Simulation-Driven Improvement of King Khalid University Non-Monthly Entitlement Workflows in AnyLogic

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***Abstract*—Aiming to offer useful recommendations for enhancing process accuracy and operational performance, this study investigates the elements affecting the efficiency and timeliness of disbursing non-monthly financial entitlements to university staff. The study developed a process workflow model using AnyLogic simulation tools and structured interviews and then conducted two main tests to enhance effectiveness. While the second concentrated on dynamic workload distribution to balance duties and maximize performance, the first conducted complete automation using an electronic platform that centralized all departmental tasks involved in financial disbursements. By lowering service times, minimizing manual errors, and thereby simplifying task allocation, the results show that combining automated workflows and real-time workload distribution significantly increased operational efficiency. Faster, more accurate, and fair processing of financial entitlements produced by this change highlights the need for technology-driven solutions in reaching lasting organizational excellence.**

Keywords*—Non-monthly financial entitlements; operational efficiency; Anylogic simulation; process optimization; university staff

I. Introduction

Higher education institutions' foundation is administrative procedures, which help to define their capacity to provide services, research, and high-quality education. From policy development and resource allocation to performance assessment and decision-making, these procedures cover a broad spectrum of activity. Good administrative systems guarantee that colleges may adjust to fast-changing educational environments, simplify processes, and promote organisational effectiveness. Strong administrative policies in higher education help to increase openness, responsibility, and resource optimization, thereby improving institutional performance, according to Johnson et al. (2021). Furthermore, these procedures help to match operational frameworks with strategic goals, thereby fostering a coherent environment for staff, teachers, and students [1].

Administrative process efficiency—especially those pertaining to cash disbursement—depends on several important elements. These cover data availability and accuracy, system degree of automation, and internal policy and procedure clarity. Also very important are outside factors such as economic conditions and legal constraints. Inefficiencies in financial disbursement systems can cause delays, mistakes, and employee discontent that finally influence organizational performance, as Smith and Brown (2020) point out. Thus, increasing efficiency and guaranteeing the timely and accurate distribution of financial advantages depend on an awareness of and resolution of these elements [2].

Non-monthly entitlements are connected to non-periodic financial remuneration paid either monthly or otherwise. These rights include incentives given to staff members on sporadic intervals and financial gains. The several types of non-monthly entitlements include unique incentives, spot awards, and annual bonuses. Understanding their influence on efficiency and the speed of payment depends on first looking at the factors influencing performance and staff satisfaction in connection with these categories. The results of Green et al. (2022) show that prompt and open handling of non-monthly entitlements can greatly increase employee morale and involvement [3].

The sensitive process of distributing non-monthly entitlements to university staff members calls for great satisfaction to guarantee operational success. The disbursement process is influenced by internal elements such the effectiveness of administrative procedures and technological integration as well as by external elements including regulatory compliance and financial restraints. Improving the process depends on an awareness of and analysis of these elements, therefore optimising the advantages obtained by university staff members. This therefore promotes a good workplace, so improving organisational performance and helping to meet institutional objectives.

This study, therefore, aimed to investigate how modeling and simulation using AnyLogic contribute to the analysis of both internal factors, such as the efficiency of administrative procedures and technology integration, and external factors, including financial constraints and regulatory requirements, that affect the process of disbursing non-monthly financial benefits to university employees. It also sought to identify the root causes of delays and inefficiencies while evaluating the impact of proposed interventions—such as automation, improved workload distribution, and enhanced intercommunication—on disbursement speed, accuracy, and employee satisfaction.

This research is structured as follows: Section I provides an overview of the topic. Section II presents the problem statement and objectives. While Section III reviews the relevant literature, the following part describes the methodology and data collection procedures used to conduct the analyses in Section IV. Section V synthesizes the key findings from both experiments and introduces the simulation model used to assess the underlying mechanism. The final section summarises the principal findings

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of these experiments and includes a discussion of the implications of the findings for future research.

II. Problem Definition

A. Problem Statement

The university's disbursing non-monthly financial obligations presents many difficulties and delays. These issues undermine administrative performance and personnel satisfaction. Although these dues help to improve employee happiness, there is no thorough investigation to pinpoint the underlying reasons for these issues.

B. Objectives

This study intends to use AnyLogic simulation and modelling techniques to investigate the several elements affecting the efficiency and timeliness of disbursing non-monthly entitlements to university staff. Investigating the fundamental reasons and variables influencing the disbursement process, the study looks at how they affect work efficiency and production. Furthermore, investigated in the study are possible fixes for found inefficiencies like automation, workload distribution optimisation, and improved interdepartmental communication.

III. Literature Review

Maintaining excellent service standards, colleges have to take care of environmental issues and guarantee administrative effectiveness just like any other company. Among the several aspects of educational excellence, administrative process management has lately attracted major interest [4]. Most facets of human life have changed dramatically in recent decades thanks to the fast advancements in global markets and scientific knowledge and technological innovation [5], [6], [7]. Equipping students with the information and the skills needed to fulfil changing labour market needs depends critically on universities [8].

Delivery of high-quality university services, including teaching and learning, depends fundamentally on administrative processes [9]. Beyond instruction, administrative processes are crucial for controlling student services, offering direction, and preserving infrastructure quality, Manatos et al. underline. Using quality control strategies in these spheres guarantees a comprehensive academic background [10]. Good internal management improves daily operations and helps institutions to provide outstanding services in several areas including student assistance, infrastructure, assessment systems, and facilities management [11]. Moreover, a key indicator of administrative service efficacy is student satisfaction [12].

The administrative structures of higher education institutions significantly impact their overall performance and operational efficiency. Strong administrative processes are emphasised by Johnson et al. (2021) as a means of promoting openness, responsibility, and resource economy [13]. Perez et al.'s 2020 research emphasises how digital platforms and automation help to expedite administrative processes. These tools streamline decision-making, reduce errors, and optimize resource allocation [14]. Further influencing the effectiveness of financial systems inside public institutions are external regulatory constraints and economic situations [15], [16].

As non-monthly rights, bonuses and incentives are quite important for raising the morale and involvement of administrative staff members. But uneven distribution of these benefits has been proven to lower employee satisfaction and productivity, mostly because of inefficiencies in financial clearances among several departments [17]. Neglect of non-monthly rights could cause more general organisational problems like higher staff turnover and worse institutional efficiency [18].

Complex workflow optimisation has benefited from simulation and modelling tools such AnyLogic. Since 2003, AnyLogic—a flexible tool for modelling discrete, continuous, and mixed-agent behaviour has been used across manufacturing, supply chain management, logistics, retail, traffic systems, aerospace, and manufacturing [19]. Kim et al. (2020) show how financial process improvements suggested by simulation models might point up roadblocks [20]. Though modelling approaches are widely used in many fields, their application within higher education management—especially in financial systems—remains understudied. There is a clear gap in the literature since little studies specifically address non-monthly financial entitlements in universities. This emphasises great possibilities to use advanced AI-based technologies to boost administrative efficiency and enhance money distribution methods.

IV. Data Collection and Methodology

A. Data Collection

Structured interviews were the main means of data collecting for this research; they were the main tool used to compile qualitative data. Carefully crafted to ensure they gathered comprehensive and practical data relevant to the study goals, the interview questions [21] Particularly focused on investigating the procedures behind financial transactions, the flow of labour across departments, and the difficulties these changes bring about was The methodical approach of the interviews allowed participants to offer in-depth observations based on their operational expertise while nevertheless allowing consistency in data collecting.

Selected staff members from two important departments—the Payroll Department and the Human Resource Operations Department—conducted these interviews. These interviews were designed to thoroughly understand the current procedures, identify operational difficulties, and compile information relevant to the scope of this research.

At King Khalid University, the data collection process took place during regular business hours to coincide with the participants' natural flow and minimize interruptions to their schedules. A purposive sampling method was used to target people directly involved in the under-investigated processes. Ten transactions in all were chosen as samples for analysis to provide a fair picture of university financial transaction handling procedures.

Every interview took a one-on-one form and lasted between thirty and forty-five minutes. Before the interview, participants were briefed on the goal of the study and guaranteed informed consent and were encouraged to provide honest answers.

B. System Design

Modelling and simulation are the main tools used in this work; the simulation model was created with the AnyLogic application. The study starts with offering a conceptual model of the university's financial entitlement dispensing system in order to set the scene. Before switching to simulation-based modelling, this conceptual model helps to clarify every stage of the system and offers complete knowledge of its process [22].

The two main operational entities in charge of starting and finishing money distributions comprised the system:

- Human resources operations department: represented by one server.
- Payroll department: represented by one server.

For every transaction, transaction record data was used to construct pertinent random variables, therefore guaranteeing correct simulation results. Among these were:

- Average waiting time: The duration a request remains in the queue before being processed.
- Average service time: The time required by each department to complete a single request.
- Average time to issue a payment order: The total duration from the initiation of the transaction to the issuance of the payment order [22].

C. System Configuration

Two studies evaluating the financial disbursement process made use of AnyLogic simulation tools. Under specified operational conditions, these tests gave important new perspectives on the efficiency and performance of the system, enabling a thorough investigation of waiting times, processing times, and general transaction completion times. Conducted throughout regular business hours, five weekdays from 8:00 AM to 2:30 PM, the simulations were based on the presumption of a limitless queue capacity.

1) First experiment: The first trial was meant to evaluate how well automated processes implemented in several departments engaged in the disbursement process worked. This experiment sought to find whether automation might cut processing times, simplify processes, and lower mistake rates.

2) Second experiment: The second experiment concentrated on bettering staff member workload distribution at every level of the process. This experiment aimed to improve operational efficiency and lower delays resulting from unequal workload distribution or bottlenecks by best allocating jobs.

3) Simulation assumptions: Four transactions arrive at regular intervals of every half hour, hence defining the transaction arrival rate. The simulation is based on these assumptions stated in Table I. Two employees are assigned to the Operations Department and two employees to the Payroll Department, therefore allocating the manpower. One hour after arrival, every department starts handling a transaction to guarantee a neat flow. Assigning transactions to the staff member not handling other transactions helps to distribute work fairly and reduces idle time [23].

4) Simulation framework: The simulation model was built to depict a queuing mechanism for the disbursement of non-monthly financial entitlements [23]. To find inefficiencies and bottlenecks, the model combines important elements of the system and models the flow of transactions between departments.

5) Queuing system classification: Kendall's notation for classifying queuing systems helps one to define this system as having:

- Multiple queues with independent, parallel paths for transaction processing.
- A queue discipline that adheres to the First-In, First-Out (FIFO) rule, ensuring fairness in processing requests.

The simulation model well reflects the dynamics of the system, thereby allowing the research to assess the performance criteria and, where needed, process optimisation [22].

6) Arrival process: The arrival of transactions is modelled as a random process, with the interarrival time (A-i) defined as the time difference between the arrivals of the (i-1) th and the i-th transactions [24].

$$(A\text{-}i = T\text{-}i \; - T\text{-}\{i\text{-}1\}) \tag{1}$$

The mean interarrival time is denoted as E(A), and the arrival rate (λ) is calculated as:

$$\lambda = 1 / E(A) \tag{2}$$

For this study, we assume transactions arrive every 3 hours, so:

E(A) = 3 hours, λ = 1/3 = 0.333 transactions per hour.

TABLE I. SIMULATION ASSUMPTIONS FOR WORKFLOW OPTIMIZATION IN NON-MONTHLY ENTITLEMENT PROCESSING

Tra No.	Transaction Type	OD	PD	AT*	SS - OD	SE - OD	WT - OD	SS - PD	SE - PD	WT - PD	Total Service Time
1	Extra Allowance Request	E1	E1	9:00 AM	10:00 AM	01:00 PM	3 hrs	2:00 PM	9:00 AM	1 hrs	24 hrs
2	Financial Dues Request	E2	E2	9:30 AM	10:30 AM	01:30 PM	3 hrs	2:30 PM	9:30 AM	1 hrs	24 hrs
3	Excellence Allowance	E1	E1	10:00 AM	11:00 PM	2:00 PM	3 hrs	9:00 AM	1:00 PM	19 hrs	27 hrs
4	Conference Attendance	E2	E2	10:30 AM	11: 30PM	8:30 AM	9:30 hrs	9:30 AM	1:30 PM	1 hrs	27 hrs

*(OD) Operations department, (PD) Payroll department, (AT) Arrival Time, (SS) Service Start Time, (SE) Service End Time, (WT) Waiting Time.

V. RESULTS

The study concentrated on the university's disbursing non-monthly financial obligations, including conference-related financial reimbursements and excellence allowances. This system runs by means of a cooperative process combining several departments. Working closely with the Payroll Department and the Financial Department, the Human Resources Operations Department is key in starting and processing transactions. These departments taken together guarantee the seamless flow of the process and preserve the accuracy and integrity of financial disbursements.

As Fig. 1 shows, the payout process consists of multiple consecutive processes carefully planned to guarantee accuracy and conformity with institutional standards. It starts with the transaction submission, therefore starting the process. The issuing of a disbursement decision, formalising the approval for payment, the creation of a disbursement statement detailing the payment specifics, and lastly, the actual distribution of funds to the intended recipient follow.

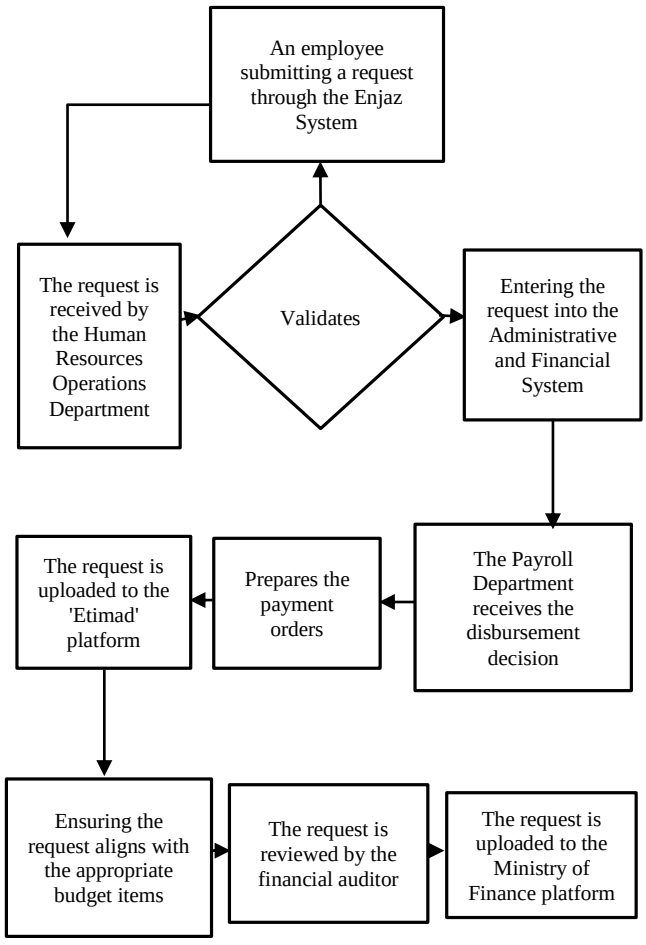

Fig. 1. Workflow figure model for non-monthly entitlement processing.

Every one of these phases entails different administrative processes and is influenced by different elements, such policy adherence, documentation correctness, and interdepartmental collaboration. Reliability and efficiency of the system depend on these components, which are essential.

The results of the organised interviews exposed a clear awareness of how the disbursement of entitlements operates the workflow. The system's workflow concept is meant to simplify processes, lower mistakes, and lessen inefficiencies. The participants underlined the need of interdepartmental cooperation and following accepted policies in reaching a flawless and efficient payout procedure.

The information gathered from the interviews contained specifics on ten transactions from which the departments engaged in the disbursement process may examine waiting times and service times. The performance of the operations department and the payroll department showed notable variations according to the study of service time and waiting time rates.

With an average service time (μ) of 115 hours and a service rate (λ) of over 0.0087 services per hour, the operations department has

$$\Pi\ (T \leqslant 50) = 35.26\% \quad (3)$$

$$\Pi\ (T \leqslant 100) \approx 58.09\% \quad (4)$$

The likelihood of executing a transaction within 50 hours is

P ($T \leqslant 50$) whereas inside 100 hours is P ($T \leqslant 100$).

With an average service time (μ) of 73 hours and a service rate (λ) of over 0.0137 services per hour, the payroll Department exhibits a notably improved performance. P($T \leqslant 50$) = 49.59% and P ($T \leqslant 100$) $\approx$ 74.59%, respectively, respectively, the chances of handling a transaction inside 50 and 100 hours.

With a waiting time rate (λ) of over 0.0278 per hour, the Operations Department averages a waiting time (μ) of 36 hours.

With a waiting time rate (λ) of 0.3333 per hour and an average waiting time (μ) of 3 hours, the payroll department shows a far shorter waiting time.

These results underline the payroll department's higher processing efficiency than the operations department, thereby stressing the requirement of focused interventions to maximise the workflow in the latter to avoid congestion and raise general efficiency.

VI. DISCUSSION

Differences in service indicate an organisational flow imbalance: slower processing times in the operations department can create transaction backlogs, causing further delays in other departments. These inefficiencies pose the potential of impairing the disbursement system's overall performance. Optimising service rates across several departments is essential to meet these difficulties. Workflow could be balanced by means of reallocating resources, automating repetitive processes, or offering people in the operations section focused training. Improving the effectiveness of the operations department will help the company to match its procedures more precisely with institutional goals, smooth operations, and increase productivity.

Fig. 2. Simulation model of the financial disbursement workflow.

Incorporating thorough methods and characteristics to precisely mirror real-world settings, the simulation model was constructed to analyse and solve the found inefficiencies as shown in Fig. 2. The first experiment concentrated especially on assessing the success of using automated processes among several divisions.

The suggested fix was substituting a centralised computerised platform for the hand-operated disbursing of financial obligations. Using a single interface, this system let administrative and academic staff members send non-monthly financial dues requests straight forwardly. To provide a more simplified and open procedure, requests were immediately passed to the necessary management for clearance. This system had a filter mechanism to confirm the completeness of turned in forms. While incomplete requests were automatically denied, therefore lowering delays resulting from incomplete entries, requests satisfying all criteria were sent straight to the Human Resources Operations Department for additional processing.

The usual transaction processing time before the automated system was 188 hours. After the new workflow was adopted and system analysis was conducted with the simulation model (Fig. 3), the average service time dropped to 59 hours per transaction rather dramatically. This shows an amazing drop of about 69%, which emphasises how well the system maximises operations.

Fig. 3. Impact of workflow automation on average service time.

The significant drop-in service time shows the good influence of process optimisation and automation. Requests were centralised and automated validation introduced helped to streamline the process, therefore minimising human mistakes and processing delays. The simplified procedure also helped to better allocate resources, enabling departments to manage transactions more precisely.

The second experiment concentrated on improving operational efficiency by means of better distribution of staff duty at every level. Based on their real-time workload, the suggested solution presented a dynamic assignment of requests to accessible staff members. This invention reduced delays brought on by waiting for staff members to handle jobs, therefore removing the need for manual job allocation.

Once a request is authorised at the first level, the automated system guarantees that it is immediately assigned to the next most qualified employee in the pertinent department. This procedure reduces idle time, ensures a fair distribution of chores, and enhances the overall processing efficiency of non-monthly financial dues. Distribution of work dynamically helps the system to minimise congestion caused by overloading stages or staff. The findings of the queue simulation show notable increase in operational efficiency. Every transaction's computed average service time was 25.50 hours. This suggests a simplified procedure that helps to handle individual transactions faster than past methods.

The efficacy of the automated workload distribution system in besting the task allocation among staff is shown in the shortened service times. Reducing delays at different phases guarantees that every transaction is handled effectively without generating congestion. This balanced workload enhances the flow of operations among departments, therefore enabling better use of resources and a more responsive system. Along with accelerating transaction processing, this development improves the general dependability and sustainability of the distribution mechanism. The results underline the need of dynamic task distribution systems in reaching operational excellence and guaranteeing timely service delivery.

From the first reception of requests to their flawless transfer across the operations and payroll departments, the use of an electronic platform for conducting financial transactions has fundamentally changed the payout process. Establishing itself as a pillar of operational efficiency, this creative approach has produced observable gains in various important spheres.

The shortened waiting times are one of the most obvious results since the platform replaced slower manual operations with a simplified, technologically driven workflow. This development not only sped up transaction processing but also cut pointless delays. Moreover, the flawless handover of transactions between departments and automatic work allocation helped to improve efficiency by guaranteeing better operations and so lowering of obstacles. Reducing mistakes, handling the difficulties with hand data entry, and improving interdepartmental communication all depend on the platform as well. More accurate and dependable data handling produced by these developments enhanced the general integrity of the system.

Beyond these operational improvements, the platform has raised staff satisfaction. Faster processing speeds and more openness helped build system trust and hence increase staff confidence in its dependability. Furthermore, the platform's capacity to provide performance monitoring by means of transaction completion rates and processing times has helped to precisely track development and highlight areas needing continuous enhancement.

VII. Conclusion

By greatly boosting speed, accuracy, and efficiency and thereby creating a more fulfilling and transparent experience for staff, the electronic platform has transformed the payout process. Combining technology and automation has shown its transforming power in solving long-standing inefficiencies and improving operational processes. These developments not only improve current operations but also provide a strong basis for reaching sustained operational excellence and therefore

supporting the long-term expansion goals of the company. The findings underscore the pivotal role of technology-driven solutions in improving organisational performance and provide a compelling case for continued investment in automation and process innovation to maintain and extend these gains.

Building on the ~69% reduction in processing time and the observed Payroll- Operations service-rate gap, future work should scale the centralised platform while using simulation–optimisation to right-size Operations capacity and routing. To sustain and generalise the gains, future studies should validate the redesigned workflow across other non-monthly entitlements and semesters, and deploy a digital twin that forecasts backlogs and recommends weekly staffing plans.

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