IMPACT OF "THE LAST PLANNER" METHOD ON SANITATION WORKS

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ABSTRACT

. This document brings together the concepts and applications of Production Management, based on Last Planner techniques, as applied in the works of Sedapal Lot 7 and Lot 10, with the purpose of passing on our experience in Sanitation Projects so that the reader can understand the dynamics applied and adapt them into his/her own work**,** related to the emphasis on planning and optimization of flows by means of waste detection and continuous improvement application.

KEY WORDS

Flow, Planning, Programming, Requirements, Production

INTRODUCTION

Currently, Peru exhibits a deficit in coverage of sanitation services, considering they only attend the needs of 79% of the population.

One of the government's main objectives is to narrow this gap, aiming for 95% coverage. This means that approximately 2,320,000 homes with water and drainage systems will need to be built. This also generates future sanitation projects where we can apply our experience and good practices.

Knowing the magnitude of the projects, their geographical characteristics, dispersion, variability, etc., it is clear that management must make a clear effort in controlling the inter-dependency between processes and reducing the variability which, by its nature, manifests itself to ensure the production flow. This, through the design, improves the processes control, simplifying them and detecting and fixing in a timely way any defect or deviation. Thus the maximum compliance possible in planning under the good practices proposed by Lean Construction is ensured and production needs are attended.

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IMPLEMENTED MANAGEMENT IMPROVEMENT

PLANNING

We detected the need to generate a system to help us carry out a more orderly, systematized and efficient work strategy to help us establish a vision of immediate and future goals in the works at both Lot 7 and Lot 10.

Work Sectoring

This is fundamental in the preparation of a good plan, and following the principles of Lean Construction, small batches with equally distributed workloads were established, allowing us to organize ourselves in an adequate manner and carry out a better control of the works.

To proceed with sectoring of work, we need know the Estimate of the project, Daily advance of a team and Deadline

For the specific case of Lot 7, we worked with teams specialized in the installation of sewer and drinking water systems. However, we realized that we had not considered the type of land, nor the interferences on each front, creating the need for reprogramming.

Programming

Programming and planning are dynamic processes which are related and carried out in parallel. Programming is part of Planning and the latter obtains feedback and updates itself based upon the results of Programming.

The In-Process Planning Routine (Izquierdo 2011) rests on the Last Planner theory by means of the following Management Tools:

- Daily Plan: Program where the tasks a specific team must carry out on a set day are shown. The Plan will be handed out at the end of the day’s work or at the beginning of the works planned.
- Weekly Plan: Program in which the foreman’s weekly tasks are shown.
- Programming Lookahead: Programming tools presented by the production engineers which show the schedule in detail (tasks) on the different work fronts. The programming horizon varies between 3 and 6 weeks.
- Constraints Analysis: Control tool which helps us to establish the main interferences and problems which arise on site with the same horizon as that which corresponds to Lookahead.
- Reliability Analysis (PPC): Tool which helps us establish how efficient our weekly programming was.

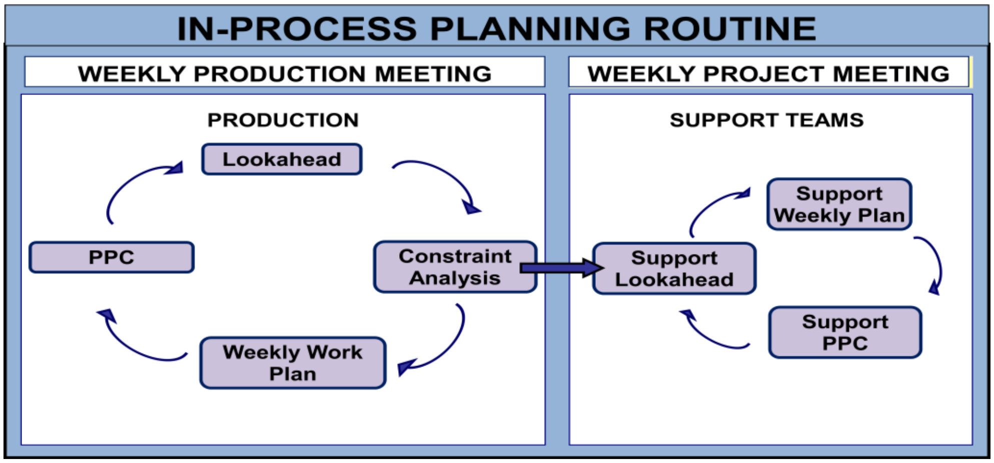

Figure 1: In-Process Planning Routine

Activity Trains

This is applicable to the sanitation works which require considerable lengths of piping installation. It is necessary to divide into sectors the work area in a uniform way so that each team carries out a similar amount of work every day (Load balance), balancing the workload through sub-quads focusing always in the same activity; hence, benefiting themselves from the learning curve.

In the Works at Lot 7 and Lot 10, we worked by dividing the progress made in linear meters of piping installation, according to the following considerations:

- Analysis and listing of the activities considered for the Train.
- We later established the sequence and the necessary resources.

We carried out a thorough analysis of both projects, with the purpose of ensuring a continuous flow. The most important was the identification of the Variability Sources and the definition of the measurements to eliminate and/or control them.

Activities	1	2	3	4	5	6
Pipe Installation						
Excavation (Line + Manhole)	S1 (35)					
Manhole Installation	S1 (35)					
Refine and level the ditch		S1 (35)				
Sand bed (incl. Compaction)		S1 (35)				
Pipe Installation		S1 (35)				
Install Connections			S1 (35)			
Hydraulic Test (Open Ditch)				S1 (35)		
Backfill and Compaction				S1 (35)		
Hydraulic Test (Covered Ditch)					S1 (35)	

5 days

Figure 2: Shows the activity train before the optimization process.

Activities	1	2	3	4	5	6	7	8	9
Pipe Installation									
Manhole Excavation	S1 (70)								
Manhole Installation		S1 (70)							
Installation of Boxes			S1 (70)						
Excavation (Line)				S1 (70)					
Ditch Refinement and Leveling					S1 (70)				
Sand bed (incl. Compaction)					S1 (70)				
Pipe Installation					S1 (70)				
Install Connections						S1 (70)			
Hydraulic Test (Open Ditch)							S1 (70)		
Backfill and Compaction								S1 (70)	
Hydraulic Test (Covered Ditch)									S1 (70)

9 days

Figure 3: Shows the activity train after the optimization analysis.

Table 1: Shows a summary of the results obtained after the process.

Comparison Between Initial and Final Design Results of Activities Train	
Beginning	**End of Optimization Process**
35 ml/day	70 ml/day
4 connections	8 connections
Ratio line = 3.90 HH/ml	Ratio line = 1.57 HH/ml*
Low reliability	Increased reliability

We must consider the impact which caused the adding of buffers:

- The cycle increased from 5 to 9 days and this forced us to increase the length of the open ditch of 140 lm (originally established) to 490 lm.
- Greater signaling costs
- Greater risk (security)

However, the yields obtained compensate largely for the impact mentioned in the previous paragraph.

Constraints Analysis

An essential component of the Last Planner theory, this stage has the purpose of identifying and providing in a timely way anything that may be missing to carry out a task.

Regarding the works studied, after analyzing the lookahead, we identified which were the activities that had constraints and were assigned to the support personnel, who were responsible for the follow-up and lifting of them. The types of constraints used were the following:

- Engineering: Evaluate if we had all the necessary information.
- Materials: Evaluate if we had all the necessary materials and consumables.
- Equipment and Tools: Evaluate if we have all the necessary equipment and tools (owned or rented).
- Previous activities: Evaluate if the preceding activities have been executed or if they will be before the beginning of the activity.
- Permits and Licenses: Verify if we have all the municipal or corresponding permits.
- Clients/Supervision: Check whether there are approvals or permits which should be given by the client and/or Supervisor.

To assign those responsible for lifting the planned constraints per production, it is necessary to have the collaboration of a list of responsible people per restriction type, as defined in the Project.

Weekly Production Meeting

The participants are: the Project Manager, the OT Headquarters and the named assistants, the Production Headquarters and production personnel. Sub-contractors for specific topics, as required.

The scope of this meeting is to achieve the following results regarding programming:

- Lookahead of the reviewed and reconciled Project
- Compilation of constraints indicating the people responsible and the reconciled dates.
- Unrestricted weekly plan as a commitment to the production area for the following week.
- After the meeting, the Technical Office and the Management distribute the constraints per responsible person. Based upon this information, each support area carried out its programming. All agreements will form part of the meetings minute.

Works Weekly Meeting

In this meeting we have a formal space so that the support areas present the inconveniences they might have encountered in lifting constraints, as well as defining the commitments of the support areas. Those present at the meeting should be: Project Manager, OT Headquarters, Production Headquarters, Support Area Headquaters, Production and Support Personnel which the Project may consider relevant.

The scope of this meeting is to achieve the following results:

- Constraints of the identified Support Areas, based on which the actions to be taken are established, appointing the responsible people and the deadlines laid down.
- We hear the commitments assumed by the Project to enable the Support Areas to lift the identified constraints as soon as possible.
- We identify those activities that must be reprogrammed.
- Review and Evaluation of the commitments and agreements assumed at the previous meeting, which were registered in the Meeting Minutes.

Weekly Work Plan

The Weekly Work Plan is made based upon the activities which are free from constraints and which every engineer in charge will undertake the following week.

This programming excercise was applied in the analyzed works, which allowed us to obtain reliable programming and a relatively high (70%) Weekly Work Plan compliance percentage, considering the conditions of the works.

Furthermore, the Weekly Work Plan allows assignment of the necessary resources for the execution of tasks, considered adequate, establishing the production commitments for the week.

Daily Plan

This consists in elaborating a program which includes the production activities to be carried out in a day, and will be prepared according to the same criteria as used in the Weekly Work Plan.

The Plan consists in evaluating, at the end of every day, the compliance with what was programmed, and reprogramming the incomplete work to be included in the next day’s daily plan. The daily plan was handed in to the foreman in a blue-print, in which every stretch was highlighted with the colour corresponding to the task to be done, following a key.

With the daily plan we try to give the foreman attainable but challenging production goals, in order to have reliable programming.

LOGISTIC CONTROL

Since the materials have an incidence of approximately 50%, it was necessary to introduce their management to planning and programming so that we established guidelines and tools in the Production-Logistics ratio which might ensure that the information was true, in such a way as to ensure production flow.

Materials Lookahead

The Materials Lookahead consists in planning weekly consumption for all standard materials (the most representative per consumption frequency, and with a minor supply deadline equal to the Lookahead horizon) starting from the production lookahead. A Lookahead is generated per work front, and it is consolidated by the person responsible for logistical control, thus generating the Works Lookahead.

The Materials Lookahead will be reviewed in the weekly production meeting.

Table 2: Materials Lookahead of the Enclosed Front - Water

Materials Lookahead - Water Networks (EL CERCADO) - Ing. Galvez

#	Oracle Code	Description	Unit	Week -42	Week -43	Week -44
1	60.42.4111	22.5 ELBOW, W/ONE HD SOFO DOUBLE HOOD, D=110 MM.(< 150 PSI)	Unit	3	5	3
2	61.11.0339	22.5" PVC ELBOW 90 MM DOUBLE HOOD	Item			
3	61.11.0340	22.5 PVC ELBOW 110 MM DOUBLE HOOD	Unit	1	3	2
4	60.44.4016	45" ELBOW W/TWO FF SOFO HOODS = 160 MM (< 150 PSI)	Unit			1
8	60.42.3913	90" ELBOW , W/TWO SOFO HD HOODS D=100 MM (< 150 PSI)	Unit	2	1	1
9	60.42.3916	90" ELBOW, W/TWO HD SOFO HOODS, D=160 MM (< 150 PSI)	Unit			
10	61.11.0271	90" PVC ELBOW 90 MM DOUBLE HOOD	Item			
11	60.42.0412	11.25 ELBOW, HD, HOOD TO HOOD D= 100 MM (< 150 PSI)	Unit	2	5	6
12	60.42.0414	11.25 ELBOW, HD, HOOD TO HOOD D= 150MM (< 150 PSI)	Unit			
13	60.42.0415	11.25 ELBOW, HD, HOOD TO HOOD D= 200 MM (< 150 PSI)	Unit			
14	60.42.0416	11.25 ELBOW, HD, HOOD TO HOOD D= 250 MM (< 150 PSI)	Unit			1

Logistic Consolidation

The logistics consolidation allows us a logistic control through an orderly system of request of materials, with which we are aiming for the following:

- Focus on the necessities of the project instead of the necessities of the logistic area.
- Avoid flow interruptions caused by logistic problems and apply Just in Time principles buying only what is necessary.
- Avoid direct orders to the buyer by the foreman or production engineer.

- Avoid the ecess of administrative work simplifying the buying process. Avoid giving attention to those who complain the most.

In Figure 7 we show the flow of the materials orders for Sedapal Lot 7, and we can see that the production engineers send their materials requests each week to the production leader who validates and sends on the order to the materials consolidator who received and consolidated the orders, assessed the logistics, verified if they were consumables or not, send procurement orders and coordinated with the buyers. He was also in charge of coordinating the order status with the production engineers.

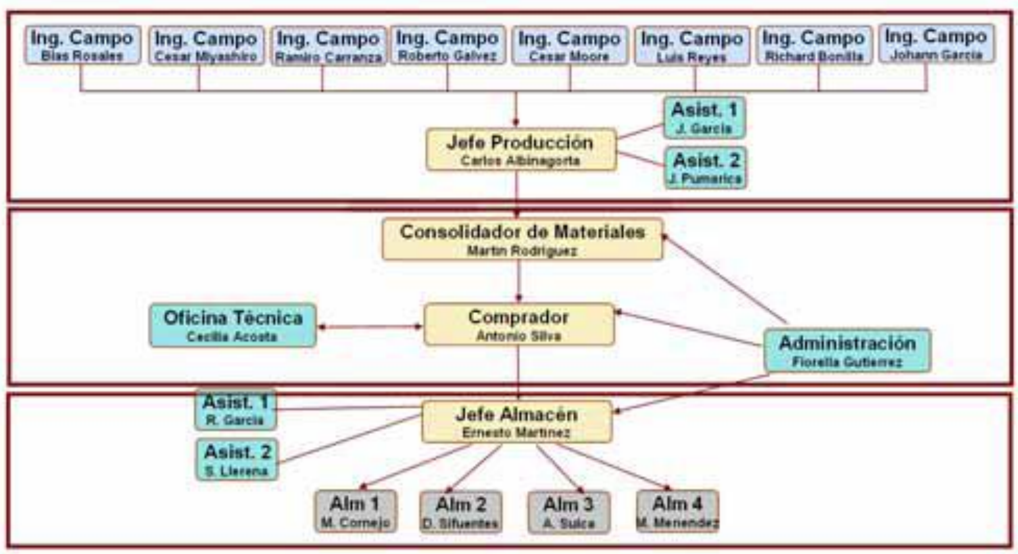

Figure 4: Flow of orders and materials consolidation.

Centralization of Orders for Aggregates and Dump Trucks for Elimination of Material

It is the implementation of an orders center at the work site where we appoint a person in charge of receiving and arranging the orders for all the fronts, and programming them with the sub-contractors, allowing a response to requests in an efficient and coordinated manner, in such a way that they optimized the use of the dump trucks

The goal is to avoid the following:

- Direct orders from the foreman to the sub-contractors
- Irregular treatment to the sub-contractor
- Irregular order frequency
- Not seizing the opportunity of reusing the materials of different fronts.

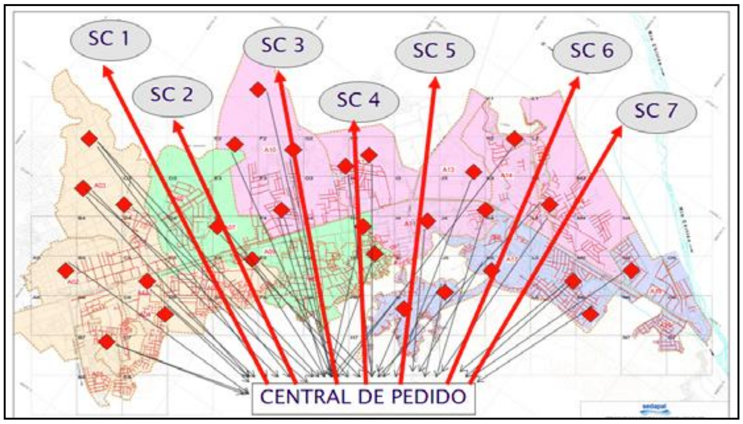

Figure 5: Centralization of the aggregates and dump trucks orders.

CONCLUSIONS

In this document, we have mentioned the experience and results obtained by applying the principles and concepts of Lean Construction theory. In the projects analyzed we have displayed a great deal of effort in programming and production control, both for production and logistic, considering the latter a key Support Area within the characteristics of the project. ,.

The final balance was favorable since the yield obtained was quite positive. In these projects we obtained great daily advances reaching 55 m per day with a team (Sedapal Lot 7) in comparison with 40m, the most competitive productivity ratios we have achieved.

The fronts, lead by engineers who had an adequate level of programming, and who, additionally, had experience in sanitation works obtained the best results. There were also engineers who did not have any previous experience in sanitation but did have an adequate system, and this established the quality of the results.

The yields of the labor force obtained in Water are similar in both works (1.74 HH/lm). On the other hand, the yield of labor force for the Sewer System differs considerably; the IP of Lot 7 is 1.48 HH/mlxh and for Lot 10 it is 2.23 HH/mlxh, calculated at average depths of 1.97 and 1.74 respectively. The reason for this difference is that in Lot 10 we began with the installation of sewage and the learning curve is reflected totally in this, whilst in Lot 7 it is reflected in Water and Sewage. Another reason is that the production Team of Lot 7 was more experienced in Sanitation and had better Management capacities. This is why we conclude that, the greater the training a person has, the better the results.

In the Works of Lot 7 we carried out the controls of the sewage yield in HH/ml and in Sedapal Lot 10 in HH/mlxh, finding the latter the more adequate since it takes the depth of the ditch into account; this is a key factor in the improvement achieved by the team.

RECOMMENDATIONS

PREVIOUS DATA COLLECTION

It is highly advisable to collect information at the work area so that planning is based upon real yields and not on historical data. For example, perform a First Run Study to define the activities' yield, both globally and separately, and establish parameters for programming and control.

PRODUCTIVITY CONTROL

It is recommended that all management be weighed up to identify defects and the implementation of improvement measures. Within the sanitation Works, the productivity control measured with the IP labour force (IP of LF) and Equipment tools (IP of ET) helped to this end. We recommend examination and analysis of these indicators during the Weekly Production Meetings.

An important additional point is to analyze the evolution process in time ratios of each of the engineers, as well as the comparison between the different work fronts.

ACKNOWLEDGEMENTS

The demonstration, through results, of this good practice would not have been possible without the dedication, commitment and professionalism shown by all the contributors who took part in the Lot 7 and Lot 10 projects. Many thanks go to them for the advances made in sanitation work management which we count on today. Thanks also to the "Project Management Control" team, and especially to Karol Flores, for the great analytical work carried out on the projects under discussion, and for remaining committed, to this day, to improving on the successes already achieved.

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