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Lean Six Sigma Approach in Enhancing the Efficiency and Consistency of Procurement Payment Document Processing in the Planning Division of the Department of Energy

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Abstract

Procurement payment document processing in government agencies is often characterized by inefficiencies such as delays, document returns, and rework due to unclear requirements and inconsistent procedures. This study aimed to evaluate the application of Lean Six Sigma (LSS) in enhancing the efficiency and consistency of procurement payment document processing in the Planning Division of the Department of Energy. Specifically, it focused on identifying existing workflow inefficiencies, analyzing common issues encountered by personnel, and implementing process standardization strategies to improve overall performance.

A descriptive-analytical research design was employed using the Lean Six Sigma DMAIC (Define-Measure-Analyze-Improve-Control) framework. Data were collected from procurement records, document analysis, and structured survey questionnaires administered to personnel involved in document preparation and processing. Key performance indicators included processing time, number of document returns, and frequency of rework. Statistical tools such as weighted mean and paired sample t-test were used to analyze the data.

Findings revealed that inefficiencies in the current process were primarily caused by unclear document requirements, inconsistent interpretation of procedures, and lack of standardized guidelines. The implementation of process improvements, including a Document Requirement Alignment Matrix and pre-submission validation, resulted in significant improvements in processing efficiency. Statistical analysis confirmed a significant difference in processing performance before and after the implementation of Lean Six Sigma-based improvements, leading to reduced processing time, minimized document returns, and decreased rework.

The study concludes that the application of Lean Six Sigma is effective in improving the efficiency and consistency of procurement payment document processing in a government setting. The findings highlight the importance of process standardization and structured improvement methodologies in enhancing administrative performance and provide a replicable framework for similar document-intensive processes in the public sector.

Keywords: Lean Six Sigma, Procurement Process, Document Processing, Process Efficiency, Process Standardization, Public Sector, DMAIC, Administrative Workflow, Government Operations

1. Introduction

Organizations across both private and public sectors have increasingly adopted process improvement methodologies to enhance operational efficiency, reduce waste, and improve service delivery. Among these, Lean Six Sigma (LSS) has been widely recognized as an effective and structured approach that integrates Lean principles, which focus on waste elimination, and Six Sigma techniques, which emphasize the reduction of process variability and errors. Through the DMAIC (Define-Measure-

Analyze–Improve–Control) framework, LSS enables organizations to systematically identify inefficiencies and implement data-driven improvements, making it highly applicable in complex operational environments.

In the public sector, administrative processes are often characterized by bureaucratic structures, multiple approval layers, and unclear procedural requirements, which frequently result in inefficiencies such as delays, errors, and repeated document revisions. In procurement-related processes, particularly those involving document preparation and submission, the absence of clearly defined and consistently applied requirements often leads to incomplete documentation, frequent document returns, and prolonged processing time. These challenges are further compounded by varying levels of personnel familiarity with procurement procedures, especially among newly assigned staff.

Existing literature highlights that Lean Six Sigma contributes to improved operational efficiency, reduced processing time, enhanced quality, and increased process consistency in both manufacturing and service-oriented environments. In government organizations, the application of LSS has been shown to address bureaucratic inefficiencies by promoting process standardization, waste reduction, and continuous improvement. Studies further indicate that the effectiveness of LSS depends on proper alignment of processes, clear definition of requirements, and consistent monitoring of performance indicators. Despite its proven effectiveness, most studies focus on broad organizational improvements, with limited attention given to document-intensive workflows, particularly procurement payment document processing in government agencies.

Moreover, there remains insufficient emphasis on the end-user perspective in existing research, particularly in understanding the challenges encountered in document preparation and submission. This gap is significant, as inefficiencies at the micro-level—such as unclear requirements and inconsistent documentation practices—directly affect overall process performance. Addressing these issues requires targeted and systematic process improvement approaches that consider both operational workflows and user experience.

In response to these gaps, this study aims to evaluate the application of Lean Six Sigma in enhancing the efficiency and consistency of procurement payment document processing in the Planning Division of the Department of Energy. Specifically, it focuses on identifying process inefficiencies, analyzing common issues encountered by personnel, and implementing process standardization strategies to improve workflow performance. By integrating process improvement methodologies with practical operational insights, the study seeks to contribute to the advancement of administrative efficiency in the public sector and provide a replicable framework for improving procurement-related document processes.

2. Method

This study employed a descriptive–analytical research design utilizing a Lean Six Sigma (LSS) approach to evaluate and improve the efficiency and consistency of procurement

payment document processing in the Planning Division of the Department of Energy. The study followed the DMAIC (Define–Measure–Analyze–Improve–Control) framework as a structured methodology for identifying inefficiencies, analyzing root causes, and implementing process improvements.

In the Define phase, the existing procurement payment document processing workflow was identified and mapped, including procedures for various procurement transactions. Common issues such as incomplete document submissions, repeated document returns, and delays in processing were documented. In the Measure phase, baseline data were collected to assess current process performance using key performance indicators such as processing time, number of document returns, and frequency of rework. Data were obtained from procurement records, transaction documents, and personnel involved in the process.

The Analyze phase focused on determining the root causes of inefficiencies using process mapping and cause-and-effect analysis. Identified factors included unclear document requirements, inconsistent interpretation of procedures, and lack of standardized guidelines. In the Improve phase, process enhancements were developed, including the creation of a Document Requirement Alignment Matrix, implementation of a pre-submission validation step, and redesign of the document processing workflow. Finally, the Control phase established mechanisms to sustain improvements through standardization, performance monitoring, and continuous evaluation.

Data for the study were collected from both primary and secondary sources. Primary data included procurement records, document reviews, and responses from personnel directly involved in procurement document preparation and processing. A structured survey questionnaire was administered to selected respondents to assess common issues encountered and validate process improvements. Secondary data included existing process documents and relevant institutional guidelines.

A purposive sampling technique was used to select respondents who were directly involved in procurement payment document processing. These included personnel from the Planning Division and those coordinating with the Accounting Division. The selected respondents were considered knowledgeable and experienced in the process, ensuring the reliability of the data collected.

For data analysis, descriptive statistics such as frequency, percentage, and weighted mean were used to assess common issues and stakeholder responses. To determine the effectiveness of the implemented improvements, a paired sample t-test was utilized to compare process performance before and after the application of Lean Six Sigma-based interventions. This enabled the study to assess whether there was a statistically significant improvement in processing efficiency.

3. Results and Discussion

3.1. Current Procurement Document Processing Workflow

The current procurement workflow is presented in Figure 1.

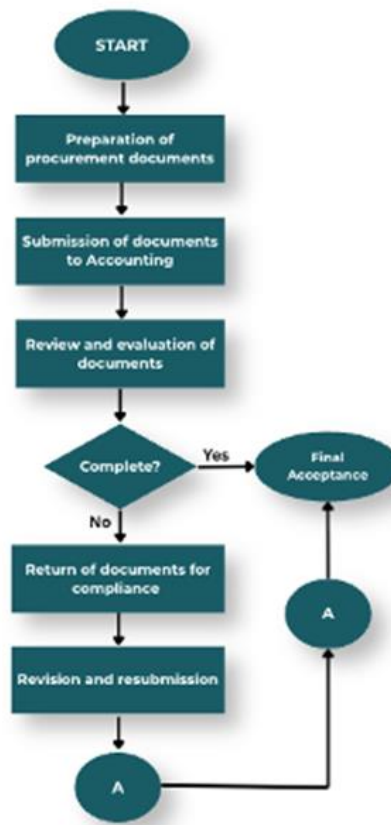


Fig 1: Current Procurement Document Processing Workflow

Figure 1 illustrates a document-intensive workflow characterized by iterative validation loops between the Planning and Accounting Divisions. These loops occur when submitted documents fail to meet requirements, resulting in repeated returns and resubmissions. This structure indicates a reactive process design, where errors are identified only after submission rather than

prevented at the source. As a result, the workflow exhibits prolonged processing time and increased rework, particularly in transactions requiring multiple supporting documents.

3.2. Identified Inefficiencies in Procurement Processing

The major inefficiencies in procurement processing are summarized in Table 1.

Table 1: Identified Inefficiencies that Cause Delays in Procurement Processing

Type	Identified Issue	Root Cause
VMA	Repeated document returns and delays	Lack of standardized checklist; requirements vary per evaluator
CS	Incomplete document submission	No unified checklist for required documents
PB	Revisions due to incorrect format/specifications	Inconsistent interpretation of requirements
SRV	Multiple returns and extended processing time	Different validation standards per evaluator
SUB	Repeated returns and delays	Absence of standardized validation and checklist

As shown in Table 1, the most common issues include repeated document returns, incomplete submissions, and inconsistencies in validation procedures across procurement types.

A clear pattern can be observed where document returns are the dominant issue, particularly in VMA, SRV, and SUB transactions. These inefficiencies are primarily caused by the absence of a standardized document checklist and inconsistent interpretation of requirements among evaluators. The findings indicate that inefficiencies are largely process-

driven, rather than resource-related. The lack of standardized validation mechanisms results in sequential identification of missing requirements, leading to repeated submission cycles and extended processing time.

3.3. Common Issues Encountered in Document Preparation

Respondents’ perceptions of the procurement process are summarized in Tables 2–5, covering clarity of requirements, process efficiency, and process-related issues.

Table 2: Respondents' Perception of the Procurement Process in terms of Clarity of Requirements

Indicators	WM	SD	Interpretation
1. The required documents are clearly identified.	3.66	1.032	Agree
2. Requirements are consistently applied.	4.00	1.095	Agree
3. The document preparation process is easy to understand.	3.83	0.752	Agree
4. Signatory requirements are clearly defined.	4.00	1.095	Agree
Average Weighted Mean	3.87	0.832	Agree

Note: Scoring Range: 4.20-5.00 (Strongly Agree), 3.40 – 4.19 (Agree), 2.60 – 3.39 (Neutral), 1.80 – 2.59 (Disagree), 1.00 – 1.79 (Strongly Disagree)

Table 3: Respondents' Perception of the Procurement Process in terms of Process Efficiency

Indicators	WM	SD	Interpretation
1. Processing time is reasonable.	3.33	0.816	Agree
2. Documents are rarely returned.	2.66	1.032	Neutral
3. Rework is minimal.	3.50	0.547	Agree
4. Coordination supports timely processing.	3.50	0.547	Agree
Average Weighted Mean	3.25	0.591	Neutral

Note: Scoring Range: 4.20-5.00 (Strongly Agree), 3.40 – 4.19 (Agree), 2.60 – 3.39 (Neutral), 1.80 – 2.59 (Disagree), 1.00 – 1.79 (Strongly Disagree)

Table 4: Respondents' Perception of the Procurement Process in terms of Process Issues

Indicators	WM	SD	Interpretation
1. Unclear requirements cause delays.	3.83	0.983	Agree
2. Standardized guidelines will improve efficiency.	4.66	0.516	Strongly Agree
Average Weighted Mean	4.25	0.524	Strongly Agree

Note: Scoring Range: 4.20-5.00 (Strongly Agree), 3.40 – 4.19 (Agree), 2.60 – 3.39 (Neutral), 1.80 – 2.59 (Disagree), 1.00 – 1.79 (Strongly Disagree)

Table 5: Overall Respondents' Perception of the Procurement Process

Indicators	WM	SD	Interpretation
1. Clarity of Requirements	3.87	0.832	Agree
2. Process Efficiency	3.25	0.591	Neutral
3. Process Issues	4.25	0.524	Strongly Agree
Average Weighted Mean	3.79	0.442	Agree

Note: Scoring Range: 4.20-5.00 (Strongly Agree), 3.40 – 4.19 (Agree), 2.60 – 3.39 (Neutral), 1.80 – 2.59 (Disagree), 1.00 – 1.79 (Strongly Disagree)

Overall, the results indicate that while document requirements are generally perceived as clear (WM = 3.87), process efficiency remains inconsistent (WM = 3.25), and process-related issues are strongly recognized (WM = 4.25). The relatively high rating for clarity suggests that personnel are familiar with procurement requirements; however, the neutral assessment of efficiency indicates that clarity does not necessarily translate to smooth execution. This gap implies that inefficiencies arise not from lack of understanding, but from inconsistencies in how requirements are applied and validated.

Notably, respondents strongly agree that unclear requirements contribute to delays and that standardized guidelines would improve efficiency. This reinforces the

earlier findings that process variability—rather than technical complexity—is the primary driver of inefficiency.

The overall perception (WM = 3.79) reflects a process that is functional but not optimized, where recurring issues such as document returns, and rework continue to affect workflow performance.

3.4. Application of Lean Six Sigma in Process Improvement

The application of Lean Six Sigma is operationalized through the proposed standardized document requirement framework shown in Figure 2.

Standardized Document Requirement Framework				
ICON	PROCUREMENT TYPE	REQUIRED DOCUMENTS	COMMON ISSUES ENCOUNTERED	VALIDATION ACTION
	VENUE, MEALS, AND ACCOMMODATION	Purchase Request; Contract; Notice of Award; Notice to Proceed; Bids and Awards Committee Resolution; Certificate of Availability of Funds; Obligation Form; Disbursement Form; Guest folio; Justification (if applicable)	Incomplete guest folio; missing justification for expenses	Verify completeness of all required documents prior to submission
	COLLATERALS AND SUPPLIES	Purchase Request; Invoice; Delivery Receipt; Bids and Awards Committee Resolution; Certificate of Availability of Funds; Obligation Form; Disbursement Form; Supporting Documents	Missing delivery receipt; incomplete supporting documents	Validate completeness of supporting documents before submission
	PRINTING AND BINDING SERVICES	Purchase Request; Notice of Award; Contract; Approved Layout or Specifications; Invoice; Bids and Awards Committee Resolution; Certificate of Availability of Funds; Obligation Form; Disbursement Form	Incorrect format or specifications; missing approved layout	Ensure all specifications and approved formats are attached
	FACILITATION OR CONSULTING SERVICES	Terms of Reference; Contract; Purchase Request; Invoice; Bids and Awards Committee Resolution; Certificate of Availability of Funds; Obligation Form; Disbursement Form	Unclear or incomplete Terms of Reference; missing details	Confirm completeness and clarity of Terms of Reference prior to submission
	SUBSCRIPTION SOFTWARE	Invoice; Subscription Certificate; Activation Date Confirmation; Authority to Pay; Bids and Awards Committee Resolution; Certificate of Availability of Funds; Obligation Form; Disbursement Form	Missing activation details; incomplete supporting documents	Verify activation details and completeness of required documents

Fig 2: Proposed Standardized Document Requirement Framework for Procurement Payment Processing

As presented in Figure 2, the framework establishes a uniform set of required documents for each procurement type, along with corresponding validation actions to ensure completeness prior to submission. This intervention directly addresses the identified root causes of inefficiency—namely, inconsistent requirements and lack of validation—by shifting the process from reactive correction to proactive verification. The inclusion of pre-submission validation mechanisms reduces the likelihood of incomplete or incorrect submissions, thereby minimizing document returns and

rework. This standardization enhances consistency across transactions and reduces variability in evaluation outcomes. These results demonstrate that process standardization serves as an effective Lean Six Sigma intervention, improving workflow reliability by eliminating non-value-adding activities such as repeated revisions and resubmissions.

3.5. Comparison of Processing Performance Before and After Improvement

The impact of the implemented improvements is presented in Tables 6 and 7.

Table 6: Comparison of Processing Performance Before and After Improvement

Procurement Type	Before Time (days)	After Time (days)	Reduction (%)	Interpretation
Venue, Meals, Accommodation (VMA)	4	3	25%	Improved
Collaterals & Supplies (CS)	3	2	33%	Improved
Printing & Binding (PB)	3	2	33%	Improved
Facilitation Services (SRV)	5	4	20%	Improved
Subscription Software (SUB)	5	4	20%	Improved
Average / Total	4.0	3.0	25%	Improved Performance

Table 7: Comparison of Document Returns and Rework Before and After Improvement

Procurement Type	Returns Before (f)	Returns After (f)	Reduction (%)	Rework Before (f)	Rework After (f)	Interpretation
Venue, Meals, Accommodation (VMA)	1	0	100%	1	0	Improved
Collaterals & Supplies (CS)	1	0	100%	1	0	Improved
Printing & Binding (PB)	0	0	No Change	1	0	Improved
Facilitation Services (SRV)	2	1	50%	1	0	Improved
Subscription Software (SUB)	2	1	50%	1	0	Improved
Total	6	2	67%	5	0	Improved Performance

Following implementation, the average processing time decreased from 4.0 days to 3.0 days, representing a 25% reduction. Document returns were reduced from six to two instances (67% reduction), while rework was eliminated (100% reduction).

All procurement transaction types exhibited improvements in processing time, while the majority showed reductions in document returns. The elimination of rework represents the most significant outcome, indicating that errors are effectively addressed prior to submission. These findings confirm that the introduction of standardized requirements and validation procedures leads to a more

streamlined workflow, characterized by fewer interruptions and improved processing continuity.

The results further demonstrate that addressing requirement inconsistencies has a direct and measurable impact on efficiency, supporting the principle that process clarity and standardization are critical drivers of performance improvement.

3.6. Statistical Analysis of Process Improvement

The statistical significance of the observed improvements is presented in Table 8.

Table 8: Difference in the Processing Performance Before and After the Improvement

Groups	Mean Rank	Z-value	p-value	Decision	Interpretation
Time (Before & After)	3.00	-2.236	.025	Reject H ₀	Significant
Returns (Before & After)	2.50	-2.000	.046	Reject H ₀	Significant
Rework (Before & After)	3.00	-2.236	.025	Reject H ₀	Significant

Note: Significant at <0.05.

The results of the Wilcoxon Signed-Rank Test show that all performance indicators—processing time, document returns, and rework—exhibited statistically significant improvements ($p < 0.05$).

The rejection of the null hypothesis confirms that the observed changes are not due to chance but are attributable to the implemented Lean Six Sigma-based interventions.

These findings provide empirical support for the effectiveness of process standardization in improving

administrative workflows, demonstrating that structured, data-driven approaches can yield measurable and reliable outcomes even in document-intensive public sector processes.

3.7. Proposed Process Improvement Framework

The proposed process improvement framework is summarized in Table 9 and illustrated in Figure 3.

Table 9: Application of Lean Six Sigma (DMAIC Framework) in Procurement Document Processing

DMAIC Phase	Application in the Study	Expected Outcome
Define	Identification of delays caused by document returns and inconsistent requirements	Clear problem definition
Measure	Collection of data on processing time, returns, and rework	Baseline performance established
Analyze	Identification of root causes such as lack of standardized checklist and inconsistent validation	Determination of process inefficiencies
Improve	Implementation of standardized document checklist and requirement matrix	Reduction in document returns and processing time
Control	Establishment of standard procedures and validation process	Sustained efficiency and consistency

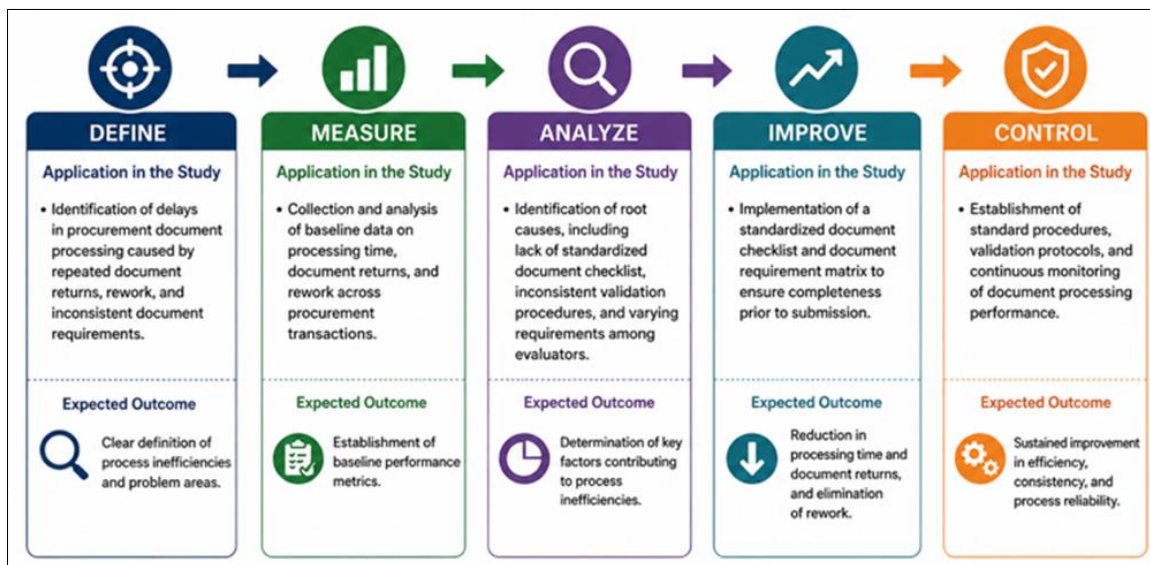


Fig 3: Application of Lean Six Sigma (DMAIC Framework) in Procurement Document Processing

The framework integrates the DMAIC methodology to provide a structured approach for sustaining efficiency and consistency in procurement document processing.

By aligning process definition, performance measurement, root cause analysis, and standardized interventions, the framework ensures that improvements are systematically implemented and maintained.

The emphasis on pre-submission validation and standardized document requirements institutionalizes proactive process control, reducing variability and preventing recurring inefficiencies.

The findings consistently indicate that procurement

inefficiencies are primarily driven by process-related factors, particularly inconsistent requirements, and absence of standardized validation procedures.

The implementation of Lean Six Sigma, through document standardization and pre-submission validation, effectively addresses these issues by reducing variability and eliminating non-value-adding activities. The observed improvements in processing time, document returns, and rework demonstrate that efficiency gains are achieved by improving process design rather than increasing resources.

Overall, the results validate the effectiveness of Lean Six Sigma as a structured approach to enhancing administrative efficiency in government processes.

4. Conclusion

Based on the findings of the study, the following conclusions are drawn:

1. Inefficiencies in procurement payment document processing are primarily caused by the absence of standardized document requirements and inconsistent validation procedures.
2. The repetitive cycle of document return, and resubmission is a major contributor to delays, indicating that the process lacks proactive validation mechanisms.
3. The implementation of standardized document requirements significantly improves the completeness and accuracy of submissions, thereby reducing document returns and eliminating rework. The elimination of rework and significant reduction in document returns highlight the effectiveness of pre-submission validation and standardized document requirements in preventing errors at the source.
4. Lean Six Sigma is an effective approach in improving procurement document processing, as it provides a structured and data-driven methodology for identifying inefficiencies and implementing targeted process improvements.
5. The statistically significant improvements in processing performance confirm the effectiveness of process standardization in enhancing efficiency and consistency in procurement operations.
6. Sustaining process improvements requires the institutionalization of standardized procedures and validation mechanisms across all procurement transactions.

5. Recommendation

Considering the findings and conclusions of the study, the following recommendations are proposed:

1. The Planning Division should formally adopt the standardized procurement document requirement framework to ensure completeness and consistency of submissions across all procurement transactions.
2. A uniform and comprehensive document checklist should be implemented and consistently applied by all evaluators to eliminate variability in validation procedures.
3. A pre-submission validation mechanism should be institutionalized to ensure that all required documents are complete prior to submission to the Accounting Division.
4. Regular training and orientation programs should be conducted for personnel to enhance their understanding of procurement requirements and minimize errors in document preparation.
5. The Accounting Division should establish clear and standardized validation guidelines to ensure consistency in document evaluation across different evaluators.
6. Future studies may explore the application of Lean Six Sigma in other administrative and operational processes within the Department of Energy to further improve organizational efficiency.
7. As a long-term plan, the Department of Energy may consider the development and implementation of a system-based or digital procurement document processing platform.

8. This system may enable electronic submission of documents, automated validation of requirements, real-time status tracking, and notification mechanisms for incomplete or non-compliant submissions. Through this approach, reliance on manual processing and physical document handling may be reduced, thereby improving efficiency, transparency, and overall monitoring of procurement transactions, while supporting the transition toward a paperless procurement system.

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