Smart Treasury: Leveraging Artificial Intelligence and Robotic Process Automation for Financial Excellence

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ABSTRACT

This research study aims to investigate the role of Artificial Intelligence (AI) in efficient management of public financial systems and treasury functions. AI involves a broad array of knowledge, including various concepts, methodologies, strategic tools, and diverse applications. It can be defined as the study of systems that gather inputs from the environment and respond through actions. Using AI in financial management and treasury presents distinct challenges and opportunities, as many treasury tasks have transitioned from physical to virtual processes, with automation advancing quickly. Financial and treasury teams are largely made up of knowledge workers who make decisions and perform analyses within dynamic frameworks. These frameworks must take into account both external and internal factors, as well as the effects of any actions on treasury outcomes. AI in finance and treasury functions closely mirrors the complexity of human nervous system, as it extends well beyond the basic automation. Like the nervous system, AI in these fields must process data rapidly and accurately, handling tasks such as data collection, classification, and integration into broader datasets. Today, neural networks within AI have advanced significantly and are widely applied across various treasury management areas, including early fraud detection, risk assessment, liquidity management, debt management, financial data quality control, extraction of hidden financial insights, accounting, and financial reporting. This review article aims to introduce readers to the various areas where AI can be applied in treasury operations, while also highlighting opportunities for enhancing accounting practices and driving digital transformation in treasury management. Additionally, it explores some potential research areas within these two fields.

KEYWORDS

Artificial Intelligence, Machine Learning, Public Financial Management, Robotic Process Automation, Treasury Management.

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Introduction

Given the environmental changes and the increasing advancements in the field of information and communication technology, using these technologies is essential for transforming the financial system of the country. Undoubtedly, strategic planning in various areas of public financial management, including government and public debt management, liquidity management, governmental financial reporting, risk management, financial oversight, and payment management, requires access to documented, reliable, and timely statistics and information. The Ministry of Economic Affairs and Finance has initiated the major project called "Transparency and Smartening of Government Financial Operations" to effectively utilize the capabilities of information technology in optimizing its missions and responsibilities. This project is pursued as one of the key and central projects of the ministry and holds unique importance and complexity.

One of the most important focal points in the project for the transparency and smartening of government financial operations is resource management. Given the existing budgetary constraints, optimal management of these resources, including avoiding the accumulation of liquidity in executive agencies, becomes crucial. Therefore, direct payments to final beneficiaries are a solution that the legislator has emphasized, obligating the Treasury to provide the necessary infrastructure for this purpose. Direct payments to the final beneficiaries, are an important and complex issue. The prominent and unique position of e-government and the widespread growth of information technology applications provide a valuable opportunity to create substantial effectiveness in resource management and achieve the goal of direct payments to the final beneficiaries. Given the government's serious need for electronic and informational systems, utilizing the emerging and advanced tools such as AI is very serious and essential.

AI technology is utilized to prevent the accumulation of government financial resources, enhance financial discipline, ensure transparency in public financial management and the Treasury, detect risks and fraud, manage accounting and financial reporting in the public sector, allocate budgetary resources efficiently and purposefully, strengthen the financial and accounting system, manage liquidity, manage debt, control the quality of financial information data, and extract hidden financial data.

AI considers the idea of replicating human talents such as creativity, self-correction, and language use. Additionally, AI is the only field that aims to create machines that can operate autonomously and automatically in complex, changing environments. AI is a broad branch that includes concepts, approaches, strategic techniques, and numerous applications, and it can be understood as the study of propositions that receive perceptions from the environment and take action accordingly (Polak et al., 2018).

AI is a central focus of global research; however, much of the research in this field remains fragmented and unstructured. This is particularly evident in the areas of financial management and treasury, where knowledge is often isolated and incomplete, terminology is inconsistent, and the number of studies on the topic is limited. One of the primary goals of this paper is to clarify the knowledge and terminology related to AI in

financial management and treasury, addressing the current lack of coherence in this field. Additionally, the paper will explore different forms of automation and AI, explaining their implementation, as well as discussing the advantages and challenges of applying these advanced technologies in public financial management and treasury (Polak et al. 2019).

Literature Review

Functions of Treasury

Many important components of the public expenditure management system are covered and supported by the Treasury. The vital functions of the Treasury include securing and transferring cash in line with annual budget, financial planning, controlling budget consumption processes, managing government cash flows, managing financial assets and debts, and accounting and internal auditing of budget execution. Public expenditure management will be effectively achieved when the government establishes powerful mechanisms and executive agencies (institutions) to support the desired functions (Pattanayak, 2016).

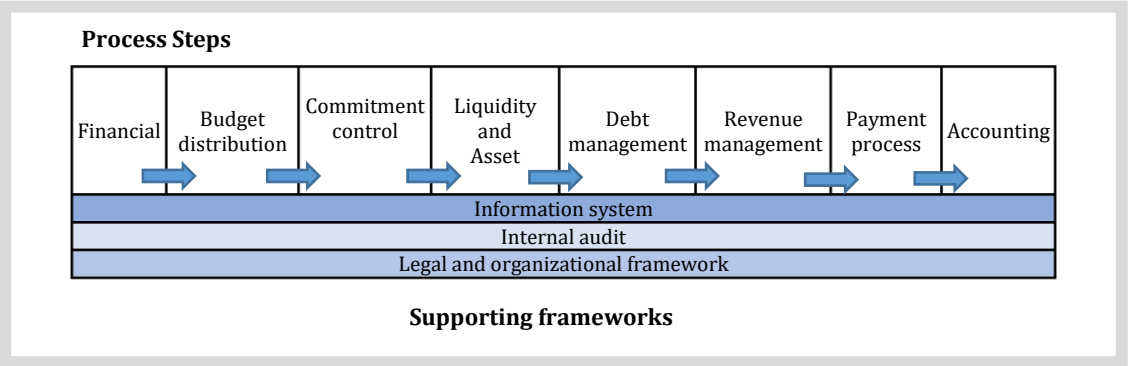
Patnaik (2016) states that the design of the treasury system is unique and varies according to the conditions of each country. In some countries, the Treasury is an independent organization with a wide network of departments that holds significant power and is largely accountable. In other countries, different treasury functions have been delegated to various sectors of the government to reduce centralization. Governments must ensure the efficient execution of the budget and good management of their financial resources, provide the necessary credits for the timely implementation of the budget to cost units, and minimize the cost of government borrowing. Additionally, proper management of financial assets and liabilities is essential. Government financial management involves a range of activities, including the formulatingfiscal policy, preparating and executing budget, controlling financial operations, enforcing accounting laws and controls, maintaining and recording historical and comparative data, and auditing the financial performance and outcomes of government policies and programs. Within this broad scope, the Treasury aims to achieve specific objectives, which may include some or all of the following:

- Cash Flow Management
- Supervision of Government Bank Accounts
- Financial Accounting and Reporting
- Budgeting and Cash Flow Forecasting
- Administrating Government Debt and Guarantees
- Monitoring Foreign Grants and International Aid Funds
- Managing Financial Investments and Assets Figure (1) describes a specific value chain as a comprehensive treasury system (Tendberg, World Bank, 2005). This figure presents a set of important functions that are defined as treasury functions in most countries. The value chain describes the process of producing (services) within the Treasury system. The value chain can serve as a framework for

analyzing the components or arrangement of the processes in a treasury system within a specific country.

The value chain and its processes highlight the importance of each component. It addresses how each of these functions and decision-making processes can be delegated to other government organizations or how needs can be met through a network of private sector resource providers by referring to these processes. The main criterion for decision-making regarding which components are included in the Treasury system is the value creation of that process and its position within the value chain.

Figure 1.
The Value Chain of Treasury



(Source: World Bank, 2005)

In Iran, the General Treasury, considering its importance and position in the public finance system from the perspective of the Constitution and conducting studies and the latest revision of the structure and responsibilities of the General Treasury, consists of three main subunits:

1. Center for the Management of Public Debt and Government Financial Relations;
2. Deputy for Treasury Affairs and Government Financial Reporting;
3. Deputy for Financial Supervision and State Assets.

In this context, the role of the functions of the General Treasury in Iran is crucial. Based on the conducted studies, the overall responsibilities of the Treasury of Iran can be summarized as follows:

- Management of government public expenditures
- Budget management and commitments control
- Management of bank accounts
- Management of public resources and risks
- Management of government accounting and financial reporting
- Management of auditing and financial supervision

It should be noted that the application of AI using information technology to generate hidden and effective information for predicting financial resources is not possible without reforming the structure of the financial system. Budget control and financial commitments, management of public resources, management of financial information,

alertness of liquidity shortages and commitments, risk management, and quality control of financial reports can only be achieved through smart automation and transparency of government financial operations. The impact of reforming the methods used in the General Treasury, particularly the organization of state-owned enterprises, will lead to increased financial controls, transparency, and fiscal discipline. The management of public funds can only be facilitated by centralizing accounts in the central bank, which will enable oversight and monitoring of government public resources and expenditures. The establishment and development of AI in the Treasury will be carried out by identifying and documenting current processes and formulating a desirable architectural document, as well as transitioning from traditional to modern systems. The publication of financial reports at government level to enhance accountability in financial and operational matters through AI and the creation of a comprehensive financial system database for forecasting and financial planning in macroeconomic policies will increase the added value of public services and ensure continuous oversight of the budget and financial performance of the government (Polak et al., 2019).

Artificial Intelligence, Robotic Process Automation (RPA), and Treasury Management

The government is required to take actions to reform the financial and accounting system and improve the operational methods used in the General Treasury in accordance with relevant laws. This will be done to achieve the objectives of the announced general policies of the resistance economy, which call for a fundamental transformation in structures and the reform and enhancement of the financial management and accounting system (Article 8 of the Sixth Development Plan Law). To achieve a smart treasury, one must pass through the path of a digital treasury, with the primary goal of the General Treasury being the full establishment of AI.

Treasuries can be categorized based on their level of adoption of AI and machine learning into high, medium, and low adoption levels. This trend often follows a predictable pattern within a country. Although the tools and infrastructure for AI in the Treasury are still in their early stages, it is anticipated that treasury management systems that have effectively integrated and utilized AI will enhance certain treasury functions and deliver genuine added value (Polak et al., 2019). AI, Machine Learning, and RPA have begun to make a significant impact on treasury management. While many of these technologies are still in the early phases (e.g., handling basic tasks such as monitoring liquidity, forecasting cash flow, and automating repetitive processes), they mark the start of a major transformation. Initially, AI enabled the treasuries to automate processes related to paper payments and remittance data. AI is often defined as the capability of machines to perform tasks that were once considered intelligent human activities. Machine learning, a subset of AI, focuses on utilizing data and statistical techniques to allow machines to learn and improve on their own, without the need for explicit programming (Polak et al., 2019).

In the near future, pattern recognition, machine learning, RPA, and advanced AI are expected to become integral parts of the standard treasury processes. In some cases, the terms data analysis" in general literature and "data analysis" in the context of machine

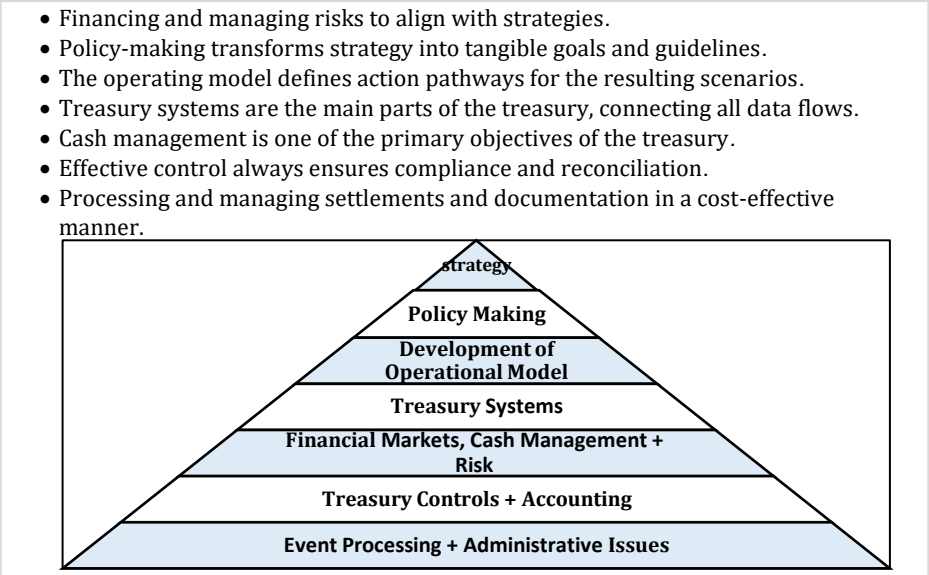
learning and AI may be used interchangeably. Although we are still in the early stages, it is clear that the application of AI in public financial management and treasury has great potential and deserves further research attention. It can be stated that AI, machine learning, and RPA have already begun to play a role in treasury management (Polak et al., 2018).

Today's computational resources and Internet-connected devices can rapidly process and store vast amounts of data in treasury management. AI techniques, especially machine learning, facilitate the collection, storage, exploration, and analysis of this data. AI can serve as a powerful tool in identifying and preventing cybercrime by detecting unusual transactions and flagging them. This capability also acts as a deterrent for cybercriminals, both within and outside the organization. Cybercrime prevention often involves a human element, offering an opportunity for treasurers to combine technology with effective people management. In data forecasting, AI enhances both accuracy and timeliness, utilizing more comprehensive and concise data that includes historical trends, budgeted, forecasted, and actual figures, all analyzed based on currency units. Additionally, this analysis is expected to be predictive. In treasury operations, AI should enable automated matching and processing to improve liquidity management, debt management, cost control, accounting and financial reporting, asset management, risk management, and internal controls. Algorithms can be created to match data, identify gaps, and fill them (Polak et al., 2019). Cash management, a key area of treasury activity, heavily depends on forecasting the cash flow, a process familiar to treasuries. Typically, past data is used to predict future cash flows, but this method fails to account for changes and developments. One of the primary objectives of the treasury is forecasting the cash flow. However, it should be noted that the level of detail, accuracy, and timing required for financial planning, in general, differs significantly from the treasury's needs. Another closely related area of treasury activity is risk management. Understanding, quantifying, and forecasting the risks with a certain degree of accuracy are crucial for effective treasury performance. When evaluating the benefits of AI and machine learning, it can be stated that simpler cash management operations are more likely to benefit from AI. AI should allow the treasury to delegate many cash flow forecasting tasks to automation, resulting in greater accuracy, reduced workload, and faster access to forecasts (Polak et al., 2019).

Technologies like RPA can significantly improve internal efficiency by reducing the time spent on administrative tasks. Some treasuries in various countries are already utilizing this technology to assist with tasks such as cash collection, financial reporting, auditing, and data consolidation. Looking ahead, as AI and RPA continue to advance, we can expect the emergence of digital assistants capable of supporting more complex and advanced tasks (Polak et al., 2019). Virtual advisors can assist treasurers in performing several essential tasks more efficiently. These tasks may include advising on the best strategies for optimizing liquidity, conducting complex risk assessments, managing immediate risks, and enhancing forecasting accuracy. By leveraging technology,

treasurers can save time, allowing them to focus on broader goals such as fostering innovation and planning for the future (Figure 2).

Figure 2.
The Value Pyramid of the Treasury

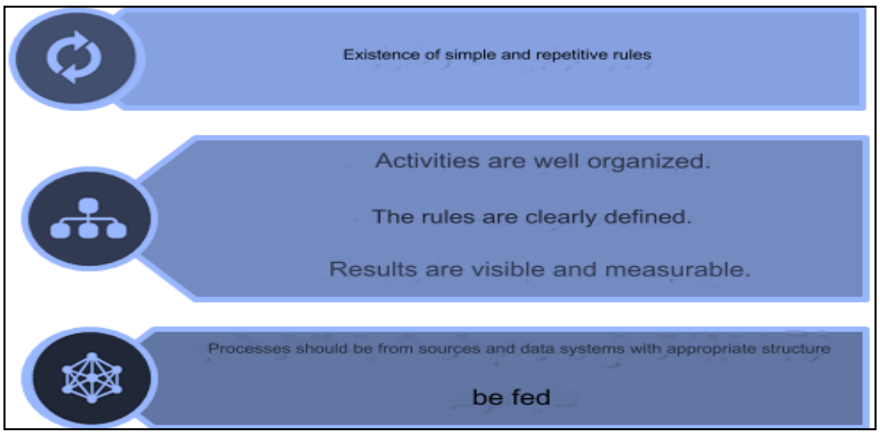


(Source: Polak et al., 2019)

AI should enable the treasury to make numerous cash flow forecasts with greater accuracy, reduced workload, and quicker access to such forecasts. RPA automates routine tasks, even knowledge-based tasks, such as cash position management and bank account opening. In treasury operations, especially in daily cash risk management, it is expected that AI will assist in skill development and further automation of classic primary activities such as cash position management. These tasks follow a well-defined logic and are performed within specific parameters. Like all change initiatives, demonstrating tangible benefits and progress is necessary and beneficial to garner and maintain organizational support and sustain project momentum. Quick success in implementing AI at a visual level, with observable tactical benefits, can significantly help in gaining support within the organization regarding the impact of using AI in the Treasury.

For instance, further automation can be introduced in cash position management by utilizing the existing data. In back-office operations, AI can help detect exceptions and identify unusual activities. Practical applications include monitoring reconciliations, verifying settlement accuracy in compliance with laws and regulations, and reporting on liquidity status. Although some of these tasks have already been partially automated, there is still room for improvement, and opportunities for quick gains remain. Moving forward, the Treasury should assess the current datasets, organize and make them accessible, and identify the resources and storage locations, as well as the data format. The next step is to leverage this data by establishing logical connections between them to support the identified workflows (Figure 3).

Figure 3.
Robotics and Automation in Treasury Management



(Source: Polak et al., 2019)

Automation Framework and Common Gateway Interface (CGI)

The challenge in treasury management and AI is that most treasury functions have shifted from physical processes to virtual ones, which are becoming increasingly automated and activated. These processes, including decision-making and analysis within frameworks that account for both environmental and internal factors, must be evaluated for their impact to guide decision-making (e.g., in areas such as risk management, resource management, and cash management) (Figure 4).

Figure 4.
Intelligent Automation Network and Framework

Primary Automation	Robotic Process Automation	Advanced Process Automation	Algorithmic Automation	Artificial Intelligence
Human-initiated Rule-based Unit system Macros, workflows	Initiated by humans or systems Rule-based processes, high volume (IT) Structured data Multiple systems Organizational level	Support for fundamental analytics / decision-making support Optical character recognition (OCR) Intelligent document processing Structured and unstructured data Simple chatbot (e.g., FAQs)	Complex processes and decisions Supported by predictive analytics Machine learning, limited intelligence, basic reasoning Unstructured and big data Language processing, chatbots	Cognitive technology capable of mimicking human capabilities, including empathy Full autonomy, hypothesis generation, reasoning Deep learning, deep neural networks Complete speech recognition and generation Fully capable virtual agents Virtual reality

(Polak et al., 2021)

Based on the information presented above, it can be said that the treasury management may currently be involved in all of these "types" of automation (Table 2).

Table 1.
Types of Automation in Financial and Treasury Management

Types of Automation	Example
Basic Automation	Instead of manually collecting bank data to integrate cash positions, this process is now automated through software and technology that collects the data and calculates the liquidity status.
Robotic Process Automation	When the treasury has surplus cash, an investment proposal is submitted within the framework of laws and regulations. This proposal can either be approved and executed manually, or, if it falls within set parameters, can be automatically executed through simple financial calculations.
Advanced Process Automation	Remittances sent in PDF format are automatically decoded using Optical Character Recognition (OCR). Fields are assigned based on predefined terms and their placement within the remittance document. This process eliminates the need for manual data entry or physical interaction with the image fields, replacing them with variable-based automation.
Algorithmic Automation	Automated predictive models evaluate the optimal coverage within legal structures, incorporating balance sheet cash, options, and future contracts, and recommend the most effective strategy. The Treasury staff can interact with the banking portal using natural language, addressing issues without needing to directly communicate with a banker, through a "virtual assistant."
Artificial Intelligence	Collection strategies leverage human analytics, incorporating messages for debt collection, inferring treasury behavior, managing liquidity, and facilitating smart payments.

(Source: Researcher's Findings)

It should be note, It can be said that all RPA solutions have been published by the four major auditing firms in the world.

Treasury Activities Prone to Automation

The concept of AI was first introduced in 1956 and refers to systems that enable intelligent actions through rule-based and automated processes. AI involves simulating human intelligence, including learning, reasoning, and self-correction. It can swiftly and accurately classify data, process it, and integrate it back into its original location. Over time, AI's neural networks have improved significantly and are now widely applied in treasury management, including areas like early detecting liquidity crises and risks, controlling financial data quality, and uncovering hidden financial information. Expert systems, a more advanced form of AI with specialized professional understanding, can address complex challenges faced by organizations. In the treasury field, AI systems can address various issues related to accounting and finance. AI in treasury management is not a centralized effort but a decentralized collaboration through technology initiatives such as RPA, treasury management systems, and the procurement of tools and services

that support managing liquidity and risk, accounting, analyzing, and forecasting. New technologies from financial service companies are continuously reshaping how treasuries interact with executive devices (Polak et al., 2019). RPA is starting to transform treasury functions by automating low-value, repetitive tasks, while AI facilitates the execution of cognitive tasks based on historical data and machine learning. Treasuries globally are identifying areas that are suitable for automation and AI implementation. The most important areas of focus for these technologies are outlined in Table 2 (Polak et al., 2019).

Table 2.
Treasury Activities Susceptible to Automation

Activities	Planning	Control	Execution
Financial Operations	Financial Procedures and Regulations	Authority and Delegation Limits Reconciliation Operations Monitoring Financial Policies	Payroll Accounting Expense Processing Accounting Deductions Fixed Assets Accounting Project Accounting Receivables Processing Payables Processing Procurement
Cash Management	Liquidity Planning Treasury Procedures and Regulations Investment Portfolio Planning Investment Procedures and Regulations	Reconciliation of Bank Statements Performance Monitoring	Cash Forecasting and Management Cash Management Operations Portfolio Management Investment Modeling Debt Management Buying and Selling Securities Settlement
Payment Management	Treasury Procedures and Regulations	Limitations on Expense Amounts Limiting the Time Horizon of Expenses Control at Various Stages of Payment	Expense Authorization Allocation of Authorization for Specific Periods and Cost Centers Cash Reserve Commitment Approval (or Certification) Payment Order Execution of Payment
Accounting	Accounting Policies and Procedures	Financial Reconciliation Review and Approval of Journal Entries	Periodic Performance Mergers
Financial Reporting	Financial Disclosure Requirements Management of Relationships with Executive Bodies	Monitoring Compliance of Reports Approval of Financial Statements	Preparation of Financial Statements Preparation of Management/Activity Reports Preparation of Compliance Reports Addressing Regulatory Inquiries
Performance Management	Management Reporting Framework Management Reporting	Performance Evaluation Integration	Management Report Performance Analysis Cost Accounting Management Creation of Dashboards and Balanced Scorecard

Activities	Planning	Control	Execution
Planning, Budgeting, and Forecasting	Procedures and Regulations Budgeting Procedures and Guidelines Strategic Planning and Goal Setting Operational Planning	Budgeting/Forecasting Model Design Monitoring Budget Policy Plan Approval	Budget Preparation Preparation of Forecasts
Risk Management and Compliance	Internal Control Framework Enterprise Risk Framework	Risk and Compliance Monitoring Control Monitoring Fraud Management	Risk Assessment and Scoring Risk Reporting Compliance and Control Reporting
Internal Audit	Internal Audit Objectives and Planning	Monitoring Audit Recommendations	Execution of Internal Audits Special Projects and Internal Consulting
Financial and Human Resources Systems	Financial Policies and Procedures Architecture of Financial Systems Workforce Planning Data Governance Strategy and Regulations Financial Service Delivery Model	Policy Monitoring Employee Performance Data Management Compliance with Financial Systems Architecture Monitoring Service Providers	Data Maintenance Management Employee Development and Retention Maintenance of Financial Systems Service Provider Management

(Source: Researcher's Findings)

Based on the information presented above, the most important applications of AI in treasury management can be outlined as follows:

A) AI and Payment Management

The Treasury manages organizational payments through a centralized payment system, which requires strategic transformation and innovation. By establishing a unified payment and settlement platform and integrating various payment channels, the treasury can achieve seamless processing across multiple access points. This platform can be applied broadly to fund transfers, payments, and settlements. An integrated enterprise payment and settlement platform consolidates scattered online transactions from different systems—such as online banking and instant payment systems—into a cohesive settlement framework, supporting a range of payment methods.

The platform can facilitate intelligent communication with payment gateways, such as banks and third-party providers, through a bot interface. Internally, it provides a single interface for all treasury systems, streamlining settlement processes and ensuring intelligent compliance with cost centers and the central bank. The system incorporates intelligent routing to select the most efficient payment path based on regulations, offering a wide variety of payment options for users through group payment methods.

Public expenditure control will be executed exclusively through direct payments to beneficiaries. The Treasury can manage costs in the public sector by delivering goods and services, fulfilling contracted agreements, issuing payment orders by authorized officials, and transferring funds to the beneficiaries. The objective of cost management is to ensure that public funds are used within set limits and in alignment with sound financial

practices. To achieve these goals, government spending generally goes through seven key stages, starting from legislative approval to the final payment to the beneficiary. These stages, which are well-suited for smart automation, include (Patnaik, 2016):

1. Authorization of Expenditures

A key principle of public finance is that both expenditure and revenue proposals must have legal authorization to ensure accountability. Expenditure authorization is usually provided through the budget law, which outlines the time frame, limits, objectives, and the responsible administrative unit for the government spending. In order to accommodate unforeseen costs, some flexibility may be allowed for reallocating funds between sectors, provided there are clear laws or criteria in place (e.g., through cash transfers or contingency reserves).

However, the budget is not the only legal mechanism for authorizing expenditures. Certain expenses can be made under permanent laws rather than annual budgets. For instance, established rules may allow for expenditures related to legal programs, debt payments, or membership fees to international organizations, which are authorized on a permanent basis but still subject to specific parameters or criteria. Nevertheless, in line with principles of transparency, comprehensiveness, and accountability, such expenditures must be documented in the budget and should be subjected to regular oversight and controls.

2. Authorization Allocation for Specific Periods and Cost Units

The allocation process aims to prevent cost units (executive bodies) from making commitments that would require additional fund approval for the current fiscal year. Once expenditure authorization is granted, funds are allocated for specific time periods and/or cost units. This process typically occurs in two phases: (1) the Ministry of Finance allocates credits on a quarterly or monthly basis to ministries, and (2) ministries or primary spending units distribute these credits to their subordinate units. Spending authority is transferred to these units through mechanisms such as guarantees or allocations. Centralized control at this stage is common across most countries and is generally overseen by the budget department of the Ministry of Finance's. This allocation process is vital for ensuring that overall expenditure limits are respected and to account for any claims or contingencies reflected in revised credit allocations. Any request for allocation or reallocation must include a financial or cash plan from the relevant ministry or spending organization, ensuring proper integration between allocation and cash management.

3. Reserve

In the public sector of some countries' financial management systems, there is a step where funds are set aside for a specific expense, even before a contract is in place. This process is referred to as "holding credit" in Spain and Portugal, and "budget commitment" in France, occurring prior to the "legal contract" or legal commitment stage. At this point, there is no formal obligation, but it is anticipated that the expense will be incurred within

the budget year, so the reserved funds cannot be used for other purposes. This reservation of funds for future expenses should not be mistaken for a legal commitment, as no official contract has been signed at this stage.

4. Commitment

The commitment stage is when a potential future payment obligation is established. It occurs when a formal action, like an order or contract, binds the government to make a payment at a later date when the other party fulfills the terms. A commitment only requires payment once the contract is executed by the third party. For ongoing expenses under a contract (such as wages, utility services, rent, and debt payments) or legal obligations (like transfers to local governments), these payments must be estimated and treated as certain liabilities. Since commitments generally become payable when the payment is due, monitoring them is crucial for managing costs and avoiding overruns. A commitment does not always mean payment will be made within the same fiscal year, especially for long-term expenses like multi-year capital projects.

5. Confirmation (or Acknowledgment)

At this stage, after the supplier has delivered goods or provided services, an authorized official in the cost unit assesses whether the delivery aligns with the contract or order, identifies the outstanding liability, and sets the payment due date. If accrual accounting is in use, the government's assets and liabilities are recorded in the books. When expenses involve an ongoing contract (such as wages, utility services, rent, or debt services) or a legal obligation (like transfers to local governments or household benefits), a confirmation is required to ensure that the commitment has matured. Expenses at this stage are often referred to as accrued expenses (as in the U.S.), payable accounts, or actual expenses. The key aspect of expenses at the confirmation stage is the creation of a liability. Additionally, there may be overdue expenses that have not been paid by the due date specified in contracts, laws, or general business terms.

6. Payment Order

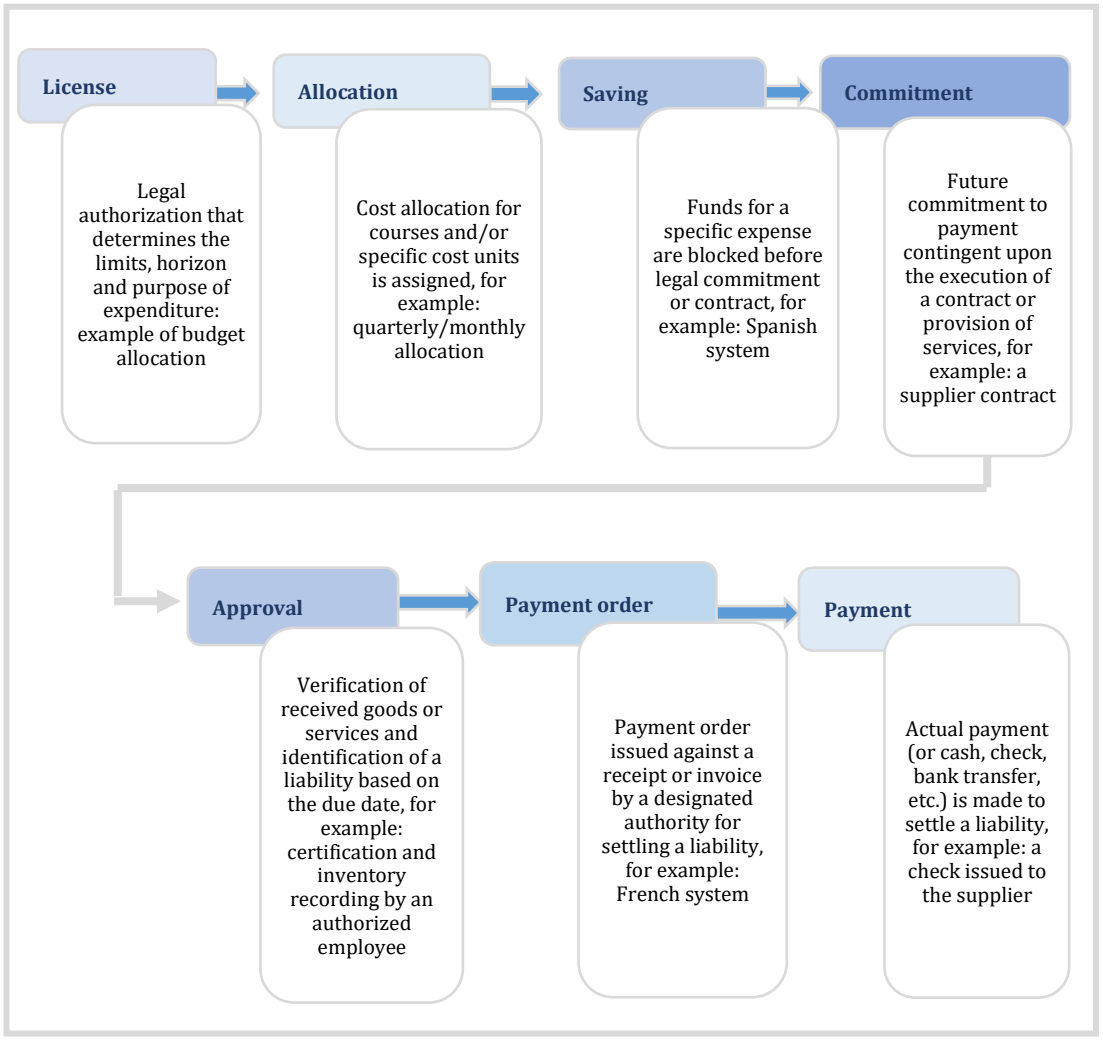
After the necessary reviews to ensure that all predetermined controls have been performed and documented, a payment order is issued. The payment order is an authorization for payment (usually against a document or invoice) issued by officials of ministries, other spending units, or the Ministry of Finance. Before issuing the payment order, the issuing authority (usually the treasury) checks whether sufficient funds are available for the payment. Once the liquidity is confirmed, a designated official approves the payment, and the payment order is issued. In cases where a centralized payment system has been established, spending units can prepare payment orders electronically and submit them through the Financial Management Information System (FMIS) for payment to the central unit/treasury.

7. Payment

Once the payment order is issued, payments are processed using different methods, such

as checks, Electronic Funds Transfers (EFT), or occasionally cash payments to the supplier or another recipient to fulfill the financial obligation. In line with internationally recognized best practices, payments should be conducted through the Treasury Single Account (TSA) system. Settling payments using revenues from the same unit is not advisable, as it undermines the transparency of reporting government revenues and expenditures at various stages.

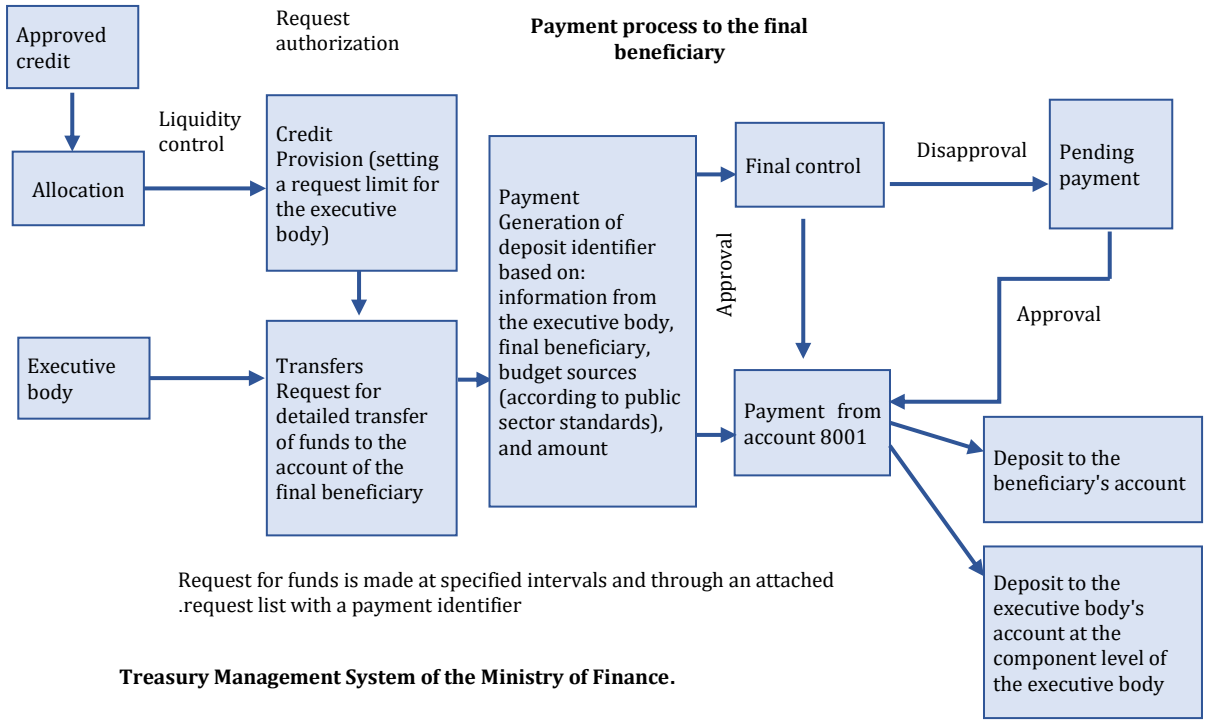
Figure 5.
The Main Stages of the Cost Chain (International Monetary Fund)



(Source: Researcher's Findings)

In the Treasury of Iran, the payment process to beneficiaries is designed as follows, and it can be automated at various stages of this process using the AI technology.

Figure 6.
The Payment Process to the Final Beneficiary in the Treasury of Iran



(Source: General Treasury, 2022)

Examining a Sample of Direct payments to the Final beneficiary and the Feasibility of Automating it

By examining the documented processes in the General Treasury, the payment process of the employee's salary was selected. The reason for choosing this process is to analyze a sample of direct payment processes to the final beneficiary. Payments based on this process are carried out in four stages, and in this section, the current status of each stage in terms of automation is reviewed, along with suggestions for automating each stage.

Stage One: Initially, the payroll list of employees from the executive agencies is uploaded to the payroll system. Based on control rules, the system generates two lists of warnings and errors. The agency must address the items on the error list and, if necessary, correct the warnings. After the payroll information of the executive agency is confirmed, it is resubmitted for alignment with the allocation. If the amount of salary exceeds the allocation, the system-generated feedback is sent to the executive agency to correct the salary information and upload it again from the beginning. If the amount of salary aligns with the allocation, a request for funds and a summary payroll list for official, contractual, and temporary employees are automatically generated and uploaded to the system after being signed by the authorized officials (The request for funds must be signed solely by the budget officer or financial manager, and the summary payroll list must be signed by the head of the agency and the budget officer or the financial manager of the agency).

Table 3.
Analysis of Stage One of the Payment Process of Employee's Salary in Iran

Current Status of Stage One	Use of Basic Automation
Automation of Stage One	**Suggestion: Use of Algorithmic Automation** After uploading payroll information, the system automatically detects certain errors, such as alignment with the allocation; however, resolving these issues is done manually by the user. In this section (alignment with the allocation and error resolution), algorithmic automation and/or artificial intelligence technology (machine learning) can be utilized to identify and rectify errors, which can enhance both speed and accuracy.

(Source: Researcher's Findings)

Stage Two: After the request for funds is submitted, warnings, the summary payroll list, the request for funds, and the relevant signatures are processed by the payroll payment expert and the head of the department. If any issues are identified, feedback on these matters will be sent to the agency, which must then make the necessary corrections and re-upload the payroll information from the beginning. If approved (this status is also visible to the agency in the system), the request for funds is confirmed by the verification department, and the relevant accounting documents, including net salary accounting documents, other deductions, and legal deductions, are generated in the accounting system.

Table 4.
Analysis of Stage Two of the Payment Process of the Employee's Salary in Iran

Current Status of Stage Two	Using Basic Automation
Automation of Stage Two	**Suggestion: Using Advanced Process Automation and Transition to AI** • Intelligent calculation and control of deductions • Intelligent detection and resolution of payroll and errors of funds' request • Intelligent creation of documents, accounting entries, and reporting • Optical Character Recognition (OCR) and intelligent document processing • Intelligent signatures of the expert and the head of the payment department

(Source: Researcher's Findings)

Stage Three: After the accounting documents are created, the head of the payroll department generates the net salary list and other deductions, along with the relevant Excel file, on the payroll system for submission to the central bank. Additionally, the agencies that need to have payments processed for them are selected.

Table 5.
Analysis of Stage Three of the Payment Process of the Employee's Salary in Iran

Current Status of Stage Three	Using Basic Automation
Automation of Stage Three	**Suggestion: Using Algorithmic Automation and Transition to AI** • In this stage, uploading the net salary list and deductions is performed by the head of the payroll department through using Excel, which can be automated using advanced automation. • Intelligent enhancement of the process for controlling the payroll list sent to the central bank.

(Source: Researcher's Findings)

***Stage Four*:** After reviewing the accounting documents issued by the Deputy and the Director General of the Treasury, the final approval is granted by them. In this case, the net salary is deposited into the relevant account at the central bank, other deductions are deposited into the agency's account, legal deductions are sent to the relevant authorities, and provincial salaries are deposited into the intermediary account of the province. Finally, the payroll department uploads the net salary list and other deductions, along with the relevant Excel file, to the PBN portal of the central bank (for payment to the main beneficiaries, namely government employees). Additionally, the list of the legal deductions paid is posted on the portal of the General Treasury. It is important to note that the payment information is recorded in the accounting system.

Table 6.
Analysis of Stage Four of the Payment Process of the Employee's Salary in Iran

Current Status of Stage Four	Using Basic Automation
Automation of Stage Four	**Suggestion: Using Algorithmic Automation and Transition to AI** As stated in Figure (4), AI is a technology capable of mimicking human capabilities. In this stage, since the documents must be finally approved by the Deputy and the Director General of the Treasury, using AI for automating this stage is recommended. Additionally, using AI is also suggested for intelligent payments and the automatic deployment of information on the central bank system. **Final Approval** • Intelligent Execution of Payments • Intelligent Deployment of Information on the Central Bank Portal

(Source: Researcher's Findings)

Automation of Controls -One of the very important aspects of the employee's salary payments is the control and oversight of this process, which includes the validation of the received information (ensuring it does not exceed the allocated amount, that employees are not duplicated, that the numbers and totals are reasonable), the accuracy of documents, and the correct payment to the final beneficiary. Therefore, automating controls and managing risks are essential. For this purpose, the use of algorithmic automation and the transition to AIare recommended.

B) Intelligent Liquidity Management

Another use of AI is to develop a smart environment for cash flow forecasting, which is particularly important for treasuries dealing with daily challenges in cash and liquidity approvals. Research by the international consulting firms highlights the liquidity management and risk management as two key elements of the treasury management. This has led many treasuries to focus on improving transparency and control over cash flows, enhancing cash flow forecasting, increasing management attention, and optimizing processes.

Effective liquidity management hinges on having access to real-time cash data, including the current liquidity level and the expected future inflows and outflows of the cash. To achieve this, the treasury must first be able to monitor its liquidity status

accurately and promptly. Next, intelligent cash flow forecasting mechanisms, powered by AI, are developed. These systems often rely on machine learning algorithms, predictive analytics, and knowledge mapping to predict future cash flows as precisely as possible and generate actionable insights. In environments where treasury functions, particularly cash risk management, are handled daily, AI is expected to support skill development and automate traditional tasks like managing cash positions (Zeidan & Shapir, 2017). AI can replace human judgment and experience, serving as a clear operational model that enhances the quality of treasury operations and facilitates greater automation. Moreover, establishing a diverse financing platform can significantly boost treasury liquidity. A range of banking financing products is employed to optimize the treasury's cash position, primarily through credit payments. Additionally, various management tools, including information systems and AI technologies, are used to enhance the treasury operations. These include "smart cash pools," "smart invoicing," "intelligent management of financial status," "smart financing," and other innovative solutions. Management systems such as "intelligent internal control systems," "intelligent cash flow forecasting systems," and "smart investment and financing platforms" are also integrated to improve the overall efficiency (Polak et al., 2019).

C) Intelligent Investment

A key function of treasuries is managing the investment of funds held in the treasury's single account. One application of AI in this area is intelligent investment, or robotic investing. This approach is based on the modern portfolio theory by Markowitz and integrates the treasury's risk tolerance with its capital status and financial objectives, utilizing intelligent algorithms and asset management strategies. Compared to traditional investment advisory methods, AI not only enhances investment accuracy but also significantly reduces the costs. Since the process can fully or mostly automate the operational management, it is often referred to as intelligent investment (Zidan & Shapir, 2017). The intelligent investment process at the treasury level typically encompasses market analysis, large-scale asset allocation, portfolio selection, transaction execution, portfolio rebalancing, and performance analysis. During the key stages of data analysis, asset allocation, and portfolio selection, the intelligent investment system tailors its services according to the risk profile and investment horizon. Following the investment, the system incorporates traditional investment theories (such as risk diversification and quantification), strategies, and other methods to create and track a portfolio in real-time, adjusting based on macroeconomic events, market fluctuations, and investor preferences. While this automation can enhance efficiency, it is essential to approach its implementation with caution.

D) Intelligent Risk Management

Intelligent risk management is expected to become a crucial technology in treasury operations in the near future. Treasury functions are typically divided into two groups of specialists who focus on Treasury Management Systems (TMS) and generalists who work with Enterprise Resource Planning (ERP) systems. AI also plays a key role in enhancing

risk management within the treasury. Financial sectors have employed various predictive algorithms to analyze different risk models, including liquidity risk, debt risk, payment processing risks, revenue collection risks, behavioral analysis, anti-money laundering, and more. The algorithms used in these analyses include Online Analytical Processing (OLAP), clustering, correlation analysis, decision trees, neural networks, predictive modeling, self-organizing maps, and network data mining, among others (Polak et al., 2018).

The rise of AI technology significantly improves the accuracy of the algorithms and models mentioned earlier, leading to more effective risk assessment. For instance, in fraud detection, AI can automatically extract text, data, and images to gain a deeper understanding, identify potential risks, and generate alerts. In the broader scope of risk management, AI optimizes risk models and enhances risk assessment by incorporating various events into the analysis using advanced learning algorithms like Q-learning algorithms (Polak et al., 2019). The first stage of intelligent risk control starts with data collection, which includes user-submitted data during data entry, information generated through usage, transaction data, and data from organizations. The second stage focuses on model development, with fraud detection being the primary task. The third stage involves optimizing and continuously improving the model through machine learning. For instance, IBM Cognos Analytics offers cognitive services based on natural language processing that provide risk monitoring services, such as monitoring, risk assessment, and compliance for bank and investment accounts (Polak et al., , 2019).

A Critical Review of AI

AI can be divided into two types of weak and strong. Weak AI refers to a mid-level system designed and trained for specific tasks, while strong AI can respond autonomously to data and information without human intervention (Polak et al., 2019).

Developing and maintaining AI is costly due to the complexity of these systems. AI involves sophisticated software applications that require regular updates to adapt to a changing environment. In the case of significant failures, restoring the system and recovering lost data may take considerable time and resources. AI as a service allows treasury departments to experiment with AI for various functions and explore different platforms before making a long-term commitment. Popular cloud-based AI services include Amazon AI, Watson, Microsoft Cognitive Services, and Google AI.

Although AI tools provide advanced practical capabilities, their use raises ethical and professional concerns, such as the risk of misuse. Hackers can exploit sophisticated machine learning tools to breach sensitive systems, increasing security challenges. This often stems from deep learning algorithms, which rely on knowledge gained during training and are effective primarily due to the data they process. As a result, the individuals involved in training AI systems must have the necessary expertise and ethical standards, as human bias can be introduced, and their work must be rigorously monitored (Moosa & Ramiah, 2017).

AI is essential for safeguarding personal data, particularly as cybercrime rates are

increasing. AI-driven fraud detection helps prevent such criminal activities. For large treasuries, AI plays a crucial role in the broader field of cybersecurity (Moosa & Ramiah, 2017).

One challenge with AI is the lack of regulation. Despite the risks it poses, there is minimal regulation overseeing the use of AI tools, and any existing laws typically address AI in an indirect manner. AI has the potential to empower a small group of individuals who are skilled in its use, creating a risk if these individuals have malicious intentions, as they could cause disruption with these powerful technologies. Furthermore, AI can replace human labor with machines that offer significant capabilities. As AI becomes more prevalent, there is a concern that people might become overly reliant on machines, potentially diminishing their creative abilities (Polak et al., 2019).

Although AI has the capacity to learn and improve, it still lacks the ability to make nuanced judgments. Humans are able to consider specific circumstances and exercise discretion when making decisions, a capacity that AI may never fully achieve. Relying on AI to replace human adaptability could lead to irrational behavior within the human-machine ecosystem (Moosa & Ramiah, 2017).

Discussion and Conclusion

AI focuses on replicating human abilities like creativity, self-correction, and language processing. It is the only field aimed at creating machines that can function independently and autonomously in complex, evolving environments. AI encompasses a wide range of concepts, methodologies, strategies, and applications, and can be viewed as the study of systems that gather information from their surroundings and take actions based on that data.

As advanced technologies like AI continue to evolve, it becomes crucial for public financial management and treasury operations to adopt intelligent solutions. The treasury leverages AI tools to optimize and streamline its processes.

AI should empower the treasury to delegate cash forecasting tasks, enhancing accuracy, reducing workload, and providing faster access to forecasts. RPA can handle routine tasks, including knowledge-based activities like monitoring cash status and managing bank account openings. In treasury operations, particularly in daily cash risk management, AI is anticipated to support skill development and further automate traditional activities, such as cash status management, which follow structured procedures within set parameters.

By integrating Blockchain technology with AI in the treasury operations, secure and efficient management of digital identity information can be achieved, improving user identification and reducing costs, while ensuring privacy, provided that there is trust among the involved stakeholders.

By systematically capturing, storing, transferring, verifying, and analyzing data, significant reductions in labor costs and intermediary fees can be achieved, while also enhancing accuracy and security. Recorded credit information becomes more comprehensive and difficult to falsify. Although Blockchain technology is still developing,

it holds the potential to eliminate fraud risks in financial transactions, remove settlement processing delays and errors, and facilitate real-time integrity between financial systems and treasury functions.

Simplicity in treasury operations offers distinct advantages. When evaluating the benefits of AI and machine learning, it can be argued that the more streamlined liquidity management processes are, the easier it becomes to leverage the full potential of AI.

Like any transformational initiative, it is crucial to demonstrate tangible benefits and progress to maintain organizational backing and keep the project momentum going. Achieving quick wins with visible, practical advantages of AI implementation can significantly help build support for its impact on the treasury management. For instance, further automation of cash status monitoring can be accomplished using the existing data. In back-office operations, AI can also play a key role in identifying anomalies and reporting unusual activities.

Treasury systems are deployed in the cloud, either as specific software-as-a-service (SaaS) solutions or through private cloud setups using dedicated databases. Despite shifts in technology trends, the Treasury Management System (TMS) remains central to treasury operations. A TMS utilizes reference data and incoming feeds to manage liquidity, process bank statements, and record transactions, settlements, and forecasts, along with assessments and accounting events. Regardless of where the TMS is hosted, liquidity status, settlements, and forecasts remain accessible.

Although AI offers robust support for treasury functions, it still faces the challenge that many treasuries are unaware of how AI can assist and continue to rely on outdated methods for data analysis and integration. The failure to fully automate the treasury activities is often tied to underutilizing AI to analyze relevant data and information.

In handling simpler financial tasks like identifying financial events, accounting, and liquidity management, treasuries often employ RPA. Intelligent financial robots can automate various financial processes, significantly boosting efficiency and service quality. RPA encompasses software applications that can gather and analyze information through configuration or interaction with other software, enabling tasks such as transaction processing, data transfer, and comparison. This technology is widely adopted across sectors, including finance, HR, and auditing. By leveraging RPA to enhance financial operations, the treasury departments, particularly in shared financial services centers, have achieved substantial reductions in labor costs and improvements in work quality. This opens up new research opportunities in the areas of accounting, AI, banking, and payment technologies, allowing for both independent and interdisciplinary studies.

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