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You've Optimized Your Process ... Now Optimize Your Organization

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You've Optimized Your Process ...

Now Optimize Your Organization

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So you've tried everything you can think of to improve your organization's production processes. You've identified bottlenecks through Theory of Constraints; you've eliminated wasteful process through Lean techniques such as process mapping; and you've decreased variation by plotting control charts as part of your Six-Sigma program. Your results have been impressive, but you want to do better. What's the next step? What else can you do to improve?

Those were the questions asked by leadership of the Naval Air Station (NAS) Lemoore Aircraft Intermediate Maintenance Division (AIMD) in January 2006. Was there more that could be done? The answer was yes!

The NAS Lemoore AIMD is responsible for maintenance of F/A-18C/D/E/F aircraft. Over the past several years, the AIMD had implemented a full-court-press on improving their maintenance processes under the AIRSpeed program—a Navy program focused on implementing process improvement techniques such as Theory of Constraints, Lean, and Six-Sigma in order to improve weapon system operational availability. The successes NAS Lemoore AIMD had achieved through AIRSpeed placed it at the leading edge in this Navy process improvement effort. Not satisfied with past successes, the AIMD teamed with the Graduate School of Business and Public Policy at the Naval Postgraduate School to investigate the utility of less traditional, yet potentially beneficial tools for improving F/A-18 maintenance.

The tool we chose to investigate was computational organizational modeling. Specifically, we chose to investigate applying the Virtual Design Team computational organizational modeling techniques developed by Dr. Raymond Levitt at Stanford University based on J. R. Galbraith's theories on information processing, and implemented using the POWer software version 1.1.6, a software program developed and maintained by Stanford University. The tool of organizational modeling differs from the AIRSpeed tools in that it focuses not on the item moving through the organization (such as an aircraft or engine), but instead on the flow of information through the organization.

Computational Organizational Modeling

Computational organizational modeling is a tool that helps managers design an organization. The concept of organizational design is relatively new and differs from the more traditional approach of simply allowing an organization to incrementally evolve in response to external and internal forces. Traditionally, when managers have been asked to take on new tasks or improve the output of tasks

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already assigned, they often considered modifying their organization to meet the new challenges. Unfortunately, their methods for assessing the impact of proposed organizational changes were at best heuristic rules of thumb employing minimal scientific rigor. In other words, they were taking their best guess at how a reorganization would impact overall performance. Although the result of this less-than-structured methodology was—for the very best of managers—considered acceptable, the reality is that not all of us are the best of managers and there's no crystal ball allowing us to predict the impact of our actions. In public organizations, prediction is even more difficult because of the lack of market feedback through pricing mechanisms.

Most organizations would benefit from a clear path to evaluating the impact of organizational change. Computational organizational modeling provides that clear path by allowing managers to build detailed organizational models on their desktop computers, then modify the models to assess the effects of proposed organizational changes. Once they identify an organizational structure that results in the desired performance, they can implement the relevant changes. This is a far better approach than the more common trial-and-error method—make a change, see how it works, and then make another change.

Modeling NAS Lemoore AIMD

In the fall of 2006, the NAS Lemoore AIMD 400 Division became the sole continental U.S. organization responsible for F414 engine intermediate maintenance. As the power plant for the Navy's newest fighter aircraft F/A-18E/F, AIMD production throughput of this engine was identified by leadership as a prime candidate for our improvement effort. Decreasing throughput time for the engine would enhance the operational availability of the F/A-18E/F.

Methodology

To improve F414 throughput, we first developed an organizational model of the 400 Division. We then validated that model, comparing predicted organizational performance to actual performance. Finally, we modified the model to represent various organizational changes in order to determine which changes reduced maintenance time.

Model Development

The modeling techniques employed in this study required us to clearly identify three components of the 400 Division: tasks associated with F414 maintenance; personnel assigned to accomplish those tasks; and key communications paths within the organization.

Figure 1 illustrates the F414 maintenance process. In the Acceptance phase, the engine is inspected to identify maintenance accomplished at the squadron level. This information is then compared against information contained in the engine logbook as well as the Aircraft Engine Management System database employed by the Similar to Automated Maintenance Environment (SAME) software application. If there are discrepancies, 400 Division administration personnel resolve the issue with the

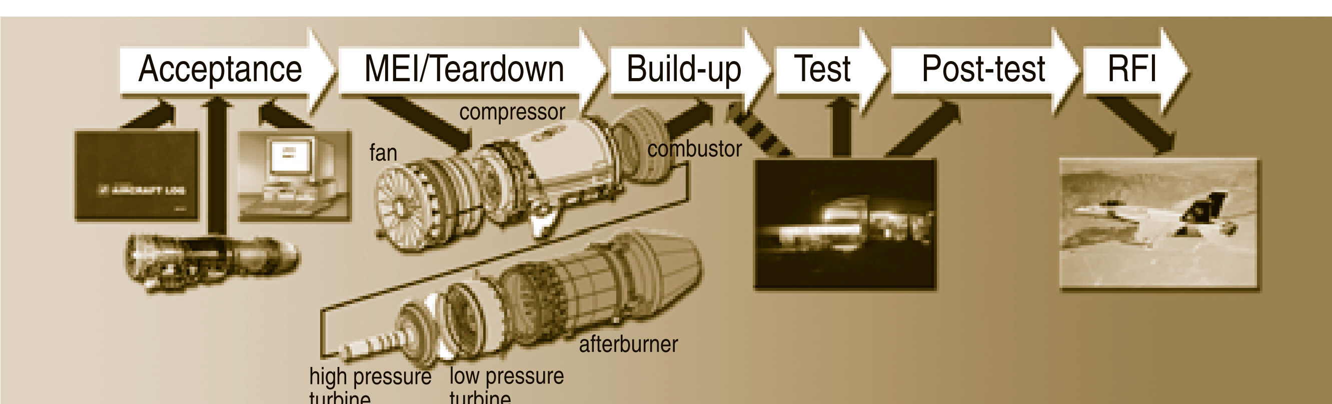

FIGURE 1. **F414 Engine Intermediate Maintenance Process**

squadron. Historically, this process takes, on average, 14 days. Following Acceptance, engine maintenance personnel conduct a major engine inspection and tear down the engine. Inoperative engine modules are identified and sent to the Navy Depot at Jacksonville, Fla. In the build-up phase, inoperative modules are replaced and the engine is reassembled. The engine is then run in the test cell through a set of pre-programmed cycles during the test phase. If the engine fails, it may be fixed at the test cell, returned to the maintenance hanger to the build-up phase or—in rare instances—sent back to the teardown phase. Following testing, a post-test inspection determines if damage to the engine occurred in the test cell. Finally, in RFI (ready for issue) stage, paperwork is completed and the engine is deemed RFI back to the squadron. Within each phase described above, there are numerous tasks that we have not detailed because of space constraints; all these tasks were modeled in terms of the time and skills required of an individual to accomplish them.

Once we had identified the tasks required to accomplish F414 maintenance, we identified the people responsible for accomplishing the tasks. The positions these personnel fill are presented in Figure 2.

Personnel were characterized in terms of their skills, experience, and available time to accomplish tasks. Accurately characterizing personnel was important, since many times, excessively long maintenance stems from mismatches between an individual's skills, experience, and available time compared with what is required by a task.

It is important to note that Figure 2 does not present a chain of command, but instead a chain of information flow within the 400 Division. Differentiating between them is critical, since within the Division—as in many organizations—an individual doesn't necessarily go to the next person in the chain of command to get resolution on a problem. Information regarding problems may flow to another individual. Our modeling required us to characterize how information would flow in an organization to solve a problem, since it is though improving this flow that problems associated with task execution can more quickly be resolved; tasks can hence be accomplished more quickly.

Computational organizational modeling can help managers identify opportunities for improving their organizations.

Our final modeling step was to identify paths of information flow. Daily meetings held to coordinate maintenance actions were key paths for information flow. Along with the primary coordination meeting held daily at 7 a.m., personnel associated with specific positions, (i.e., controllers, engine maintenance, and supply), held morning and afternoon meetings to coordinate the efforts for their specialty. Meetings are, of course, a two-edged sword. They are great for transferring information, but they also take time away from accomplishing tasks. As part of our organizational modeling effort, we wanted to characterize this information flow and determine the utility of meetings currently being held by Division.

Model Validation

In our study, we did not attempt to prove the validity of the virtual design team modeling techniques employed. Instead we accepted the validation results of previous studies. We did, however, validate our particular model of the 400 Division by comparing the actual and modeled F414 maintenance throughput durations. As the primary metric of interest in this study, we felt that if the actual maintenance throughput time closely matched the model predicted time, we had developed an accurate model of the Division. The average actual time required to accomplish F414 maintenance was 21.77 days while the model predicted 21.09 days. With only a 3 percent difference, we felt our model accurately represented the 400 Division.

Model Interventions

Once validated, we modified the model, evaluating potential changes or interventions to the 400 Division that may reduce F414 throughput time. Among others, we considered the following five interventions.

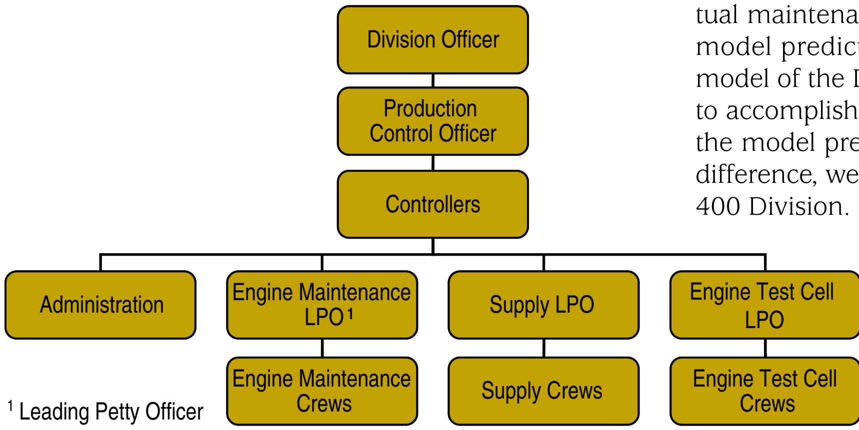

FIGURE 2. **400 Division Personnel**

Paralleling engine acceptance process: As shown in Figure 1, the current acceptance process must be completed prior to conducting other maintenance actions. This intervention evaluates the impact of conducting this effort in parallel with all other maintenance actions.

Combining the administration and controller positions: As shown in Figure 2, these are currently separate positions. This intervention was the result of interviews with 400 Division personnel, where it was suggested that administration personnel could, with some additional training, do the same work as controller personnel. This intervention evaluates this assertion.

Decreasing centralization: One of the effects of implementing the AIRSpeed tools is decentralizing organizational control. Although this is normally considered beneficial, there are drawbacks to decentralization in terms of rework when poor decisions are made at lower levels. This intervention evaluates this tradeoff.

Combining meetings: Since the F414 maintenance tasks are well defined and accomplished by highly skilled personnel, we hypothesized that 400 Division personnel may not need as many coordination meetings. With this intervention, we wanted to evaluate the tradeoff between having more meetings resulting in better information flow and fewer meetings resulting in more time to conduct engine maintenance. Specifically, we combined all of the morning meetings into one meeting attended by all personnel, and separately combined all of the afternoon meetings also attended by all personnel.

Decreasing meeting duration and frequency: Here we evaluated the tradeoff between longer, more frequent meetings, which reduce the risk of re-work resulting from inaccurate information transfer; and shorter, less frequent meetings, which afford greater time to conduct engine maintenance. We focused on the key 400 Division coordination meeting, which currently occurs every day at 7 a.m., evaluating 30 combinations of meeting duration and frequency.

Figure 3 presents the impact of the interventions presented above as predicted by our model. The critical metric was project duration. Did these interventions increase or decrease the time required to conduct the F414 maintenance? At the same time, we were also concerned with how these interventions impacted the risk of accomplishing each task associated with F414 maintenance. Risk is quantified in terms of the amount of maintenance rework required as a result of such issues as skills mismatches, inadequate time available to accomplish tasks, and insufficient information to accomplish tasks. As a result of the complex nature of the algorithms employed to quantify risk, an in-depth discussion of this assessment is not within the scope of this article.

The first intervention, paralleling the acceptance process, decreased engine throughput time by 58.6 hours. Although the risk of administration personnel failing to complete tasks associated with the acceptance process increased slightly, we assess the significant benefit of decreased project duration outweighs this risk.

In contrast to the first intervention, the second intervention, combining the administration and controller positions, had an adverse impact on both project duration (increasing it by 56.7 hours) and on risk. We believe the benefits of specialization drove this result.

Decreasing centralization, the third intervention, reduced maintenance throughput duration by 4.4 hours but had no significant impact on risk. We believe this benefit comes about because F414 maintenance consists of well-defined tasks accomplished by highly skilled personnel. The benefits of decreasing the time required to make decisions by pushing decision authority to lower levels outweigh the potential risk of poor decisions resulting in rework.

The fourth intervention, separately combining the 400 Division morning and afternoon meetings, also decreased project duration, specifically by 7.3 hours, while having no significant impact on the risk of accomplishing maintenance tasks. This result is somewhat intuitive when you consider that if everyone in the organization is going to attend at least one morning meeting and one afternoon meeting, it makes sense to have everyone in the same meeting. Each individual consumes the same amount of

Intervention	Impact on Project Duration	Impact on Task Risk
Paralleling engine *Acceptance process*	58.6 hour decrease ↓	Slight risk increase associated with tasks conducted by *Administration* personnel
Combining the *Administration* and *Controller* positions	56.7 hour increase ↑	Risk increase associated with tasks conducted by *Administration* personnel
Decreasing Centralization	4.4 hour decrease ↓	No impact
Combining Meetings	7.3 hour decrease ↓	No impact
Decreasing Meeting Duration and Frequency	6.6 hour decrease ↓	No impact

FIGURE 3. **Impact of Interventions**

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time, and the risk of misinterpreting information presented in the meeting and then passing it down to subordinates is decreased.

Finally, the fifth intervention identified a benefit from decreasing meeting frequency to every other day. While there was no benefit to increasing meeting duration, decreasing meeting frequency decreased maintenance time by 6.6 hours. We believe that this benefit is the result of F414 maintenance consisting of well-defined tasks accomplished by highly skilled personnel. There were greater benefits to spending more time working on engines than coordinating maintenance efforts and transferring information in meetings every day.

Impact of Computational Organizational Modeling

Before having an organizational model, the 400 Division leadership's only method for evaluating the impact of these five interventions on F414 engine throughput was to sit around a conference table talking over their best estimates based on previous experience. Although such discussions are helpful, they're more productive when based on quantifiable information. A computational organizational model provided 400 Division leadership with the opportunity to evaluate these changes, quantify the impact, and determine if the potential benefits were worth the risks of making the organizational change. Without this capability, leadership might forego certain organizational changes because they are unable to quantify the benefit when the risk of change is high. At the same time, they may also choose to make an organizational change that on the surface appears beneficial, but later realize there were significant second-order effects that erase any perceived benefit. In short, an organizational model provides leadership with a tool for making informed decisions about organizational change.

Our research shows that computational organizational modeling—like the tools associated with Theory of Constraints, Lean, and Six-Sigma—can help managers identify opportunities for improving their organizations. Computational organizational modeling differs from those logistics tools, however, in that it focuses on how to improve organizational performance by optimizing the flow of information through the organization. Computational organizational modeling can allow managers to quantify the complicated interactions associated with tasks and personnel in an organization, and determine how best to align personnel with tasks in order to accomplish their mission.

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