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Improvement of a Key Performance Indicators Monitoring System Using a Systems Engineering Approach: A Case Study of the Institute of Engineering, Suranaree University of Technology

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Abstract

Quality assurance in higher education is essential for reflecting organizational performance and supporting strategic decision-making. Key Performance Indicators (KPIs) are widely used to evaluate academic performance, research outcomes, and resource utilization. The Institute of Engineering at Suranaree University of Technology applies KPIs to monitor institutional performance in alignment with national and international quality frameworks, including EdPEx 300 and the Thailand Quality Class (TQC). However, the existing KPI monitoring process relies heavily on manual data handling, resulting in redundant data entry, fragmented data storage, and delays in reporting. Process analysis shows that the current (AS-IS) process consists of seven major steps and requires approximately 27–29 days per reporting cycle. This study aims to analyze and improve the KPI monitoring process by applying a Systems Engineering approach integrated with the ECRS principles (Eliminate, Combine, Rearrange, and Simplify). A redesigned desired-state (TO-BE) process is proposed, emphasizing centralized data integration, automated data processing, and real-time dashboard visualization. The results indicate that the proposed process reduces the number of operational steps from seven to five and shortens the reporting cycle to approximately 10–12 days, representing an efficiency improvement of about 60%. The improved process also enhances data accuracy and reliability, thereby supporting organizational decision-making.

Keywords
Key Performance Indicators; Systems Engineering; Process Improvement; ECRS; Higher Education Quality Assurance

1. Introduction
Quality assurance operations in higher education institutions require empirical data to reflect organizational performance. Key Performance Indicators (KPIs) are therefore used as a primary mechanism to monitor progress and evaluate the performance outcomes of organizational units (Sarrico et al. 2010). Research at the policy level indicates that the use of KPIs should be aligned with the strategic objectives of institutions and their organizational context (OECD 2010). However, many studies still focus on the identification of indicators rather than structuring an effective

monitoring system at the process level. Currently, the Institute of Engineering at Suranaree University of Technology monitors KPIs by collecting data from multiple sources and processing them in a fragmented manner. Data are transferred among units without proper integration, resulting in duplicated work, repeated data verification, and delays in reporting. The existing process consists of seven steps and requires approximately 27–29 days per reporting cycle. This situation reflects characteristics of waste in operational processes, which requires the elimination of waste based on Lean principles to improve operational efficiency (Ohno 2019). Process improvement concepts propose analyzing the existing process (AS-IS) and designing a new process (TO-BE) to enhance organizational efficiency (Harrington 1991; Davenport 1993). However, the application of these concepts to KPI monitoring systems at the faculty level remains limited, particularly in terms of the structure of information flow from the point of data generation to report summarization. At the same time, systems engineering perspectives suggest viewing processes as components of an interconnected system (INCOSE 2015; Blanchard and Fabrycky 2010). Therefore, this study applies selected systems engineering principles, including system boundary definition, information flow analysis, and process restructuring, to redesign the KPI monitoring system to achieve greater integration. The redesigned process shows a reduction in the number of operational steps and an improved structure of integrated information flow, resulting in a significant reduction in reporting time. This study focuses on integrating systems thinking with process improvement concepts to enhance the efficiency of the KPI monitoring system at the institute level. The contribution of this study lies in integrating selected systems engineering principles with process improvement concepts to redesign the KPI monitoring process in a higher education context. Unlike previous studies that mainly focus on dashboard development or indicator design, this research emphasizes the structural redesign of upstream data processes to improve monitoring efficiency. The proposed framework demonstrates how systems thinking can be applied to administrative processes to achieve measurable improvements in operational performance.

1.1 Objectives

This study aims to achieve the following objectives:

1. To analyze the current KPI monitoring process (AS-IS) and identify structural problems that contribute to reporting delays and data inconsistencies.
2. To design a desired-state KPI monitoring process (TO-BE) by applying selected systems engineering principles together with the ECRS concept.
3. To compare the results before and after the improvement in terms of the number of process steps and reporting time.
4. To evaluate the quantitative efficiency improvement of the KPI monitoring system and its potential to support managerial decision-making.

2. Literature Review

Improving a Key Performance Indicators (KPI) monitoring system requires consideration of several dimensions, including performance measurement, data management, and process structure. Previous studies related to these issues can be categorized into three main groups: (1) performance measurement and the use of KPIs in higher education, (2) KPI monitoring systems and the use of dashboards or business intelligence tools, and (3) process improvement using lean principles and systems perspectives. The purpose of this literature review is to identify research gaps and establish a conceptual framework for developing a KPI monitoring system in the context of the Institute of Engineering, Suranaree University of Technology.

2.1 Performance Measurement in Higher Education

Previous research has shown that performance measurement in higher education plays an important role in evaluating organizational quality and performance (Sarrico et al. 2010). In addition, the use of performance indicators should be aligned with the strategic context of the institution (OECD 2010). However, many studies still focus on the design of performance indicators rather than the structural design of monitoring systems, particularly at the faculty or departmental level. Furthermore, studies on KPI monitoring systems in universities indicate that factors such as system acceptance and perceived usefulness influence the actual use of the system by users (Muniandy et al. 2011). This finding suggests that KPI monitoring systems should not focus solely on indicators but must also consider system structure and supporting processes.

2.2 KPI Monitoring Systems and Dashboard

The application of information technology to support the monitoring of Key Performance Indicators (KPIs) is often implemented through dashboard systems and business intelligence tools. These technologies help collect, analyze, and visualize data to support managerial decision-making. Research in the context of higher education indicates that data visualization through dashboards can improve transparency and enable administrators to monitor organizational performance more effectively (Azevedo et al. 2021). However, the success of business intelligence systems does not depend solely on visualization tools. It also depends on the quality and consistency of data structures across organizational units. If data standards are not consistent, integration and analysis of information may be limited (Popovič et al. 2012; Seddon et al. 2017). Most existing studies still focus on the development of dashboard tools rather than improving upstream data processes.

2.3 Process Improvement and Systems Perspective
Process improvement concepts propose analyzing the existing process (AS-IS) and designing a new process (TO-BE) to improve operational efficiency (Harrington 1991; Davenport 1993). Lean principles emphasize eliminating non-value-added activities and reducing waste within operational processes (Ohno 2019). In the context of Thailand, the application of ECRS principles has been shown to significantly reduce operational steps and processing time (Kasemset et al. 2014). From a systems engineering perspective, systems thinking suggests considering the relationships among system components, including system boundaries, information flow, and process integration (INCOSE 2015; Blanchard and Fabrycky 2010). Applying these principles at the process level can help restructure KPI monitoring systems to improve integration and reduce data redundancy. In addition, analysis of the current process often uses process mapping techniques to illustrate the sequence of activities and the relationships among stakeholders. This technique helps identify bottlenecks and redundancies in a systematic manner (Davenport 1993). In this study, process mapping is used as a supporting tool for systems-based analysis.

2.4 Research Gap
The literature review indicates that most studies on KPIs in higher education focus on defining performance indicators and developing dashboard tools, while studies on process improvement are typically conducted in manufacturing or general service contexts. The integration of systems perspectives with the improvement of KPI monitoring process structures at the faculty level remains limited. Therefore, this study proposes an approach that integrates selected systems engineering principles with process improvement concepts to develop a more efficient KPI monitoring system in the context of the Institute of Engineering, Suranaree University of Technology.

3. Methods
3.1 Research Framework Overview
The research methodology was designed as a systematic sequence of steps in order to ensure that the analysis is clear and verifiable. The study consists of six main stages: defining the scope of the KPI monitoring system, examining the current process, analyzing problems and prioritizing them, identifying root structural causes, applying ECRS principles for process improvement, and designing the desired-state process. The overall sequence of these steps is illustrated in Figure 1.

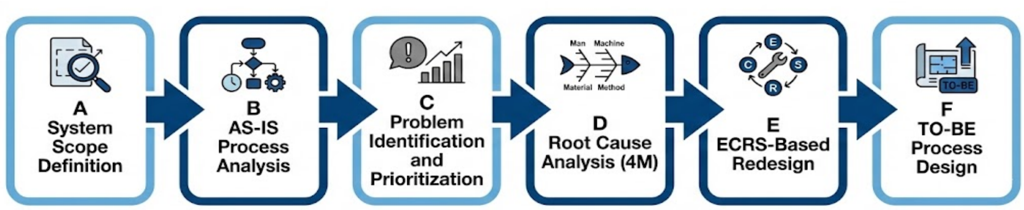

Figure 1. Research framework for KPI monitoring process improvement

As shown in Figure 1, the design of the new process does not begin directly with proposing improvement solutions. Instead, it begins with understanding the system boundary and the structure of the current process. Subsequently, structural problems and root causes are analyzed to ensure that the application of ECRS principles is based on a clear analytical foundation. This study does not apply the complete systems engineering process according to international standards. Instead, only selected processes that are appropriate for the context of improving administrative processes in the Institute of Engineering are applied. These include system boundary definition, process structure analysis, and the design of a new system. The details of each stage are explained in the following sections. In addition, the operational processing time was measured based on actual working records for each KPI monitoring cycle. The duration of each process step was recorded and aggregated to obtain the total processing time per cycle. The same measurement approach was applied consistently to both the AS-IS and TO-BE processes to ensure comparability of results.

3.2 System Scope Definition

Defining the system scope is an important step in applying systems engineering concepts because it helps establish a clear analytical boundary, reduce ambiguity, and prevent unnecessary scope expansion. In this study, the unit of analysis is defined as the KPI Monitoring Process at the institute level for the academic year 2024. Each academic semester is considered one cycle of KPI monitoring. The scope of this study focuses specifically on the structure of the process for collecting, verifying, integrating, and reporting KPI data within the institute. It does not include university-level policy formulation or the design of new performance indicators. Limiting the scope in this way allows the analysis to focus directly on structural issues within the KPI monitoring process.

3.2.1 System Scope

In this study, the KPI monitoring system is defined as an open system, which receives input data from KPI owner working groups and delivers outputs to the management processes of the institute. The main components of the system can be described as follows: Input: KPI data from working groups G02, G04, and G10 in each academic semester. Process: Activities involving data collection, verification, data integration, and report preparation, with the Organizational Planning and Development Working Group (G01) serving as the central coordinating unit. Output: KPI performance reports at the institute level. Feedback: The use of KPI reports in performance review meetings, development planning, and managerial decision-making. However, this study focuses primarily on the process layer, since this component frequently experiences delays, redundancy, and data inconsistencies during each academic semester.

3.2.2 System Stakeholders

Stakeholders involved in the KPI monitoring system of the Institute of Engineering can be classified according to the data flow structure into three main groups as follows:
(1) KPI Owners. This group includes the working groups responsible for specific performance indicators:

- Research, Academic Services, and Innovation Management Working Group (G02)
- Customer Voice and Relationship Management Working Group (G04)
- Student Development Working Group (G10)

These groups are responsible for collecting and preparing KPI data from primary data sources in each academic semester.

(2) Organizational Planning and Development Working Group (G01). This group serves as the central unit of the system. It is responsible for collecting, verifying, and synthesizing KPI data before preparing reports for the institute's management. From a systems perspective, G01 functions as the central integration node of the KPI monitoring process.
(3) Decision Makers. This group consists of institute-level administrators and the institute executive committee who use KPI information to review organizational performance and support policy-level decision-making. Classifying stakeholders based on the structure of data flow helps identify hierarchical dependencies and enables systematic identification of bottlenecks within the process.

3.3 AS-IS Process Analysis Method

After defining the system scope, the next step is to study the current KPI monitoring process (AS-IS Process) in order to understand the operational structure, sequence of activities, and the interfaces among organizational units. In this study, the AS-IS analysis was conducted through three sub-steps: identifying the current sequence of operational activities, analyzing the interfaces among stakeholders, and identifying points that may cause delays and redundancies in the process.

3.3.1 AS-IS Process Mapping Method

To understand the structure of the current KPI monitoring process (AS-IS), this study applied process mapping using Swimlane Diagram. The procedure consisted of the following steps:

(1) defining the starting and ending points of the process,
(2) collecting operational steps from actual work practices,
(3) grouping activities according to responsible roles,

(4) arranging the activities in chronological order, and
(5) verifying the completeness of the process structure.

The analysis shows that the current KPI monitoring process consists of seven main steps. The process follows a sequential workflow, and in some stages rework loops occur. The AS-IS process structure is illustrated in Figure 2.

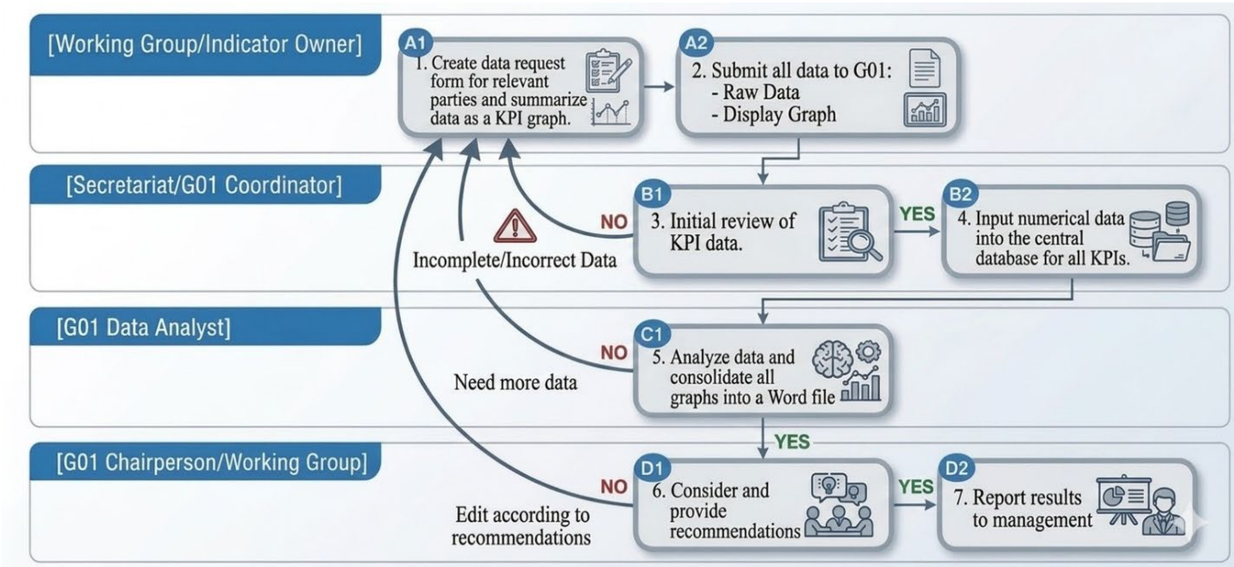

Figure 2. AS-IS Swimlane Diagram of KPI Monitoring Process

The process diagram shows that the current KPI monitoring process follows a sequential workflow, in which each step is performed consecutively over time. In some cases, data must be returned for revision before proceeding to the next step, resulting in rework loops. The swimlane diagram clearly illustrates the responsibilities of each working group and the interfaces among organizational units. At this stage, the analysis focuses only on the structure of the process and does not yet evaluate process efficiency or outcomes.

3.3.2 Structural Analysis Method

After constructing the AS-IS process diagram for the academic year 2024 in each semester, the next step was to analyze the structural characteristics of the KPI monitoring process. The purpose of this analysis is to identify relationships among activities, interfaces among working groups, and structural constraints that may contribute to delays and data redundancy. Three example KPI indicators were used in this study:

- number of student awards (G10),
- percentage of faculty members engaged in technology and innovation transfer (G02), and
- percentage of students willing to recommend the institution to others for study or services (G04).

Each academic semester was considered the primary unit of analysis. The structural analysis focuses on three main aspects:

Sequential Dependency

The analysis indicates that the current process follows a sequential structure. Data prepared by KPI owner working groups must be submitted to the Organizational Planning and Development Working Group (G01) before verification and synthesis can take place. As a result, delays at the upstream stage may affect the overall processing time of the entire system.

Inter-Unit Interfaces

Data transfer between G02, G04, G10, and G01 represents a critical interface in the system. It was found that the data formats differ across indicators, requiring G01 to spend additional time standardizing formats, verifying completeness, and coordinating data corrections.

Rework Loops

In many cases, when incomplete or incorrect data are identified, G01 must return the information to the KPI owner working groups for revision. This creates rework loops, which become a major cause of delays in each academic semester. This structural analysis provides a system-level understanding of the problems and serves as an important foundation for designing the desired-state (TO-BE) process, which aims to reduce sequential dependencies, minimize unnecessary interfaces, and reduce rework loops within the KPI monitoring process.

3.4 Problem Identification and Root Cause Analysis

After constructing the AS-IS process diagram, the next step is to identify the actual problems occurring in the KPI monitoring process and analyze the structural root causes of these problems. The objective of this step is to provide a foundation for designing process improvements in the following stage. This stage consists of two parts:
(1) problem identification and prioritization, and
(2) root cause analysis using a fishbone diagram based on the 4M framework.

3.4.1 Problem Identification and Prioritization

Problem identification was conducted by collecting incidents that occurred during KPI monitoring cycles, reflecting delays, incomplete data, and data inconsistencies. These problems were then categorized, and the frequency of occurrence for each issue was recorded across reporting cycles. The criterion used for prioritizing problems was the frequency of occurrence. Problems that occurred repeatedly across multiple monitoring cycles were considered higher priority because they represent systemic impacts rather than isolated incidents. At this stage, the analysis focuses on categorizing and prioritizing problems, without conducting causal analysis. The analysis of root causes is presented in the following section.

3.4.2 Root Cause Analysis using the 4M Framework

After prioritizing the identified problems, this study applied a Cause-and-Effect Diagram (Fishbone Diagram) to analyze the structural root causes of the problems. The main problem (fish head) was defined as: "Delays in the KPI monitoring process and inaccuracies in data." The causes were then categorized according to the 4M framework, which includes:

- **Man** – personnel-related factors
- **Method** – work procedures and operational methods
- **Machine** – tools and technology used in the process
- **Material** – data and information resources

The categorization of causes was conducted by examining the relationships between the observed problems and the relevant system components. This approach helps provide a structural understanding of the problem rather than focusing only on the visible symptoms. The cause-and-effect diagram of the KPI monitoring process is illustrated in Figure 3.

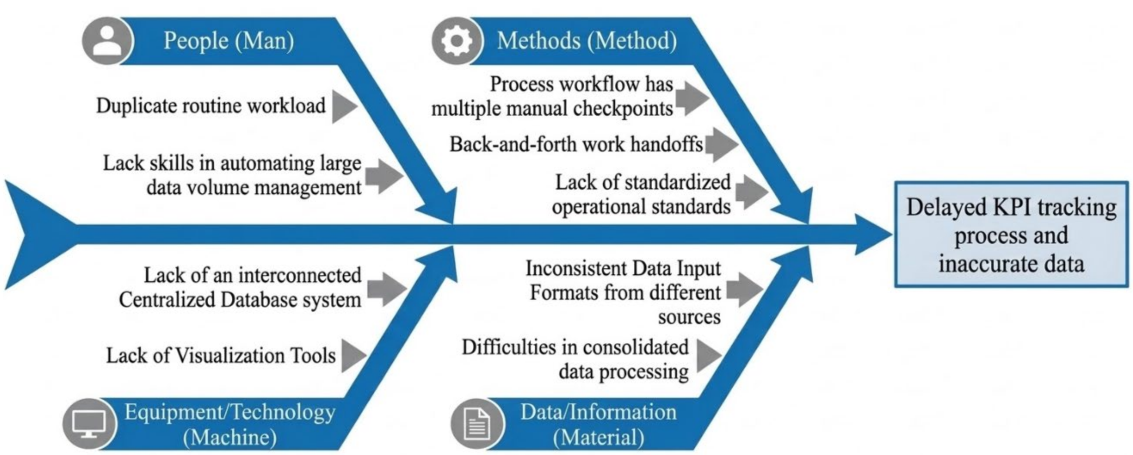

Figure 3. Cause-and-effect diagram of KPI monitoring process problems based on the 4M framework

The purpose of this analysis is to identify the relationships among factors that contribute to delays and data inconsistencies. At this stage, no corrective solutions are proposed. The improvement strategies will be presented in the next step using the ECRS principles.

3.5 Application of ECRS Principles for Process Improvement

After analyzing the problems and their structural root causes, this study applied the ECRS principles to determine improvement strategies for the KPI monitoring process. The objective is to reduce redundancy, minimize bottlenecks, and improve data accuracy. The application of ECRS principles is summarized in Table 1.

Table 1. Application of ECRS principles to problems in the KPI monitoring process

Principle	Related Problems	Conceptual Improvement Approach
Eliminate	Multiple rounds of data verification / post-submission data correction	Reduce repeated verification by establishing a single primary verification point
Combine	Multiple stages of data collection and transfer	Integrate data collection and verification into a single stage
Rearrange	Process sequence that causes waiting time	Adjust the data flow sequence to align with logical workflow
Simplify	Inconsistent data formats / Lack of common standards	Establish standardized data formats and clear operational guidelines

The application of ECRS in this study provides a conceptual guideline for redesigning the process. These principles serve as the foundation for designing the desired-state process (TO-BE), which is presented in the following section.

3.6 TO-BE Process Design

After analyzing the structure of the current process and defining improvement strategies based on the ECRS principles, this study designed the desired-state KPI monitoring process (TO-BE). The design aims to transform the data flow structure from a fragmented sequential process into a more integrated and centralized structure. At this stage, the focus is on presenting the structural design of the new process, while efficiency outcomes are not yet evaluated. The performance results will be presented in the results section (Table 2).

Table 2. Structural Comparison between AS-IS and TO-BE Processes

Comparison Aspect	Current Process (AS-IS)	Proposed Process (TO-BE)
Number of steps	7 steps	5 steps
Data recording format	Multiple forms separated by organizational units	Single standardized form across the organization
Data verification	Multiple verification points with partial manual checking	Automated verification using data rules
Data storage	Data stored in multiple files and locations	Centralized database (Single Source of Truth)
Data processing and analysis	Manual data consolidation and analysis	Automated data processing and analysis
Reporting	Reports prepared manually	Real-time dashboard visualization
System structure	Fragmented and sequential workflow	Integrated and centralized data structure

Based on the structural comparison above, the desired-state KPI monitoring process was designed as illustrated in Figure 4.

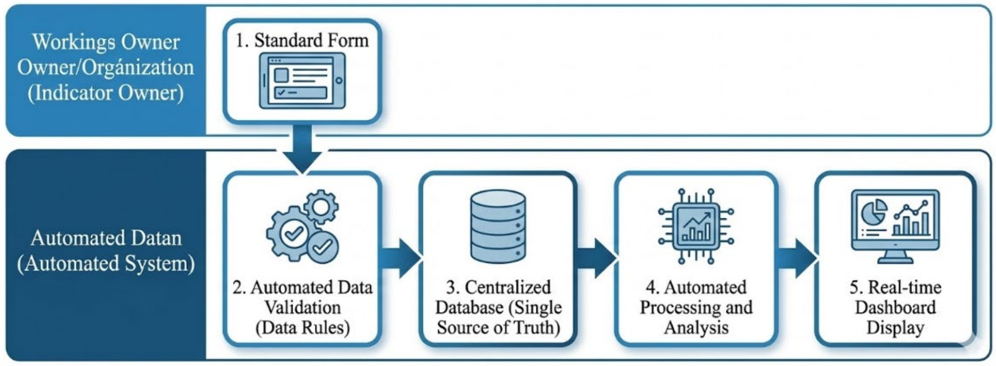

Figure 4. Structure of the desired-state KPI monitoring process (TO-BE)

As shown in Figure 4, the desired-state process consists of five main steps. The process begins with data entry through a standardized form with an automated validation system. The validated data are then stored in a centralized database (Single Source of Truth), which supports automated data processing and real-time dashboard visualization. This structure reduces sequential dependencies, minimizes unnecessary interfaces among units, and decreases the likelihood of rework loops. The efficiency outcomes of the redesigned process will be presented and analyzed in the following section.

4. Data Collection

This study used data from actual operational activities during the academic year 2024, which consists of three semesters: Semester 1, Semester 2, and Semester 3. Each semester was defined as one KPI monitoring cycle and used as the primary unit of analysis for comparing the current process (AS-IS) and the desired-state process (TO-BE). The study covers three case-study KPI indicators and analyzes both process structure data and operational time data. The data collection framework is summarized in Table 3.

Table 3. Summary of Data Collection Framework

Component	Description
Academic Year	2024
Unit of Analysis	1 semester = 1 KPI monitoring cycle
Case Study KPIs	(1) Number of student awards (G10) (2) Percentage of faculty members transferring technology (G02) (3) Percentage of students recommending the institute (G04)
Data Type	(1) Process structure (2) Operational processing time
Data Collection Method	Review of operational documents, process step analysis, and time recording

The use of a single academic year (2024) aims to control organizational context variables and maintain consistency in administrative structure during the comparison between the AS-IS and TO-BE processes. The use of three KPI indicators and three academic semesters provides a consistent basis for comparison, allowing the analysis to reflect both structural process characteristics and operational performance over multiple cycles.

5. Results and Discussion

5.1 Problem Prioritization Results

Based on the collection of actual incidents occurring during KPI monitoring in the academic year 2024 (three semesters), the problems were categorized and the frequency of occurrence in each reporting cycle was recorded. The results are summarized in Table 4.

Table 4. Frequency of Problems in KPI Monitoring per Semester

No.	Problem Type	Frequency (times/semester)
1	Inconsistent data from multiple sources	8
2	Incomplete data	7
3	Fragmented data storage	7
4	Delayed data submission	6
5	Time-consuming report preparation	6
6	Post-submission data correction	5

From Table 4, it can be observed that the top four problems account for more than 70% of the cumulative percentage of all issues, indicating that factors related to data inconsistency and fragmented data management represent the primary problems of the current system. To visually illustrate the prioritization of problems, a Pareto chart was constructed, as shown in Figure 5.

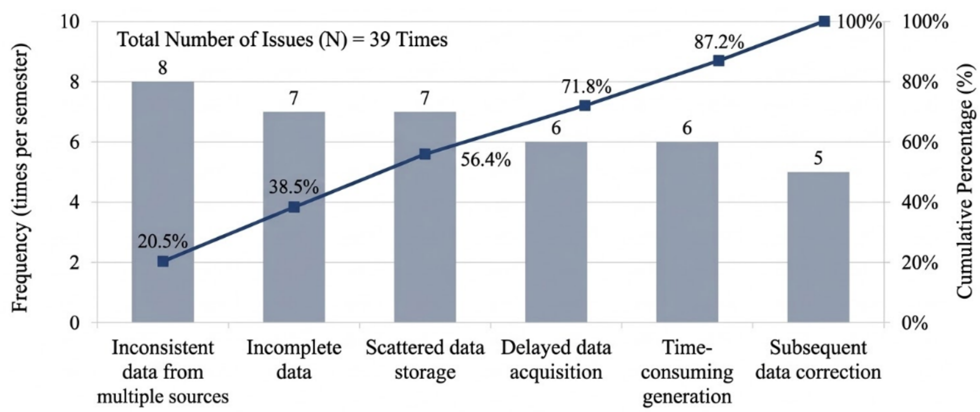

Figure 5. Problem prioritization of KPI monitoring using a Pareto chart

The Pareto analysis confirms that addressing structural data management issues would have the greatest impact on improving the overall efficiency of the KPI monitoring process.

5.2 Root Cause Analysis Results

Based on the root cause analysis using the fishbone diagram under the 4M framework, which was presented in Figure 3 in Section 3, the results indicate that the main causes of delays and data inconsistencies in KPI monitoring are primarily concentrated in the Method and Material dimensions. In terms of Method, the process structure is characterized by multiple sequential dependencies, repeated data verification steps, and the occurrence of rework loops when data are incomplete or incorrect. These conditions significantly increase the overall operational processing time. In terms of Material, the analysis shows that data are stored across multiple sources, lack standardized formats, and are not integrated into a centralized database. This situation leads to inconsistencies in data across different organizational units. The Man and Machine factors play a supporting role. In particular, routine workloads often overlap among personnel, and the absence of automated verification systems increases the likelihood of manual errors. However, the analysis indicates that the primary root causes are related to process structure and data management, rather than individual personnel factors. These findings provide an important foundation for defining improvement strategies in the desired-state process design. The improvement focuses on reducing redundant steps, establishing standardized data formats, and integrating data into a centralized database.

5.3 Performance Comparison between AS-IS and TO-BE Processes

After designing the redesigned process, a comparison of the KPI monitoring time was conducted under the same organizational context of the academic year 2024, where one semester is defined as one KPI monitoring cycle.

Table 5. Comparison of KPI Monitoring Time

Semester	AS-IS (days)	TO-BE (days)	Days Reduced	Percentage Reduction
Semester 1	29	11	18	62.10%
Semester 2	27	10	17	63.00%
Semester 3	28	12	16	57.10%
Average	28	11	17	60.70%

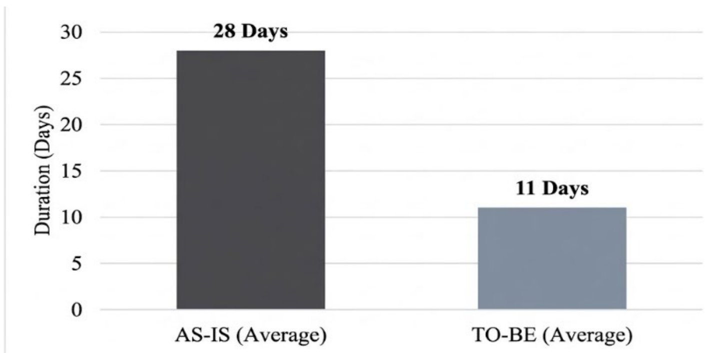

Figure 6. Comparison of average operational processing time

From Table 5, it can be observed that the current process (AS-IS) requires 27–29 days per monitoring cycle, with an average of 28 days. In contrast, the proposed process (TO-BE) requires only 10–12 days per cycle, with an average of 11 days. As a result, the monitoring time is reduced by an average of 17 days per cycle, representing an average reduction of approximately 60.7%. The overall comparison is illustrated in Figure 6, which clearly presents the difference in average operational processing time between the two processes. The graph shows a significant structural reduction in processing time, with a consistent decreasing trend across all three semesters. To further ensure that the observed improvement is not due to random variation, the consistency of results across all three semesters was examined. The reduction in processing time shows a stable pattern, with all semesters demonstrating more than 57% improvement. This consistency indicates that the improvement is structurally driven rather than influenced by temporary operational factors. In addition, the reduction in both process steps and processing time reflects a systematic elimination of non-value-added activities through the application of Systems Engineering principles and the ECRS concept. Therefore, the results can be considered reliable and repeatable within similar organizational contexts. These results demonstrate that the proposed process improvement approach can substantially enhance the efficiency of the KPI monitoring system. The findings of this study are consistent with previous research on process improvement in service organizations, which suggests that eliminating non-value-added activities and reducing data redundancy can significantly improve operational efficiency. Li et al. (2019) reported that the application of Lean Six Sigma in higher education service processes can reduce operational time and improve data accuracy. Similarly, the study by Popovič et al. (2012) indicates that the success of Business Intelligence systems depends on the quality and integration of source data. Therefore, the results of this study support the idea that improving the structure of data management processes through centralized data integration, automated data processing, and standardized data formats is a key factor in enhancing the efficiency of KPI monitoring systems within organizations. In addition, by introducing a centralized database (Single Source of Truth) and automated data validation mechanisms, the redesigned KPI monitoring system minimizes redundant verification activities, improves data consistency across organizational units, and supports real-time decision-making for institutional management. To further validate the effectiveness of the proposed process, the results were examined across all three academic semesters under the same organizational context. The consistent reduction in processing time, ranging from 57% to 63%, indicates that the improvement is structurally driven rather than caused by random variation. This consistency across multiple cycles supports the reliability and repeatability of the proposed approach in similar operational environments.

6. Conclusion and Recommendations

Improving the Key Performance Indicators (KPI) monitoring process through the integration of systems thinking and the ECRS principles demonstrates the potential of structural design in enhancing the efficiency of administrative processes within higher education institutions. The results of the study for the academic year 2024 indicate that the desired-state process can reduce the number of process steps from seven steps to five steps and shorten the average KPI monitoring time from 28 days to 11 days per cycle, representing an efficiency improvement of approximately 60.7%, consistently observed across all three semesters. This study contributes to addressing the research gap in performance indicator management in higher education institutions by focusing on improving the KPI monitoring process rather than designing new performance indicators. Previous studies in this area have largely focused on developing dashboards or business intelligence tools for data visualization. In contrast, this research proposes an approach that analyzes and restructures the data monitoring process from the upstream stage, applying systems engineering concepts together with the ECRS principles to design a KPI monitoring process with an integrated information flow structure. The results highlight the structural relationship between process design and operational efficiency, particularly through reducing rework loops, establishing standardized data formats, and integrating data into a centralized database supported by automated systems. This study therefore demonstrates that the application of a systems engineering framework can effectively address structural problems in organizational processes without relying primarily on increasing human resources. However, this study was conducted within the context of a single organizational unit and over a single academic year. Future research should expand the scope to multiple organizational units or institutions and consider long-term data collection to support statistical analysis and broader validation of the results. In addition, all research objectives of this study have been successfully achieved. The current KPI monitoring process was systematically analyzed, the desired-state process was designed using systems engineering and ECRS principles, and the efficiency improvement was quantitatively validated through a comparative analysis of process steps and operational processing time.

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