NAC **Executive Insights**

Improving Work Flow Reliability on Projects

Key Points

This Insight will share benefits of improving work flow reliability through a case study. Key points and benefits for improved work flow reliability include:

- Increased labor productivity
- Increased speed of project delivery
- Achieving successful project outcomes

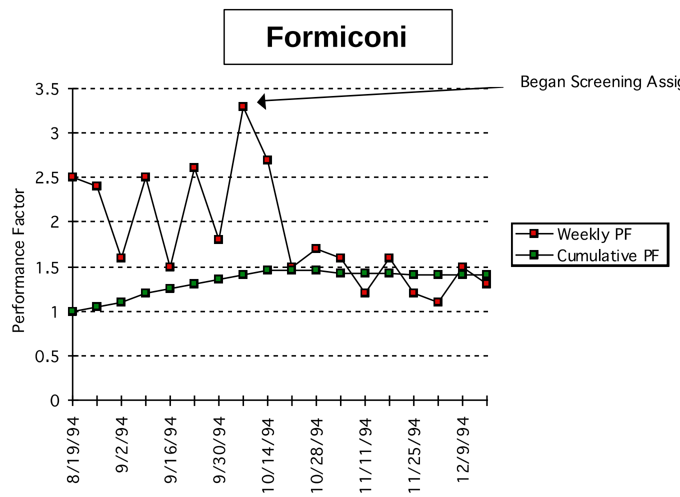
Introduction

PARC was a national oil company's refinery revamp, a $1.2B project in 1994 dollars. Just one year away from scheduled completion, the project was well behind schedule, and the construction manager estimated that 8,000 additional workers were needed in order to complete on time. The 8,000 workers with acceptable skills were unavailable, so the project had no choice but to improve the productivity of the 10,000 workers already on site. Consultants proposed a plan based on improving workflow reliability and improving work methods.

Project planning and control too often floats above production, above designing and making the asset clients need to achieve their objectives. Who will do what when is left in large part in the hands of design and construction contractors. So long as they are on schedule and budget, all is assumed to be okay. While monitoring the match between actual and plan is needed, this reactive control must be coupled with proactively steering the project toward its objectives. One key to proactive steering is work flow reliability, based on learning to make more reliable promises. Work flow reliability means that others can count on work being released to them when expected. When work flow is reliable, it is worthwhile to invest time in design of work methods.

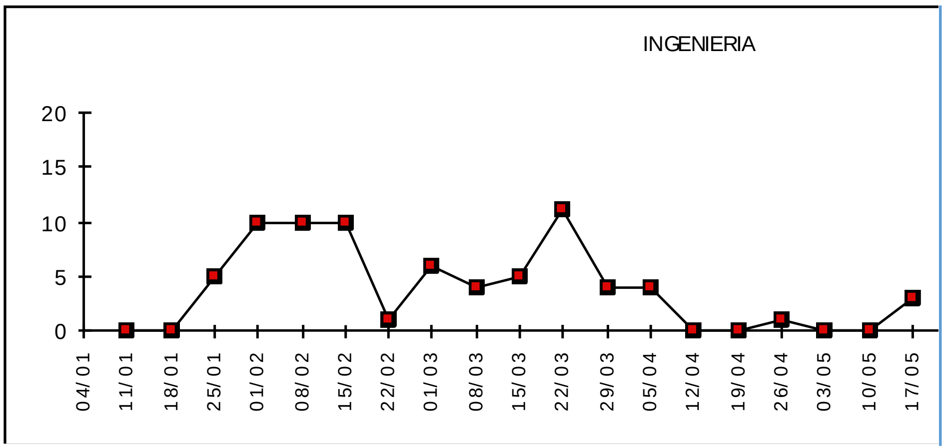
Productivity Improvement Program Details

A steering committee was formed for the program, drawn from the 10 subcontractors managing most of the 10,000 workers and from the client's construction manager. Assessment of initial conditions found that subcontractor schedules showed how many workers of each craft were to be in specific areas for certain periods of time, but did not specify what work they would do in what sequence. Also, the production planning process did not include design of methods for performing that work. The impact of that approach to production planning is illustrated in the figure below, which shows productivity over a period of four months for subcontractor Formiconi, with productivity measured by performance factor (PF)—actual vs budgeted performance. Over a period of only two months, cumulative PF (green) grew to 1.5 labor hours per unit vs the 1.0 budget. In that same time period, weekly PF (red) fluctuated wildly. The arrow shows when this contractor, responsible for two process units within the project, began following the rule to only commit to work that should and can be done. This screening immediately reduced variation in weekly PF and reversed the cumulative trend from negative to positive. Implementation of this rule also put pressure on the various internal and external logistics functions to do a better job of making scheduled tasks ready to be performed when scheduled—by identifying and removing information, material, and resource constraints. This contractor completed its scope of work with a PF=1.32, but said they would have completed around 2.5 if they had not changed their production management approach.



Beginning in November 1994, all 10 subcontractors were introduced to the Last Planner System, which includes various elements of detailed production planning: six-week lookahead schedules, screening processes for creating workable assignments, sizing assignments to crew capacity, and charting and acting on reasons for not doing planned work. The key measurements in the Last Planner System are PPC charts, which measure the percentage of weekly planned activities that are completed, and Reasons charts, which measure the distribution of causes for failing to complete planned work. These provide the subcontractor and the EPC contractor means for controlling and improving plan quality and productivity.

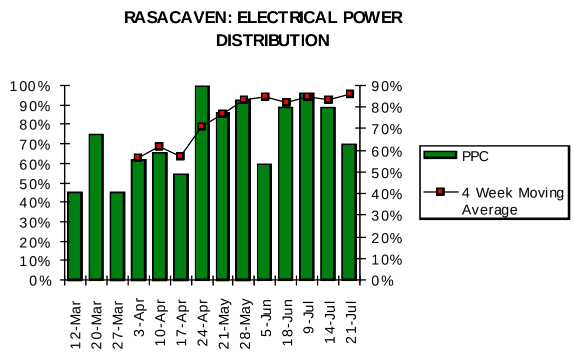
Subcontractors tracked the reasons why planned work was not completed in order to identify actionable causes and to improve the quality of planning. As "reasons" were removed, the percentage of planned tasks completed (PPC) increased, and capacity could more often be applied to tasks that advanced the project toward completion. The EPC contractor may have been unable to provide engineering information or materials to the subcontractor when the work was originally scheduled to be performed. However, the subcontractor should not have planned on doing work next week for which all resources were not on hand. "Reasons" included engineering, materials, access, scaffolding, changes in priority, and others. Tracking the reasons helped subcontractors learn how to do a better job of short-term planning and also provided feedback to EPC contractors regarding the flow of engineering and materials. The chart below shows how instances of plan failures from engineering declined over time in the early weeks of 1995.



All 10 subcontractors adopted this production management method, and all improved substantially. Work flow reliability was measured by the percentage of planned tasks completed each week (PPC). The impact on work flow reliability is shown in the table below.

Subcontractor	Improvement in PPC
Ata	90%
Costa Norte	33%
Den Spie	64%
Distral Termica	50%
DSD	33%
Formiconi	50%
Piaca	30%
Rasacaven	45%
Sadeven (electrical)	70%
Segema (Pkg A)	50%

To better explain how improvement was calculated: The first 18 weeks of Rasacaven’s chart, shown below, shows an initial four-week moving average of 60%, then a sharp increase in the seventh week, followed by a steady PPC around 87%., which is a 45% increase from 60%.



With work flow now more reliable**,** the focus of improvement efforts shifted to work methods design. The consultants taught engineers from each of the 10 subcontractors how to improve work methods by having them observe the consultants' training of foremen in their companies, then by coaching them as they delivered that training to other foremen. The impact of engaging foremen and crew members in work methods design is shown in the table below. All subcontractor crews improved substantially. Shown here are only selected examples.

Sub	Before	After	% Improvement
Ata	3 supports/day	22 supports/day	600%
Costa Norte	1 54" dia. pipe in 4 hr-19 min	...in 32 min	700%
Den Spie	1 wire/5 min.	1 wire/3 min.	70%
Distral	10 isos/week	15 isos/week	50%
DSD	0.087m/min.	0.9 m/min.	800%
Formiconi	2.75 mh/LM	1.72 mh/LM	50%
Piaca	1 column/hr	3 columns/hr	200%
Rivaco FM	1 siding/13 min.	1 siding/8 min.	60%

Overall productivity improvement is shown in the table below that compares performance to budget in each phase of the project. With the exception of two systems that could be completed afterward without penalty, the project completed on time.

	Craft Workhours (x 1 million)			
	Class III (3/93)	**Class II (3/94)**	**J95 Budget (2/95)**	**Sep Fcst (9/95)**
EPC A	8	11.7	15.7	16.6
EPC B (site)	1.8	2.2	4.1	4.5

EPC B (mod yard)	1	1.1	1.5	1.8
EPC D	11	13.9	18.8	20
PARC	21.8	28.9	40.1	42.9
% Increase		1.33	1.39	1.07
Yearly PF vs Est.	1.28	1.28	1.01	

About the Authors

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