Core Banking Modernization

Justin Kilimnik and Chris Pavlovski

Abstract-- **The banking experience for many people today is fundamentally an application of technology to be able to carry out their financial tasks. While the need to visit a bank branch remains essential for a number of activities, increasingly the need to support mobile usage is becoming the central focus of many bank strategies. The core banking systems that process financial activity must remain highly available and able to support large volumes of transactional activity. These systems represent a long term investment for banks and when the need arises to modernize these large systems, the transformation initiative is often very expensive and of high risk. We present in this paper our experiences in bank modernization and transformation, and outline the strategies for rolling out these large programs. As banking institutions embark upon transformation programs to upgrade their banking channels and core banking systems, it is hoped that the insights presented here are useful as a framework to support these initiatives.**

Index Terms—**Banking, Modernization, Transformation.**

I. INTRODUCTION

Core banking traditionally refers to range of functions including deposits, loans, payments processing, merchant support, and card related transactions. For institutional banking this will refer to monetary exchange markets, commercial loans, and wealth management. Although the broader scope will differ between financial institutions, there is general acceptance of these functions as being the traditional core banking domains. These core functions form the mission critical daily operations to be supported by banks. The information technology and communication systems required to support these services have the highest availability requirement with any outages to business continuity having a significant impact to banking revenue and operation. For instance, it is reported that the average cost for downtime for financial and brokerage firms ranges from USD$1.5 million to USD$6.5 million per hour [1]. Additionally, the large volume of transactions to be supported also means that high-end platforms or large clusters of commodity hardware are key decision points for these systems.

The choice of platform and technology to build core banking systems has evolved to the point that packages now offer a broad range of capabilities to address the various functional areas. However, in practice these banking packages typically require significant customization for deployment within the targeted institution, often causing significant delays and costs during the project development life cycle. We aim to describe an approach to core banking systems upgrade and/or replacement based upon lessons learned in large transformation projects. Whilst banking institutions have undergone such upgrades in the past, often tackling a full systems replacement in one phase, the same *big bang* philosophy is unlikely to be the best option today and will foster significant risk due to the increases in complexity of capability offered, diversity of technologies, and the large number of systems to integrate with.

In this paper we discuss the approaches that are applied to core banking system modernization programs. We highlight the lessons learned that are applicable to these programs and note the similarities with transformation programs in alternative industries. We also propose a high-level strategy to carry out a major banking system upgrade that balances the risks associated with large projects, the technologies applied, together with the time and resources required. Given the significant costs associated with core banking replacement (sometimes up to several billion dollars), it is hoped that the presented approach and lessons may be useful to banking organizations embarking upon similar large scale modernization. These observations also have applicability in other industries. Hence we view the main contributions of this paper as follows.

1. Define the scope of core banking modernization programs.
2. Discuss the strategies and approaches available for core banking platform replacement.
3. Present lessons learned in banking transformation, with approaches presented that balances risk, costs, and time.

In the next section we review the literature related to core banking and modernization. This is then followed in section III by a discussion of the functional scope that defines core banking and the associated support systems. We then outline in section IV several approaches and methods to implement a modernization program for banking. This is then followed by a discussion of the lessons learned in core banking replacement. Finally, in section VI we summarize and discuss the work presented in this paper and note that there are several areas of further work.

II. RELATED WORK

There has been much recent work on banking system trends focused upon the application of recent technologies such as mobile devices, SOA, and payment systems [4, 5, 10]. All these advancements rely upon core back end banking systems, the focus of this paper.

There are several papers that explore the core banking functions and their implementation. The features and architecture for core banking systems are detailed in [2], where

J. M. Kilimnik is with IBM Australia (justin.kilimnik@au1.ibm.com).
C. J. Pavlovski is with IBM Australia (chris.pav@au1.ibm.com).

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a functional architecture of the banking sub-systems are described. This includes treasury modules, retail banking, private institutional banking, wholesale modules, and multi-channel capabilities. A further paper discusses the core banking capabilities in the context of electronic banking [3]. Whilst it may be argued that the majority of banking is now focused towards some form of electronic banking, the authors puts forward the notion of the disruptive nature of e-banking and identifies eight core capabilities to apply to emerging information technology trends and to reconfigure existing business models.

There are several papers which discuss the application of SOA to core banking [4, 5]. The case for a meta-architecture is argued in [4]. The authors suggest a layered architecture to reduce complexity of design with a set of defined views to improve clarity of understanding of the systems involved; key to this is the use of SOA to provide a layer of banking services for interacting IT systems. Other published works support the approach for an incremental and progressive transformation of core banking systems based upon SOA design principles [5]. The paper also reviews the trends in banking globally observing that banks are taking advantage of technology to improve margins, transforming to become customer centric, and are coming under increased pressure from new imposed regulations. To tackle the challenges for 'bank renovation' the authors suggested that SOA can be applied to manage the transformation in a progressive manner, rather than the more risky approach of total replacement as one implementation.

In [6] the success of IT implementation of a banking system is studied, where a case study is used to support the finding that the success of IT systems is closely related to the alignment achieved with understanding the banks business operations. Another paper that follows a case study also reviews the management practices and their associated impact to effective implementation [7]. The paper presents a number of findings including the balance of out-sourcing and use of in-house resources, the need to communicate benefits of newer technologies to bank staff, and improve management of IT within the bank.

A further paper studies the attributes of repeatable success in core banking implementations [8]. The authors explore the linkage with business and technical requirements describing the importance of IT delivery execution through planning and project implementation processes. They also note the importance of capturing lessons learnt as a key differentiator to be applied. We follow this line of thinking and explore in greater detail the experiences in core banking system modernization, describing the technical and functional principles to be observed during these implementations. This area appears less well studied and hence we present our observations and findings so they may be applied by similar projects embarking upon modernization; with a view to help manage the complexity and reduce the significant risk and costs associated with these programs.

III. CORE BANKING FUNCTIONAL SCOPE

In this section we describe the functional scope that embodies core banking as well as the set of extended functions that often comprise these core operations. The exact scope of core banking will differ between institutions however the presented capabilities appear to be generally accepted by the financial industry. For completeness we also outline the operational banking and channel support systems. The following diagram (Fig. 1) illustrates the position of core banking systems with respect to other banking systems. The following sections provide a more detailed discussion of the components depicted.

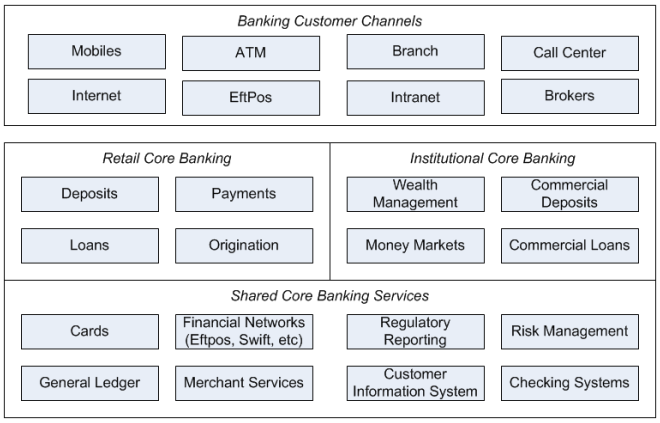

Fig 1. Functional View of Core and Supporting Bank Systems

A. Retail Core Banking Systems

The precise nature of what is termed core banking does vary to some degree by region and institution, however the functional domains typically classified as core banking include: deposits, loans, origination, and payment cards. In the core banking sense these services are generally associated with the retail customer as well as commercial entities; we now briefly describe each of these core banking services further.

Deposits represent the cash management functions for supporting retail customer bank deposits. Whilst historically the bank deposit was a straightforward account that offered a variable interest rate yield, a number of products now require support including: traditional savings accounts, loan offset accounts, term deposits, check accounts, and trust accounts.

Both secured and unsecured loans form core banking services to both retail and commercial customers. Secured loans are those loans with assets associated, such as home loans, whereas unsecured lending represents higher risk financing; this includes personal loans, credit card debt, and lines of credit. Origination deals with the process of applying for a new loan, and hence involves verification of customer identity, credit checking, and risk profiling. Extensions to the standard loans process may also include mortgage brokers and other parties which require further systems support to cater for brokerage fees and commissions.

Payments card support has expanded considerably over recent years, with many alliances in place between banks, merchants, and other 3rd parties such as Internet payment providers. The card types typically include credit cards, debit

only cards, and hi-value credit cards. In each case, a variety of interest rates combined with annual fees will apply to these cards, making the transaction landscape more complex. In addition to the Internet, transactions may be routed via financial networks such as EFTPOS, SWIFT, and Maestro.

B. Institutional and Other Shared Core Banking Systems

Institutional banking represents the set of financial services to support small to medium businesses and large corporations. This includes management of large financial portfolios, international transactions, and engaging the money markets (investment and trading). Hence some of the core capabilities are similar to retail core banking such as deposits, loans and payments; however, these are oriented to support commercial scale operations for business. Additionally, these systems furnish capabilities to support wealth management (such as superannuation), merchant support services for processing payments over financial related networks, and extended interfaces for international clearing networks.

The money market systems enable investment and trading for the business customer, this includes securities, foreign currencies, derivates, and shares trading. These systems provide functions for lending and credit.

Further core banking systems include Wealth Management (e.g. SMSF; often as a separate banking division), merchant services, and checking systems. There is also support required for various local regulatory reporting standards and international clearing networks.

The General Ledger is the final destination for recording all transactions processed by the bank. The system provides a range of accounting, budgetary, and reporting functions with key interfaces to the core banking systems such as deposits, loans, and payments. The typical capabilities include transaction journals, reconciliation, financial statements, daily balancing, and budgetary analysis. Additional banking services are supported with interfaces to fixed asset systems, risk systems, and other financial accounting systems.

IV. ROLL OUT STRATEGIES IN MODERNIZATION

In terms of complexity, duration, and cost, the strategic decisions for implementing a core bank modernization program are not dissimilar from several other industry solutions which undergo large transformation initiatives. Often, one complexity which large programs overlook is the time and effort required for adapting the organization to accommodate the new IT systems together with the new business processes that need to be altered and established. As in many programs the initial starting point for scope is believed to be focused and manageable, but as the complexity of interfacing systems and the specific needs (the requirements) of the business become clearer, the scope can easily propagate well beyond initial estimates.

Time and again it has been shown that project initiation and managing requirements (both functional and non-functional) are critical to successfully completing large complex programs. Sound project management and architectural guidance during the development and implementation of the program is another absolute to ensure continuity in program direction. In addition, delivery fundamentals in methods, tools, and processes are needed to provide the foundation for a broad team of people to be able to effectively and efficiently implement the scope of the modernization program.

In the following sub-sections we now expand upon our experiences in banking and other industries to illustrate some of the key strategies and considerations to made in defining and executing a core bank modernization program. We commence by describing the overall strategies for delivering functionality and then discuss the roll-out approaches for core banking, on-line channels, and banking support systems.

A. Phased Deployment Strategies

The most immediate strategy that is always discussed is to deliver the entire scope of functionality in a single release, i.e. *Big Bang*. This is often considered the highest risk approach as it requires the largest allocation of both time and duration in order to complete the banking solution, often over several years. We have observed that historically a *Big Bang* approach has been successfully implemented by some banking institutions. However, this was perhaps during the early 80's and 90's where the scope of functionality, based upon banking financial products, was much smaller in number compared to today's environment. Additionally, the banking channels did not contain the breadth and complexity as present day multi-channel environments. Hence, the prospects of success using *Big Bang* is considerably more challenging today due to high technology dependence, complex range of products offered by the bank, and the increased number of integration points.

Notwithstanding, for smaller institutions and those willing to accept the risks there are several key lessons and techniques to be observed if attempting such an implementation approach. It will be essential to have multiple initial pilot releases to refine aspects of the system prior to full go-live. In addition, dress rehearsals (or live but limited pilots) of the deployment, operation, and roll-back are also vital. During a dress rehearsal release, the issue of consolidating and merging all transactions (including financial, origination, and analytical) created during those times with the production databases also need to be accommodated. The option can be taken of course to stage these dry runs in non-production environments, but this then diminishes the overall ability to reveal problems that may be expected in the final production system launch.

A phased delivery approach is often the most likely strategy adopted by large banks for their modernization program. The most pressing issuing to deal with when developing a program with multiple releases is what is the way functionality will be progressively deployed? This can be achieved in several ways including rolling out the system by product, by customer, by region, by branch, or roll out by core banking function. We explore each of these techniques in more detail.

B. Rollout by Product

Rollout by product involves primarily the deposit and mortgage related offerings. The approach to deploy system

functionality by product line requires an analysis to consolidate what is in practical use and of strategic importance. In general, the number of financial products offered by banks has grown over time to the point that these have gone beyond a manageable set, hence consolidation is required. In order to develop a phased delivery based on products it is also important to consider the how these inter-related. For instance a deposit account can actually be an offset account that is linked to a loan, a line of credit account is also a form of loan arrangement, and one product may be available in multiple systems due to previous attempts to upgrade or transform the core banking landscape. In addition, customers are likely to have products split between banking systems so the transition to a new platform is likely to cause challenges in maintaining a seamless view to the customer. A typical approach to counter this issue of multiple systems is to re-engineer the on-line channel to hide these complexities, using some form of service integration bus. This of course increases the overall costs while these technical measures are used during the transition period.

The key challenge of course for any phased approach is that there will be that two systems in operation until the program is completed and the former system retired. Hence, it is necessary to consider the impacts associated with the other related core banking systems. This includes treasury, collateral, collections, CRM, fraud management, data warehousing (particularly for regulatory compliance), and brokerage systems. All these systems, along with the on-line banking channels, will require some form of integration whilst multiple core banking systems are in place until final cut-over occurs. Once again, the use of a service integration bus between adjoining systems will hide much of the complexity and if not already deployed would be a key component to include as part of the core banking program.

C. Rollout by Customer Segment

A roll-out by customer segment may be by customer type (business or retail), by customer accounts held, or by customers recorded in a particular system. The later segmentation hints at one of the first challenges in this approach, which is to identify which banking system the customer actually resides. Over time many financial institutions have attempted to consolidate customer records into a central repository. This is true also for other industries, where the result often means that multiple customer repositories are in existence, with different information stored about the customer in each system. Furthermore, it is not uncommon that customer data is duplicated in these systems and these in fact may not match.

The most pressing challenge when dividing a rollout by customer is how to present a simple and consistent interface to the customer via the on-line channels. Whilst branch and back office staff may be able to deal with the complexity of multiple systems, the same is not true for the customer's on-line channel experience. The immediate solution to this is to hide the complexity by redirecting the customer to the appropriate system; alternatively it is possible for customers to access multiple on-line systems by ensuring that standards exist on user interface experience to hide the differences of multiple on-line systems. In spite of the integration approach adopted, the question of whether to modify the existing channel or deploy anew is to be addressed. There is additional training and organization change required to support new systems, and quite often new systems cannot be rolled out until the data schema for the customer repository is finalized and agreed.

Where possible, the approach of building a new on-line channel that commences after a period of time following the start of the core banking upgrade is more ideal. This gives time for the fundamentals of customer data and product definition to be finalized, and hence not subjecting the channel development project to excessive change during project delivery. However, in practice in may be too overwhelming to have two large programs running in parallel, even for a period of time, as such often these programs are attended to sequentially.

D. Rollout by Region or Branch

Deploying a core banking program progressively by region or branch is often an approach that appears favorable. This allows the bank to limit customer impact as a series of production pilots that gradually increases the migrated customers. The approach lowers the overall complexity of the program when customers are distributed homogenously on a small number of banking systems. A further benefit is that the ability to target an initial smaller customer population (associated with a branch or region) is bestowed. Organizational training may also be coordinated by branch roll-out. Whilst this approach is very sound when there are fewer duplicated banking systems, in practice however, there can be several challenges. The diverse nature of products and customer types means that a single branch is likely to need support of all core banking systems that form part of the modernization program. This means that the full functionality is required in all affected systems to enable cut-over of the customer base for each region or branch. Further, the operation of multiple on-line channels and core banking support systems will require support for customer and branch staff access. Finally, it may be generally the case that a subset of the bank branches will contain the majority of customer accounts hence the deployment progress is skewed considerably until the larger branches are accommodated.

In spite of these challenges, a deployment approach that is a combination of a defined customer segment and a branch rollout, offers a balance in managing risk and scope in a reasonable way. A subset of the customer base can be the target of an initial roll-out and by focusing on a branch or region for an initial deployment the organizational change aspects can also be managed in a rational manner. Such an approach is often employed by other industry segments such as telecommunications, energy distribution, and healthcare. This provides a good basis for scheduling deployment over time.

E. Rollout by System or Core Banking Functional Domain

A further approach to be considered is to sub-divide the modernization program by core banking system, or rather, functional domain. An obvious choice that presents is whether to engage in modernizing the on-line channel or core banking

system first. This is further subdivided by functional area, by prioritizing the need to modernize either origination, loans, deposits, payments or customer repository as the initial target system. This decision has a flow on effect to other banking systems that are impacted by changes to these core systems.

The key observation to make regarding changes to foundation systems such as core banking is that essentially it is the data that is stored, both transactional and customer related, that dictates many of the design decisions that are to be dealt with by both upstream and downstream systems.

It is generally observed that there are three states of data, referred to as data at rest (in database), data in motion (traversing network or memory), and data in use (under active change) [9]. We refine further the state 'data in use' here and note that data on entry requires further consideration and is largely represented by the on-line channel and banking support systems used to capture data. Moreover, such data to be captured is dependant upon the data model used when at rest, i.e. the core database systems that support banking. Hence, the key starting point is often the main database schema due to its impact to the design of upstream and downstream systems. This is further revealed in the need to rationalize products offered, reduce duplication of customer data, and then need to capture certain information for regulatory control. As such, whether a banking channel or core bank systems is chosen to be renewed first, it will be the central database repositories that dictate the extent of work required to display, integrate, or analyzing financial information.

Ideally the ability to tackle both the channel and core bank system simultaneously would seem a good choice, but the complexity due to the magnitude of effort would often be prohibitive. Hence, a sound approach is to commence with the core banking system and associated database architecture, followed where practical by upstream systems (such as the banking channels). There is no right or wrong answer to which system to include in a modernization program, and ultimately the decision is based on the individual needs of the bank, which is a function of balancing time, cost, scope, together with the risks, skills, and organizational needs to be addressed.

V. LESSONS LEARNED FROM TRANSFORMATION

Before we describe the lessons learned, we first discuss the key motivations for modernization. This provides some context to many of the risks the delivery team will encounter and will help management decide which risks are to be addressed and those to hold in consideration during the program.

A. Motivation

The motivation to modernize is often due to several factors that have influence upon the bank that eventually gather enough critical mass, creating the inertia to proceed. In general, the momentum commences with existing systems and processes that restrict the business from delivering new financial products rapidly to the market. They may be viewed as inflexible and a limiting factor to business market agility. Other motivating factors that often then emerge include:

- Legacy systems constrain the business to support multiple emerging banking channels, such as mobile and internet, since the design of older systems predate the newer virtual channels.
- Too many financial products create additional complexity and hence product consolidation and reduction is often a key motivation to engage in modernization within the bank.
- In order to manage costs, the need to rationalize and simplify the number of banking systems in operation.
- Increasing transaction volume is placing pressure on contemporary systems that requires either an upgrade or warrants introduction of a new core banking system.
- Competing banks in the region make announcements to modernize and hence viewed by the marketplace as more progressive due to their willingness to embark upon change, as apposed to remaining stagnant.

Finally, the constant change due to mergers, acquisitions and disposal of business units is also a disruptive contributor to the technology landscape. Often this results in duplicated systems, even if merged business units rely upon the same core banking platforms there will be significant difference so as to require separate instances and hence support.

There are a number of considerations to observe when planning the modernization program such as technology choices, scope of program, and broader risks associated with systems integration. We now describe those experiences.

B. Master Customer Data

Will the master customer data management system be replaced as part of the program or an existing system used? An upgrade or replacement of the master customer database will contribute to the risk due to the reliance by nearly all core banking systems, it follows that changes to this system will impact all integrating systems. As mentioned previously, often customer data is duplicated in several systems, hence the opportunity to address this may be appealing as part of the modernization program. There is always the need to ensure the data is accurate and a data cleansing exercise will need to be factored into the schedule as data is migrated from one system to any proposed new system.

C. Service Integration Bus

Many institutions have introduced an integration bus of some way to help disentangle the traditional forms of point to point integration. The benefits of SOA and Enterprise Integration are well discussed. Integration layers contribute to technical rigor by establishing consistent messaging between platforms, reduces technical dependence between systems by accessing services via a single adaptor technology, and enables reuse of services. Where an integration bus is in place, extending the existing bus platform will be the most practical balance of scope and effort. If no integration bus exists the opportunity to introduce such a layer is granted. Although this means the introduction of another moving part to the overall program, this is still likely to reduce overall program complexity and risk.

D. Incumbent Bank Transformation Programs

Core banking modernization will be a key aspect of an

ongoing set of banking transformation initiatives. Transformation is often a continual effort and there is likely to be several other programs underway within the bank, and so consideration is to be given on the impact to those existing projects. Where adjunct platforms are being upgraded it is worthy to consider placing these into a more static maintenance mode, so as to avoid excessive rework and change to integrate and interoperate with those systems.

E. Cloud Technologies

The use of cloud as hardware infrastructure or cloud as an application service is featuring more as a viable solution option. If cloud is to form part of the solution, clearly identifying the boundary of what components will be cloud and what shall remain in traditional data centers is vital. The security implications of components deployed on cloud also needs to be considered as this is more complex to control in terms of data privacy, securing transmissions, and most important – adherence to financial regulatory controls. In an attempt to make better utilization of hardware infrastructure, the use of virtualization has introduced new complexity to the supported hardware environments. Cloud also offers a way to offload this technical overhead.

F. Package Selection

Package selection poses a significant challenge to banks as quite often there is an attempt to select a banking platform that provides the functionality desired 'out-of-the-box'. However, in practice there is always the need to customize, sometimes significantly, contributing to unexpected costs and project delays. A vital aspect of the selection process is to consider the organizational impact of the chosen package. Whilst it is a challenge to replace the information technology systems and components, the effort required instituting new business practices and supporting processes is also a significant burden to the bank that needs to be estimated and factored into project schedules. If the intention is to select a major package to replace one or several existing core systems, a sensible criterion to apply is to ensure the functionality expected is of sufficient maturity to be useful with minimal tailoring. Often the upgrade of a previous version of a banking platform to a new version may also result in a program that is similar to a replacement, due to the breadth of change between platform versions. As in any high risk technology adoption it is most practical to carry out a proof-of-concept deployment of selected features to validate aspects of the platform under consideration, in particular the maturity. This will also give the opportunity to consider more seriously the reuse of existing systems to form part of the final solution versus those components to be replaced by a new package.

G. General Large Program Challenges

There are numerous additional challenges that are typical for any large transformation program that are not specific to any industry. This includes skills and resource availability with the selected platform, technology, or implementation language. Supportability of the chosen package and is there a local onshore or offshore support base? Accurate estimation of the effort to complete a large program of work, ensuring coverage for package vendors, internal IT teams, and the time required for organizational change. The effective capture of requirements and the need to manage these during design and implementation can always pose some of the greatest risks. Change management and project delivery lifecycle management in addition to deployment and transition into *business as usual* operations. There are many other risks that emerge during any large program and having access to experienced people who have dealt with these problems is the most practical defense.

VI. CONCLUSIONS AND DISCUSSION

The ability to carry out a bank modernization program requires solid support from stakeholders and business sponsors. Experience has shown that such programs, as with any large transformation, will be subject to considerable pressure during delivery and will benefit from sound technical and project management practices in place. We have presented some strategies and lessons learned for core banking transformation and provided some detail to the type of activities involved. This is useful to both program teams and sponsors embarking upon similar work and it is hoped that these insights are useful in aiding delivery teams to complete their programs with reduced risk.

There is further work on studying the impact of cloud and multi-tenant solutions for core banking. Whilst cloud technology trends are viewed as candidate frameworks for other banking components, time critical systems such as core banking may find deployment models in cloud unacceptable to banking institutions and regulatory bodies.

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