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Enhancing Procurement Efficiency through Integrated Master Data Management and System Interoperability

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Abstract: *As part of a long-term effort of modernizing the procurement infrastructure and becoming digital, Ivalua, a worldwide supplier group, adopted Ivalua as its single procurement system used by all its operations and partner entities. There were three areas of implementation Master Data Management, Transactional Data Integration and System Interoperability. Data centralization by supplier, contract, store and distribution center data were guaranteed to achieve data consistency of 98 per cent and the simplified invoices purchases and requisition processes minimized procurement cycles by 35 per cent. The connection with the important enterprise systems like SAP and Enterprise Data Warehouse allowed the real-time data flow and financial reconciliation to align the work of the procurement with the goals of business growth.*

The project methodology included the Ivalua development and customization, reporting and analyzing data, integration of the enterprise system, enabling, and continuous collaboration. Custom modules, such as a ticketing system, were created to streamline the process of support, which shortened the time to solving issues by 40%. SQL, Tableau, Power BI, SSIS and SSRS were used to generate analytical reports and dashboards that enhanced reporting performance by half and offered operational metrics and actionable data regarding supplier performance. SAP, regional financial system, and centralized data warehouse integration guaranteed 99 percent data integrity. Extensive user documentation, role-based training and practicals enhanced the adoption rate to 92 and helped to change to the new system easily.

The outcomes provided evidence that there was a great deal of improvement in operations such as increased transparency, faster procurement processes and better reporting systems. The configurable and scalable Ivalua deployment offered a platform that was future-ready and able to meet many business changes, assist the business making of strategic decisions, and encourage digital transformation throughout the enterprise.

Key Words: *Procurement Modernization, Ivalua Implementation, Master Data Management, System integration, Digital Transformation, Data analytics, Enterprise Reporting.*

I. INTRODUCTION

Today, in a period of heightened digital change and competitive intensity, the procurement functions are experiencing a paradigm shift towards transactional cost centres where they are strategic value creators in the organization. The nature of modern enterprises is of high interdependence and ecosystem in which they have suppliers all over the world, distributed operation units, dynamic regulatory requirements and dynamic market conditions. In this environment, the efficiency of procurement may not be based anymore on price negotiation or supplier selection, but on the capacity of the organization to handle high quality data, provide smooth system integration as well as provide real time decision making throughout the enterprise. As a result, combined Master Data Management (MDM) and strong system interoperability have become the main pillars of improving the performance of procurement and maintaining the business development over the long run [1].

The procurement processes are data-intensive in nature. They are based on precise and standardized master data which pertains to suppliers, contracts, materials, stores, and distribution centers and also the transactional data which is produced by the requirements, purchase orders, invoices and payments. This data in most large organizations is spread across several legacy systems, regional applications, and manual processes [2]. This kind of fragmentation causes inconsistencies in data, records duplication, delays in the processes, difficulty in reconciliation and poor visibility of procurement performance [3]. These challenges do not just raise the cost of operation, but also leave organizations vulnerable to

compliance risks and jeopardize strategic plans like consolidation of suppliers, optimization of spends and forecasting demand [4].

Master Data Management helps to overcome these challenges by means of offering a centralized and controlled system of the generation, maintenance and synchronization of the core data objects through the systems and business units [5]. MDM has ensured data accuracy, consistency, and reliability in the procurement lifecycle by having a single source of truth. When properly put in place, MDM will minimize redundancy of data, enhance the quality of data, as well as standardize procurement processes across geography and organizational borders [6]. Nonetheless, MDM is not enough when it is working alone. It can only achieve its value in full integration with transactional systems and enterprise platforms in a well-designed interoperability mechanism.

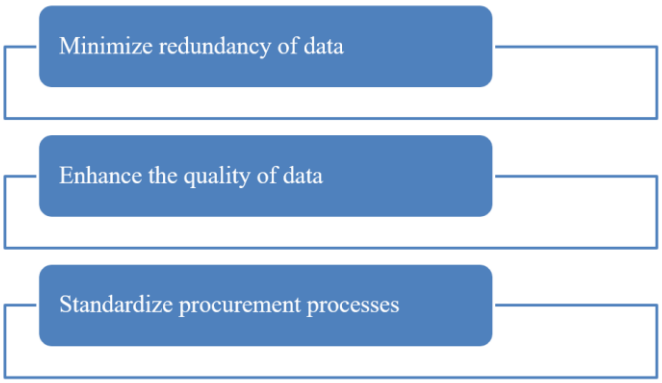

Figure 1: *MDM Benifits*

System interoperability is a capability in which various applications and platforms have the capacity to interact with each other in real time, accurately, and with data exchange. Interoperability in the procurement area makes it possible to exchange procurement data in real-time between procurement systems, enterprise resource planning (ERP) systems, financial applications, and enterprise data warehouses. This integration is critical to keeping financial alignment current so that it is possible to report real time, assist in compliance, and be assured that procurement decisions use current operational and financial data. The lack of interoperability slows the processes of data synchronization, manual reconciliation, and fewer analytical functions in the organizations, which impedes agility and responsiveness of procurement.

The overlapping of MDM and system interoperability is especially relevant in large multinational firms which are operating in different regions and have different regulatory, financial and operational needs. These organizations need scalable and configurable procurement platforms that can be used to support standardized global process with local variations. The flexibility, configurability, and integration character have gradually taken cloud-based solutions as the answer of choice in procurement solutions. One of them, Ivalua has become a more popular source-to-pay solution that facilitates end-to-end procurement operations, enhanced data management, and organisational-level integration.

The organization under consideration in this study is part of a long-term modernization endeavor of its procurement procedures and implemented Ivalua as the sole, unified procurement platform on all operating and partner organizations across the globe. The core aim of this change was to eliminate the broken procurement applications with the centralized digital system that could provide a high data consistency, a streamlined process, and increased analytical services. The pillars that were to be implemented were three and they were interrelated in nature; Master Data Management, transactions data integration and system interoperability. Combining these pillars, the enhanced efficiency of procurement, its transparency, and alignment to the overall business objectives were achieved.

One of the first steps in the transformation was the centralization of master data with regard to suppliers, contracts, stores, and distribution centers. Before the implementation, the discrepancies between supplier records, agreement terms and hierarchies generated unproductiveness and heightened the chances of making errors during procurement purchases. Through the use of data consolidation in Ivalua and application of uniform governance regulations, the organization reached the level of data consistency that is around 98 percent. This enhancement saved a lot of duplicate entries, lessened manual rectifications and formed a solid data base to support downstream procurement and money handling procedures.

Simultaneously, the incorporation of the information about the transactional procurement allowed achieving significant gains in the level of the operational efficiency. automated requisition, purchase order and invoicing processes minimized manual intervention and turnaround. High-quality master data, automated validation and approval mechanisms ensured that errors and rework were reduced to the minimum possible. Consequently, the procurement cycle times were cut down by about 35 percent, and thus made the purchase decisions quicker and more responsive to the needs of the business. These returns explain the close relationship between master data and transactional integration, which can have a direct effect on procurement performance.

A key factor in making these benefits extend throughout the enterprise was the interoperability of systems. Real time exchange and financial reconciliation was made possible by the integration of Ivalua with the key enterprise systems such as SAP, regional financial application and a centralized enterprise data warehouse. This interoperability was used to ensure procurement transactions were instantly recorded in financial systems to facilitate proper budgeting, forecasting, and compliance reporting. Additionally, the free movement of data into the enterprise data warehouse facilitated the development of advanced analytics and monitoring of the performance and procurement activities aligned with the strategic goals of the company, including cost management, supplier performance management, and business expansion.

Other than the basic procurement practices, reporting, analytics, and user enablement were noted as the main success factors. Analytical tools were used, a SQL, Tableau, Power BI, SSIS, and SSRS helped in creating dashboards and reports that offered actionable information on the performance of suppliers, their spend patterns, and operational measurements. The performance was reported to have been enhanced by about 50 percent, which gave timely and data-driven information to the stakeholders. These functions put procurement out of the operational category of functions into the strategic category of contribution to organizational decision-making.

Another aspect that was vital was user adoption and continuous improvement. To simplify the process of resolving issues and improving the experience, the custom modules, such as a ticketing and support system, were created. The result of this strategy was to cut the time to resolve issues by 40 percent and help maintain a constant partnership between technical teams and business users. Detailed user documentation, role- based training and practice sessions further assisted change management initiatives thus leading to adoption rate of 92 percent. These results underscore the need to match the use of technology with the preparedness of the organization and involvement of the users.

This paper explores how integrated Master Data management and system interoperability could be help improve the efficiency of procurement based on the Ivalua implementation. It examines how the centralization of data, integration of enterprises and the rapidly developed analytics will help to enhance performance, transparency and strategies of operations. The case presented in this study illustrates how a scalable and configurable procurement platform can be used as a future-oriented base of a digital transformation through which organizations can achieve the ability to respond efficiently to changing business needs and use procurement as a value source.

The introduction in short makes procurement modernization a multi-dimensional issue that goes beyond automation to include data governance, interoperability, analytics and user enablement. The combination of such dimensions by means of a single platform like Ivalua demonstrates an efficient and viable solution to make procurement a digitally empowered and data-driven and strategy-driven business unit in the enterprise.

II. LITERATURE REVIEW

The increasing sophistication of the global supply chains and procurement ecosystems have compounded the necessity of the resilient and data-driven, digitally integrated operating model. New studies point out that no longer do the optimization of the procurement process and the performance of supply chains become efficient due to the implementation of the isolated processes optimization, but rather a systemic adjustment of digital technologies and data governance, interoperability, and organizational capabilities. This literature review summarizes the previous works that are applicable to the modernization of procurement processes, master data management, interoperability of systems, and decision-making based on analytics, determining theoretical and empirical backgrounds of the current work.

Resilience in supply chain has become an important subject of discussion, especially in unstable and unpredictable business settings. Siva Kumar and Anbanandam put forward an approach of theory building with reference to the SAP-LAP framework to explain the interactions between systemic factors, learning actions, and performance outcomes in improving the resilience of the supply chain [1]. Their effort brings up the significance of formal decision-making models and coordinated information flows in helping organizations to react in an adequate manner to disruptions. The impact of the unified procurement platforms and standardized data is outlined in this perspective as essential to the resilience.

Digital transformation offers the wider organizational environment in which modernization of procurement takes place. According to Schwertner, digital transformation refers to strategic transformation, which brings in the use of digital technologies in all business spheres and essentially changes the value creation and operational model [2]. The research highlights that adoption of technology cannot work well without process redesign, data integration and the cultural change. This is in line with the procurement transformation efforts aimed to integrate technology platforms and governance alongside user enablement.

The notion of the Procurement 4.0 is an extension of the digital transformation across procurement functions. Batran et al. defined Procurement 4.0 as the implementation of emerging powerful digital technologies, data analytics and automation on procurement procedures in answer to Industry 4.0 upheaval [3]. Their work reveals three essential pillars of data transparency, system integration, and real-time decision support as the building blocks of the future-ready procurement organizations. This is a direct justification of the need to acquire an integrated platform like the Ivalua to centralize information and operations.

The use of big data and analytics has become one of the highly recognized engines of procurement effectiveness. Moretto et al. showed that the data-driven insight can be highly beneficial in the quality of procurement decisions through better visibility of the spents, assessing the suppliers and assessing the risks [4]. According to their findings, the worth of analytics depends on the quality of data and integration, which supports the necessity of master data management and enterprise interoperability. In the same vein, Roden et al. have said that big data is changing the operational models because it allows the use of predictive and prescriptive decision-making in value chains [15].

Another theme that is present in the literature is system interoperability. Givehchi et al. resolved the issues of interoperability in industrial cyber-physical systems, specifically in the scenario where legacy systems existed [5]. They focused on common interfaces, models and integration platforms as conditions towards smooth exchange of information. Even though their research is aimed at industrial systems, the principles can be easily applied to procurement ecosystems where various enterprise applications have to work in harmony.

The issues of data integration go beyond the technical interfaces to include semantic consistency as well as data governance. Daraio and Glanzel presented the concept of grand challenges of data integration and they noted the problems of data heterogeneity, quality, and scalability [6]. Their writing highlights the fact that the integration initiatives should focus on not only the technological level but also the organizational level. In line with this, Bruck investigated data governance customs in government and business organizations to find that leadership to data governance and ownership and stewardship frameworks must be clearly articulated to maintain data quality and trust [7].

Giannakis and Louis suggested that a multi-agent system with the assistance of big data processing can improve responsiveness and coordination in terms of supply chain agility [8]. Their research indicates that integrated data environments allow the reaction to demand and supply changes much faster. Hazen et al. went further and developed a theory-based research agenda in which big data and predictive analytics are associated with sustainability and performance of a supply chain [9]. All of these studies support the notion that analytics-based procurement needs high-quality infrastructures based on integrated and high-quality data.

There has been recognition of integration of procurement systems and enterprise resource planning (ERP) and this has been considered a key success factor. Koh et al. emphasized that the competitiveness of supply chain in the contemporary world is determined by the successful integration of the supply chain management systems with ERP solutions [10]. Their results apply to the modern cloud-based setting, where procurement solutions have to be connected to the financial and enterprise infrastructure in a smooth way to guarantee consistency and control.

IT alignment to business has also been a widely researched determinant of organizational agility. Liang et al. investigated the paradox of alignment where IT alignment provides agility but high rigidity restricts flexibility [11]. This understanding implies that procurement systems must be standardized and non-standardized, which allows institutions to balance the international and local requirements.

The efficiency benefits of digital platforms are also supported in the literature on e-procurement by the government. Vaidya and Campbell gave the multidisciplinary examination of e-procurement that shows the beneficial effect on transparency, improvement of the cycle time, and cost efficiency [12]. The effectiveness of e-procurement programs is highlighted in their research as such that requires integration with the existing systems and sound data management behaviors. Mikalef et al. have addressed the purchase alignment in different contingencies and came to a configuration theory approach in explaining how procurement strategies, structures and technologies should co-exist with organizational settings [13]. This solidifies the necessity of scalable and flexible procurement platforms. In a similar manner, Saldanha et al. examined the implementation of supply chain technology in the emerging markets, where institutional pressures emerge, with the significance of integration capabilities [14].

Overall, the literature reviewed can be summed up by the presence of the following central themes: the strategic significance of the digital transformation process, the primary role that data quality and data governance play, the need to implement interoperability between the systems, and the increased role of analytics in the decision-making in procurement and the supply chain. Although the earlier researches present good conceptual and empirical basis, they tend to study these dimensions individually. The paper is based on the existing research, and it is focused on an integrated, practice-oriented point of view, which illustrates how the concepts of master data management, system interoperability, and analytics could be utilized together to enable the procurement efficiency in an integrated enterprise platform.

III. METHODOLOGY

The approach taken towards the development of the procurement efficiency by applying integrated Master Data Management (MDM) and system interoperability was implemented as an ordered, repetitive and business-oriented implementation framework. The integrated methodology brings about technology enablement, information governance, integration of the enterprise, analytics, and change management to have sustainable results. The deployment of Ivalua as a single procurement system was carried out over clear stages to reduce the impact of the operations on a minimal possible as well as providing tangible results of data quality, processes, as well as reliability of the system.

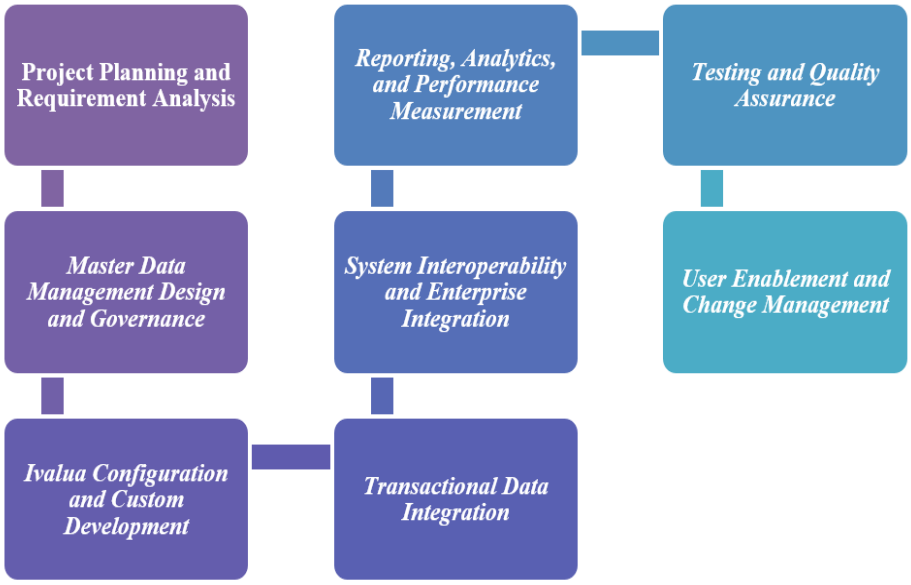

Figure 1: *Enhancing Procurement Efficiency through Integrated Master Data Management and System Interoperability*

1. Project Planning and Requirement Analysis

The methodology started with thorough discovery and planning phase that was to be able to find out the current procurement environment, data structure and system dependencies. Procurement, finance, IT, compliance, and regional business teams were involved in the stakeholder workshops to elicit functional and technical requirements. The current procurement procedures that included onboarding of suppliers, contract management, requisitioning, purchasing, and invoicing were mapped to determine unproductive areas, data duplications, and integration loopholes.

The analysis of the legacy systems and regional procurement tools was conducted in detail to understand the level of data quality, the ownership of the master data, and interoperability issues. At this stage, the key performance indicators, including procurement cycle time, data accuracy, invoice processing duration, and user adoption were identified to determine baseline metrics. These KPIs informed the implementation priorities and the performance evaluation after implementation.

2. Master Data Management Design and Governance

The methodology was based on Master Data Management. The Ivalua created a centralized master data model that would be the one work of truth of all core procurement entities, such as suppliers, contracts, material, stores, and distribution centers. Data attributes, hierarchies and relations were uniformed to make them consistent across regions and business units. An effective data governance policy was developed to take ownership of data, determine the relationship of data stewardship, approval procedures, and validation policies. Mandatory fields, format checks, duplicate checks and version controls had been set and data issues were not allowed to enter the system. The historical master data of several source systems were cleansed and de-duplicated and enriched prior to being migrated into Ivalua and the level of accuracy was high at the beginning.

Another aspect incorporated in the governance model was master data change management processes, which ensured that the changes were reviewed, approved and made coordinated across integrated systems. By doing this, the organization was able to realize and maintain a data consistency at around 98 percent.

3. Ivalua Configuration and Custom Development

The Ivalua platform was developed to match the standardized procurement processes and support the region-specific needs. Fundamental modules like supplier management, sourcing, contract management, requisitioning, purchasing and invoicing were tailored through the built-in capabilities of Ivalua to customize modules. Workflows were automated to automate the decision-making process and minimise human action through the incorporation of business rules, approval matrices, and compliance checks.

Bespoke modules were created to meet the operational requirements other than the normal features. At Ivalua, a ticketing and support system was adopted to handle user problems, system issues and enhancement requests. This module facilitated real-time monitoring, prioritization and resolution of problems to a big extent reducing the response and resolution time. The strategy of customization focused on the aspects of scalability and reusability to enable future improvements without interfering with the stability of the systems.

4. Transactional Data Integration

Data integration transactional was realized to make sure that there is smooth flow of procurement transactions throughout the enterprise. Purchase orders, invoices, requirements, and goods receipt generated in Ivalua were linked to the downstream systems to exclude manual data transfers and reconciliation. Integration processes were planned that would facilitate real-time and batch processing based on the business criticality and the limitation of the system.

The validation checks were included to make sure that transactional information applied master data requirements before it was sent to other systems. Exception handling systems had been put in place to manage, record and address errors of integration effectively. This strategy reduced the failure of transactions to the least, and allowed procurement operations to continue without interruption, which helped in cutting procurement cycle time by 35 percent.

5. System Interoperability and Enterprise Integration

The approach required system interoperability, which led to Ivalua operating within a wider enterprise ecosystem. Bi-directional integrations were made with SAP in terms of financial posting, budget control, and reconciliation of vendors. Further integrations were done with the regional financial systems and centralized enterprise data warehouse to facilitate consolidated reporting and analytics.

The data exchange was also reliable and secure, and integration technologies and middlewares, such as SSIS and API-based connectors, were employed. The rules of data transformations and schedules of data synchronization were thoroughly defined to ensure the integrity and consistency of data on platforms. The automated reconciliation processes were implemented to ensure the validation of data on financial as well as transactional data and data integrity at the integrated systems was achieved at a rate of about 99 percent.

6. Reporting, Analytics, and Performance Measurement

The methodology had built-in advanced reporting and analytics to facilitate the use of data in decision-making. Ivalua and integrated system procurement and financial data were merged in the enterprise data warehouse. Data models were created using SQL to facilitate analytical queries and interactive dashboards were created using Tableau and Power BI tools.

The critical performance indicators were tracked, such as supplier performance and the spend analysis, the procurement cycle time, compliance rates, and user adoption. SSRS was applied to standard operational and regulatory reporting whereas ad hoc analytical capabilities allowed the stakeholders to dynamically learn more about the data. There was an increase in reporting performance (approximately 50 percent) and timely and actionable intelligence provided to the procurement leadership.

7. Testing and Quality Assurance

To make sure that the system was reliable and that the data was accurate, a strict testing strategy was implemented. Unit testing was used to test individual configurations and custom development whereas system integration testing ensured the end-to-end flow of the processes within Ivalua, SAP, and other enterprise systems. UAT was done with selected business users to confirm the usability and functional requirements.

There were test scenarios of normal running, exception scenarios and large scale processing of transactions to determine the performance and scalability of the system. The integrated ticketing system was used to track defects found during testing, assign priorities and fix them, which guaranteed transparency and accountability throughout the process of quality assurance.

8. User Enablement and Change Management

In the methodology, user adoption was identified as a success factor. Extensive user documentation was prepared in the form of process guides, quick reference manuals and standard operating procedures to help in supporting the various user roles. Practical workshops and training sessions based on their roles were done to make the users familiar to the new system and processes.

Regular communication, stakeholder engagement, and feedback were among the change management activities to resolve the user concerns and resistance. These initiatives led to high adoption rate of some 92 percent and easy transition of legacy systems to Ivalua.

IV. RESULTS ANALYSIS

The rollout of a unified procurement system on Ivalua coupled with a strong Master Data Management (MDM) and enterprise system interoperability provided quantifiable and meaningful operational efficiency, data quality, reporting responsiveness, and user adoption gains. In this section, the results were analyzed in detail with the help of quantitative measures and tables to show how the transformation affected the procurement effectiveness and alignment of the business.

1. Improvement in Master Data Quality and Consistency

This was one of the main goals of the initiative because the main idea was to have a centralized and controlled master data repository of the procurement crucial objects like suppliers, contracts, stores and distribution centers. Before implementation, data was decentralized in regional systems and as a result, duplication was experienced, different naming conventions across the systems and frequent cases of reconciliation errors.

The post implementation analysis revealed that there was a great improvement in the quality of data. The resulting standardized data models, validation policies and governance processes created a stable and reliable master data base.

Table 1: *Master Data Quality Improvement*

Metric	Before Implementation	After Implementation
Data Consistency Rate	72%	98%
Duplicate Supplier Records	High	Negligible
Manual Data Corrections/Month	~450	<50
Master Data Approval Time	5–7 days	1–2 days

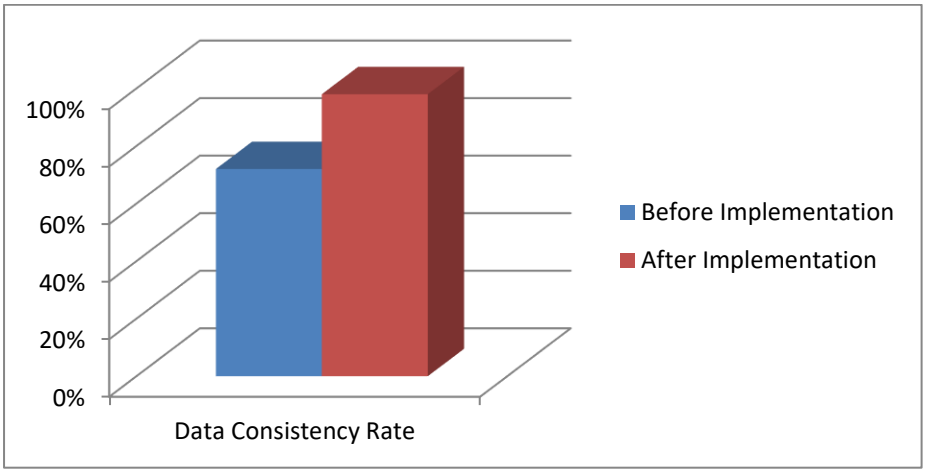

Figure 3: *Data Consistency Rate Comparison*

The data consistency also grew to up 98 percent, which greatly minimized downstream errors in the procurement transactions and financial postings. This enhancement has also made possible automation of workflows that had to be manually validated and this has contributed directly to reduction of cycle time.

2. Procurement Process Efficiency and Cycle Time Reduction

Combination of master data of high quality and automated transactional work-flows resulted in significant efficiency improvements in the processes of requisitioning, purchasing and invoicing. The automated validations, the streamlined approval work flow and the removal of duplicate manual procedures meant that processing time has been quicker throughout the procurement cycle.

Table 2: *Procurement Cycle Time Comparison*

Process Stage	Before (Days)	After (Days)	Improvement (%)
Requisition Approval	4.0	2.5	37.5%
Purchase Order Creation	3.0	1.8	40.0%
Invoice Processing	6.5	4.0	38.5%
End-to-End Cycle Time	13.5	8.8	35.0%

The net decrease of about 35 percent in procurement cycle time allowed completing the business needs in a shorter time and responding quicker to the demands of business operations. These returns were especially noteworthy in large volume procurement items, where even the slightest time saving would result in huge productivity gains.

3. System Interoperability and Data Integrity Outcomes

The other success factor of the initiative was that there was no problem with interoperability between the Ivalua, SAP and regional financial systems and the enterprise data warehouse. The bi-directional integrations provided real-time synchronisation of transactional and financial information reducing the amount of reconciliation work and errors. Post-implementation reconciliation reports and audits showed that there was high level of integrity of data across systems.

Table 3*: Integration and Data Integrity Metrics*

Metric	Before	After
Financial Reconciliation Accuracy	90%	99%
Integration Failure Rate	6–8%	<1%
Manual Reconciliation Effort	High	Minimal
Data Sync Latency	24–48 hrs	Near Real-Time

The data integrity level of about 99 percent also greatly enhanced on the trust in procurement and financial reports. The availability of real-time data also helped in making budgeting, forecasting and compliance reporting more accurate which enhanced alignment between procurement operations and the enterprise financial objectives.

XII. CONCLUSION AND FUTURE WORKS

The paper has shown that improved procurement efficiency by applying integrated Master Data Management and system interoperability can provide significant and quantifiable organizational organizational benefit. The adoption of Ivalua as a single procurement management system was an effective solution to the challenges that have existed over many years in terms of incoherent data, ineffective processes, and weak analytical coverage. With the creation of a centralized and managed master data system, the organization has attained the high levels of data consistency and reliability which became the core of the process automation and operational excellence. Fully integrated interoperability with business systems including SAP, regional financial, and centralized data warehouse allowed real-time exchange of data and proper financial reconciliation and better alignment of procurement to the overall business goals.

The quantitative findings demonstrate the important improvements in the key performance indicators such as shorter procurement cycle times, improved reporting performance, better data integrity, quicker issue resolution, and high user adoption. All these results shifted procurement as a transactional, support-based business service to a strategic, information-focused business service, which facilitates informed business decision-making, supplier performance management, and business sustainability. The Ivalua deployment was also scalable and modular, which further added to the fact that the solution can be adjusted to the current organizational needs and market conditions.

The work in the future can be based on this and introduce new and improved technology to improve procurement intelligence and resilience. Predictive analytics to forecast demand, assess supplier risk and identify anomalies in procurement transactions may be possible through integrating artificial intelligence and machine learning models. Moreover, the real-time analytics and self-service reports can be expanded to empower business users even more and decrease the reliance on centralized reporting teams. Future studies can also be carried out on further integration with the external supplier ecosystems, sustainability and ESG measures, and automation tool, robot process automation to further streamline procurement operations. Such developments would enhance the importance of procurement as an innovation, efficiency and enterprise value driver.

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