How to Handle a Massive Change: Guidance on a Process Improvement Project, Our Journey to Excellence

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Abstract. In this paper FNSS's Design & Development (D&D) Process Improvement studies are presented. With the increasing number of projects and employees FNSS launched an improvement project aiming to revise and enhance its D&D processes to remain competitive and efficient under these circumstances. Based on the gaps between "As-Is" and "To-Be" process models, existing process is revised and improved. Numerous new and significant practices like Earned Value Management and Lessons Learned Capturing & Sharing Sessions are introduced within the new process. A management practice based on PDCA (Plan-Do-Check-Act) approach is defined and currently being used for the management of the new D&D process. Through all this effort, FNSS obtained a streamlined but also flexible process which creates outputs that add value. Results show that improvements made throughout the project contributed to the output quality, through put time and stakeholder satisfaction considerably.

Keywords: Design Process, Process Improvement, Interface Management, Defense Industry, Performance Management, Engineering Management, PDCA

1 Introduction

FNSS Savunma Sistemleri A.Ş. (FNSS), a joint venture company owned by Nurol Holding Inc. and BAE Systems Inc., is a leading manufacturer and supplier of tracked and wheeled armored vehicles and weapon systems for the Turkish and Allied Armed Forces. FNSS develops its wide range of indigenously designed tracked and wheeled vehicles and weapon systems at its own R&D Division, and using its own engineering experience. In the last seven years, the number of concurrent programs tripled and and this significant growth in business volume resulted in a considerable increase in number of engineers in the R&D department. In order to ensure quality and remain competitive, FNSS needs to continuously improve its processes in that exponentially growing environment [1].

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The existing process was mostly valid for a small, dedicated group working on a single project. With a small group of engineers and relatively less workload things were going well. However, as it comes to doing many things with many people, a comprehensive and well defined process (in terms of interfaces, inputs, outputs, responsibilities etc.) is required to ensure quality and efficiency. In addition, with increasing number of projects, stakeholder management became vital for FNSS and it should be effectively managed. Therefore, it was highly required for FNSS to reconsider its processes to align with stakeholder expectations.

For this purpose, the company launched a project in consultation with Truenord Management Consultancy aiming to redesign, deploy and improve its design processes. This study covers the story of FNSS's Design Process.

The rest of the paper is organized as follows: in Section 2 we introduce the design process and highlight major improvements, Section 3 is devoted to the deployment phase. In Section 4 we discuss results achieved and in Section 5 conclusion is given.

2   Design & Development Process

D&D processes improvement studies started with the establishment of a project team, including representatives of all stakeholders (both internal and external). The core team, who runs the project actively, consisted of functional managers, project managers and capture managers. Besides, a review team consisting of upper management and functional & program directors was established to review and approve the progress at pre-defined milestones of the project.

After the team was established, our next step was to analyze the "As-Is" situation. Throughout the workshops organized with the participation of all stakeholders (supporting units, engineers from different hierarchical levels etc.), areas in the "As-Is" model that need improvement were determined. Based on the feedbacks from workshops and team members, "To-Be" model was constructed and gaps between the current state and future state were identified. Existing design processes were then revisited and main steps in the process were redefined. After main steps were established and approved, related parties worked on the detailed process steps, input-output definitions, interface and responsibility distributions accordingly.

In this section, we discuss distinctive aspects of FNSS's new D&D process and what we improved throughout our project.

2.1   Responsibility Matrix:

Step by step definition of a process provides a road map for how things should be done. RACI (Responsible, Accountable, to be Consulted, to be Informed) matrix (Please see Fig.1) defines responsibilities for design steps. It is a useful tool to streamline complex chain of events, enable clear communication, facilitate quick and efficient decisions and establish accountability among team members. It also clarifies interfaces with other departments such as Project Management and other project team members. Lack of such clarity often causes trouble if responsibilities are not defined clearly. [2]

Task #	Task	Input	Output	Function 1	Function 2	Function 3	Function 4	Function 5	Function 6	Function 7	Notes
1.	Process Step 1										
1.1	Task/activity 1.1	xxxx document	xxxx document	C		A	I	R		I	
1.2	Task/activity 1.2		xxx report		A	R	I		C		
1.3	Task/activity 1.3	xxx report	xxx plan	R		C	A		I		FS dependency with 1.1
2.	Process Step 2	xxx plan	xxxx document								Interface with 1.2
2.1	Task/activity 2.1	xxxx document	xxx drawing		C		R		A		
2.2	Task/activity 2.2	xxx report	xxxx document	C		A	R				FS dependency with 2.1

Fig. 1. RACI Matrix

2.2 Design Reviews:

Design reviews are vital to assess the degree of completion of technical efforts related to major milestones before proceeding with further technical effort. [6] Therefore, design review activities are defined at related milestones throughout the process. With the RACI matrix, contributors' responsibilities for these reviews are stated. Besides, design review content is defined and a standard design review presentation template is provided to design engineers. This ensures that vital information and risks are reviewed, design review entry & exit criteria are met and related decisions/mitigation plans are approved by the authorities before continuing with the next steps in design. Review meetings are being audited to ensure that the design review content complies with the provided template and meeting objective is achieved.

2.3 Tailored Process:

Technical specifications differ a lot from project to project. Therefore, following the same, rigid, step by step defined process for all projects is not reasonable. In the planning phase of a project, related parties decide on which parts should be tailored. This decision is made through a review and approval cycle defined in the RACI matrix.

2.4 Lessons Learned:

Capturing important lessons learned to prevent future failures and improve the processes is crucial for all businesses. With increasing number of projects and employees, this is also essential for FNSS. To ensure capturing and transfer of the lessons learned in one project to the others, specific process activities are defined at several stages throughout the process. Furthermore, weekly meetings are held where technical leaders share the lessons learned with functional managers and other technical leaders. These lessons learned items are then documented in the Lessons Learned Database and shared with the rest of the organization.

2.5   Earned Value Management.

Another concept introduced was Earned Value Management (EVM), which provides greater visibility and control of activities, enables proactive decision-making, and raises awareness of time, cost and performance among project team members. [3]

For this purpose, a heat map report is designed and deployed (Please see Fig. 2) [4]. In this report, schedule and cost performance indicators are calculated for each work package and the status is visualized using a color scheme. Using heat map, related parties analyze the status, identify possible bottlenecks, and decide on schedule and/or budget updates when necessary.

Project Space	Task Name	Estimated Start Date	Estimated End Date	Plan % Complete	Eng Hours Budget	Eng Hours Spent	Eng Hrs %	Actual % Complete	Schedule Status	Eng Hrs Status	Owner
Project 1	WP 1	21.03.2017	25.05.2018	97,00%	1400	1112,35	79,45%	93,59%	0,96	1,18	Engineer 12
Project 1	WP 2	28.03.2017	8.05.2018	100,00%	800	574,55	71,82%	96,82%	0,97	1,35	Engineer 13
Project 1	WP 4	10.04.2017	27.04.2018	100,00%	840	904,92	107,73%	88,10%	0,88	0,82	Engineer 14
Project 6	WP 5	4.04.2017	27.04.2018	100,00%	640	261,5	40,86%	83,61%	0,84	2,05	Engineer 3
Project 1	WP 6	21.03.2017	10.05.2018	100,00%	740	700,25	94,63%	89,58%	0,9	0,95	Engineer 3
Project 1	WP 7	20.03.2017	27.10.2017	100,00%	440	240,5	54,66%	100,00%	1	1,83	Engineer 8
Project 1	WP 8	16.05.2017	2.05.2018	100,00%	800	809,1	101,14%	71,43%	0,71	0,71	Engineer 5
Project 2	WP 9	15.06.2017	29.06.2018	80,00%	1728	1744,75	100,97%	79,82%	1	0,79	Engineer 21
Project 1	WP 10	1.03.2017	27.07.2018	96,00%	320	718	224,38%	96,00%	1	0,43	Engineer 22

Fig. 2. Heat Map

Based on heat map, project level Schedule Performance Indicators (SPI) and Cost Performance Indicators (CPI) are also calculated and presented to upper level management each month (Please see Fig. 3).

Project	Sum of Total Reported Hours	Man Power Budget (EAC)	Current Eng Hour Budget (Heat Map)	Sum of Total Reported Hours / Current Eng Hour Budget (Heat Map) %	Planned completion %	Actual Completion %	Actual completion % / Planned completion %	Actual completion % / Sum of Total Reported Hours / Current Eng Hour Budget
Project 1	125831	375338	235458	53%	58%	51%		
Variant 1	93615	100500	100500	93,1%	95,0%	85,0%	0,9	0,9
Variant 2	2296	5000	5000	45,9%	50,0%	55,0%	1,1	1,2
Variant 3	23753	56333	56333	42,2%	45,0%	47,0%	1,0	1,1

Fig. 3. Project Status Report

2.6   Management of D&D Process:

Apart from aforementioned specific improvements on D&D process, we set a thorough system based on PDCA (Plan-Do-Check-Act) approach for the management and execution of this new D&D process.

Plan.
In the planning phase, required resources are determined and the standard D&D process is tailored in accordance with the projects' technical requirements and approved by the related authorities.

To manage the design plans for different projects, a task management platform "Enovia" is used. Design schedules, responsibilities are defined and monitored with the help of this platform.

To support resource planning, a master engineering schedule (MES) where main phases of all projects are seen on the same schedule is prepared and maintained. Based on this schedule, monthly resource requirements of projects are determined and updated when necessary.

Do.

"Do" consists of the documented processes and procedures which define how we do what we do. Our RACI matrix is an important element of the "Do" part.

Check.

"Check" is the part which provides a snapshot of the essential information required to review the current status by making use of KPIs and some pre-defined reports. Also, based on stakeholders' expectations additional reports can be generated and reported to the related parties.

Four KPIs are used in order to provide a snapshot of the essential information required to review the current status:

KPI #1: Process adherence is measured for each project at different milestones, by using a set of questions, and improvement areas are determined.

KPI #2: Compliance to the contractual requirements is measured to ensure quality of the process.

KPI #3 & KPI #4: Engineering hour utilization rate and on time completion rate of the process are also measured, which provides information on efficiency of the process in terms of time and cost.

In addition to the process KPIs defined above, automatic performance reports are generated and sent to related parties with different frequencies depending on the organizational levels. These reports include;

- Percentage of tasks completed on time in the previous period
- Number and list of late activities
- Work package level schedule and engineering hours status

These reports support management of the design tasks and facilitate proactive decision making at different hierarchical levels.

Act.

In regular meetings, process KPIs are reviewed and required actions are planned. Actions are tracked regularly. Besides, if any retrogression is observed in the performance reports, this is escalated to the superior manager through automatic escalation reports. For instance, if any task is late more than 15 days, department manager receives an escalation report regarding this situation. If the task is late more than 30 days, then the escalation report is sent to the R&D division director. Based on the escalation reports, managers are expected to take action.

3   Deployment

In this section, we discuss the deployment phase of the new D&D process.

As a first step, several meetings were held where the details of the new process and improvements made were shared. Most of the participants had already attended the workshop sessions made throughout the project. The last sessions were more of a summary/reminder of what had been done during the deployment phase. Giving the stakeholders the chance to contribute to what is being done in the early stages of the project increases the sense of ownership and hence eases deployment.

Another important decision in the deployment phase is the implementation of the new D&D process on the ongoing projects. For that, a deployment plan is made together with the related technical leader and functional managers. Current status of each project is evaluated and the closest upcoming D&D process activity is determined. From that activity on, new D&D process is implemented.

To deploy and improve the D&D process, adherence is measured within certain intervals through audits. These audits include a set of questions that measures adherence to the process plan tailored in the planning phase. D&D process adherence audit is performed in two parts: concept design phase and detail design phase.

In the concept design phase audit, technical leader answers four questions listed below for each task completed in the concept design phase.

- Is the task completed as per plan (on time)?
- Is the task done as per RACI?
- Are all inputs completely taken into consideration and collected in standard format?
- Are expected outputs completely delivered and accessible?

In the detail design phase audit, engineers who designed subsystems are audited by the technical leader. This audit questions whether tasks in the D&D process flow are completed as required and on time for that specific subsystem or not.

Audit results are then processed and improvement areas are reported. Reported issues provide considerable feedback for future projects and hence promote improvement. This improvement can be seen quantitatively in the audit results presented in the Fig. 4 and Fig. 5. Our overall process adherence maturity level rose to 80% from 69% from one project to the next one within one year period. Our aim was to achieve 90% adherence level within 2 years period; currently we have scores above 85% on the newest projects and we are very close to reach this objective.
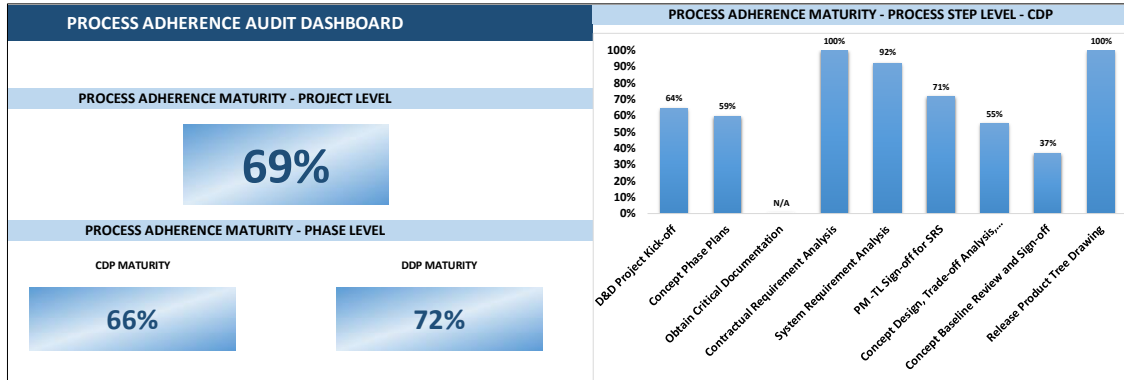
Fig. 4. Process adherence audit results of the 1st project after deployment of the D&D process
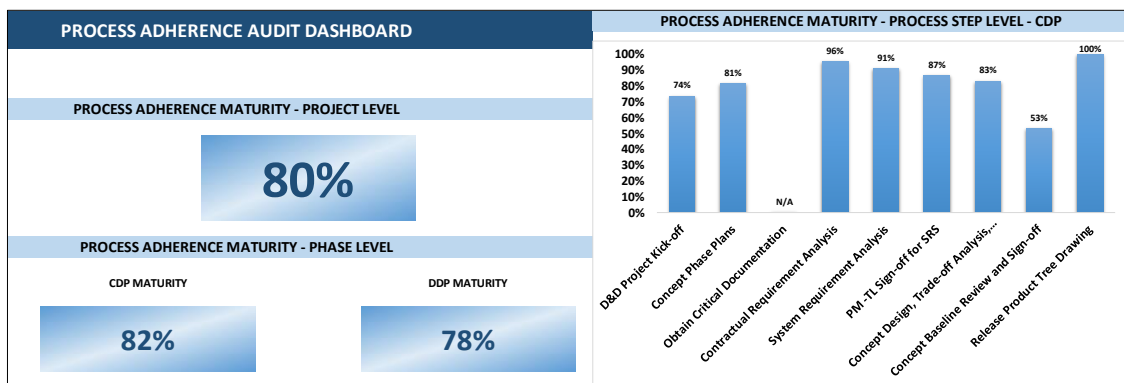

Fig. 5. Process adherence audit results of the 2nd project after deployment of the D&D process

4 Results Achieved

New practices contributed to the output quality significantly. After deployment of the new D&D Process, number of Corrective and Preventive Action Requests (CPARs) from other departments decreased (Please see Fig. 6). This is a good sign of how this new process increased quality of work done and produce outputs that add value.

As in all multi-stakeholder environments, interface management was a problematic issue for FNSS as well, even within the same department, it was troublesome. Feedbacks gathered from supporting units after deployment of the new process improvements indicate that interfaces are now managed more effectively and collaboratively. Additionally, external stakeholder satisfaction is measured through periodical surveys. As survey results show, new D&D process boosted external stakeholder satisfaction also.

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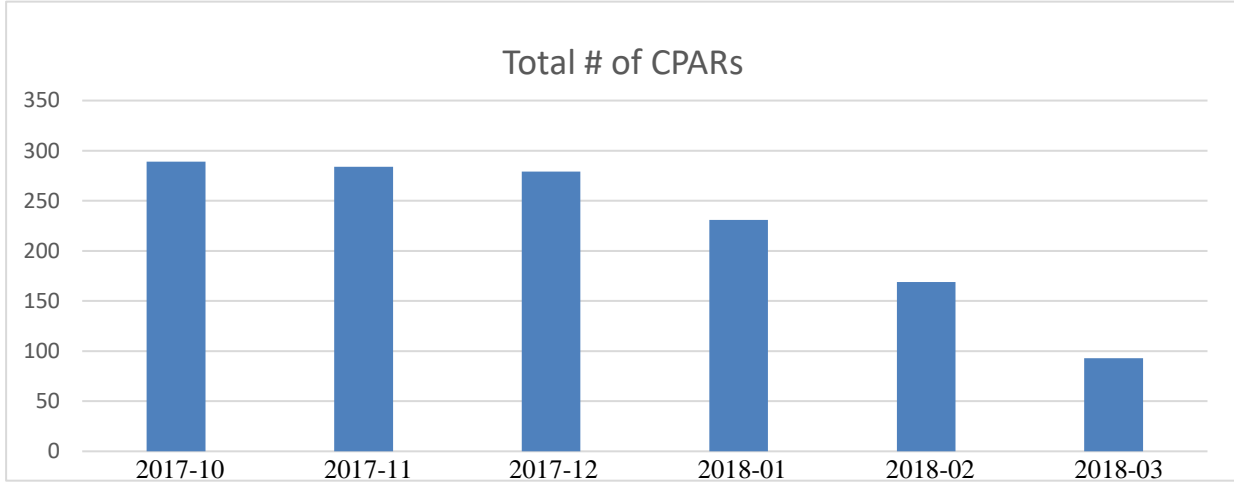Journey to Excellence

Fig. 6. Decrease in CPARs

Introduction of Earned Value Management approach to the D&D process contributed to engineering hour budget and schedule adherence significantly and hence makes it possible to reach project timelines within budget.

5   Conclusion

In this paper, we discussed FNSS's journey on D&D process in the significantly growing environment. Through all this effort, FNSS obtained a streamlined but also flexible D&D process. Output quality and throughput time improved significantly. Increased involvement of stakeholders resulted in better management of interfaces. Last but not least, as the process improvement team, we are continuously working to maintain and improve our processes based on the standards &guidelines like CMMI-DEV, IpX etc. and adapt new practices when necessary.

6   References

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