figure 4 presents a model mapping information flow between pull /phase scheduling sessions, cluster group meetings, and team planning meetings.

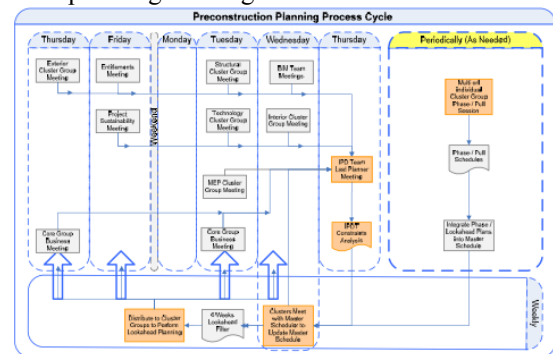


Figure 4: Information Flow Model for Planning Processes (Modified from The Last Planner Handbook, 2009)

Before the beginning of a phase, each individual cluster group meets and develops a phase schedule. The master scheduler incorporates phase schedules into the master schedule which is built and updated biweekly in a meeting involving cluster-group representatives.

A six-week lookahead is filtered from the master schedule and sent through the planning facilitator to cluster leaders or project engineers who in turn filter tasks by discipline and forward them to the designated project parties.

### User Acceptance

In this research, we evaluate the knowledge of lean, reduction mount the uncertainty and progress which totally in work engineer after applying lean. The researcher was having a time todo the sit-in-plan during a week to discuss and to conduct the tryout of theory which researcher has been used in this research. The aspect lean also is evaluated to determine if uncertainty have earned overcome by lean planning effectively, evaluating progress by totally and amenity to remain at schedule which have been determined.

Then all engineer asked to do the evaluation to some different statement, as summarized in tables 1 which deal with accomplishment of schedule and adaptation to consumer request when before and after applying of lean planning. Evaluate scale is between 1 until 4 (where 4 is the highest point). From this evaluation is gotten information that schedule accomplishment which have been determined, adaptation to consumer request, coordination of inter department and good information stream have had the improvement in general equal to 25 % after applying of lean planning ( scale of 2- 3).

Table 1 Lean Evaluation

| STATEMENT  | BEFORE | AFTER |
|--|--------|-------|
| The difficulty to adapt to the change in the customer requirements   | 2      | 3     |
| Respect of the schedule  | 2      | 3     |
| The ease to keep the schedule  | 2      | 3     |
| The ease to handle technology uncertainty in the design              | 2      | 2     |
| The effectiveness of the information flow in the engineering process | 2      | 3     |
| Better coordination between disciplines                              | 2      | 3     |

### Previous Study

Some research have been doneby some people and become the benchmarking for this research. Mostly the research had done in management area and economic. They are:

- Pranoto, Y (2005) in its dissertation explain how effect human deflect in management performance enchain the pasok. He concluded that decision influenced by human bias systematically gave deviation into effort to maximize the profit. Similarity which researcher has been done is the topic of how human bias influence the decision-making processes. The difference is, Pranoto discuss it in supply chain management context and analyze the advantage which possible happened improvement had been done.

- Welsh, BeggandBratvold (2009) in his research explain how human bias in oil and gas industry has been the cause of the loss of billion

dollars. Research was conducted to 51 students of final year of Australian petroleum school, with questionnaire method. The result showed how systematic training can be done to prevent the loss which possible happened. This research is shown the influence of human bias in decision making. This was in line with what we have done.

- TraoreandRymarava (2011) in his research explained how human bias in decision making happened in shipbuilding industry and their types. The method used was questionnaire method its sample is engineering department. This research has similarity with what we have done that is confirm the theory which have been explained by Kahneman and Tversky.

### Company Implication

From the result and what we have demonstrated in engineering department, can be shown the potency of performance improvement. Besides respect to the schedule, company can make re-documentation of projects that have been done, ongoing and is going on. So the time target and performance improvement can be achieved. As shown in figure below:

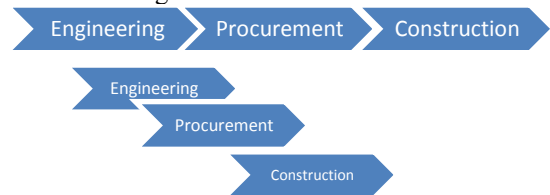


Figure 6: Changing EPC flow that has been expected

### Limitation

The study faced a limitation that relies on the availability of resources. The researcher was able to get data from a company only. But, the result was sufficient to get a picture of all process that we have done.

### Conclusion

This research was based on an interdisciplinary framework combining decision making under uncertainty, lean planning and information in supply chain. The research was conducted in the engineering department of XYZ permits to identify some of the main sources of uncertainty, which cause delays on the planning. We also identify the main biases occurring in the department. The presence of bias due to the use of heuristics as availability and representativeness lead to decision-making errors and wrong estimate of value and probabilities. They cause wrong decisions in case of uncertainty and affect the planning.

The main biases occurring in the department are availability bias, representativeness bias, reliability bias and anchoring bias. Due to these biases, wrong problems can be addressed and

wrong decisions create more delays and affect the planning. It is therefore important to keep the lean planning and take advantage of this planning approach.

Our research permits to identify the main sources of uncertainty and the main biases existing in the engineering department. From the results, we notice that the difficulty in the coordination of the engineering work and the third party activities is due mainly to ineffective information flow and lack of capacity. The delays in the execution of the different steps of the work come principally from imprecise and unavailable technical documentation. These delays are caused also by late customers' requests and rework.

The evaluation of lean planning reveals an improvement of 25 % of the respect to the schedule and the coordination between the disciplines. The overall improvement brought by lean planning on the engineers' work is not enough. However as evaluated by the engineers, it permits to reduce significantly the level of uncertainty in the engineering process.

The human biases above-mentioned cannot be completely eliminated but their impact on the decisions can be reduced. This allows decision makers to tackle uncertainty more effectively and provide some flexibility in the engineering process.

The techniques use to reduce the impact of biases on the decisions are multi-person processes through six thinking hats technique, the premortem technique, checklists and memos. Besides that lean planning and the last planner system in engineering process can make the process to have a better certainty. Therefore it is important to get benefit of them.

## Future Works

Further researches can evaluate the impact of each of the techniques on the reduction of the effect of human bias. They can evaluate the impact of each technique for better decision-making under uncertainty. Also in the future works different ways of analyzing biases and uncertainty can be included, in order to see whether the use of lean planning is helping to reduce uncertainty level and human bias level.

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