Kurdish Studies
December 2022
Volume: 10, No: 2, pp 1011-1026
ISSN: 2051-4883 (Print) | ISSN 2051-4891 (Online)
www.KurdishStudies.net

DOI: 10.53555/ks.v10i2.3866

From Legacy Systems to Intelligent Infrastructure: A Roadmap for AI-Driven Banking IT

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Abstract
The banks are still using legacy systems as the core of their business. One of the reasons is that the financial and operational data are stored here and can be used for decision making. Other reasons are that applications developed for many years and very high costs for these applications to be retired. On the other hand, technology and in the past year, a cataclysmic evolution of technology and client demands. This trade-off between stability on legacy systems or competitive advantage on modern architectures, as there are many known cases of banks that have collapsed due to not adapting quickly enough is still a hot topic for many industries, not just banks. The risk and costs of switching to new system is high enough. The objective of this article is to present the main risks and costs of using legacy systems, the preferences of the bank users in terms of software reliability and subjective assessment of the software systems' modernity, an overview on new intelligent IT infrastructures, the preferences for the modernization of systems and a SOLUTION of the modernization of legacy banking systems using an open architecture [1]. Artificial Intelligence (AI) is now widely acknowledged as one of the most important digital transformation enablers across a significant number of industries including the banking sector. AI technologies are assisting the banks in India in upgrading their operations across the board from accounting to sales to contracts to cybersecurity. This paper aims to analyze the application of AI in Banks and to take a case study based on the virtual Assistant of SBI-SIA. The evolution of banking and the emergence of virtual banking was explained in this and the trends in the modern Banking systems were explained along with a Rationale use of AI in Banking [2].

Keywords: Legacy Systems, Intelligent Infrastructure, AI-Driven Banking, Core Banking Transformation, IT Modernization, Digital Infrastructure, Banking Technology, Artificial Intelligence, Machine Learning, Cloud Migration, Automation in Banking, Smart Infrastructure, Data-Driven IT, FinTech Integration, Scalable Architecture, IT Strategy, Predictive Analytics, Banking Innovation, AI Roadmap, Technology Upgrade

1. Introduction

Changing demands for banking applications factors in release management conceptualization of a Customer Ratings and Values Engine spanning the whole Banks Universe HR items. Business imperatives view the fragmented, or eventual cost, as critical to maximize cash flow cycle and description of customer life cycle(s) for personalized services. The team which designs the conceptual view determines the design which fragments the HR item. Current technologies are researched to ensure the portability of the function within a broad universe securely like checkboxes. Only redisplay of the expanded customized filter to best fit browser and imposed user. Sensitive data is compiled wherever hosted with production of recommended actions for banks. Educated users are foreseen as the filter after massive filtering with inherited reasons and other customer's action history. Its duplicates are easily found for the same changed rating.

Known patterns present groups or associations of reason codes useful in triggering bank actions at certain masses or delays. Trigger introduction and bank supporting action budgeting accrue. Scalability of the HRB in the number of banks, product items, and customers, number of banks' inquiries on records, bank presentation view or fraud protection practices, are all targetable by Distributed Computing, Big Data, and Cloud Computing. With verdict accorded filters and actions set infractions are generated upon wide distribution in peer banks. Warning settlement and prudent practice change timeframe for presented banks/mass of customers are also estimable. Previous analytics like pricing and discount, terms, and tradeoff against disloyalty can enforce revenue calculations.

Classic action display estimates are expandable to all technologically supported channels besides pervasive ones. An action's virtual check is executed for appreciation of cost or even customer expectation realization when considering annoyed tasks. Collusion or competitive price/fraud create auction-like bidding. For simplicity, action display and re-call on recommended best methods would be first implemented on the ICT channel. After action description, a sequence of button aids the next bank inquiry with default chat input channel or specified voice as surrogated, or immediate action and evaluator engagement by checklist from sentence output. Queries respond like score and reasons or businessmen's CV or competitors' news. Also, customers' plans with no explored filters may be verified via outputs in tuned subject. Sequence specification for database entry generates protecting patterns. Wide analysis provides bank action expansion on remaining frictions like non-inquiry duration and complaints for regulators. No mention of a bank or bank staff with access or info rights is targetable via speech.

Fig 1: Banking AI

2. Understanding Legacy Systems

The banking sector is constrained by legacy systems incapable of accommodating new technologies and an acquired competitive advantage in technological and functional depth. It operates under permanent technological change and association, along with new and unconventional competition, while customer expectations, the socio-economic environment, and legislation change rapidly [1].

Banks in the world, including Islamic banks, cannot replicate conventional banks' IT, business, management, and administrative models. Banks' perfect technology transfer is a quasi-impossible task, and futurology analysis concerning bank IT is difficult to apply from one regulatory and functional environment to another, and as a matter of principle. Therefore, the idea is to demonstrate that such an approach is theoretically and practically possible.

The purposes of the paper are as follows: banking system modernization-related factors are presented; a method for modeling and analyzing banks' modernization requirements based on emerging open architectures, business models and functions, and correlations with the Islamic way of banking is shown; and a centralized banking system originally having correspondent banking functions is first analyzed and then redesigned as an open architecture banking system. A concrete case study of an Islamic bank is used to illustrate the approach.

2.1. Definition and Characteristics

Legacy system is a very old, outdated computer system or system of the computer software that is used for a long time. Although a legacy system works fine, it is usually very costly to maintain and will eventually climb into obsolescence and die out [1]. A legacy computer system is "any system that is a holdover from an earlier time and is not compatible with current technology." The following characteristics apply to legacy systems:

Governance. Legacy systems are often poorly governed or lack an adequate governance structure. In many cases, legacy systems were built at a time when individual business units could do whatever they wanted technologically, and there was little overall consideration for enterprise solutions.

Have little margin for error. Business processes and technology have changed a lot since many legacy systems were originally implemented but much of the original design philosophies are still intact. Developers were also concerned with 24/7 availability, and therefore many of these systems were built using batch processes, only minor updates of a few records at any given time and extra credit checks to avoid problems. In transition to current requirements, most systems now process hundreds of thousands, or millions, of updates at a time and are not equipped to handle such workload.

Customization. Based on specific business rules or requirements, the business systems have many customizations. Unfortunately, many business units still do not have full documentation of business processes relying on person memory of employees.

Data. Data cleanliness and quality are also a concern for legacy systems. In many cases, data quality rules were not designed as the corporate rule, and recently becoming an issue under possible centralized repository.

Technologies. Legacy systems may be using old technologies and programming languages that people learned many years ago and are now facing a challenge of keeping such developers. Replacing older development tools with compatible versions is often essential, and this is usually costly and time-consuming. Some old COBOL systems are still running in production under larger mainframe computers.

Post Implementation Problems. In unforeseen cases, legacy systems might have ongoing post implementation problems such as inadequate tests, slow performance, low payback, high maintenance costs, and lack of proper documentation. There is also a crush of historical data, and not the constraint of a hard kill-access, but challenges associated with clean but useful retention to support any possible regulatory needs.

2.2. Challenges of Legacy Systems

The following are the challenges of legacy systems, which consist of several components like coding languages, platforms, models, and front-end technologies. Banks have long implemented competitive software and hardware solutions primarily to listen to their customer needs. Along with the growth of the banks, software products have been installed. It benefitted the banks a lot initially, but as the products became legacy systems, several limitations have appeared, which became obstacles for the operational institutions. As the current limitations are transient from the major upgrades and maintenance of the systems, the lifetime approaches problems that need to be solved in the very near future [1]. Huge investments are needed in the architecture of the system to modernize it and remove the limitations. On the other hand, there are already several constraints regarding the usage of the legacy systems. Any decision that needs to be taken needs to take into account the constraints. The reputation acquired either in time or due to the large efforts are seen as assets. Competitors are using new technology, which often results in better reliability and security than older technologies. However, the attached internal banks' knowledge is so valuable that the consequences of documentation errors within competing systems to change the system are considered. Competing banks implemented large systems. This is an implementation of large projects. The banks know they have to face systems again during their lifetime. Competing banks are expected to remodel based on newer models and enrich planning and auxiliary systems based on latest implementations to make their reengineering verifiable and support auditing. Recognizing diversifying processes and implementation weaknesses, groups of banks implementing them are cooperating to develop common variations of banking systems with well-defined modeling, programming, supporting, and operation interfaces. Specifications have to meet each other as deadlines for extensive cost estimation reports are contained within a whole planning system, which is not being bought or copy/fitted from another bank. Each model was manually copied within DFDs and their correspondence layers in control structures.

3. The Need for Intelligent Infrastructure

In the context of rising expectations for finance organizations to include ESG in their Investment Policies and across their activities, one area of improvement is the Information Technology (IT) systems that these organizations rely on. The IT systems must integrate and accommodate additional engagement, portfolio assessment, asset allocation, and reporting metrics and capabilities… [3]. A considerable amount of work will fall onto the architecture of Data Infrastructure, which includes the components that accommodate the collection, aggregation, and dissemination of relevant ESG data. The core components of a contemporary data architecture required to address these challenges include Data Integration, Data Engineering, Data Quality, and Data Observability, with an additional component Data Catalog (Asset Management). Enabling Data Infrastructure requires substantial modifications to Banking IT systems, applications, and processes. The modifications are required to support banks' standards on the data to be integrated, aggregated, and consolidated. Some traditional Enterprise Application Integration (EAI) tools are still required, but additional technologies will be needed to accommodate Data Value Chain architecture. Along with the integration of internal systems, third-party vendor Data Feeds for certain non-standard data such as Climate Risk and Scoring Mitigation are required to be integrated. Much of this extensive integration work is typically undertaken by Systems Integrators (SI). In addition to the modifications to Data Infrastructure, banks will still be required to develop applications that meet new Data Management and Strategic Analytics requirements. These new applications are required not only for the management and acquisition of ESG data but also for a catalogue of models for financed emissions, environmental metrics, default-fraud-monitoring scoring and Data Modeling approaches, physical emission, climate risk, ESG scorecards, climate-related stress tests, and climate-adjusted ratings [1]. Most of these applications will likely involve the implementation of extended data pipelines and/or re-engineering monitoring processes with accompanying visualizations and alerts which require additional changes to IT infrastructure, spanning applications, platforms, data architecture, and data governance disciplines.

Eqn.1:Legacy System State Equation

$$S_L = f(C_L, A_L, F_L, E_L)$$

- S_L = Legacy system state
- T_0 = Initial time (legacy system state)
- C_L = Legacy computing capacity
- A_L = Automation level (low)
- F_L = Flexibility of architecture (e.g., monolithic = low)
- E_L = Efficiency

3.1. Market Demands and Trends

The needs of the new banking era go beyond the framework of the existing system, which has become increasingly tight. For institutions, this is the inherent demand brought by business, which, when coupled with regulatory demands, often becomes risk. The implementation of a digital financial ecosystem can be a good breakthrough, but this technology is very young and needs to address many questions [4]. For the financial industry, APIs should be opened and a complete bank cross-industry interface should be established. As the "gateway" of finance in and out, the bank is more than willing to approach the unregulated public chain finance, but it should be noted that open also means leakage, which leads to great hidden risks. More importantly, the intensification of market competition will impact banks' thought chains and coordination efficiency. The low willingness to cooperate across industries and cumbersome processes of traditional banks tend to form silo effects and exacerbate greedy trends. In addition to the inherent demand behind the upgrading of financial services, the outer pressure presented by the popularization of big data is also often difficult to bear for institutions with relatively modest scalars [1]. The massive increase in data sources threatens to drown data storage and processing capacity, while the emergence of instantaneously available platforms triggers the race of speed. Prompted by external pressure and internal demands, intelligence is a fundamental way out for banks. The current competency of advanced technology departments is limited. Even Google has to request Oxford University to build the world's most powerful supercomputer network to win the competition with TextFind. For institutions with a relatively modest scale of technical strength, the negative impact of imagined competition should be prevented, and the working focus should be shifted to problems that can be reasonably addressed. The demand structure can start from prevention, accuracy, and timeliness, and extend the coverage and capacity of data-driven institutions; the monetization structure can firmly grasp the upper limit of risk tolerance.

3.2. Benefits of Intelligent Infrastructure

Intelligent Infrastructure (II) expands the existing capability and service offering of the banking infrastructure service provider, and potentially provides the banking sector with a paradigm shift in how they manage infrastructure and its services. Such infrastructure II yields substantial gains in reliability, availability, and performance. Further, the integration of intelligent infrastructure into decision support systems increases opportunities to make intelligent and cost-efficient decisions. Here, ill-founded decisions can result in large financial losses.

There are a number of fundamental components of the relevant development efforts. As II borders upon various disciplines, a careful mapping of the current state-of-the-art in each, and of the various current and anticipated actors in the banking sector, is advisable. The banking domain is diverse and heterogeneous, involving a myriad of different stakeholders, often with competing interests. However, the general interest in the success of II may drive collective development efforts.

The broad dimensions of II encompass a number of components fundamental to the use of knowledge technology and professional services in banking. Future collaboration with manufacturers, system integrators and other knowledge it's recommendations that fit across relevant sectors. There has not yet been carried out a similar mapping of expectations, standards, and potential roles for such actors in the context of banking. Further, there is a mix of proprietary and open technical solutions and standards, combining relevant general specifications with differing realizations of proprietary components. The selection of which to adopt, build, or buy is crucial to, both the practical developments and future growth of the II [1].

Intelligent infrastructure and its ability to realize "smart" maintenance decisions and predictions has been implemented in a number of cases, with fairly general cost estimates and experiences of different potential implications. Such a mapping should result in case stories to communicate in which specific ways II will result in cost savings or service enhancements across the banking sector. Here, due to the presently realized differing human capacities for understanding related line-of-business benefits and technical implications, the synergistic effects with a roll-out over several phases should be addressed, showing exemplars of illustrative intermediate implementations of II.

Fig 2: Integrating AI into Legacy Banking Systems

4. AI Technologies in Banking

AI is an umbrella term for the disciplines of mathematics, engineering, logic, cognitive science, linguistics, and computer science used to construct machines or software capable of developing knowledge or capable of human-like intelligence. The goal of AI is to reproduce certain human abilities in machines and computer programs. The aim is to develop machines that can do activities that require human thought and cognition, including reasoning, learning, and perception. Machines with AI can solve issues and do challenging jobs. AI techniques and algorithms improve a machine's ability to perform like a human [2]. AI is now widely acknowledged as one of the most important digital transformation enablers across a diverse set of industries [3].

AI technologies support banks in enhancing operations across the board, including compliance, accounting, sales, contracts, cybersecurity, and customer services. AI is a sophisticated simulation of human intelligence in machines that are engineered to think like humans and mimic their actions. AI techniques have a major impact on decision making, forecasting, risk control, event identification, customer relationships, and knowledge retrieval in the banking and finance sectors. AI has transformed banking operations through the introduction of virtual assistants. It is able to hold human-level chats with customers by using intelligent bots that can mimic human language. AI capabilities are highly synchronous, quick, and accurate, with prompt response times. It services customers at any time and from anywhere in a unique and innovative manner. Conversational banking is a completely different experience that utilizes platform-oriented business concepts.

Advances in the banking system lead to the emergence of virtual banking. Technology is changing life in the banking sector as well as arrangements in customers, from a launch pad to telephonic banks to ATM services to online and mobile banking. In order to serve new-aged clientele and expand their development potential, Indian banks are progressively using technologies of the future.

4.1. Machine Learning Applications

Financial institutions utilize AI and machine learning (ML) to strengthen operations and improve customer experience. AI banks use analytic engines and conduct optimal interactions via chatbots. AI properly partners with ML to transmute customer data into actionable insights and predict customer needs [5]. AI is used widely to bring mechanical improvements in banking. ML offers smarter access on behalf of supervision and compliance, which assists customers in navigating transaction data links.

The classification of ML applications in banks extends into various domains under two primary categories. There are seven bank operation categories: predictive modeling; risk scoring; fraud detection; virtual digital assistants; customer resource management; sentiment analysis; and real-time monitoring [2]. There are also five marketing prediction models: targeting; statutory complying prior-buy prediction; churn prediction; next-buy prediction; and survival modeling. 691 active AI/ML projects are being catered globally by banks. 94% of banks' engagements in AI are dedicated toward consumer-centric; operational-centric; and legal-centric applications, which refer to consumer facing banking, internal operations, and supervision & compliance factors respectively. 128 individual banks or bank groups that deal directly with stakeholders or information are analyzed, and it is found that banks in developing regions are at the very beginning stage of AI adoption.

4.2. Natural Language Processing

Natural Language Processing (NLP) is one of the great innovation drivers in the banking industry. Intelligent agents to answer customer questions and chatbots to apply for credits are widely in use today. Many other process automation use cases rely on NLP but are less well-known. The analytics of documents containing unstructured, typically text information is a formidable but also labor-intensive scientific and engineering challenge. Intelligent document processing systems often combine several disciplines, e.g. through Optical Character Recognition, a application of Computer Vision to make documents machine-readable, with graphical text layout understanding, table extraction and Natural Language Processing. They have long found application in other industries and recent developments of document analytics systems addressing financial services industry specific needs are being announced.

Besides document ingestion aspects, document analytics systems must use a variety of analytical methods to make information in natural language text available for and consumable by downstream automated workflows. Information extraction methods yield process related entities from documents, structured data such as dates, events and amounts after preliminary unstructured content interpretation. Named entity recognition approaches applied to raw textual inputs classify character sequences of string tokens into given semantic types, e.g. date of booking, action type, responsible department. Often NER is combined with batch processing frameworks achieving near real time processing of large document corpora such as all annual reports of companies listed in the stock exchange.

Moreover, various approaches have been tested and evaluated to answer fact-based questions on the content of document knowledge bases in the context of insurance contracts. Beyond standard questions, complex multi-node questions must be decomposed into a composite query graph and rewritten into logical rules for existing knowledge graph-based systems to properly execute the underlying nested query. Borrowing from natural language processing methods of textual entailment and semantic matching, several approaches translate event history logs of complex process sequences into an equivalent textual description covering included activities. Following this understanding approach, a subsequent document analytics step search for evidence of event expressions therein and decide on compliance using classical textual inference methods.

4.3. Robotic Process Automation

Business Process automation aims to automate the execution of business processes. This consists of both automating the process steps that have been executed by humans and automating decision making in those business processes. Robotic process automation goes one step further and also provides bots with the necessary capabilities to interact with Graphical User Interfaces (GUIs) directly. These new converging technologies provide great opportunities for organizations to automate their entire business processes, which optimally would yield substantial financial savings. However, end-to-end process automation has not been widely adopted to date, especially not in large organizations. A major reason is the limited accessibility of automation technology to business users with limited technical backgrounds. Several organizations have started to build integrated models for automating end-to-end business processes incorporating both lower and upper automation layers and developed enterprise RPA frameworks to increase the engagement of business users [6].

With Robotic Process Automation (RPA) nearly at its peak in terms of awareness and capabilities, organizations are starting to explore what lies beyond it. This paper categorizes process automation technologies into a hybrid framework based on three interrelated dimensions: the automation layer (i.e., the business process layer, the user interface layer, and the system/application interface/ protocol layer), the artificial intelligence capabilities (i.e., the level of intelligence, the nature of the intelligence, and the choice of the automation path), and the underlying architecture (e.g., in-house development or off-the-shelf solutions). Based on this framework, a diverse range of cognitive process automation technologies and their application in different banking, insurance, and market contexts are described [7].

The organizational transformation needed to implement cognitive automation technologies successfully is discussed. The implications for RPA technology vendors to expand their ecosystems and the implications for organizations to develop cognitive automation capabilities are outlined. Lastly, the challenges that organizations face to evaluate, select, and implement such technologies are presented.

5. Roadmap for Transitioning to AI-Driven Systems

The race of tech giants and founders to define the future of intelligence and AI with respect to opportunity, function and governance. Along with the profound implications these ongoing changes will have on every enterprise in terms of systems, workflows and capabilities. Preceding AI Foundation Models now collectively being referred to as GenAI, Large Language Models, Chatbots and/or Agent or Cognitive Systems are in themselves a comparatively recent innovation in terms of transformational potential. A fundamental nature of technology generational transformation is that a few lagging sectors get pushed into action after many others have already made substantial gains. This is the case for Banking Technology and Banking Operations that need to catch up having adopted little in the way of modern capabilities even prior to the emergence of Foundation Models.

Much before the emergence of GenAI a plethora of FinTechs were servicing the needs of a new cohort of retail and business customers while the banking incumbents were largely resting on their legacy architecture. However, the matter of basic cognition was seldom addressed leaving the pre-digital systems and workflows intact. The tentative exploration of Foundation Models is one where the use cases, governance and technical solutions are ongoing and uneven. However as proven by the many generations of change preceding it, the eventual impact of General Purpose Technologies tends to be vastly larger than anticipated and felt much more quickly in mature industries like Banking. Thus, while the outcome of the transformative phase being discussed is marred by uncertainties, it is prudent to begin framing and executing the next adequate organizational choices.

Describes the basis and architecture of old Banking Technology and management practices as foundational systems. It also discusses the nature and purpose of Intelligent Banking Infrastructure as a new basis of Banking Operations and Banking Technology and describe why the two can now coexist. The aims and properties of Intelligent Banking Ecosystems as the new charge for Banking Facilities are also discussed along with implications for Bank Personnel and Executives as well as for the Public at Large. The last section summarizes and indicates further directions of inquiry. It is a well-established fact that good product and service quality however defined, must have at least three ingredients as found with respect to the traditional banking system: (1) Capital (Assets and Capital) with respect to some accounting scheme is obligatory (2) Credit Value (Liabilities) is also obligatory, and (3) Cognition (Computing, Information Retrieval, Analysis, Storage, Organization, Processing and Communication) is optional. The cognition function and purpose are new and incidental to Banking as overall governance or theory of motion.

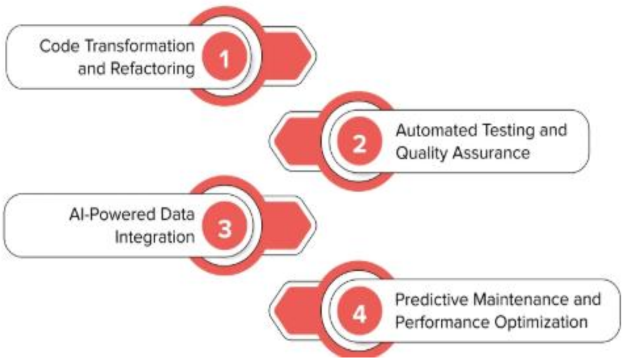

Fig 3: AI for Legacy Application

5.1. Assessment of Current Systems

Most banks developed a computerized system somewhere between 1970 and 1990, after that they tried to adapt the system to changes in the bank's organizations and in the legislation. In the last ten years banks have changed very much, due to the emergence of a new competition: foreign banks and specialist ones. The subject of the paper is the legacy systems. These systems supply a very rigid environment, difficult to match with the changes. The adaptation solutions chosen by different banks produced systems barely satisfying the new requirements, at high costs and risk, very far from the ideal flexible one, unique for all banks. These legacy systems persist because of the high costs and risks of replacing them. The developed application strictly covers the initial needs, without the view of the long run applicability. These applications survive because of very good technical skills of a few people, with deep knowledge of all systems and all business logic. They are based on a few hardware circuits designed during the eighties, adapted continuously to new technologies, still very expensive for purchasing and maintenance [1].

For getting together in a unique environment, the different applications developed in each bank need to "talk" with each other. The standard way of exchanging data depends on the packets representation and their communication protocols. Statistics and knowledge need to be exchanged among them. Very few banks use a middle-ware solution to enable this dialogue. Existence of a very old realization drives numerous trillions of calculations each second, on which stable and capital banks depend nowadays. This approach adds complexity and redundancy instead of standardization and minimization. There are signs that banks start to realize that the on-going process to unify them is too expensive regarding time, costs, and risks. These existence of a new architecture on which most of them should be based on have. With the legacy systems, these banks are very far from the ideal architecture [2].

Immediate need appeared software not taking into account the long run. Starting in the 70-s, the different applications were progressively adapted to new requirements. At a first look, this enhancement succeeded but, at a closer inspection, some moral constraints appeared. The continuously adding of new modules produced complex applications with deep business logic. If banks purchase or develop new systems, a clearly statement of the configuration, given by parameters like: the system volume, number of client discs and simultaneous users, should be drawn up. The implementation should be written strictly in a language that proficient programmers are able to use. Still, the difference between what a bank is ready to give and the amount of money, in terms of services and source code, offered is huge, and since there is no suspension, the demand should be nevertheless found. At any moment, the writing of the high level description gives an upper bound on what can be asked after being unveiled documentation, and not an easy task to be resumed. If a company provides a product from the first point of view, very simple. Higher demands contradicting the main idea of any commercial should be anticipated all the time, and documented regarding their specification, aiming to purchase an error-free product.

5.2. Strategic Planning and Framework

A key characteristic of the introduction of the AI technology stack is to ensure its adoption and acceptance by the organization holistically and enterprise-wide. This means AI investments should treatment across all areas to capture synergies and avoid organization fatigue from fighting silos. The AI transformation should be an enterprise-wide initiative coordinated at the strategic level. The introduction of this technology stack must be supplemented with an organizational framework to leverage it across the organization and minimize the risk of balkanization. Such a framework maps horizontal enterprise-wide roles (exploiting the AI tech stack generically) to vertical business roles (use cases that differ across lines of business) [8].

Eqn.2:AI-Driven Infrastructure State Equation

$$S_A = f(C_A, A_H, F_A, E_A)$$

- S_A = Intelligent (AI-enabled) infrastructure state
- C_A = Scalable computing (cloud, edge)
- A_H = High automation (via AI/ML, RPA)
- F_A = Flexible, modular architecture (e.g., microservices)
- E_A = Enhanced operational efficiency

At the strategic level, a three-prong institutional architecture can foster the introduction of AI generically, while ensuring coordination with business areas. First, an AI Office or equivalent coordinating unit can leverage the AI tech stack across functions to minimize duplication of effort. Second, AI governance is required to configure guardrails for the AI agenda and AI efficiency. Explicit governance is necessary to proactively address regulatory questions presented as existential threats to AI initiatives and deployments. Further policy decisions will also be necessary to ensure the ethical and responsible use of AI applications, avoiding biases, transparency, and explicability [9]. Finally, a horizon scanning function can explore the AI competitive landscape to maximize the chances of being a winner.

An AI first organization consists of roles at four different strata, with horizontal roles assumed across the enterprise orchestrated at the enterprise level and vertical roles that are function specific at the business unit level. In this square, the complimentary pieces can be configured to resource AI teams and realize the advantages afforded by a foundation based AI technology stack.

5.3. Implementation Phases

Front office processes are being automated across the banking value chain, and the introduction of product automation is a key strategy in this movement. Clients gain immediate benefits from increasing automation in the retail front office [1]. The investment in automation in the investment and corporate banking front office is directed to gain an edge over competitors, and the race for product and service automation with suppliers begins. However, there are significant costs involved. It is estimated that 10-20% of a bank's IT budget is allocated to continuous maintenance and upgrading of aging financial product engines. Downtime during upgrades and cross-commissioning of new product components in legacy systems carries very high costs and disruptions to business processes.

As part of the modernization project, a set of new operational processes will be introduced for the bank. The implementation of the new processes will require substantial changes to legacy systems, which in turn involves significant investment in upgrading them. The investment in modernization is not only in new software but also in training the people to take on the new roles, resolving the organizational changes that the introduction of new operational processes entails, and developing new risk assessment and management frameworks for managing the bank's business under the new rules of the game resulting from the new operating environment [2].

A multi-phase change management program is proposed that will first implement new operating processes for the non-retail front office. A fully automated environment focused on one product line will be deployed. A pilot implementation of the changes will be implemented based on the selected product line in the wholesale banking domain. A multi-year sequential implementation of other products is planned. Engagement with the pilot implementation will provide a live environment for the development team to learn and fine-tune the processes and tools for the full-scale deployment in the legacy environments. A single automated product processing environment will be developed, which presents its own set of challenges from an architectural point of view as it involves heterogeneous environments and a rich palette of technologies.

6. Data Management and Governance

Despite new technology solutions being available, financial institutions are still grappling with legacy systems. Many banks maintain core legacy systems put in place decades ago when the technology was supplied by a handful of vendors. They are unable to swiftly update these systems and provide clients with innovative services. Such systems cannot be constructed or updated in-house, which increases institutions' risk exposure to the monopolistic vendor market. Client, asset, and funding data is recorded in silos, and there are limited capabilities for connecting components across systems. In addition, or outright prohibitive, licensing and maintenance fees are charged by the monopolistic vendors for the apps and extension modules available on legacy systems. It can be financially, but also operationally, infeasible to leave legacy systems behind and construct everything anew. A strategy for modernization must take into account the financial institution's specific characteristics and ethos, the contemporaneous technology options, the uniquely challenging supervisory framework, and the mounting market pressures to adopt smarter, more smooth, and more efficient infrastructure [1].

The approach is to recommend a solution for modernization based on a service-oriented solution with time-tested and up-to-date open-source technologies that would operate on top of existing back-office systems, whatever their vintage, without disturbing their operation, and geared on migrating/preparing models along a self-service paradigm. The resultant open architecture is expected to become a bank's nervous system, connecting people to institution processes and services, and these services with data coming from various but integrated sources. Such systems call for a risk-oriented governance model given their distributed architecture, reliance on composite services, and ability to be altered via pattern development and local implementations. It is argued that distributed governance based on uniform security guidelines that developers must adhere to should be able to ensure the system's robustness without hampering innovation. Consequently, management platforms deploying rigorous audit mechanisms are envisioned to enforce compliance and ensure banks' control over the modifications made to their systems.

The key goal of this article is to lay the conceptual groundwork for a guidance system that banks can build upon or further modify according to their specific characteristics. The aim is to underline the desirability of a distributed governing system and suggest how it may be implemented, and in connection with what tools, options, and issues. Satisfying conditions for self-governance here means balancing price-efficiency and rigour, forecasting and holding people accountable, and leveraging the appropriate level of technology to avoid duplicating the compliance obligations of front-office employees [9]. The proposed approach discards the attentional and technical bottlenecks inherent in centralized governance.

6.1. Data Quality and Integration

The organizations should design and build the components for data quality monitoring and data quality integration in an open way instead of proprietary systems. This enables them to share their data quality solutions with others in the value chain of data. Their vulnerabilities can be addressed by creating a broader ecosystem of trusted service providers. The organizations may also join as early partners of a data space in the respective domain. The data space represents the most powerful concept to establish a new paradigm for data sharing where guarantees for data privacy and security are respected. Under these circumstances, even sensitive data, such as customer data in banking, can be safely shared with trustworthy partners.

However, integrating and preparing data for modeling poses new challenges. Although new, native cloud services are emerging, best practices for building them are still lacking. The organizations would like to understand what architectural decisions to take when building data and ML pipelines on top of data lakes as data- and model-centric solutions. They expect such pipelines to produce outputs that they trust, but also to be convinced of this trust in a scientific way. They would like to have a principled understanding how to guarantee respective properties. To achieve this, a novel technique from verification, called quantitative conformance checking is applied to test that they style the model somewhat similarly to the training data.

Under such conditions, the rules for building models would be generalizable rather than tailored to the bank at hand. Consequently, they would be easier to verify. The assumption is that a model is built on top of some primitive components. In addition to model building, they are concerned about compliance checking and why it takes so long. The deployment, monitoring, and governance of ML models still remain tedious manual tasks. How to automate and integrate them.

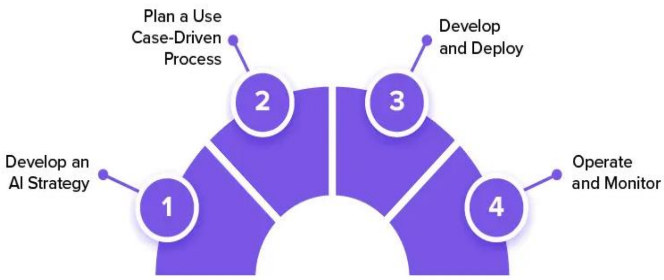

Fig 4: AI in Banking is Shaping the Industry

6.2. Compliance and Regulatory Considerations

New intelligent technology poses fresh regulatory issues for banks, and if banks do not arrive at solutions fast enough, they risk overregulation. AI systems have transformed and redefined many aspects of life, including how we work, how we live, how we consume, and how we transact [9]. They are at the core of smart products and smart cities and the backoffice functions of companies in every corner of the global economy. In finance, AI systems are reshaping the interaction between organizations and customers, and the dynamics of competition. They are changing trade, compliance, operational and fraud risk monitoring, credit risk, model risk, identity verification, cybersecurity—and even investment practices themselves [10]. This is relevant as well for trust, confidence, reputation, and monetary and fiscal system stability. AI systems have also been at the core of major financial disasters and crises. The regulatory agenda dealing with AI could be rather mundane, addressing understandable worries about the scalability of risks. Plans and drafts now on the table are however ambitious and transformational in scope, looking to redefine entire markets, business models, sectoral limitations, and business conduct econometrics.

Regulatory steps could therefore result in immediate turbulence in markets—both asset markets but also the markets of trust, confidence, and reputational risk. Regulations elaborated ten years from now would extend and deepen into an economic walkback of the new intelligent technology in finance—until that redeployed backoffice technology resorts to the older eras of accounting and pre-digital one-size-fits-all trades (included backoffice monitoring). Regulators should have a clear understanding of the financial visions and processes enabled by AI systems to identify where to drive them. They need industry-wide cooperation on standards from conception rather than ex post splintered rectification processes, otherwise regulations will become interminable cat-and-mouse games. On the other hand, regulators risk becoming even more vulnerable to tech lobbies than they are now. If appropriate standards are defined by regulation, the inherent advantage of global players and technology developers for procrastinating on new ethics and privacy standards will shift to the advantage of non-existing firms and SMEs which all have the chance to become AI aware.

Other financial institutions or critics missing the earlier boat would become unable to remedy this discrepancy—and the implication on their reporting and watchdog roles remains uncertain. Regulators will also need time to adapt to fast-changing technology if all players cooperate on open specifications. A smooth transition would evolve around dialogue, friendly concretization and testing proposals, and creating common data sets to monitor if and how errors are propagated. During the more turbulent rediscover phase in tech firms of the late 20th century, only the eventual re-organization of the competing regulators—given the wide cross-section, jurisdiction, and enforcement capabilities of AI systems—could have a smoothing effect, but also some collateral damage. Financial firms will need time as well to re-prioritize their strategies and reset expectations on AI systems. Care should be taken with avoiding firesale.

7. Change Management in Banking IT

In the case of banks converting their legacy processing platform to an SOA/XML approach, or event series reverse engineering and application migration, a due diligence assessment was allocated for the banking application portfolio. Additionally, to understand which applications are obsolete and need to be re-engineered in order to adjust to the company's vision of speed and flexibility of the processing platform, as well as to determine how SOA compliant are these applications [1]. The main objectives in outlining the banks' application portfolio were: to provide an A0 overview of technical architecture (high-level design) to point out and to deep dive into the level 1 applications, containing legacy, obsolete (not maintained), migrated to open on the banks SW portfolio. Create a glossary with the applications details and a document describing the preliminary high-level view of business aspects mastered by applications and their association with banks' core capabilities began by identifying for the applications' delivered functionality classification criteria for the applications identification base shared by the comparison criteria.

A set of general classification rules was developed to classify how SOA compliant these applications are. The key classification concepts were implementation changes possible, performance and stability, and cost and benefit. As general comparison criteria used in a number of due diligence assessments together with the above-mentioned classification rules, these criteria stabilise the comparison decisions amongst the nominated banks' applications. As a consequence these criteria need to be adapted to comply with the application domains and business specifics of each applications' portfolio. A worldwide bank approached Bratislava and Vienna market for heavy lifting data extraction and preparation processing buildings brick development, loading and report generation frameworks. The core bank tabular and analytic reporting requests identification and branch pricing tools pipeline reimplementation was conducted. Additionally, performance test benches and macros were built in case of any below 5 min batch increase in execution time. In this setting, banks is facing the following challenge: front- mid- and backend systems were developed by regional banks' IT vendors on a series of home- or COTS developed technologies. The initiatives were implemented in isolation leading to components interoperability issues, data conversion delays, data access performance hardships, and batch generation delays.

7.1. Stakeholder Engagement

Banks are often discussed from two perspectives: the regulatory and the commercial, both of which are components of a banking IT ecosystem. Although there are many stakeholders involved in the banking business, developers usually focus on only a few key stakeholders including clients, regulators, administrators, and support. There may be many other stakeholders who interact with banking systems, such as the media, with which traditional systems usually interact through the bank's portal, and AI can be used to generate news articles automatically based on the bank's actions and services. Other stakeholders of banks may also include investigating bodies and the Central Bank that monitors the transactions based on the risk profile of the account holders serving as the pitch for AI algorithms to detect transactional trends.

The banking business is one of the strictest regulated industries. Overall, however, regulatory agencies and laws differ from one country to another. To illustrate, various regulatory authorities have their own regulatory technologies. Similar approaches could be followed by other regulatory authorities, such as support in development and production for new legislation, or tools to periodically audit the organizational factors and the political risk of their attributed clients regularly. At smaller banks, usually, they have more optimistic predictions about potential growth, thus larger political risks, which are positively related to credit risk. A bank's early warning system makes it more risk averse, and its security is quite important. A required approach would be to gather and integrate the CRAs, non-banking, and press data with their publicly available databases and apply AI algorithms to detect possible ex-ante investment risks. Another approach could also be used to provide documentary evidence regarding antecedent data assuring a smooth daily audit.

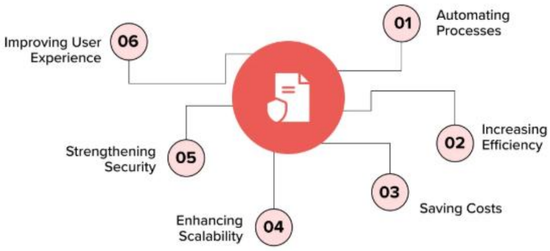

Fig 5: AI for Legacy Application Modernization

7.2. Training and Development

A bank's success and viability depend on a cost-effective IT landscape. This requires initial, ongoing, and adaptive investments. Optimal management of banks' legacy IT systems requires a systematic approach to building and maintaining its IT landscape in line with external demands and from within the organization. Such maintenance includes ensuring efficiency and effectiveness, and their optimization if necessary. Companies are more than ever dependent on their digital services and IT systems. Having a fit-for-purpose portfolio of IT systems that are maintained in a cost-effective manner is a primary requirement for a viable enterprise. Also, banks can only remain competitive if their systems can be adapted quickly and effectively to new market developments [1]. 'Adaptable' means: in being able to apply new IT systems functionality and interact with such new functionality embedded in new packaged offerings. This requires long-term investments and ongoing involvement of IT professionals in the design of the packages. 'Optimal' means: minimizing the overall and structural costs of digital technology. Companies will have to redesign their portfolio of IT systems, adapting both the applications and technology, if they want to avoid the spiraling costs of keeping and maintaining non-adaptive legacy systems. They also will not be able to hire the required human resources to keep their systems fit and agile [11]. To avoid escalating costs, but also for transparency regulation compliance, it is vital that banks systematically manage the costs of their IT landscape, guaranteeing their effectiveness and efficiency. This requires an understanding of the cost structure of IT systems comprising the capacity to determine the influence of changes in the composition and usage of IT systems on their costs. Modeling cost structures is generally a complex endeavor because of the correlation and dependency of costs and technologies; this is exacerbated by the existence of multiple cost drivers affecting costs at different abstraction levels. Nevertheless, methodologically sound ways exist. To that end, complexity, both in terms of available technologies and of possible interactions in value networks, is on the rise. This results in massive databases and multiplicity of interacting decision entities. However, as a result of similar evolutions in society at large, a growing body of methods and techniques has been developed to cope with them.

8. Case Studies of Successful Transitions

The banking industry has undergone transformation in the last three decades as it faced challenges posed by new players, products, technology, and regulations. Banks have realized that the IT infrastructure should evolve in a more intelligent way to accommodate these requirements. This paper presents a roadmap for developing a predictive, pro-active, and automated intelligent IT infrastructure. The idea is to develop a knowledge base on the existing technological landscape, identify interoperability policies for next generation banking products, and evolve both infrastructure and products over the policies. This will eventually lead to an intelligent banking infrastructure that is flexible, cost-effective, can add-on features with little risk due to anticipated failures, and self-heal in the event of process failures. This paper gives a four-tier architecture, and explains the developed morphological analyses and on-going work for realizing simplicity and modularity in the first tier of infrastructural evolution [1].

Digital transformation strategy teams, under executive director oversight, are responsible for executing and monitoring the overall digital strategy. Company-wide oversight is increasingly common in areas ranging from acquisition to transition planning to talent development. These team functions are still mostly supportive, but they are being provided authority due to the emergence of large-scale, company-wide initiatives [2]. Frugal digital banking is an environment in which a bank must operate with limited financial resources yet be productive, efficient, and customer-oriented. With a large number of different banking services at low costs, and in some cases without charging anything, a bank must turn to technology to serve its customers well. The case illustrates what technological developments are recommended, given a bank's absence of a strong IT infrastructure.

8.1. Case Study 1: Major Bank A

A major bank in Est Europe was operating a large legacy banking core system built on mainframe hardware complemented by various middle tiers for reporting and orchestration around it in a homogenous stack. The core banking functionality and stability was at best satisfactory, but the systems lacked in flexibility and exploration of the value-creating capability of data. Thus, management decided to engage with a consulting firm to explore modernization options and end state architectures supporting AI-driven transformative solutions. The framework of modernized options was assembled together with a senior bank architecture team focusing on long-term architecture planning, product stock taking, and tech stack harmonization. Starting platforms, distribution principles, cloud readiness, and general investigation principles were discussed at a workshop attended by both teams. As a continuation, the modernization approach was explored with the delegated senior architects at a 2-day design session. The brainstorming session was structured around consolidation, disaggregation, and dissolving the case bank's legacy systems. On passing through the 4D framework discussion, a tonal shift was detected. While the first iterations emphasized modernization focusing on the preservation of legacy functionalities by using wrapping solutions, during the design sessions, a focus on design principles circumventing wrapping solutions emerged. Next, discussion points related to principles going directions and transformative disaggregation approaches were elaborated on. The contextual questioning subsequently arose on how to progress in hardening current design principles and crucial decisions in the eventual design process and stability.

8.2. Case Study 2: Major Bank B

Central Bank B has over 2,500 customers, including money trading companies, insurance companies, brokers, investment funds, and others. Risk-management and financial analyses for enormous currency positions require not only the most accurate market data but also extremely high-performance systems implementing even the most complex algorithms. To service such high-performance clients, Bank B adopts market technologies and is among the first financial institutes applying high-performance computing within its trading activities. Owing to its computing capabilities, Bank B also maintains a significant share of computing-related banking services like hosting and operating individual market models. Installing a vendor-supplied algo-trading framework with the trading system's components split into a centralized service bus and various external server applications enabled handling thousands of FX and set trading orders every second. On the other hand, customer surrounding market feeds are accessed through the legacy installment central Exchange Interface, HIQ. HIQ maintains and guarantees a reasonable volume in terms of additional and expired instruments, but since its establishment trading surfaces are undergoing global constructions/overhauls. Previously, constructing traded instruments on the service bus required merging vendor functionalities with Bank B proprietary implementations in the conversion of reference messages, introducing various interdependent bottlenecks. Besides, the repartition of the incoming and package pairs' keys on the output channels greatly lacks flexibility, thereby hard-coding spreading strategies within sliced buffer implementations. Further, filter criteria depend on ever-changing customer requirements requiring also remodels of the emerging message structures, thereby causing significative workload for bank arranging resources. Therefore, in order to accommodate not only planned expansions on the transforming service bus toward client-side and cloud-service read/write operations but also to improve performance and flexibility, HIQ representatives were gathered for preliminary vision and use-case discussions working from the ultimate component/operation towards asked solutions. For legacy block memo applications a simple design integrating or proprietary protocols and able to shunt market events to databases and storage on a gateway was built to ensure controllable perspective data queries.

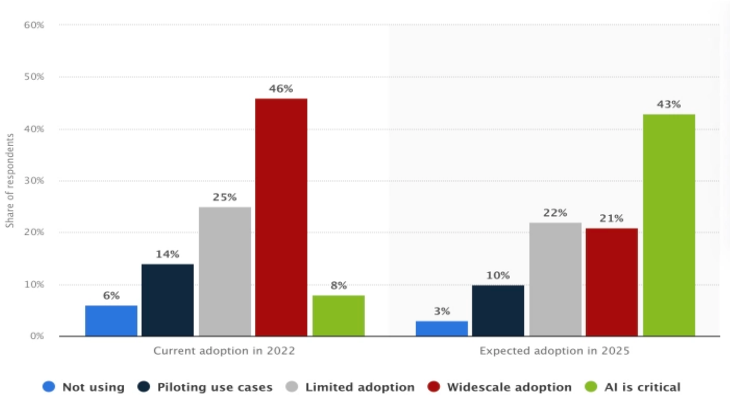

Fig : AI in Finance Reshaping the Industry

9. Future Trends in Banking IT

The banking industry has been a pioneer in adopting electronic markets with exchanges, clearinghouses, and multilateral trading facilities having become the backbone of today's globally integrated financial transactions. This position paper argues that the financial crises, the changing behavior of customers, upcoming innovations based on information technology (IT) and financial services offered by non-banks are strong drivers towards more customer-orientation in the financial industry. A large variety of banking IT innovations has emerged and illustrates that traditional banks are expected to have less power to impede competition at the customer interface and in consequence need to re-position themselves. Building on these developments and existing electronic market infrastructures, the concept of a customer-oriented financial market infrastructure is proposed as a possible future solution. Besides describing the threat to existing banks, the position paper also discusses the perspectives for banks. The innovative application of information technology (IT) has a strong transformation potential [1].

The traditional competitive advantage of the banking sector – the provision of information via a well-defined and regulated two-sided market – threatens to give way to an IT-driven customer-oriented market, where neither intermediaries nor traditional banks play a pivotal role anymore. As this transformation process has already begun with success in other domains, structuring the problems and chances involved on the one hand and operational steps to a possible vision on the other hand is imperative before falling behind in competition. The banking industry is about 20 years behind the telecommunication sector where Open Service and the concept as pioneered by global service exchanges has given way to a variety of new markets and participants [12].

9.1. Emerging Technologies

Today's financial services sector is witnessing an explosion in the adoption of intelligent data technologies. The race is on to transform existing operations and develop new business models to capitalize on the vast potential of data. Artificial intelligence (AI) promises smart systems that can analyze data intelligently rather than just analyzing data at high speeds. AI systems can replicate human-like intelligence by using biophysical principles behind human thinking, perception, and recognition.

Banking is a profession that is on the verge of radical transformation due to the almost ubiquitous adoption of AI-related technologies. The rise of cloud computing, big data, blockchain, internet of things, algorithmic computing, and social media is radically changing businesses and entire industries. In order to stay ahead, the banks will have to fundamentally rethink their operational and business models. They will have to build next generation digital platforms that can infuse intelligence wherever it is gathered in their IT infrastructure for the immediate and long-term future. In addition to being data competent, the next big wave in digital transformation in banking will be AI competence. Intelligence is an outgrowth of complex data—blockchain is structured, while social networks are semi-structured. Suppose banks want to capitalize on the intelligence that is generated and matured in their complex data. In that case, they will require a fundamental shift in their governance processes, organization and operational models, ecosystem engagement approaches, and technology architectures. They will have to create an integrated intelligent data competence and BI architecture on top of their legacy systems. Such a platform is mandatory for implementing a broad range of intelligent analytics, learning, and cognition processes. It will have to provision the entire spectrum of intelligent data processing workloads from batch to near-time to real-time and autonomous. Banks investing in this area will have more objective evaluations than others that depend on human expertise [1].

Intelligent process re-engineering is the primary work of the platform. It will aim at harnessing existing domain knowledge and business procedures present in structured documents, business rules, legacy systems, and spreadsheets, transforming them into intelligent algorithms, and incorporating them in intelligent processes that would execute the algorithms. Process re-engineering will gain greater relevance in banks' digital transformation processes. Current automated scripts running on traditional RPA platforms will need to be replaced with intelligent agents driven by machine learning algorithms and utilizing advanced techniques for textual image, sound, video processing, behavior simulation, semi-structured data integration, etc. Such algorithms will recognize the meaning of business events, decide whether they require action, and initiate appropriate actions in complex event processing and business rule systems [2].

Eqn.3:Transformation Function Over Time

$$S(T) = (1 - \Phi(T)) \cdot S_L + \Phi(T) \cdot S_A$$

- $T \in [T_0, T_1]$ = Time from legacy to intelligent infrastructure
- $\Phi(T)$ = Transformation progress function

9.2. Predictions for the Next Decade

The banking landscape has shifted as firms of all sizes face pressures to invest in improved infrastructure, thereby enabling speed of transaction and adoption of new tools. Progressive consumers have adopted new businesses that often provide seamless service on leading technologies. The legacy systems which represent 80 percent of the global banking IT budget are no longer sufficient, hence the increase of pressure to invest. A portion of infrastructure investments would definitely be in regard to renovation of existing infrastructure while a small fraction would be left for improvements on behalf of stopping or preventing rapid damage son business outcome [1]. On the renovation side, these are the core solutions that would have to be implemented within large banks: foundation of a clean room to isolate core banks from the back office operations and corporate applications, investments in Java development platforms, 3rd party database and environments, architecture using drill-down systems, Document Management System software which would integrate all the processes producing any kind of document, introduction of the Data Warehouse concept, and stand-alone applications for management information. All of these systems have been hard found and neglected during many years, they were purchased with great effort to have very few in use. On the ordering side, three aspects must be treated and can ensure significant efficiency pressures on product development teams. The first one is education on the new technologies and its implications, even in regards to the new traditional paradigms. The return on strategic preferences in a company can not rest and can only cover expects regarding short manga-systems offered by highly specialized firms. The second aspect regards having a back office product training soundly organized as the technology to be learned needs the catalogue to come around and the scenarios to build on. One or two day shows of how modules function are not enough for the product knowledge to be properly recognized and assimilated in most solutions case. Most needed are onside demonstrations of the extent of the viability of the product technology on terminal hardware. The last aspect regards hiring efforts if any left to be made on enlarging the group then account for a strong increase of acquisition for product knowledge.

10. Conclusion

Banking is an efficient and innovative service industry based on technology. In recent years, the banking system has witnessed an explosive growth of Information Communication Technology (ICT) services, providing innovative online service facilities to customers. Financial innovations provide a solution to the problem of financial exclusion and also add more value-added innovative measures to the existing product and service portfolio. Innovations in account opening processes, form filing with pre-tested queries and clarification, amongst others is increasing the customer oriented approach of banking services. AI is now widely used in the banking sector. The technology to perform simple tasks is ruling the banking sector. ATM is the best example of how a routine task of drawl of cash by a customer is made automated. Tellers have been replaced by ATMs and now banks can manage effectively with lesser number of human resources. Technology and time are two indispensable elements for the banking industry to maximize profits with ease and narrow down unnecessary operational costs. AI has come into play to assure technology upgradation in the banking sector with its remarkable efficiency, security and sophistication attached with predictive analysis. With the aid of AI, core banking has undergone huge transformation. Core banking ensures a banking experience for customers irrespective of branches and geographical boundary of banks. But there are still some banks which operate in a manual process with a single branch operations. Operational performance is enhanced by process/technology automation and non-intrusive best practices. The banking sector in India has witnessed a conspicuous transformation with the changing needs of customers in the recent years. Banks have introduced new services such as internet banking, mobile/ telephone banking, ATMs and a host of modern banking services to cater to the growing needs of customers. In India, the nationalized banks are still using the legacy systems AS400 and IBM mainframes, which were 25-years-old and hindering the mobile banking, Internet banking, ticket and taxi bookings etc. [1] Several banks from the private sector have transitioned from fully integrated to distributed systems, which is a collection of software components that troubleshoot and address different business issues. Stack upgrades become the new rage, making older systems vulnerable to attacks. The interoperable new systems ensure flexibility of operations. Surging pilot projects of RTGS, IMPS, NFS, and so on using standard technical architecture underpin this growth. Competitors are simply not in the banking route with service delivery at superfast speeds. These non-banking organizations can be dangerous competitors armed with languages, enhanced memory and cast iron fiddles.

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