

# U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER (ARDEC) CASE STUDY

## Building an Enterprise Culture of Continuous Improvement

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## ORGANIZATIONAL BACKGROUND

The U.S. Army Armament Research, Development and Engineering Center (ARDEC), centered at Picatinny Arsenal, New Jersey, is one of the U.S. Army Materiel Command's specialized research, development, and engineering centers. It is the hub for the advancement of armaments technologies and engineering innovation for the U.S. Army, Tri-Services and Department of Defense (DoD).

APQC spoke with members from ARDEC's Strategic Management and Process Office and the Lean Six Sigma Competency Office about their efforts to develop an enterprise-level culture of continuous improvement.

## HISTORY OF QUALITY AND PROCESS IMPROVEMENT

ARDEC's formal commitment to quality management began in the mid-1980s, built upon teachings of Edward Demming and included such initiatives as "Zero Defects" and Total Quality Management (TQM). Given ARDEC's critical mission of developing the highest quality armaments and munitions for the Army and Tri-services, institutionalizing quality management was essential.

In the 1990s, specialized toolkits, such as Lean Six Sigma, ISO-9001, and Capability Maturity Model Integration (CMMI) emerged, and ARDEC used these tools to assess the effectiveness and efficiency of its processes. After evaluating various business models, ARDEC adopted the Baldrige Excellence Framework as its overarching business performance system.

In 2000, ARDEC saw significant acceleration in its deployment of Lean Six Sigma, ISO, and CMMI, prompted by its focus on the Baldrige criteria (leadership, strategic planning, customer focus, measurement, analysis, and knowledge management, process management, and results). Furthermore, the organization became more focused on institutionalizing best practices within those frameworks.

ARDEC further emphasized program management and systems engineering, ensuring that the organization was performing voice of customer and requirements traceability as effectively as possible – the right product, at the right cost and at the right time. ARDEC looked to Lean Six Sigma for ways to create new, improved, and streamlined processes; emphasizing cost improvements and performance quality for key customers, including project managers, product engineering officers, other federal government agencies, and industry partners.

## PROCESS MANAGEMENT AND THE PCF

In 2005, ARDEC formally established the Process Improvement & Management Group (PIMG) within the Strategic Management and Process Office. In 2007, PIMG began to participate and collaborate in a learning group study with APQC on a process management, which introduced

ARDEC to APQC's [Process Classification Framework \(PCF\)](#)<sup>®</sup>. Following an APQC knowledge transfer session, ARDEC spoke with other organizations about their processes, one of them being United Illuminating, which shared its enterprise process framework. ARDEC saw the value in this company's framework as a means to create clarity, standardization, and clear communications around the organization's processes. By 2010-2011, ARDEC used the PCF primarily as a validation tool to ensure there were no gaps in the frameworks and tools that underpinned its processes. As the organization developed a process, it would look at the PCF activities and tasks and evaluate whether they should be incorporated. ARDEC expects to use the PCF even more extensively in the next several years.

## IMPROVEMENT TEAMS

Process management and continuous improvement are the responsibility of two teams within ARDEC:

1. Process Improvement and Management Group (PIMG)
2. Lean Six Sigma Competency Office

Though the two teams have different responsibilities they work closely together on improvement initiatives and efforts.

### PROCESS IMPROVEMENT AND MANAGEMENT GROUP

The PIMG is a sub group within the strategy team and is comprised of a manager and six individuals. The team's primary purpose is to work with process owners across ARDEC to help develop, deploy, measure, and improve internal processes. In addition to the general process management and improvement roles there are three specific roles on the team:

1. **Enterprise architect**—is responsible for the development of a business architecture framework.
2. **Process repository manager**—individual works closely with the knowledge management office to develop, manage, and improve ARDEC's process repository.
3. **Chair of process group**—is a consultative role and the first person that people within the business meet with to scope their process development needs.

There are also people on the PIMG team with deep CMMI experience, so those individuals play a significant role in any CMMI efforts across the organization. For example the ARDEC Armament Software Engineering Center is at a CMMI Maturity Level 5, and PIMG helps them with class A, B, and C type appraisals. The center has to get recertified every three years, and PIMG assists in identifying any noncompliance risks.

*We're kind of like the big picture problem solvers that come into the room. These teams are trying to either jump right to a decision or to a particular solution...We come in, and we're able to help capture their process, so that they can take a step back and see all the different components they need, and we can bring up other areas of ARDEC they should work with for better integration. We're not just coming in to do a process map for you; we're helping you make better strategic decisions about your own problems.*

— Kathleen Walsh

In some cases, process owners approach PIMG with their process improvement needs; in other instances, PIMG might approach the process owners, or a joint meeting could inspire an impromptu discussion about potential collaboration. Process owners often send representatives to meet with PIMG on a regular basis. In the past, individuals came to PIMG with a problem and asked for help in developing a new procedure to fix it. Now PIMG encourages those people to look at their whole end-to-end process in order to develop a more complete process that can prevent further problems.

### LEAN SIX SIGMA COMPETENCY OFFICE

The Lean Six Sigma team is primarily responsible for the development and the teaching of Lean Six Sigma principles for the improvement of processes and products. In addition to providing training on the materials and principles of Lean Six Sigma the team also provides consultative support services—support and mentoring teams within the business working on improvement projects.

#### Process Owners

In addition to the process teams, ARDEC uses process owners to support standardization and process improvement efforts. Process owners are the highest-level people within the business involved in a process—the person with the authority to control the process. They are responsible for maintaining the process, and they develop and implement a training program for the process. The PIMG works with the process owners to provide oversight and assistance, as needed.

*We might just have seven people in the PIMG group, but we have hundreds and hundreds of people supporting [ARDEC's process improvement] capability. Lean Six Sigma does a lot of the education, but whether it's a Lean Six Sigma office project, or one of our offices, there are a lot of people who are learning from us."*

*– Kathleen Walsh*

#### Process Configuration Control Board

The process configuration control board is responsible for providing cross-functional oversight in the enterprise framework and any new or updated process. The board is led by the PIMG's manager and is comprised of high-level process owners, typically competency directors from all of the key functions in ARDEC (e.g., munitions, quality engineering, systems engineering, and project management.)

### PROJECT PRIORITIZATION

ARDEC has over 200 projects, and PIMG does not have the resources to provide process assurance representatives on all of them. Consequently, PIMG must prioritize the projects and stratify them:

1. **Level 1 projects** have the highest visibility, strategic importance, and/or financial value. Some PIMG team members are assigned to support these projects as process assurance representatives. As such, the representatives help identify the processes and templates

the projects need. Instead of reinventing the wheel, PIMG helps them identify and implement resources that ARDEC already has in place.

2. **Level 2 projects** have a lower priority level and/or value.
3. **Level 3 projects** typically are smaller projects that have a shorter duration of approximately six months.

PIMG focuses primarily on Level 1 projects, given the groups limited staffing. The Lean Six Sigma Competency Office, however, also plays a role in level 2 and 3 projects as well and works with those teams developing processes. If individuals identify product improvement or process needs, they often apply Lean Six Sigma tools and methodologies, and frequently those projects will become Lean Six Sigma certification projects. ARDEC's Master Black Belt and Black Belt individuals serve as mentors who help identify the underlying problems triggering the product or process improvement needs.

## ENTERPRISE PROCESS FRAMEWORK

ARDEC believes that having a robust process framework is essential in order to evaluate the organization's strengths in those areas. In 2007, ARDEC began the development of its enterprise process framework (Figure 1).

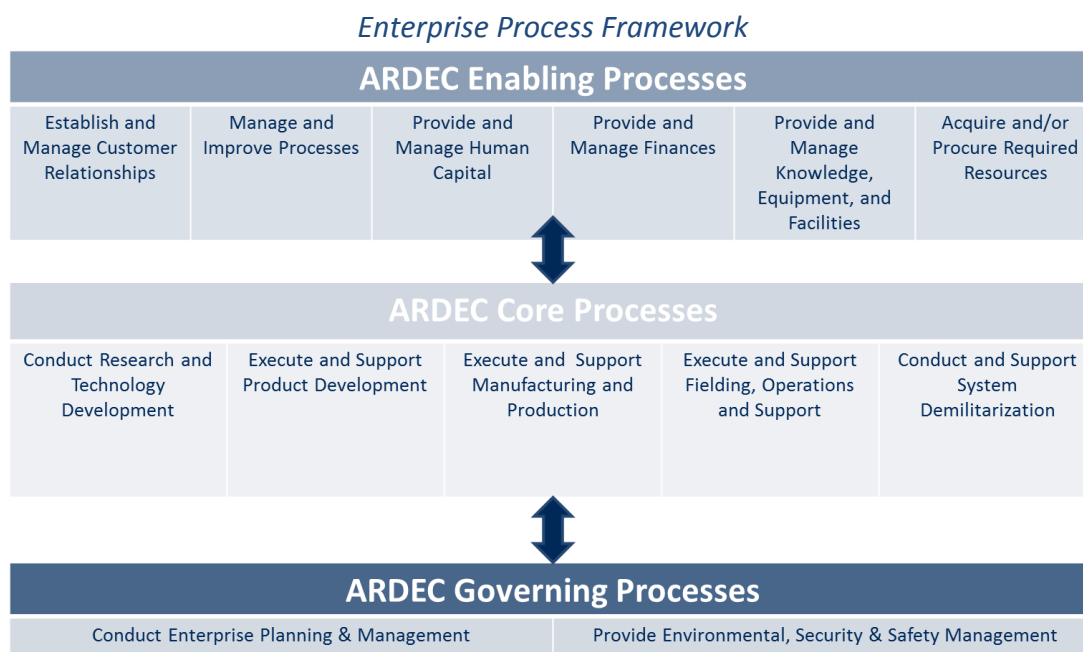


Figure 1

Given that not all processes are created equal ARDEC categorizes all process elements (from process groups to activities and tasks) into three categories:

1. **Core**—refer to all processes that are directly related to ARDEC’s purpose and ability to meet customer needs (e.g., product development or customer support).
2. **Enabling**—these are the back office processes that ARDEC needs to support its ability to execute the core processes (e.g., knowledge management and procurement).
3. **Governing**—these are the processes that create the direction and frame ARDEC’s efforts (e.g., strategic planning or environmental, health, and safety).

## KEEPING THE FRAMEWORK FRESH

To ensure the framework remains relevant ARDEC’s process configuration control board, conducts regular reviews—every three years—of the enterprise framework. The goal is to ensure the processes are still relevant to how work is accomplished and to make sure each process element is represented at the appropriate level. For example, in 2014 the board made changes to the enterprise process framework including adjusting the level of configuration management under systems engineering processes and adding some additional processes.

## MANAGING PROCESS KNOWLEDGE: THE PROCESS ASSET LIBRARY (PAL)

ARDEC understands that the documentation and standardization of processes by themselves are only half effective. For processes to be truly actionable they need to be connected with the documents, information, and people that help execute the work. Hence The PIMG team maintains a process repository, the Process Asset Library (PAL) (Figure 2).

### *Process Asset Library (PAL)*

**PROCESS ASSET LIBRARY (PAL)**  
Process Improvement & Management Group (PIMG)

Home Documents By Functional Area Enabling Processes Support Functions Core Processes Engineering and Project Management Governing Processes Oversight/Regulatory Functions Other Submit PAL Content

Home Documents by Functional Area All PAL Files

**ALL PAL FILES**

**Procedures**

	Procedure Name	Version	Date	Status	Owner
	101 – Project Management Procedures	Draft 6	2/23/2017	Draft	PIMG
	102 – Estimation Procedure	Draft 4	3/15/2017	Approved	PIMG
	103 – Measurement and Analysis Procedures	Draft 3	4/2/2017	Draft	PIMG

Figure 2

Initially the PAL began simply as a list of documents, it now includes a strong search engine, and you can click on a list of ARDEC’s enterprise process framework categories (e.g., enabling

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processes, core processes, etc.) and see all the processes associated with that category. PIMG has worked very closely with ARDEC's knowledge management group in developing the PAL. The system began on Oracle, but it is now on SharePoint, due to the input of knowledge management.

The PAL includes:

- ♦ a link to every process,
- ♦ the designated process owner for each process,
- ♦ a glossary of all definitions,
- ♦ policies that underwrite the need for different processes,
- ♦ lessons learned from the development and implementation of the processes, and
- ♦ a wide range of process templates.

However, just because you build something does not mean it will get used. A Lean Six Sigma project uncovered that many people throughout ARDEC were not aware of the PAL and the processes and procedures contained therein. Consequently, one of the executive directors suggested a grassroots approach, reaching out to all competency managers and training their staff on the PAL's process assets. As a result, PIMG trained three-quarters of ARDEC, at their convenience, in their own conference rooms, and typically following another already-scheduled meeting. PAL usage went up significantly after that, and word-of-mouth has continued to increase ARDEC's knowledge and use of the PAL.

Another way PIMG has spread the word about the PAL is through rotational assignments, where people come from other offices to work in PIMG for a finite period of time. Then, when they return to their home organizations, they often recognize processes they are doing themselves that should be documented in the PAL, and they approach PIMG to implement this.

## PROCESS DEVELOPMENT AND IMPROVEMENT

When ARDEC wants to improve or change an established process, individuals must submit an organizational change request. There are really two levels of projects and their approach is slightly different.

1. **Process design or revisions.** These projects are typically smaller in scope (e.g., additional lower level processes or incremental improvements to current process).
2. **Organizational process changes.** These projects are typically larger in scope and either have enterprise-wide impact.

Regardless of the type of project all projects include a scoping conversation, pilot program, and ongoing performance measurement. For many of these projects the Lean Six Sigma group is involved, particularly in the piloting stage. However the scale of the review process tends to vary

depending on the scope of the project. The PIMG team works in collaboration with key stakeholders to thoroughly scope, vet, and finalize new processes (Figure 3).



Figure 3

There are five key steps in ARDEC's new process reviews:

1. **Project initiation.** The PIMG's process group chair is the primary point-of-contact for individuals who want to implement a new or update a process. At the onset of the project the process group chair works with the business to understand and outline the project. Once the scope is developed a cross-functional team of typically eight process owners in relevant functions conducts an initial review of the scope. The review team—the process group—members include representatives from the functions that are affected by the change and usually includes systems engineering, project management, two engineering centers (munitions and weapons), and quality engineering. These members review and provide feedback on each process. The process group chair meets with process owner representatives, who conduct a preliminary review of a new process, on a biweekly basis.
2. **Leadership review.** Once the new process has been developed and approved by the process group the PIMG sends the process out to the tier two (organizational managers) and tier one (senior leadership) managers for their organizations' feedback on the new process. Typically more senior leadership from the same functions represented in the process group.
3. **Board Review.** Once the process has been approved and been through the pilot phase it is then sent to the process configuration control board for feedback and approval. The board reviews all the comments that have come through the earlier review processes and ensure they have been incorporated.



4. **Final Approval.** The final arbiter in approving ARDEC processes is the organization's Director.
5. **Process Launch and Review.** Once the tested process has been finalized it is added to PAL, announced to all relevant stakeholders in the organization, and monitored for performance.

Whenever a new process is developed, PIMG asks the process owner to identify the success measures for that process or procedure. The next steps are following up with the process owners to gauge how the measures are progressing and discussing success measures more across the board in the process configuration control board meeting—something ARDEC is currently working on doing more consistently.

There are a couple of key factors that make this review process successful. The first is the use of cross-functional review teams to ensure that an adjustment to one process or activity does not have repercussions on adjacent or related processes. The second is the increasing level of the reviewers' seniority as the process goes through the review cycle. Not only does this approach ensure that the processes are aligned with organizational goals it also socializes new processes throughout the every level of the organization.

## FUTURE ROLE OF THE PCF

PIMG first developed its Enterprise Process Framework in 2007 before it became familiar with the PCF. However, PIMG is now using the PCF more extensively as it develops new processes or updates existing ones. When working on new process projects the PIMG looks at the PCF processes, activities, and tasks and determines if those best practices should be incorporated into PIMG's process.

PIMG maintains a list of ARDEC key processes that indicates which ones incorporate the PCF and other frameworks/models. CMMI is very prescriptive, so if that model applies, PIMG typically looks at those best practices first. However, some processes are not covered well in CMMI, so those are the ones where the PCF is even more valuable.

Additionally, the PIMG team is using the PCF as a reference as it develops a business architecture framework. Namely, the enterprise architect is using the PCF to identify and compare the differences between capabilities and process areas. ARDEC evaluates its capabilities in terms of people, process, tools, and information. The end goal of the framework is to extend the PCF further and use the capabilities information to help communicate on needs and integration points within the organization.

## SUCCESS MEASURES FOR EVALUATING EFFECTIVENESS

ARDEC's PIMG uses a color-coded tracking spreadsheet to manage the effectiveness of its portfolio of process development and improvement projects. ARDEC measures cycle time, which is important to ensure process development continues to progress and does not stagnate. The tracking sheet is also sent to all process owners and members of the process configuration control board to ensure transparency and motivate stakeholders to keep projects moving. Green, for example, would mean a process has been in progress for under 14 days, yellow would mean it has been in progress for 14-30 days, and red designates over 30 days.

*We just started sending the color-coded process tracking spreadsheet to our process owners... if processes are stuck; it really helps move things along. It's a little external pressure, because all process owners can see that status of the processes that need attention.*

ARDEC also tracks every comment it gets on a process document that goes through the review and approval process. Whether it is a large or small problem, ARDEC wants to ensure it captures and corrects it during the first review, which is at the process group review level. ARDEC's Software Engineer Center (CMMI Level 5) has developed a defect containment matrix, demonstrating the processes they have put in place to reduce defects, such as peer review. Consequently, defects in process documents that ARDEC noticed later on in the process previously are now being caught earlier, when they are a lot easier and less expensive to fix.

Other ways ARDEC measures its success are by assessing customer satisfaction, schedule, risk, quality, and cost. For each Lean Six Sigma project, the project team comes up with a cost savings avoidance estimate starting on day one, which must be verified and validated by the financial management office at the completion of the project. Each phase of the project, from the beginning through the end, is documented in a LSS Gate Review Scorecard and is tracked in a Lean Six Sigma project database.

### ABOUT APQC

APQC helps organizations work smarter, faster, and with greater confidence. It is the world's foremost authority in benchmarking, best practices, process and performance improvement, and knowledge management. APQC's unique structure as a member-based nonprofit makes it a differentiator in the marketplace. APQC partners with more than 500 member organizations worldwide in all industries. With more than 40 years of experience, APQC remains the world's leader in transforming organizations. Visit us at [www.apqc.org](http://www.apqc.org), and learn how you can make best practices your practices.