The Design of Global Financial Systems: A Case Study

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THE DESIGN OF GLOBAL FINANCIAL SYSTEMS:

A CASE STUDY

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ABSTRACT

This thesis examines some of the key issues which arise in the design of Global Systems. Specifically, this thesis is a case study of a Global Custody system currently being implemented at a major international bank based in New York. The Global Custody business includes clearing of trades, accounting of portfolios and reporting on corporate actions for a mix of international securities. At present, this business is largely carried out using error prone and expensive labor intensive methods. The Global Custody system being implemented at the bank promises to dramatically improve the quality of service by permitting direct links to depository systems, real-time, on-line access to aggregated portfolio information and production of custom summary reports for clients. These capabilities will give the bank a unique competitive advantage with respect to its competition. The bank believes that, in the long run, only the low cost providers of high quality service will survive the inevitable shake out in this market and is thus positioning its services to achieve these goals. Three issues--Organization, Data Administration and Deployment--are presented and analyzed in detail, especially as they relate to the bank's ultimate low-cost service strategy. This thesis examines how the global nature of the system makes these issues more complex and concludes by offering a checklist of issues for any organization contemplating the design or implementation of a Global System.

KEYWORDS AND PHRASES: Global Systems, Financial Systems, Global Custody, Integration, Information Systems, Organizational Issues, Data Administration, Deployment, Rollout

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CHAPTER 1: INTRODUCTION

The purpose of this thesis is to investigate some of the key issues in the design of Global Systems. We will do this through a case study approach, identifying the key issues, the range of options available and the particular choices made. Specifically, we will study the development of a Global Financial System to automate the Global Custody operations at a major New York bank. We will conclude this thesis by drawing some general conclusions from the case studied which would serve as a checklist of issues for any organization contemplating the design or implementation of a Global System.

1.1 Global Systems

Let us first define what we mean by the term Global System. An organization is generally made up of different *functional areas*, each responsible for carrying out their business purpose. These functional areas are generally equipped with *processing systems* which enable them to carry out their function. The processing systems may be manual and labor intensive or they may be automated and technology intensive. (Other combinations are also possible.) A *global system* is one which involves distribution of function and/or processing across geographically dispersed boundaries. It is this geographic diversity of Global Systems which makes both its study interesting and problems complex to solve.

• *Distribution of Function*: An organization may wish to distribute its functions for a number of reasons. In some cases the different functions might be distributed, yet each function itself may be entirely concentrated at one location (see *Figure 1A*). For example, a firm might locate its labor intensive manufacturing in a low wage area and its sales unit near its customers. In other cases, the functions themselves may also be distributed. For example, different stages of manufacturing might be distributed to take advantage of proximity to different sources of raw materials needed at each stage of the overall manufacturing process. Likewise, the marketing unit might be distributed across the different markets served by the firm. For example, an international bank which sells financial services across the globe might have different marketing units physically located in the countries where it does business. This would permit the bank to tailor the marketing efforts for different financial products to better serve the local markets.

• *Distribution of Processing*: Processing might also be distributed for a number of reasons. For example, an international bank may have to distribute processing due to regulatory requirements. Different countries might require the processing of data to be physically carried out within national boundaries[1] forcing the bank to distribute its processing over countries (see *Figure 1B*). In other cases, it might simply be more convenient to distribute the processing.

• *Hybrid Global Systems*: Several firms may choose to distribute both function and processing (see *Figure 1C*). Such hybrid global systems are common among multi national firms. As we shall see, the case study which we present in this thesis, the design of a Global Financial System, is an example of such a hybrid global system.

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[1] For example, West Germany has such as requirement.

Figure 1A: Distribution of Function

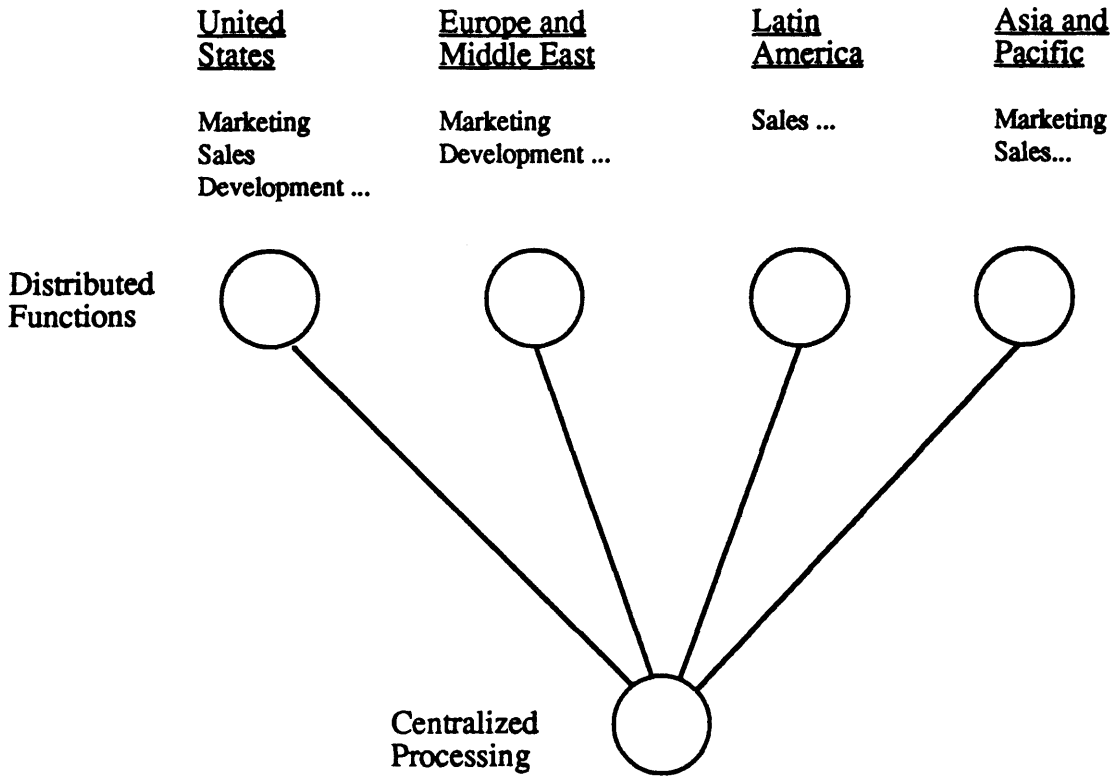


Figure 1B: Distribution of Processing

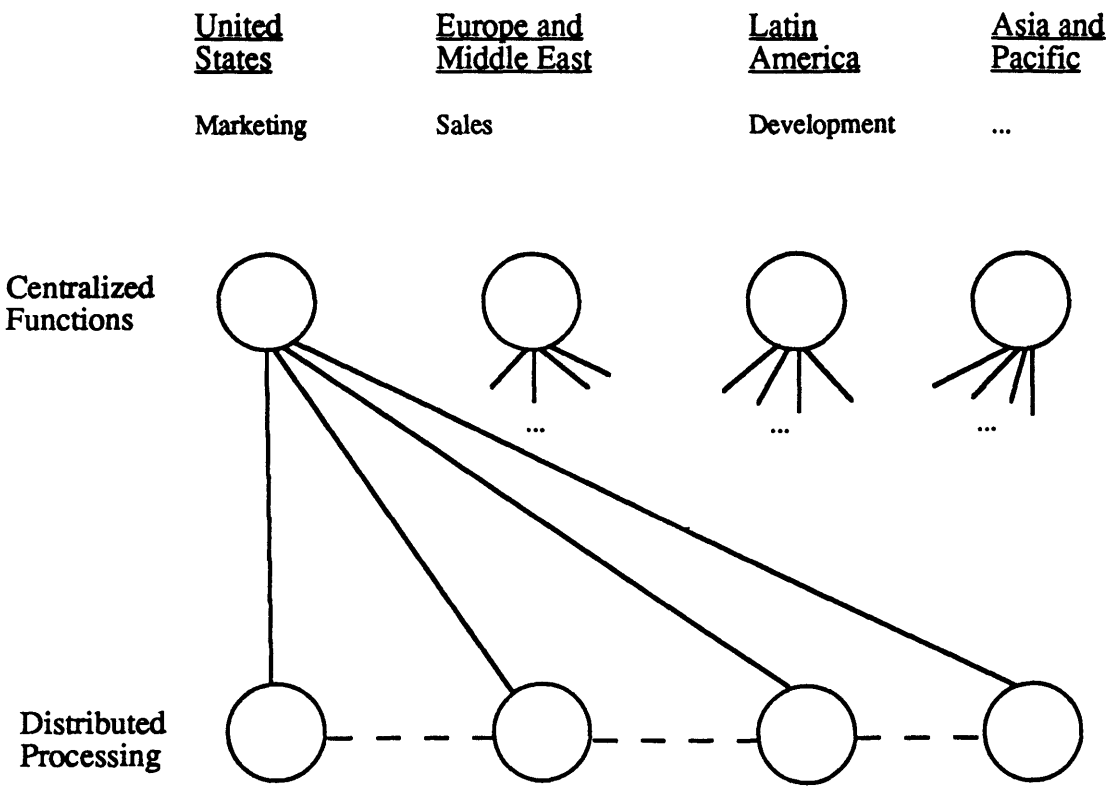
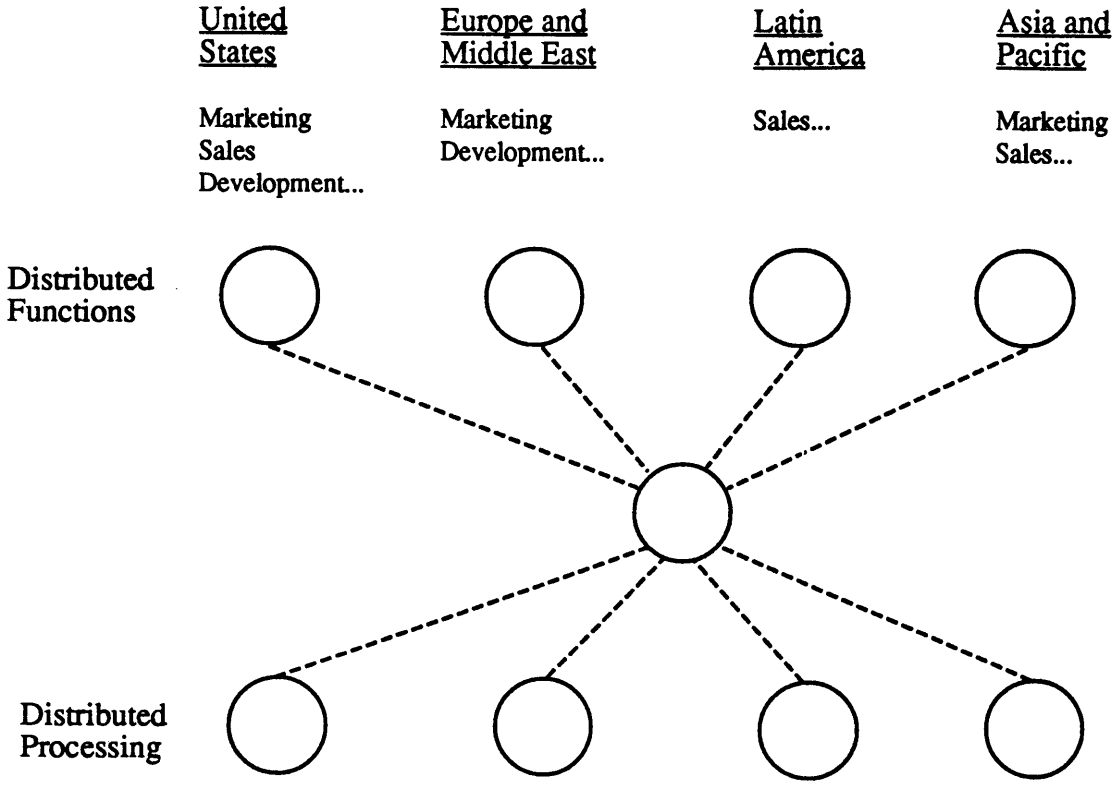


Figure 1C: Hybrid Global Systems



This system has examples of distributed functions (e.g. Data Administration) as well as distributed processing (e.g. Distributed Database Management System).

1.2 Related research at M.I.T

The case study presented in this thesis is related to the research efforts of the Composite Information Systems Laboratory (CISL)[2] [3] headed by Professor Madnick at the M.I.T. Sloan School of Management in that a Global Financial System is a good example of a Composite Information System (CIS). Simply stated, the goal of a CIS is to integrate independent, geographically distributed and disparate databases. The integration should (1) Permit users to have a more unified view of the underlying data; (2) Allow expensive resources to be shared in a transparent manner; and (3) Make possible the extension of the system without having to make extensive changes to the existing software. The CIS approach also advocates a simultaneous balance between technical and organizational issues at each step of the design of a heterogenous system. As we shall see, the design and implementation of the Global Financial System presented in this thesis shares many of its goals with the CIS approach.

1.2.1 Overview of Composite Information Systems

Simply stated, the goal of a CIS is to integrate independent, geographically distributed and disparate databases. This integration serves a number of useful purposes. Firstly, it provides a *unified view* of the underlying collection of databases. That is, a user may access logical records of data without any particular concern as to where the components of the logical record physically reside. Secondly, the integration permits the *sharing of resources*. Users may access and utilize expensive resources, such as large mainframe computers, located at central locations in a totally transparent manner. By transparency, it is meant that the user need not have any special knowledge of the specific operating environment at the resource location, in our example at the mainframe site, for successful access to the resources. Thirdly, the CIS approach provides for *extensibility*--the ability to add new functions without having to rewrite or make extensive modifications to the existing software.

The capabilities of having a unified view of the data, of sharing resources and of extending the system, enable an organization to gain *strategic advantage* with respect to its competition. The unified view permits the organization bring together data from diverse sources to better serve it customers or to operate more efficiently. In an extreme, the diverse data sources might be geographically distributed all across the world. Given that firms are entering an era of increasing global competition, such a capability would make the firm more competitive in its ability to function on a global basis. Indeed, the very focus of this thesis--a case study of a Global Financial System--is on analyzing the design of an Information System to allow for a global, unified view of the underlying distributed data. Sharing of resources would allow for exploiting economies of scale and scope, thus lowering the firm's costs of doing business. This would make the firm more competitive along the cost dimension. Thus, for example, a firm may choose to centralize development activities in a particular geographic region in order to take advantage of a large pool of available programming talent. Finally, extensibility would enable the firm to respond more quickly than the competition to changes in market conditions.

1.2.2 The CIS Planning Framework

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[2] "CISL: Composing Answers from Disparate Information Systems." Stuart Madnick, Y. Richard Wang et al. Extended abstract for the IEEE workshop on Heterogeneous Database Systems. CISL internal document. September 1989.

[3] "A Polygen Model for Heterogeneous Database Systems: The Source Tagging Perspective." Y. Richard Wang and Stuart E. Madnick. Paper accepted for 1990 International Conference on Very Large Databases.

What makes the CIS approach unique is its simultaneous attention to two very important issues at every planning step: *Technical* and *Organizational*. The importance of organizational issues in the success of information systems has been the subject of many recent studies.[4] It is now widely believed that any major information system which is not designed with the organization in mind will probably not function very effectively. At worse, the system might even completely break down due to organizational resistance.

1.2.3 Summary of the CIS approach

To summarize, the CIS approach is a way to bring together heterogenous data sources in order to provide a single, unified view of the data. The approach is top down in that it starts with the firm's strategy, then identifies the hurdles which must be overcome and finally identifies the various technical and organizational solutions to overcome these hurdles. The approach is unique in that it explicitly recognizes the importance of the interplay between organizational and technical issues at each step of the design process. Accordingly, the methodology calls for a detailed examination of the organizational and technical implications of choices. A CIS can be a source of competitive advantage: either by lowering costs or by providing additional capabilities enabling the firm to create effective entry barriers, or possibly using both methods.

1.3 Global Financial Systems

This thesis presents a case study of a Global Financial System (GFS) being developed at a major international bank, which we shall refer to simply as "the bank," headquartered in New York. We find a GFS to be a good example of a Global System for study because, firstly, it involves distribution both of function and processing, and secondly it is also a good example of a CIS, presenting numerous issues, both technical and organizational in nature. Specifically, we will study the development of a product which we shall refer to as the Financial Institutions Securities Manager (FISM).

1.4 Issues in the design of a GFS

The diversity and complexity of issues in the design of a Global Financial system make its study of particular interest.[5] Let us first list some of the major issues.

1.4.1 Organizational

Organizational issues tend to dominate the design and deployment of Global Financial Systems. It is the global nature of the system which greatly magnifies the nature of organizational problems.

Organizational issues generally fall into one of the following categories: Development, Operation, Coordination and Incentives. The nature of the organization tends to influence approaches taken to tackle these issues.

- *Development*: The development of the system may be done in one central location or it may be subdivided and distributed among several units within the company. Centralized development generally

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[4] "Beyond the Globalization of Information Technology: The Life of an Organization and the Role of Information Technology." Yang W. Lee and Y. Richard Wang. Sloan School of Management, M.I.T. Working Paper # 3136-90-MSA. March 1990. To appear in June 1990 issue of Information Technology Management.

[5] "Creating a Global Look" by Larry Marion. Institutional Investor. March 1987.

simplifies (or does away with) the problem of coordination between units, but it may also preclude the organization's ability to take full advantage of specialized resources which it may have at its disposal throughout the company, for example, a development center located in another country. In addition, centralization also greatly limits the organization's ability to capitalize on pockets of "local knowledge" which may exist among its different units. Decentralized development, on the other hand, may allow the organization to make better use of its resources, but at the cost of greatly increased complexity of coordination between regions.

The decision to centralize or decentralize is also largely a function of the culture of the organization itself. Organizations which function as highly autonomous business units might prefer to centralize development to preclude coordination problems.

• *Operation*: The operation of the system could be carried out in a distributed or non-distributed manner. As we have already pointed out, organizations may choose to distribute the functions or processing or both. A non-distributed approach has the advantage of simplicity and easy of administration. A distributed approach, on the other hand is complex and much harder to administer. However, a distributed operation may allow the physical operations to be close to the end market. This proximity may, in turn, enable the company to react faster to changes in market conditions, thus giving the company a distinct competitive advantage over its competitors.

• *Coordination*: We have already seen that the extent of coordination needed may be influenced by how the development and operations are organized. However, global systems make coordination much harder. Firstly, there is often a need to coordinate in a multi-lingual environment. This means that documentation and other written forms of communications must be made available in a number of languages. It may even be essential for some personnel to possess multi-lingual capability. Secondly, going beyond the need for multi-lingual capability, is the need to coordinate in a multi-cultural environment. Even if the language is the same, there may be subtle differences which confound coordination. For example, English spoken in the U.S. and the U.K. can differ quite significantly. In the U.K. it is common to hear traders refer to bonds as stocks. Thus it would be consistent for a trader in the U.K. to refer to a "stock with coupons." Of course, in the U.S. there is no such thing as a stock with coupons attached.

• *Incentives*: Operating in a global environment also requires the firm to put in place proper incentive systems. These incentive systems should be such that they align the personal goals of the managers with the common goals of the organization. Appropriate accounting and reward systems are key to ensuring this alignment of management and corporate interest. Providing appropriate incentives becomes harder for geographically dispersed organizations where cultural differences might necessitate the firm to incent managers differently depending upon the region. But in all cases, the end result would have to be the same: to align the interest of the manager with that of the firm. For example, if the organization favors autonomous units, each having their own Profit and Loss responsibility, then an appropriate system of charge backs should be developed to ensure proper accounting of costs. For highly integrated organizations a different set of criteria may have to be used to provide the right incentives. For example, reward based on group performance may be one form of an incentive system which might be adopted under these circumstances. In both these examples, the added dimension of the cultural context will have to be examined for ultimate suitability of the proposed incentive scheme.

1.4.2 Data Administration

The Data Administrator's task is to maintain control over a vital corporate resource: *Data*. This includes consistent *usage* of data items across the organization, meaningful *naming* of data items such that they are consistent with the function or business purpose served and, finally, promulgation of *standards* to promote overall consistency of data across the organization.

Development of a Global System generally requires an organization to standardize on its Data Element definitions based upon the business requirements in order to ensure consistent usage across the organization. These data element definitions are stored in a Data Dictionary against which all developed systems are validated. However, in a global environment, additional requirements posed on the system as a whole complicate the process of standardization. The additional complexity could be due to differences in the constituents of the data element or could be due to differences in the interpretation of the data element itself.

• *Differences in constituents of data element*: The Data Dictionary may define the data element "Customer" as consisting of a first name, middle initial, followed by a last name. While this definition is perfectly acceptable in the United States, it may not be suitable for other countries. For example, in some European countries people refer to the first name as the "christian" name, while in many Asian countries it is customary for the last name to appear first. A common Data Dictionary would ensure consistent make up of the Customer data element. However, as our examples illustrate, in a global operating environment, this goal is not a simple one.

• *Differences in interpretation of data element*: The same data element name may have a different meaning from country to country. For example the precise meaning of the Data Element "Account" may greatly vary. In one region a T-Bill may be treated as an account, whereas in another region it may be treated as another data element type "Product". Data Dictionary administration thus requires a detailed knowledge of data element usage across the enterprise; a global environment greatly expands the scope and complexity of the data administration process.

The decision of whether or not to distribute the data administration function becomes very important in global settings. If the Data Dictionary is centrally maintained, developers located elsewhere in the enterprise would have to submit requests to the central administrator for additions or other changes to the data dictionary. This could mean long delays which could potentially slow down the development process. On the other hand, if the data dictionary is separately maintained at each region, the organization as a whole runs the risk of inconsistent usage of data elements. To reduce the inconsistency, organizations, such as the one we shall study in this thesis, might mandate a periodic "resynchronizing" of data dictionary across regions. While this certainly lessens the potential inconsistency of data element usage, a host of other issues related to coordination and control are immediately raised such as: "how often should the resynchronizing be performed?"

Finally, the Data Administrator must take care to ensure that none of the data elements are redundant or duplicate the function of some other data element. This again, requires the data administrator to have a detailed knowledge of the actual meaning and usage of data elements throughout the organization.

1.4.3 Rollout

The problem of rolling out a new Global System presents special problems, especially when one is replacing an existing system with a newer one. Coordination between regions is one of the biggest issues. We need to decide whether all the regions should be simultaneously brought on line or whether a phased approach is better. Each of these approaches has its own set of advantages and disadvantages. A phased approach would mean operating for some amount of time with the old and the new system, potentially causing problems if data between the two systems are incompatible. However, a phased approach would also allow for minimizing other risks. For example, the rollout might call for an early installation at a region with small volume. This would permit operation in a small, live environment. Should problems arise at this installation it would be much easier to respond to them than if all regions had been simultaneously brought on line. Documentation also becomes a very important issue when rolling out Global Systems. The documentation may have to be expressed in many different languages. In addition,

the documentation may also have to account for different operating conditions which may exist at the different locations of deployment.

1.4.4 Other Issues

There are numerous other issues of interest in the design and development of a Global Financial system. These issues tend to be primarily technical in nature. Examples would be the overall architecture of the system, specific merits of different hardware or software systems or issues having to do with connectivity. These issues have been studied in some depth in prior research conducted at the CISL[6] and it is not the intention of this thesis to explore these issues in great depth.

1.5 Overview of Case Study

We now present a brief overview of our case study in order to set the framework for discussion in later chapters.

1.5.1 Global Custody: A new business opportunity

The development of FISM was driven by the bank's strategy to become a major player in the high growth *Global Custody* business sector. Global Custody is a service used by the bank's clients to engage in investment activities on an international basis. These services include settlement of trades (e.g. buying or selling securities), servicing of instruments (e.g collection of dividends), corporate actions (e.g. informing clients about a "rights offering") and generating reports. Risk reduction through geographic diversification, increasing integration of world capital markets and the high return on investments in "emerging markets" are thought to be the major reasons behind this trend towards international investing.

1.5.2 Business Issues

There are two main business issues for the bank: Revenue and Profitability.

• *Revenue*: Global Custody is a high growth business offering the possibility of a steady and growing revenue stream. The potential market at present is thought to be barely penetrated. For example, the Pension Funds sector, currently the largest single potential market segment for Global Custody services, has approximately $2.3 trillion under management in the United States alone. However, of this amount only about $100 million are currently invested in international securities. Given that Pension Funds are typically authorized to invest up to 10% of their portfolios in overseas financial instruments, we have $0.23 trillion as the potential dollar amount available for overseas investments. Thus the potential market is not even penetrated 1% as of this time.

• *Profitability*: Global Custody currently yields management fees several times more than equivalent Domestic Custody services. Domestic Custody services generally yield about 4 basis points[7] in fees whereas Global Custody services yield 15 to 20 basis points. However, custodians are coming under increasing pressure from clients to reduce fees, especially as new, efficiency improving innovations are adopted, like the creation of a book entry system through the Depository Trust Corporation (DTC).

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[6] "Integrating Systems for Financial Institutions Services using Composite Information Systems" by Maria de las Nieves Rincon. Master of Science thesis submitted to the Sloan School of Management, M.I.T. June 1987.

[7] A basis point is one hundredth of one percent of the value of the assets under management

Moreover, clients are beginning to increasingly view custodial services as commodity like. As long as a minimum set of service requirements are met, they tend to shop on price.

These two issues and the trends outlined above mean that while the business opportunity is substantial, the successful custodian will be the one who can provide *quality service* at *low cost*. After a period of five years, the bank aims to be one of the few remaining low cost producers of high volume transaction processing services. In 1989, such services contributed $40 million to the bank's bottom line; by 1993, the bank hopes that this figure will be about $200 million.

1.5.3 The Existing System

The bank currently has a processing system called *Cosmos* which is over 20 years old. Cosmos employs technology which is outdated by current standards and is also not very extensible. Indeed, in our talks with the manager in charge of the Pension and Employee Benefit Plan segment of the bank's business, we gathered that the current processing system was seriously limiting the bank's ability to win new Pension Fund accounts. In addition, the lack of sophistication of the current processing system was hurting the bank's general image as a technological leader among financial institutions. Finally, the lack of flexibility in the current processing system worked against the bank's strategy of being a "full service" provider, that is, the ability to provide a full range of financial services to all of its major client segments. For example, making modifications to the system to process new types of financial instruments has become a very difficult task. In addition, different operating units, over time, have acquired different hardware and have made local modifications to the system independent of other operating units. As a result the maintenance and enhancement of the entire system as a whole has become a near impossible task. Common changes to the system have to be separately implemented at each of the different sites of the bank. One manager summed up the situation in one word: *chaotic*.

1.5.4 Operating Philosophy

The bank itself is made up of a number of highly decentralized operating units who have historically functioned in a very autonomous manner. The bank takes great pride in its ability to operate in this manner. Managers often cite this as a source of great competitive advantage which has enabled local managers to make "on the spot" decisions to react more rapidly than the competition to changing local market conditions. However, the autonomous and decentralized nature of the bank are also recognized to have led to the chaotic state of the current processing system.

1.5.5 The Proposed New System

Recognizing the limitations of the current system, the bank embarked upon an ambitious project to redesign and build a new processing system called the Financial Institutions Securities Manager (FISM).

• *Development*: Recognizing that many of the problems with the existing system stemmed from the fact that the bank had effectively lost control over the system's evolution, they decided that it would be best to centralize the development and maintenance of the core part of FISM.

• *Operation*: The operation of the system has been designed to be distributed by employing sophisticated distributed data base technology coupled with an advanced global communications network. This is consistent with the bank's traditional decentralized approach to management and the autonomy enjoyed by the local operating units. The system has also been designed to allow for customizing at the local level. This customizing involves no modifications to the core code and is done entirely through "street side" modules which contain the country or region specific information. In effect, they have

provided regional centers with the capability to alter some aspects of the FISM's operation to suit local operating conditions without having to modify the core code.

The FISM design overcomes, at least in theory, the problems of proliferation of the core system, as was the case with the old system, but at the same time preserves the ability of the bank to be flexible at the local level through the street side capability. As the system has yet to become fully operational it is not as yet clear as to whether or not this approach is feasible.

1.5.6 Benefits of the new system

• *Flexibility*: To further enhance flexibility, FISM has been built on top of a platform which we shall refer to as the Foundation Software Architecture (FSA). FSA consists of a highly optimized set of primitive functions which are used by layered products such as FISM, thus providing independence from the actual underlying hardware and operating system. Moving FISM to other hardware platforms in the future will be easier since the major work would involve supporting the FSA platform, a smaller and more manageable body of software, on the new hardware. Layered software such as FISM will be simply "ported" through recompilation. *Figure 2* illustrates the FSA/FISM architecture and also indicates some products other than FISM which are also being built as layers over the FSA platform.

• *Lower Costs*: FISM will lower costs in a number of ways. Firstly, the maintenance and enhancement of the system will be much simpler and requiring fewer persons because changes will now have to be made to only one system. Secondly, the bank intends to eventually sell FISM to other financial institutions. Not only would this permit the bank to recoup some of the development costs, but it would also reinforce the bank's image as a technology leader in the financial services arena. Flexibility also promises to further reduce cost by enabling the bank to select the hardware which both meets their needs and is available at the most advantageous terms.

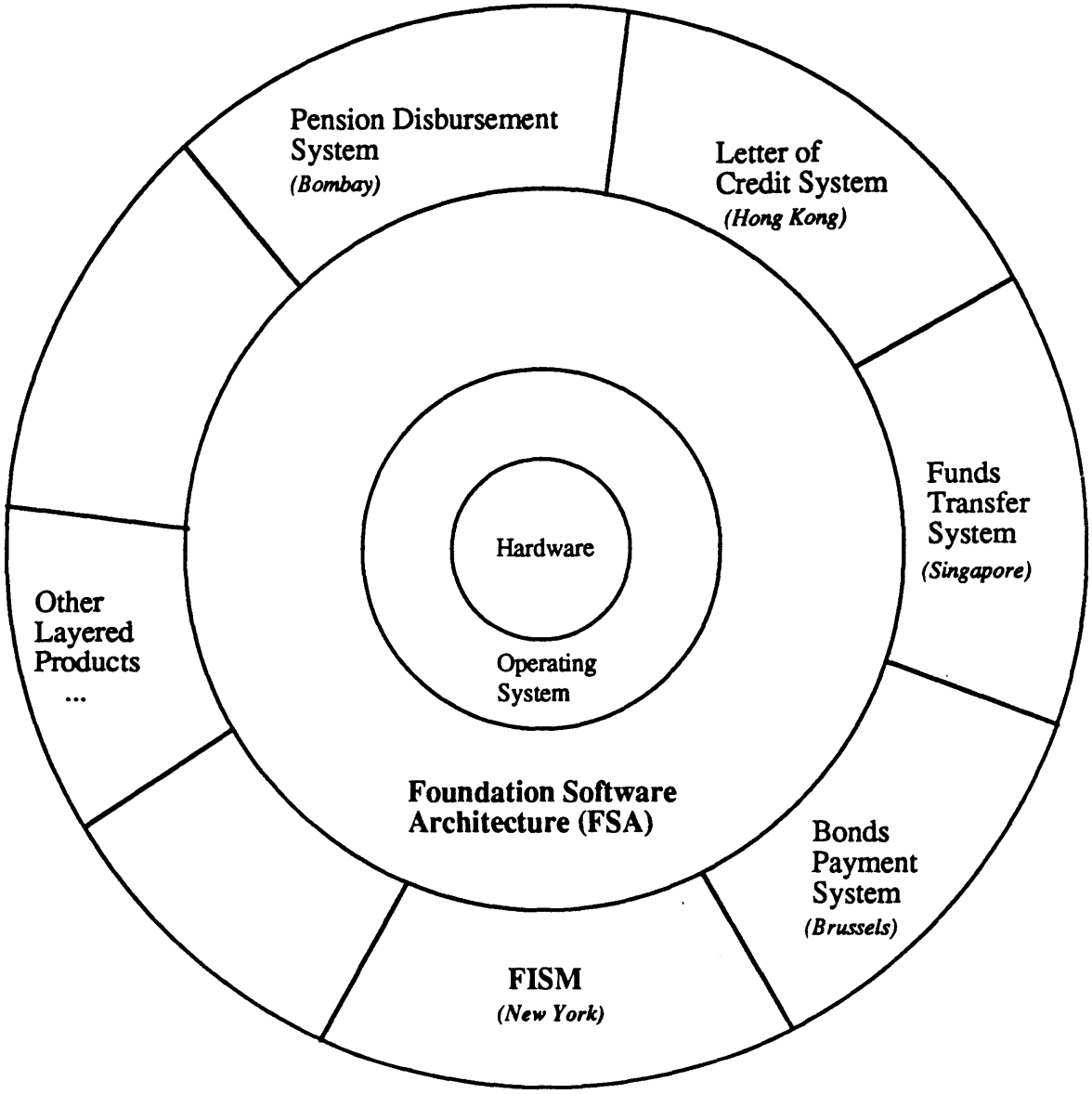

Figure 2: FISM/FSA Architecture

• *Improved Quality*: Along the quality dimension, FISM promises to be a big improvement over the old system in a number of ways. Firstly, FISM will provide clients with a unified view of their portfolio. That is, the ability to view the collection of all securities held world wide under the umbrella of a logically single account. This is a capability which currently does not exist. Secondly, it will provide real-time, on-line access. In our talks with the Pensions manager, such a capability is viewed as key to winning more Pensions-based Global Custody business. Thirdly, FISM will eliminate the need for double entry of data. While different pieces of the data might be distributed, there will be no duplication. A single data group will be stored in one place only; a distributed access mechanism will make the data available to other locations. This promises to improve the quality of the data itself by reducing the number of errors. Finally, FISM will enable the bank to generate a variety of reports from the data in custom formats for different customers. From the point of view of customers, customized reports would represent an improvement in the quality of the system since they would now be able to view reports in a familiar or more useful format. This could even lead to better decision making ability for customer, further underscoring the improvement in quality.

1.5.7 Risks

There are a number of significant risks in the approach taken by the bank. Firstly, the layered software, also frequently referred to as "middleware," may degrade the performance of the systems to unacceptable levels. While the current implementation appeared to perform satisfactorily during a recent acceptance test, it is yet unknown as to what the performance might be over the longer term, especially after the system has had some time to evolve and to acquire some amount of the inevitable inflexibility that comes about through sheer entrenchment. Secondly, there appear to be significant possibilities for coordination bottlenecks. For example, the success of orderly corporate wide data administration is predicated in part on smooth, efficient and timely responses (within 36 hours) between the Global Data Administrator and several Regional Data Administrators. Again, the system so far has worked reasonably well, but it still remains to be seen if such close coordination can be sustained over time. Among other potential risks are the large scale deployment of Distributed Database technology on a world wide basis. The ultimate success of the systems depends upon the ability of this technology to provide a seamless view of data emanating from heterogeneous sources and distributed across the globe. Such an ambitious undertaking has never been successful before on such a large scale.

CHAPTER 2: FINANCIAL INSTITUTIONS SECURITIES MANAGER

In this chapter we will give an overview of the *Financial Institution Securities Manager* (FISM) being developed by the bank. FISM represents the bank's most ambitious effort to date to build a logically structured, globally distributed database to manage securities related information on a worldwide basis. Once fully operational, FISM will give a unified view of securities data. This unified view promises to give the bank the competitive edge it needs in an emerging and profitable line of business, *Global Custody*. FISM is an example of a hybrid type of Global System as it has aspects of both function as well as control which are distributed. As we shall see, the design philosophy behind FISM also embodies many of the key principles of a CIS design, namely the close attention to the interplay between technical and organizational issues in each step of the design phase.

2.1 Overview of Custodial Services

An institution is generally said to act as a custodian when they function in a non-advisory capacity. That is they perform functions like *safekeeping* of the physical securities, periodic collection of dividend and interest payments and keeping track of corporate actions such as mergers and acquisitions. In the latter, custodians simply alert their clients in a timely manner so that the clients may take any appropriate actions as necessitated by the corporate action. It is important to note that the custodian does not actually make any decisions on behalf of the client. In addition to safekeeping, custodians often perform a *clearance* function. Having executed a trade, a client may turn to his or her custodian to clear the trade. This may include transfer of securities, cash or other value either by physical delivery or by electronic book entry mechanisms.

The bank's custodial services are segmented in the following manner:

2.1.1 Domestic Custody

This term is generally restricted to custodial services provided to US clients for securities traded in the United States.

2.1.2 International Custody

When domestic custody services are offered to overseas clients, the business is referred to as International Custody. As with Domestic Custody, the securities under custody are all traded in the United States.

2.1.3 Global Custody

This is essentially the most sophisticated type of "anywhere to anywhere" custody service. That is, the custodial services are offered to clients situated anywhere in the world and for securities which are also traded anywhere in the world. Global Custody emerged as a business entity in the mid-1970s and today encompasses a group of services. The core global custody services include settling trades; safekeeping securities; servicing the asset, which includes receiving dividends and accounting for corporate actions such as stock splits and tax reclaims; and providing information about investors' portfolios. Securities lending, foreign exchange and cash management are among the peripheral services the global custodian provides.[8] Global Custody is growing in importance because of the increasing interest shown

[8] "Trust stays afloat in the Global Market." Sheila O'Heney. Computers in Banking. March 1990.

by large portfolio managers to engage in cross border investments as a part of their portfolio activities.[9] Investment managers have cited several reasons for this trend including risk reduction through geographic diversification, participation in high growth opportunities offered by some "emerging markets" (e.g. Korea, Taiwan, Brazil) and changes in compensation schemes for the investment fund managers. The last point bears some further explanation. Up until the last decade, the compensation for pension managers was generally fixed with little or no component of their compensation tied directly to the fund's performance. The last decade has seen a dramatic shift in compensation schemes. Increasingly, the compensation of pension managers has become tied more and more to the actual performance of the fund. During the same period, many of the emerging markets of lesser developed countries (LDCs) have blossomed offering returns on investment far greater than the markets of New York and Western Europe. In an attempt to boost yields, fund managers have thus shown increasing interest in overseas securities. This has led to a sharp increase in demand for global custody services.

2.1.3.1 Evolution of Global Custody

Most institutions who offer Global Custody services got their start with Domestic Custody. As the economy of the United States got more attractive to invest in, institutions offering Domestic Custody branched out into International Custody where they offered essentially domestic custodial-like services, but to international clients. Many institutions created separate administrative units to service their International Custody operation, a move which now many in the custody business regard as a mistake because it led to needless duplication of functions.

With growth in cross border opportunities came about the birth of the Global Custody concept. Several institutions, again, created separate administrative units to service the needs of Global Custody clients.

Today, the custody business is marked with duplication of function, a fact that is coming increasingly into the limelight as financial institutions are looking at various ways to improve the bottom line through increased efficiency of operation. Indeed, it is the goal of many institutions in the custody business to offer a consolidated custody system which would be used by clients regardless of geographic location to invest in domestic as well as global instruments. The Global Custody system would provide the client with one unified view of his or her portfolio, in multiple currencies and with on-line, real-time information regarding the status of various securities which comprise the portfolio. The system would track both domestic and international instruments under one core accounting system. The global custody system would also reduce the amount of duplication of effort between different types of custodial operations within the firm, improving both the utilization of human resources and the quality of available data. In addition, such a system would result in fewer "failed trades"[10] as a result of the availability of more accurate and timely information.

What does such an ambitious undertaking entail for a custodian? At the very least it means that the custodian will have to have the mechanism in place to service trades in markets located all over the world. Familiarity with regional differences in regulations, practices, language and culture are just some of obstacles which a Global Custodian will have to overcome. However, providing the client with one unified

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[9] "Global Custody." A supplement to Banking Technology magazine. December 1989/January 1990.

[10] A "failed trade" is a trade which does not settle. The settlement could fail for a variety of reasons ranging from the counterparty's failure to deliver on the contract impled by the trade to simply incorrect information about the trade being entered into the system.

view will also mean a heavy investment in the appropriate technologies, such as Distributed Databases, to provide the seamless integration of data from heterogenous sources.

2.1.3.2 Global Custody Market Segments

There are a number of market segments in the custody business. These segments are almost identical for all three distinct types of custody operations: domestic, international and global. Thus the following market segments are applicable for all types of custody services.

• *Pension and Public Funds*: This is the largest potential segment though they have been among the slowest to engage in aggressive cross border investment. Several possible explanations for this reticence have been advanced. These range from extreme risk aversion to simply fear of the unknown. In terms of dollar amounts, the potential investible assets are approximately $2.3 trillion while the actual current investment in global securities is only to the order of $100 million. Pension fund managers are typically authorized to invest up to 10% of portfolio assets (i.e. $0.23 trillion) in global securities. Thus the potential market for Global Securities is not even 1% penetrated as of early 1990. Clearly, this segment offers attractive growth prospects for global custody services. A recent study concluded that while currently, the number of private pension funds alone with international holdings hovers around 10%, that figure is expected to grow to 30% in three years.[11] In addition, longer term trends such as portable pension plans[12] and prefunded health care[13] promise to further enlarge the Pension Fund pools and, in turn, the demand for global securities.

• *Mutual Funds*: This segment shares a lot of the characteristics of public and pension funds, with the exception that players in this market have been somewhat more aggressive in pursuing global investment strategies.

• *Insurance Companies*: Players in this segment are mostly US insurance companies. While they are not a large segment per se in dollar amounts, their actions influence the investing behavior of the first two segments, Pension funds and Mutual funds.

• *Banks*: This segment comprises of regional or other small international banks who cannot offer their own global custody services. These banks typically contract out with a larger bank, such as New York-based Citibank, for custodial services on behalf of their clients.

• *Individuals*: This segment is very small and comprises of a few high net worth individuals who engage in global investment strategies for their own account. However, this segment is currently insignificant, both in size and influence.

2.1.3.3 Global Custody Market Players

In the United States we have the following institutions who are the major providers of Global Custody services:

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[11] "Trust stays afloat in the Global Market." Sheila O'Heney. Computer in Banking. March 1990.

[12] A provision to allow employees to move their pension plans from employer to employer is reportedly under consideration in the United States Congress.

[13] Prefunded health care is operationally very similar to a Pension Plan, with the main difference being that in this case the funds are specifically earmarked for post retirement health care costs.

• *Chase Manhattan*: Chase Manhattan has the largest pool of securities under its Global Custody services. Chase has spent $90 million on its operations and systems center in Bournemouth, U.K., which is the hub of its global custody network. One of the bank's primary goals is to develop systems that will ultimately allow its clients to electronically review a portfolio regardless of where it is held and regardless of how they want the information sorted. Being able to view information in a variety of report formats would give clients dramatically improved decision making capabilities. For example, a client would be able use information from all over the world to determine exposure by industry and well as currency. Using this information, the client might decide to liquidate a deutsche mark denominated security issued by a German auto maker. Currently, Chase has over 100 installations of its Client Access System which gives its clients such a capability.

• *State Street*: State Street has a strong reputation with mutual funds and they have successfully parlayed this strength in with public and pension funds. They have recently started converting clients to an in-house developed world-wide multi-currency accounting system. This systems will handle both international and U.S. assets. Clients can track investments through on-line access to account information.

• *Citibank*: They have a very extensive international network of branch offices and sub-custodians. This extensive network gives them an edge when it comes to handling global securities. Local branch officials tend to be familiar with the regulatory and legal environment, the language and market conditions, thus providing the bank as a whole with an effective network of persons to deal with the myriad of differences between countries. Citibank is also considered to be a technology leader in the financial services industry.

• *Northern Trust*: Northern Trust in Chicago has undergone a steady evolution since it entered the Global Custody business in the early 1980s. Initially, Northern Trust used the services of a Swiss correspondent bank for processing of global securities. In 1984, they went live with their own system in London and Chicago. Northern's on-line domestic reporting system is reported to be one of the best in the business. They are now working to provide the same level of sophistication for global reporting. Northern Trust specializes in the servicing of Public and Pension funds.

• *Morgan Stanley*: Morgan Stanley Services, Inc., a business unit of Morgan Stanley & Co., recently began providing global custody services to institutional investors. Clients include Wells Fargo Investment Advisors and Prudential Insurance. Morgan's strong european connections through the Euroclear securities clearing system gives them an edge in servicing European securities.[14] Morgan's global custody operations are centrally run out of the United States. It is believed that this operating structure is, in part, a reflection of Morgan's centralized management style.

• *Other "Boutique" players*: The so-called "boutique" firms have narrow specialties. For example, Boston Safe Deposit & Trust Co. recently collaborated with Harvard Management Company Inc.[15] and the Bank of Boston to develop a global custody systems to serve the needs of Harvard Management. Brown

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[14] "Morgan Bank Quietly profits operating Euroclear system." American Banker. Thursday, June 18, 1987.

[15] The Harvard Management Company, Inc. is a group which manages the endowment and pension funds for Harvard University.

Brothers Harriman is another example of a boutique player; they were recently hired by the Basel, Switzerland based Swiss Bank Corp. to keep custody of their U.S. based securities.[16]

• *Overseas Players*: Outside the United States, *Barclays* and Midland Bank of U.K. and Mitsubishi Bank of Japan are considered key players in the Global Custody business. Most overseas banks are rapidly bootstrapping themselves into the global custody business by purchasing software from financial software firms. For example, *Midlands* recently purchased a global custody system from New York-based Vista Concepts, Inc., and worked jointly with the company to heavily customize it. This system, reportedly, has a very flexible securities movement and control (SMAC) system upon which they aim to build systems for reporting, multi-currency, etc. *Mitsubishi*, with more than $8 billion in assets, has purchased Premier Systems Inc.'s "Global+Plus," a totally integrated portfolio accounting/securities processing system for global asset management. This systems offers a powerful multi-currency accounting systems for tax reclamation, foreign exchange contracts and domestic and international corporate action processing. It also provides full support for worldwide cash management and easy communication links to global data sources."[17]

2.1.3.4 Nature of Global Custody services

Global Custody can be a *profitable* business when compared to Domestic Custody. Domestic custody services generally yield about 3 to 4 basis points[18] in fee revenue whereas Global custody services generally yield fee revenue in the 30 basis point range. This is almost a ten fold difference! Global Custody, however, is a very *complex* business.[19] It is "multi-everything": multi-national, multi-currency, multi-language and multi-procedure. Global Custody is also currently very labor intensive. In addition, seamless integration of data from disparate sources across international boundaries is also a complex task, both logistically and technologically. To operate in a world wide market today, banks need a *flexible* system that can satisfy varying country specific regulations and customs while meeting the processing requirements of investment instruments such as foreign exchange futures contracts.

2.1.3.5 Pressure to reduce fees

There is tremendous pressure on Global Custodians to reduce the cost of their services. Whenever they implement efficiency improvements, clients demand immediate reduction in fees, very often before the global custodians have had a chance to actually realize any economic benefit from the efficiency improvements undertaken. As an example, consider when the Depository Trust Corporation (DTC) came into being. The anticipated reduction in transaction cost was dramatic: from $16 to $1.50 per transaction. However, this was to occur over a period of time. But clients demanded reductions in transaction costs much ahead of the institutions being able to realize the savings. It is not uncommon nowadays for Pension Fund service providers to have to periodically justify their costs to their clients. Sometimes clients will ask for "rebids" where in addition to the incumbent firm, others are also invited to submit competitive

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[16] "Firm picked by Swiss Bank as U.S. Securities Custodian." The Wall Street Journal, Page A2, April 17, 1990.

[17] For example, the system obtains pricing and corporate action information from Extel and Telekurs, the European pricing services.

[18] A basis point is one hundredth of one percent of the value of the assets under management

[19] "The Rocky Road to Globalization." by Larry Marion. Institutional Investor. October 1986.

bids for future business. The implication of these trends are that serious players in the Global Custody business will necessarily have to be in it for the long haul: sacrificing short term profits for long term steady business. Institutions who do not have the financial muscle to play this long term game will be the first ones to succumb.

2.2 History of FISM

The FISM system was developed to unify securities handling at the bank and to form a basis for their Global Custody operation. At present the old systems are still in place, though they are slated to be replaced by FISM within the next year. We first proceed to describe the current systems for securities handling, because, as we shall see, several aspects of the old system are key to understanding why certain choices were made in the FISM design.

2.2.1 Current Securities Handling Systems

2.2.1.1 Domestic Custody

Domestic Custody is handled by the *Astra* Securities Movement and Control system. There are essentially two parts to Astra. The first permits input of instructions into the system. This part is also known as *Star*. The other part of Astra permits for the Settlement and Movement/Control functions of Astra. Astra was developed almost 20 years ago in the pre-DTC era and has since been modified several times to meet the evolving needs of DTC and other automation functions. According to a manager at the bank who was involved with Astra development, "We kept modifying Astra until it could not be modified any further." Currently, the bank is in the process of rewriting the settlement function; this new settlement module is called *Span*.

2.2.1.2 Global Custody

Global Custody is handled by a system called *Cosmos*. Cosmos was originally developed at a European location for use within the branches of the bank within one country only. Cosmos was a big success at this level. Cosmos enabled the bank to streamline many functions which were previously separate and marked with duplicated efforts. News of Cosmos's success spread quickly throughout the bank's other offices around the world. Soon units of the bank in other countries began inquiring how they might adopt Cosmos at their sites. Thus management made a decision to distribute Cosmos to the offices which requested it. It was always intended that the actual development of Cosmos be managed out of one location. However, the reality of business pressures often led to local "enhancements" to the Cosmos system to support functions which were unique to the local operating environment. In the current Cosmos system, all centers have made their own sets of modifications to the original code to adapt the system to the local operating environment. Other than adhering to some common message interchange formats (out of sheer necessity), the systems have now diverged to the point that they are now treated as essentially separate software entities. Functional changes have to be separately implemented in all copies of the software.

2.2.2 Securities Handling under FISM

The problems associated with maintaining and extending Cosmos convinced the bank's management that it was time for change. According to one manager in charge of Pension Funds, the bank's inability to extend Cosmos to handle new types of securities servicing was hurting the bank in very direct ways: it was losing business to the competition. For example, the bank had recently lost the Wells Fargo account to Morgan Stanley's global custody operation. Thus the bank decided to embark upon the development of FISM, a new system for securities handling with the capability of providing a common

record keeping system for use throughout the world. FISM, it is also believed, will greatly reduce the risk of failed trades. The goals of FISM are to provide the following in one integrated system:

- Real-time, on-line capability on a global basis
- Multi currency handling
- Fully integrated Cash, Foreign Exchange and Securities management
- Flexible Accounting (via Trade date, Contractual settlement date or Actual settlement date).
- Average cost calculation for Tax reporting purposes
- Securities movement and control functions
- Recordkeeping
- Issue Servicing
- Reporting

It is fair to say that competitive pressures are one the main driving forces behind the decision to develop FISM. Astra and Cosmos are acknowledged to be outdated; some at the bank acknowledge that the lack of a system with FISM like capabilities may have hurt the bank's reputation as a technology leader. However, risk reduction is another force which is driving FISM. The number of failed trades for global securities is several times more than for domestic securities. Very often a global security will fail to clear because of incorrect information being entered into the system. FISM will improve the overall quality of information in the system thus leading to a direct reduction in risk.

There is unanimous agreement that FISM is what will give the bank the competitive edge in the increasingly global operating environment of tomorrow.

2.3 FISM Implementation

FISM represents a significant departure from traditional methods at the bank along a number of key dimensions:

2.3.1 Portable Implementation using FSA

FISM is built on top of a basic software platform called the Foundation Software Architecture (FSA).[20] FSA is an integrated environment of packages and modules which provides comprehensive facilities for the development and operation of applications. FSA provides a standard gateway to the outside world for applications software. This link to the systems environment provides application builders with a standard, simplified, "logical view" of this outside environment, thus facilitating portability of application systems and supporting the migration of future systems. With FSA, it is hoped that new releases of the Operating System software would not be as disruptive as they have in the past since resolution of compatibility issues would now be localized to FSA, a smaller and more manageable body of code. Finally, FSA defines and enforces the technical architecture of the overall system, providing a standard communication interface and allowing for a transparent evolution and distribution of processing functions and data.

The FSA platform provides the programming and operating environment upon which the rest of FISM software is layered. Thus migrating FISM to a new hardware platform would mean simply porting or rewriting FSA, a smaller and more manageable body of code, to the new platform. This concept will be shortly validated at the bank. Beginning May of 1990, some limited software entities will be ported from an IBM environment to a DEC based system.

2.4 Support of Multiple Platforms

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[20] The information presented in this section was derived from the bank's internal documents.

The bank will support FISM on multiple platforms for a number of reasons. Firstly, they have an existing base of computers from a variety of hardware vendors. Secondly, terms of trade tend to vary from country to country. Thus, for example, IBM hardware could be advantageous to acquire for United States installations but DEC hardware may be obtained on more attractive terms in Europe. To take advantage of both the existing multi-vendor hardware installations and the differences in terms of trade it was considered necessary to support multiple hardware platforms.

2.5 FSA Overhead

The *Foundation Software Architecture* is what has made support of FISM on multiple platforms possible. FSA consists of a set of highly optimized basic functions which provide application programmers with a simplified and unified view of the hardware. In addition, FSA also contains a set of common input and output functions. From a programmer's point of view, the common programming environment means a familiar development process. From a user's point of view, the common input/output system leads to familiar presentation. Applications software, such as FISM, are always layered on top of FSA. Thus the task of supporting FISM on another platform reduces to first supporting FSA; once FSA is supported, FISM code is simply ported over to run as a layer over FSA.

Going through "middleware" such as FSA does entail some amount of performance degradation. A recent article in *American Banker* was critical of the bank's middleware approach.[21]. This article pointed out that the bank's approach had not worked in the past in the few banks that had tried it.[22] The article, however, acknowledged that the bank's approach was "doable." Nevertheless, the skeptical tone of the article was clear. The bank has taken a number of steps to ensure that the degradation due to middleware overhead is minimal. The IBM version of FSA was subjected to a detail design review by IBM's CICS Laboratory in the U.K. An additional review by a third party consulting firm concluded that on an IBM platform, FSA entailed no more than a 5% overhead. The bank will enlist the support of hardware vendors to rewrite FSA software from scratch to optimize performance for their hardware. Note that FSA will be *rewritten* and not ported for each new hardware platform, perhaps with major portions written in the natural machine language to fully take advantage of any "low level" performance opportunities presented by the hardware's unique architecture. Layered software, such as FISM, will simply be *ported* through recompilation. Such an approach was followed to support FSA on DEC platforms. FSA was first rewritten for DEC hardware. Layered software was then simply ported. Interestingly, the performance degradation due to FSA was actually less on DEC platforms when compared to IBM, due to performance efficiencies arising from the use of DEC's VAX computers in a clustered configuration. Rewriting FSA to take full advantage of the clustering was credited for this rather pleasant result. The DEC experience also validates the basic methodology for supporting multiple hardware platforms: *first rewrite FSA for the new hardware, then port layered software such as FISM.*

2.6 FSA Components[23]

Figure 3 illustrates the main components of the FSA platform. The following is a summary of the functions in each of the major FSA components.

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[21] "Global Link of Accounts -- A Bold Risk ..." by Richard Layne. American Banker. Friday, March 2, 1990.

[22] These banks all experienced sluggish performance as a result of the middleware overhead.

[23] Details were obtained from the bank's internal documents.

2.6.1 Message Exchange Service (MXS)

MXS is used both for input and output of messages. This system works off of both old style Telex messages and the newer Swift format electronic messages.

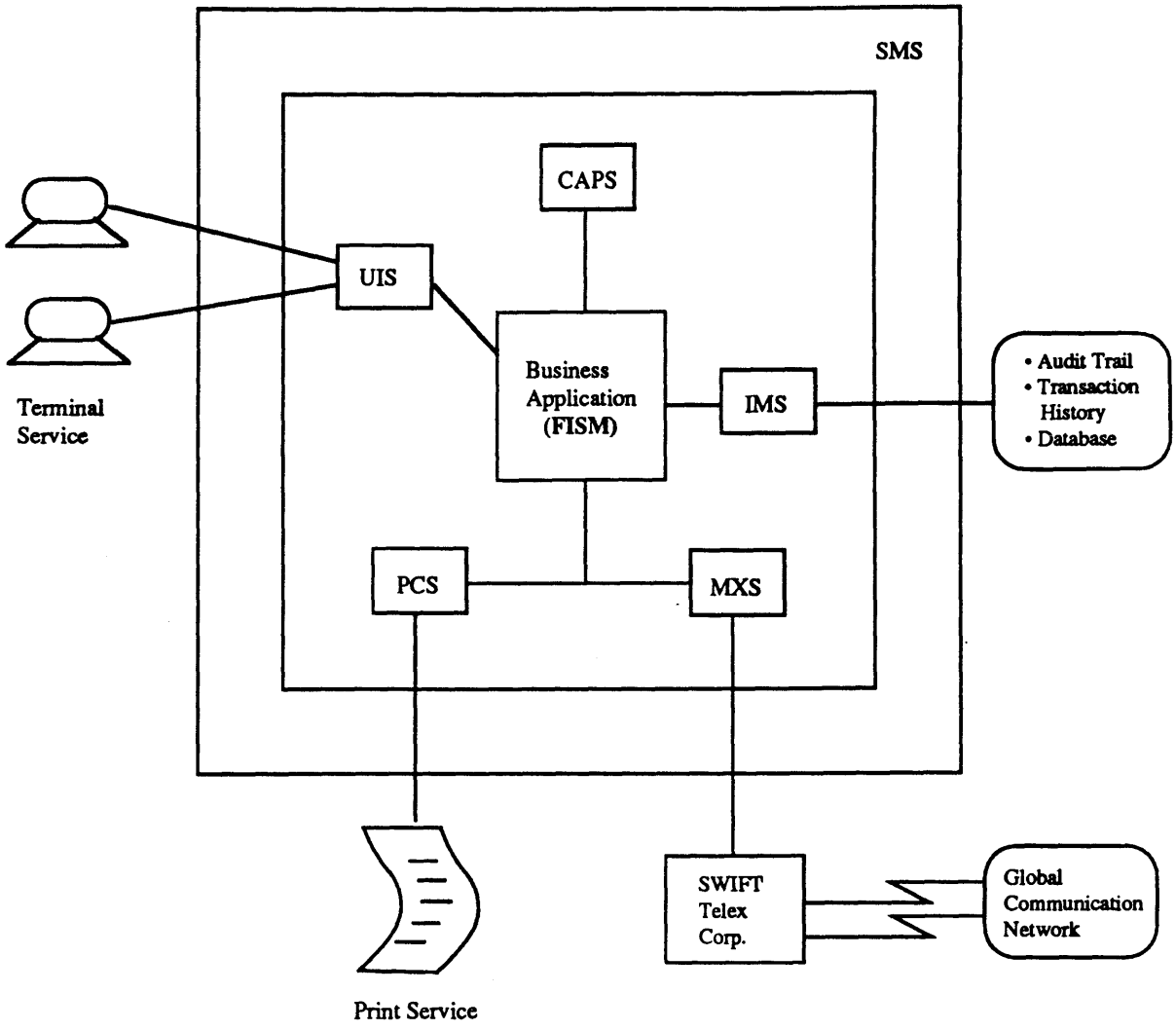

Figure 3: FSA Components

2.6.2 Print Control Server (PCS)

PCS permits routing of output to a variety of print devices. Applications themselves are insulated from the specific details of the print device. PCS is responsible for all of the printing and related formatting aspects and interfaces with the spooling facilities available in the physical environment. Production of on line reports, batch reports produced during end of day processing and screen based hard copy functions are all under control of PCS. Thus changes to the physical environment, report format changes or the production of reports in different foreign languages do not impact application systems.

2.6.3 Security Management Service (SMS)

SMS permits definition of security functions at several levels of granularity using a variety of criteria like Transaction level, Range of account number, Time of day, Terminal number, etc. The system also permits for field sensitivity by allowing selective views into a record, i.e. the capability to view some fields but not others within the record. SMS enforces regular changes of passwords by automatically prompting the user for a new password at regular intervals. SMS also provides a full audit trail capability for every file. Finally, SMS provides a variety of control functions which allow the administrator to perform essential duties in ensuring the integrity and safety of the entire environment.

2.6.4 Information Management System (IMS)

This is a logical interface to the actual file management system. Files are not directly updated; rather a request to IMS is made which then in turn does the physical update. IMS provides a logical view of the data. That is, while the data may be dispersed over a number of separate physical files, IMS has the capability of providing a logical structure permitting a single unified view of the data as one logical record. Thus one IMS request may be made to update one logical record which in turn may result in physical updates to a number of files where the data physically resides. Currently IMS is basically VSAM on an IBM platform. Consideration is being given to move to an Oracle based data base management system on both IBM and DEC platforms.

2.6.5 User Interface System (UIS)

The user interface system governs the actual interface functions. It has several interesting features such as permitting the definition of screen forms and mandatory/optional data within the forms along with their permissible formats, precision, etc.

2.6.6 Common Applications Modules (CAPS)

Commonly used functions are available as encapsulated routines called Common Application modules (CAPS). CAPS are routines are with a sufficiently general interface to make them useful in a variety of contexts. For example, the routine to calculate interest payment is available as a general purpose subroutine. Such a design approach to software is also referred to as Object Oriented programming where generalized routines are written encapsulating all information about the object to be manipulated ("interest rates") along with all the necessary instructions to perform the manipulation ("line of code").

The following is a partial list of the CAPS available. This list is not complete, but is merely presented to give the reader some idea of the different types of functions which are presently available as CAPS:

- Numeric Validation and Editing
- Calendar Date Validation, Editing and Formatting
- Date and Day manipulation

- Cross currency conversion
- Extraction of Common system information
- Customer mailing address formatting and selection
- Conversion of figures into letters

2.6.7 Data Dictionary Service (DDS)

The DDS enables management to control and optimize a valuable resource: Data. By gaining control over its data resource, the organization goes a long way to effect a productive and cost-beneficial management information system. DDS controls all data definitions required by the system and maintains them in a central Data Dictionary. This Data Dictionary includes all business data definitions and all definitions required by the FSA platform. The DDS also has a maintenance function which enables the Data Administrator to perform updates of entities definitions.

2.7 FSA Benefits

The FSA approach provides a number of benefits during application design, development, operation and support.

• *Reusable Software*: Common functions are developed only once and encapsulated in CAPS. Moreover, these CAPS may be highly optimized to take full advantage of any special features of the operating environment. Application programmers need only understand the interface to the CAPS without having to have a detailed knowledge of the systems hardware or software configuration. This enables the application programmer to concentrate more effectively on the main task at hand: the design of the business application.

• *Independence from environment*: The FSA platform allows application to be independent of any changes in the hardware (such as a new processor) or software (such as a new release of the operating system). Any problems which arise with changes and hardware and software are localized to the FSA platform and are thus resolved more easily. In addition, the system may be tuned by focusing on the operation of FSA, without having to disrupt the applications.

• *Consistent User Interfaces*: Consistent user interfaces reduces the need for training operators every time they are moved to a new application.

2.8 Incremental Design Approach for FISM

The FISM system has its origins in an earlier securities handling system call LASS developed at the bank's London office. LASS is built on top of FSA and provides some of the functions of FISM but is much more limited in scope. LASS is already operational and its development has served to prove the viability of the FSA platform. While the New York group does not intend to directly extend LASS, they will use some concepts and functions of LASS as a starting point for FISM development. In fact, FISM development is well under way at this point with major building blocks implemented and tested. Some other smaller systems have also been implemented on top of FSA. For example a *Letter of Credit* processing systems in *Hong Kong* and a *Bond Processing* systems in *Brussels*. The bank feels that by having first implemented these smaller applications on top of FSA, they have obtained the requisite incremental experience needed to tackle a much larger project such as FISM.[24]

2.9 Overall FISM design principles

[24] One manager at the bank estimated the code size of FISM to be approximately three times that of LASS.

In our talks with the manager in charge of FISM development in the bank's New York office, we gathered some important design philosophies which the bank has decided to adhere to for the FISM design.

• *Non redundancy of data*: This principle states that a fundamental piece of information should be stored only once in the system. Thus updates have to be made only at one place--where the data is stored--and the overall database is therefore always current.

• *Highly reliable system*: This means that the system should always function correctly, even if given incorrect inputs. They termed this as "maximum error repellency." Thus all inputs to the system are always put through an extensive validation process.

• *Highly available system*: The system should be up and running "all the time." This is a requirement if the system is going to function in a real-time, on-line environment.

• *Full transaction audit*: An audit trail of all transactions is to be maintained. It is interesting to note that there is no "back end repair" capability in the system. Thus corrections for incorrectly entered transactions are achieved by entering a new transaction which undoes the effect of the incorrectly entered transaction. A log of both, the bad transaction as well as the correcting transaction is maintained. Thus at all times, a complete transaction history is available for inspection by auditors.

• *Flexible Architecture*: We heard managers using the phrase "planning for the unknown" which points to the need for having a flexible architecture. Such an architecture will allow the bank to accommodate new or changing market needs as they emerge.

2.10 Decoupled Streetside processing

FISM has a customizable *"streetside"* module capability. A Streetside module is essentially a database of information which describes the unique requirements of the local operating environment and depositories. For example, in the US, partial settlements are not allowed by the SEC. However, in the UK, partial settlements are permissible. Thus the New York streetside module would disallow partial settlements whereas the London streetside module would permit partial settlements. The advantage of having a streetside customization capability is that provides a clean way to decouple country specific processing from the main line code. All regional centers would now run exactly the same code with differences in operating environments being specified through the streetside module. This has a number of important implications. Firstly, the *centralized development and maintenance* of FISM is now easier to implement and control because there will be at all time only one, identical copy of the code running at all locations. Secondly, it will also permit them to have a firm control over the evolution of functions in the code. As we have already seen, the bank's earlier decentralized development experience with Cosmos got out of hand primarily because of loss of control over the development and evolution of the code.

2.11 Phased implementation

FISM will be brought on-line in stages. The initial implementation will have multiple copies of the system running at regional centers around the world. These separate systems will communicate using message-based interface. Later project phases will allow for a closer coupling of the systems using a distributed database management system from a major vendor. During the phased implementation great care will be given to migrating the data from older systems to FISM in a carefully controlled environment. Basically, what the bank wants to avoid is throwing the great big ON switch to go from the old system to FISM. The issues for the FISM rollout will be discussed in greater detail in a subsequent chapter.

2.12 Overview of FISM components

FISM has several subsystems. The following summarizes the main components which comprise FISM along with their current status.

2.12.1 Reference Information

A database of static information like Customer names, broker names, addresses, etc. Other information in this database pertains to interest rates, foreign exchange rates, etc. Contained within this subsystem is the Security Master module. This module maps external security reference numbers like CUSIP and CEDEL[25] numbers to a standard bank internal security reference number. Within FISM, all securities are always referenced by the standard internal security number. Thus all external security references are first translated into the internal reference number; upon output the reverse translation is performed to convert the internal reference number back to whatever numbering system happens to be in use by the external environment.

It is important to note that the internal security number is truly *unique* For example, it is common for restricted and non-restricted securities to be identified by the same CUSIP designations. This is because while these securities currently trade at different prices when the restriction are in force, once the restriction period expires the restricted securities revert to regular non-restricted securities. Use of the same CUSIP designation is a source of confusion when entering trades as some indication must be present to identify the flavor of the security. However, the bank internal numbering system permits just such a distinction to be made. While the restrictions are in force the internal numbers of the two flavors of the security are identified by different and distinct numbers.

The following summarizes the capabilities of the Reference Information database:

- Provides full support for U.S. Domestic and International securities
- Has the ability to identify a security by any of its standard identifiers: ISIN, CUSIP, SEDOL, CEDEL, Ticker and CINS.
- Supports information updates from multiple sources, utilizing a variety of formats, at various times of the day.
- Provides historical pricing data from multiple sources in multiple currencies.
- Provides historical corporate action data

The Reference Information sub system has undergone systems test and is now in the acceptance test phase.

2.12.2 Transaction Processing

This subsystem provides for the processing of securities, cash and foreign exchange contracts. These processing functions are tied together because they often occur in conjunction with each other. For example, an order placed by a US mutual fund manager to buy Toyota shares often also entails placing a simultaneous order to convert dollars to yen to pay for the shares purchased. Transaction Processing has undergone systems test and is now in the acceptance test phase.

2.12.3 Balance

[25] These are standard security numbering schemes. CUSIPs are used in the United States, whereas CEDELs in Europe.

Permits real-time, on-line update capability. This module provides three types of balances: Traded, Contracted settlement and Actual settlement. For tax accounting purposes this module can compute average cost numbers, etc. Such processing is typically done in batch mode in other systems; however FISM differentiates by having the capability to do this on line. The on line capability is also used to make retroactive changes (to make corrections, for example). The Balance component is in systems test.

2.12.4 Reporting

The Reporting components allows customer and operational reports to be created in a variety of formats. On line reports are also possible. There is a great deal of flexibility built into this system. Reports can be generated in a customer specific format and in multiple currencies. The system also has a what-you-see-is-what-you-get report capability where an exact on line image of the report may be viewed on a 132 column CRT terminal. The Reporting component is in systems test.

2.12.5 Reporting Ledgers

Reporting Ledgers allow for auditing reports for accuracy. This component is also currently in systems test.

2.12.6 Corporate Actions

This subsystem keeps track of corporate actions. For corporate actions like interest and dividend payments, the system initiates payments to client shareholders of record. In case of errors, the system has a "Reverse/Reexecute" function to permit for corrections. For other types of corporate actions like rights offerings, etc appropriate actions is taken to inform the client shareholders. This component is in systems test.

CHAPTER 3: ORGANIZATIONAL ISSUES

3.1 Overview of the bank's Organization

The bank is one of the largest banks in the world. Founded in the early 1800's, it has grown steadily over the years. The total world wide revenues for the 1989 fiscal year was $13.75 Billion. After deduction of operating expenses, the net income for the bank was $498 million.[26]

The bank has evolved as one of the preeminent international banks with a presence in over 90 different countries. Given the increasing global integration of both capital and financial markets, the bank views this international presence as a unique competitive advantage and is thus committed to the continued expansion of this global presence. In a letter to shareholders, the bank's chairman mentions, "We remain committed to 'Globality' both within the interlinked world of Europe, North America, Japan, Australia and New Zealand and the broader world encompassing developing economies from Africa, the Middle East, and Latin America to the exciting markets of Southeast and Northern Asia."

3.2 Evolution of the Bank[27]

When the bank started in the early 1800's, it served mainly as a traditional "money house" where people could leave their money for safekeeping. The bank continued to perform money house functions for the next century until the second world war. The post-war economy thrust a new role upon the bank: to provide the financial capital to rebuild the industries in the United States and in allied countries. Many millions of dollars were lent out by the bank during this period to assist in the rebuilding effort. As America's economy boomed in the 50's and 60's, the bank entered the new and rapidly growing area of consumer banking. During this period, the bank made a big push overseas to participate in the rapid growth of the banking sector in foreign markets.

In 1990, the bank has evolved into a strong financial services organization with three major business sectors: *Consumer* Banking, *Investment* Banking and *Institutional* Banking.[28]

Each of the above sectors are divided into four geographic regions: North America (NA); Europe, Middle East and Africa (EMEA); Asia and Pacific Regions including Australia and New Zealand (ASPAC); and Latin America (LATINO).[29] Within each region, managers are organized by function or product line. Functional managers are usually located at the regional headquarters whereas product managers are mostly located at the operating branches within the region. *Figure 4* illustrates the bank's organizational structure.

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[26] This information was obtained from the bank's 1989 Annual Report to shareholders.

[27] The evolution of the bank has been traced in greater detail in "Gaining Strategic Advantage through Composite Information Systems" by J. L. Massimo. Thesis submitted for the degree of Master of Science in Management, M.I.T. Sloan School of Management. June 1987.

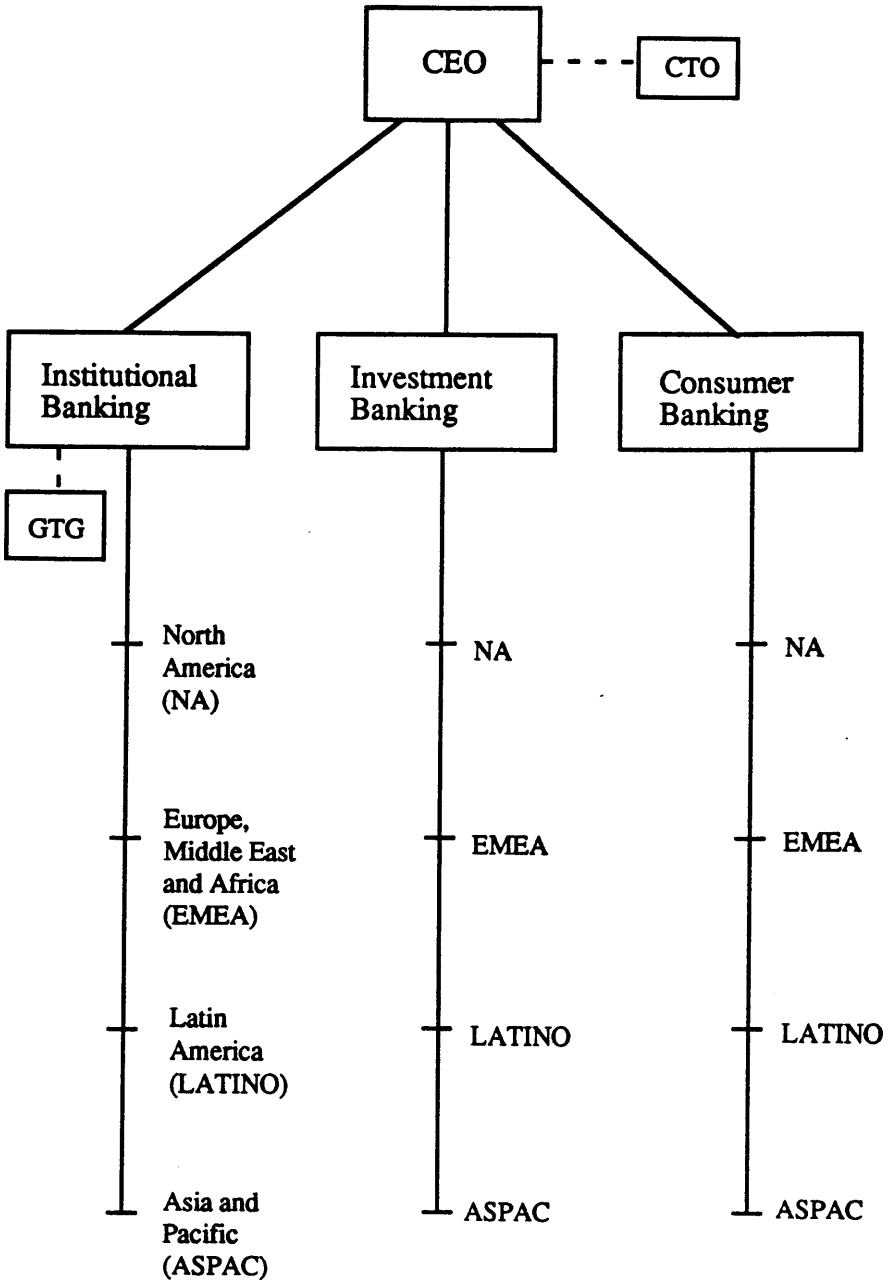
[28] The Global Financial System which is the topic of our case study falls under the bank's *Institutional* Banking sector.

[29] It should be noted that while in the North American region, the three different business sectors function as totally separate business units, in the other regions the distinction is not that clear. For example, personnel and/or facilities may be shared in these regions to improve economies of scale and scope.

3.3 Organizational Culture and its influence on Cosmos evolution

"Autonomy" is the best way to describe the culture of the bank as a whole. The autonomy exists both at a cross-regional and cross-functional level. This autonomy has been both a source of strength and occasional problem for the bank as a whole. The development of the bank's first global custody system, Cosmos, illustrates some of the different ways in which autonomy manifested itself over the Cosmos period.

As we have already noted, it was initially intended to maintain Cosmos out of one regional office. Local offices could make "minor" modifications to tailor the system to their requirements. Strict change control procedures were set up to manage this process. However, over time most of these procedures were essentially abandoned. Towards the end of Cosmos's life cycle, it became somewhat of a misnomer to refer to Cosmos as "one system." What eventually came to be was a proliferation of different versions of Cosmos source code. In some cases the duplication was extreme. Different countries using the same hardware platform would be running different versions of Cosmos. Similarly named code modules at two different Cosmos sites would contain code which was substantially dissimilar in design and function. Corporate wide functional changes would have to be implemented separately by teams of programmers at each Cosmos site, each using different coding standards and in the process further exacerbating the divergence. Today the systems have diverged to the point of being essentially treated as totally separate software entities.



(Parts omitted for clarity)

Figure 4: Bank Organizational Structure

3.4 Problems with the Global Cosmos

The problems which developed during the deployment of Cosmos may be analyzed along a number of dimensions. But along all of these dimensions, we shall see that the autonomous nature of the bank had a big role to play. That is, we shall see that most of the problems had their roots in the lack of communication between regions.

3.4.1 Extent of modification

Management greatly underestimated the extent of local customization which would prove to be necessary to get Cosmos to work throughout the world. Business conditions and practices varied greatly from region to region. In addition, differing regulatory requirements posed different challenges to each region. Cosmos, as it was originally written, did not have such diversity of operating conditions in mind. At one level, entire functions were missing in Cosmos. These had to be written from scratch at other regions. At a somewhat lower level, but posing a far greater problem, was the fact that Cosmos was not "parameterized." By this we mean that certain operating conditions which proved to vary from region to region were actually "hard coded" into the Cosmos system. It is widely believed that Cosmos was deployed too hastily, without doing the necessary prior thinking that should have prevented exactly these types of problems. Perhaps this haste was due to the urgency to respond to market pressures as previously noted. But it should also be noted that the autonomous operating style of the bank did little to foster inter-regional communication and, perhaps, was equally at blame. Had the regions held regular discussions prior to the global introduction of Cosmos, issues such as parameterizing would surely have arisen and, hopefully, would have been resolved.

3.4.2 Lack of uniform programming talent

Regional offices were free to make minor modifications to the Cosmos system to adapt it for their specific needs. But very often, regional offices lacked the expertise to perform these modifications. The problems was particularly acute in lesser developed countries where programming talent was not as abundant as some of the other more developed nations.

3.4.3 Poor documentation

The inner workings of the Cosmos system were very scantily documented. Given that the system was to be modified locally, this was a major oversight. What little documentation there was, existed only in one language. Regional offices would frequently complain of their programmers being unable to understand the comments in the code.

3.4.4 Variability of control

Whatever controls were present, we applied in a very haphazard and disorderly manner. For example auditing standards varied widely. Some regions like Europe required very detailed auditing to be done while others kept auditing to a minimum. Procedures for revision control varied tremendously. Some regions maintained a detailed history of all changes which were implemented. Other regions simply dispensed away with these procedures as being too cumbersome. Again, we see excessive autonomy contributing to the problem, in this case excess variability.

3.4.5 Lack of responsiveness

Regions felt a certain lack of responsiveness from the developers of Cosmos. While making modifications, regional offices would often run up against problems requiring the assistance from the

developers. However, telexes to central development would often go unanswered for days. The regional managers felt that central development was not being responsiveness to their needs. At the same time, central development was being flooded by requests from a number of reasons. From their perspective, a delay in response was justified. But, due to the autonomous nature of the organization itself, this fact was never adequately communicated. Blame was thrown back and forth as a result.

3.5 Cosmos today

Other than a broad set of corporate guidelines there had been little centralized planing. In fact, this decentralized type approach to doing business has often been cited by the bank as one of its key competitive advantages. It is claimed that the ability of local management to make quick decisions "on the spot" has enabled the bank as a whole to be more responsive to changes in local operating environments. However, this approach had several problems. Firstly, it was very costly. Duplicated effort lead to waste of human and financial resources. Secondly, the high degree of autonomy prevented the bank from fully exploiting synergies between regions.

There was generally very little organization wide consensus on the functions and purpose of Cosmos. Every local manager had his or her own view of what was important. Invariably, this view was highly influenced by the manager's immediate operating environment without concern for the organization as a whole. As a result, Cosmos's effectiveness varied widely from region to region with some regions reporting great success while others remaining essentially indifferent.

Autonomy also led to a sense of isolation at the local level. Managers who were faced with the task of adapting Cosmos to their environment complained that they had been handed a gigantic system with little or no documentation to help their programmers understand the inner workings of the system. The problems was much more acute in lesser developed countries where programming talent was particularly hard to find.

In some sense Cosmos has achieved some of its original goals. It has permitted the bank to extend its range of services. It has also resulted in some amount of integration between regions. Perhaps the global Cosmos has also resulted in a faster, more efficient and accurate system than what existed prior to Cosmos. But all this comes at a tremendous cost. Firstly, there has been a great amount of duplicated effort at the regional level due to a lack of coordination between essentially similar efforts. Secondly, the decision to permit "minor" local modifications was greatly flawed. The modifications proved to be anything but minor. The resulting proliferation of code as resulted in a multitude of systems, all of which now have to be maintained separately. Duplication of effort to maintain this multitude of systems has cost the bank dearly in term of resources.

3.6 The decision to replace Cosmos

This adverse experience with Cosmos convinced the bank's management that Centralized development of at least the core software components was essential to retaining control over functional evolution and costs. On the other hand, development of street side modules--essentially subsystems that exhibit characteristics in function or design which are of a extremely local nature--should be decentralized. Personnel at local sites are the ones most familiar with the requirements and they are the ones who are in the best position to develop and maintain the system and to enhance the system fast enough to respond competitively to changes in local market conditions.

3.6.1 Core development in New York

The bank decided to build a new system called the Financial Institution Securities Manager (FISM) as a replacement for the aging Cosmos. FISM is to be the core securities handling system. The core itself

will be modified and maintained at one location only -- New York. Different applications will be developed by the regional centers, but always with a view to being ultimately deployed in a global manner. Thus street side processing will be clearly delineated from the main line code to permit for local customization.

There are several reasons why the bank chose to develop FISM out of its New York regional office.

3.6.1.1 Availability of technical talent

New York happens to have a large concentration of available technical talent which has both experience in the design and development of large software systems and in the intricacies of finance. Few overseas locations can match New York along this dimension.

3.6.1.2 Sophistication of US markets

Location in the heart of the most sophisticated and complex securities market in the world was yet another advantage. Spill overs arising from up-to-date knowledge and know-how in the operational area made a New York-based FISM development strategy all the more attractive.

3.6.2 Operation

FISM will ultimately be deployed at all the four regional centers; however a distributed database environment will present a single, unified view of securities irrespective of where the securities are actually traded. This is consistent with the view that in today's highly integrated financial markets the local identity of a security is greatly obscured. Today, it is possible to trade most blue chip securities on a round-the-clock basis in any financial market which happens to be functioning at that time of the day. Thus a distributed database which could present a unified view of securities would simply mirror this reality. Settlement of trades, on the other hand, is usually very much a local affair dictated by local customs, practices and regulation. Having FISM operational at different regional centers would permit the necessary street side support of settlement functions.

3.6.3 Data Dictionary Management

The management of the data dictionary is centralized out of Hong Kong[30]. The Global Data Administrator has world wide authority to maintain and promulgate appropriate corporate-wide standards. Regional data administrators must make requests for addition of new data elements to the Global Data Administrator. The GDA is mandated to respond to all requests within 36 hours. To further facilitate open communication and dialogue between regions, the data administrators meet on a regular basis. We have already identified Data Administration as one of the key issues in the design of a global financial system. We shall discuss this in much greater detail in a subsequent chapter.

3.6.4 Distributed vs. Non-distributed

The extent of distribution could range from one FISM installation per country to a single, central FISM system for world-wide use.

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[30] While currently based in Hong Kong, the GDA is organizationally under the Global Technology Group (described later) and not under the regional management structure in Hong Kong. The GDA function may be moved at some later time to the U.K.

In the bank's analysis, extreme distribution, that is one FISM installation per country, seemed excessive. Some basic infrastructure needed to be established at each location; the costs for establishing the basic infrastructure in each country were large. When the additional costs for communications, personnel and equipment were factored into the analysis, the one FISM per country approach seemed prohibitively expensive. In 1989, the bank spent approximately $1.3 billion on technology--hardware, software and personnel. There is a corporate-wide awareness to not let these expenditures get out of hand. Thus the one FISM per country option was ruled out.

On the other extreme, total non-distribution in terms of a single FISM system handling worldwide requirements does result in significant economies of scale and scope, but with some other significant disadvantages. Firstly, such an approach goes against the very grain of the *corporate culture* at the bank. The bank prides itself in its decentralized decision making capability. It is often cited as one of their competitive advantages, permitting them to rapidly respond to changing market conditions and emerging opportunities. Secondly, the bank would like to maximize the use of specialized resources--personnel and equipment--at its disposal at various locations scattered around the globe. A single FISM strategy would logistically complicate deployment of specialized personnel. Specialized equipment physically located at great distance away from the FISM site would be virtually impossible to deploy.

Thus the bank chose the middle ground settling on four regional centers to service geographically adjacent clusters of countries. These regional centers located in New York (NA), London (EMEA), Hong Kong (ASPAC) and Pompano Beach, Florida (LATINO). Such an approach was thought to be a good compromise.

3.6.5 The Global Technology Group

The GTG is an ad hoc committee formed primarily to coordinate the Foundation Software Architecture (FSA) platform development and other related activities. GTG also serves as a forum for the exchange of ideas and opportunities related to new technologies. The GTG comprises of the heads of the regional Institutional Banking sectors from NA, EMEA, ASPAC and LATINO.

The GTG was voluntarily created with the charter of coordinating the development and deployment of the FSA platform. The group meets every month, generally at a different regional office with the local head acting as the host, to discuss matters related to FSA. The GTG Executive, based in London, manages the FSA development on a full time basis. It is the responsibility of this person to manage the relationship between the bank and a London-based company called ITB, the developers of the FSA platform.

Under the aegis of the GTG, there are also regular meetings held between the regional data administrators (DAs). The goal of these meetings is to ensure coordination of data definitions between regions. The common data dictionary, naming policies, etc are subject of much discussion during these meetings. The goal is to have the DAs meet every quarter.

3.6.5.1 Funding for GTG/FSA

The GTG does not appear as a separate entity in the bank's corporate wide reporting chain. Instead there are dotted line relationships between the GTG and the regions through participation by the regional heads. There are no explicit chargebacks to the regions for GTG. Instead the funding for GTG comes from the regional offices, with each region paying for an equal share. All expenditure related to FSA development comes out of GTG's budget.

3.6.5.2 Funding for products based on FSA

The common funding for GTG is, however, limited to activities related to the FSA platform. Specific products (such as FISM) which are based upon FSA are funded entirely by the region responsible for developing the product. There is an understanding that the developing region would design its products in a manner to make its deployment as smooth as possible at the other regions. Indeed, the monthly meetings of the GTG are designed to foster the open communication needed to make this goal a reality.

3.6.5.3 Sale of FSA based products

Once developed, products such as FISM will be made available for use in all regions at no cost. These products will also be available for sale to other financial institutions. This is consistent with the bank's goals of becoming a low cost, high quality provider of information processing services. Sale of its products would give the bank visibility and would also enable them to recoup some of the development costs. At a somewhat broader level, this decision is also consistent with the bank's attitude that it is best to share in the gains gotten through technology. While there may be short term revenue loss associated with technology sharing, it is more than made up by the longer term revenue increase through new opportunities created. As an example, a manager at the bank cited the creation of the Depository Trust Corporation (DTC), of which was the bank was a champion. Prior to the formation of the DTC, the bank had a significant revenue stream from serving as the agent for correspondent banks. However, with the creation of a book entry system for securities at the DTC, the bank saw its revenue from correspondent banking decrease. But with the creation of the book entry system, the instruments also became much more tradeable. For instance, short term commercial paper could now be used to back repurchase agreements. The bank estimates that the additional revenues from newly created opportunities has more than made up for the short term loss of being disintermediated. (It is interesting to note, that in this particular instance there was also an immediate short term gain. With the book entry system, the number of failed trades greatly decreased which, in turn, led to lower risk associated with clearing of securities.)

3.6.5.4 Regional Development

Currently the regional offices are developing applications based on the FSA platform, as follows:

New York: The New York office is currently developing two applications based on FSA. The first is *FISM*. The second product is a *Pension Disbursement* system. The Pension Disbursement system is actually being developed under contract by a subsidiary of the bank called COSL[31] based in Bombay, India. Although COSL is a subsidiary, it functions as a totally autonomous profit making venture offering contract programming services to financial institutions, not necessarily limited to the bank and its subsidiaries. New York has utilized the services of COSL in the past with very good results. Previous projects farmed out by NY to COSL have all been completed on or ahead of schedule and within a budget which was inconceivable in New York. The bank has addressed the problems which arise in trying to manage development across almost 10,000 miles in a number of ways. Firstly, the specifications are as detailed as possible. Frequently, a team from COSL is resident in New York during the design phase. Thus when they return to Bombay for the implementation, there is a firm understanding on both sides as to the specifications of the product. Secondly, NY has tended to farm out projects to COSL where their talent is proven. For example, the Pension Disbursement product is very much like a Payroll module, an area in which COSL has accumulated much expertise.

Asia/Pacific: ASPAC is currently engaged in the development of two products under FSA. The first is a *Letter of Credit* processing system being developed in Hong Kong. The second is a *Funds Transfer* system being developed in Singapore.

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[31] "Ease-West Cooperation reaps excellent results." Internal newsletter published by Investor Services Systems Division of the bank's World Wide Securities Services. January 1990.

Europe, Middle East, Africa: EMEA is developing a *Bonds Payment* system in their Brussels office.

3.6.6 Role of the Corporate Technology Office

The Corporate Technology Office (CTO) is a New York based technology group whose head serves as an ex officio member of the GTG. Unlike the GTG, the CTO comes directly under the bank corporate headquarters reporting to the chairman. The CTO serves a staff function, ensuring corporate level involvement in technology policy making, primarily in an observer or consultative role. The GTG functions quite independently of the CTO, though on occasion, the CTO has been called upon to make specific recommendations. For example, recently the CTO was asked to conduct a study of available CASE Tools and Methodologies for possible use within the bank and to return with specific recommendations.

3.6.7 Relationship with the Group of Thirty

While there is no explicit relationship with the Group of Thirty[32], GTG is, in general, committed to the overall goals of the G/30. In fact, the bank views the G/30 goals to legitimize and promote the ideals embodied in initiatives such as FISM.

The G/30's goals may be broadly stated as follows:

- Assist and encourage the creation of depositories to do away with the need for physical security movement as a means of settlement
- Streamline settlement system across financial markets to reduce counter party risk and to increase liquidity
- Encourage participation by a variety of market players including investment banks, institutional investors and brokerage houses
- Set standards for securities identification, rules for settlement, timeframes, etc.
- Ultimately aim for paperless securities of all types (i.e. all in book entry system

The bank's commitment to the G/30 goals are evidenced in an number of ways. The Government of Chile recently asked the bank to investigate and make specific recommendations on how they might set up a DTC-type depository system. In addition, the bank's chairman was actively involved in the G/30, making specific recommendations related to securities settlement.[33]

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[32] The Group of Thirty is a private sector group concerned with the working of the International Finance System. This group consists of representatives from major industry segments including investors, traders, exchange officials, bankers and regulators drawn from institutions all over the world.

[33] "Clearance and Settlement Systems in the Global Securities Markets." Group of Thirty Report of the Working Committee. December 7, 1988.

CHAPTER 4: DATA ADMINISTRATION

Data Administration is coordinated out of the bank's Hong Kong office under the control of the Global Data Administrator (GDA). Organizationally, the GDA reports to the head of the Global Technology Group, the GTG Executive (currently located in the U.K.). The Regional Data Administrators (RDAs) at each of the four regional centers report to local management and coordinate their needs with the Hong Kong based GDA. The GDA controls the Data Dictionary[34] for the FSA project. RDAs maintain their own data dictionaries which include data entity definitions for region specific project such as FISM out of New York. The regional data dictionaries are periodically resynchronized[35] with the global data dictionary.

While the global data dictionary is currently only in use for the FSA project under the bank's Institutional Banking sector there are a number of reasons to believe the GDA's sphere of influence will be enlarged to span other projects and business sectors. For example, the body equivalent to the GTG in the Investment Banking sector was recently merged with the GTG of the Institutional Banking sector whose functioning we have already described. This consolidation will ultimately allow for the data administration function to be rationalized across business sectors[36].

4.1 What is Data Administration?[37]

Data Administration (DA) refers to the decisions and activities that directly lead to or have an immediate impact on operational databases. The Data Administrator title is given to the individual who has technical responsibility of the database. It is important to note, that, in general, the DA is not concerned with how the data elements are used. Rather, the major concern of the DA is that they are entered, stored and retrieved in a manner that facilitates the use of information within the organization.

4.1.1 Entity-Relationship Diagrams

An E-R diagram is used to identify logical groupings of business data and the relationships between these groupings. As the name implies, the diagram is made up of "Entities" and "Relationships." An *Entity* is a person, place, object or concept about which the organization wants to collect data. An example of an entity is "Safekeeping Account" because it represents a roup of data which must remain together in order to meet a business objective, in this case to provide the client with consolidated information about a global securities account. A *Relationship* describes the type of connection between entities. Thus a "Safekeeping Account" is related to another entity, "Customer." But in describing this relationship, an E-R Diagram might qualify this relationship by illustrating that an account can have one customer, whereas a customer can have many accounts.

4.1.2 Entities defined for FSA

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[34] The global data dictionary is currently physically located with the GDA in Hong Kong. The GDA function along with the dictionary may be moved later this year to the U.K. where the GTG Executive is located.

[35] Current agreement between the GDA and the RDAs stipulate that this be done at least once a quarter.

[36] This is mainly for the United States where the business sectors function as totally separate business entities. For the other regions, as already noted, the business sectors already share functions and/or facilities to achieve scale economies.

[37] This information was derived from the bank's internal documents.

The following is a list of entities defined for the FSA project:

• *Data Element*: A data element is a basic unit of data which has a name, a definition and a set of values for representing particular facts. It may be thought of as the most elementary type of entity maintained by the DDS. Each definition holds the element's format details together with a description of its usage.

• *Data Type*: Used in conjunction with the creation of Data Elements, data types define the validation and format for the data and which formatter to use for conversion of the data between internal to external formats. Data types may be viewed as entities which link together data elements sharing the same physical format.

• *Alias Element*: The alias elements mechanism permits sharing of data elements. The details of the physical format of data in one data element can be copied to the definition of another data element. The data element from which the details have been copied is known as an alias.

• *File*: The file entity is used to define a set of parameters required by the system to create and maintain the physical file.

• *Record*: The Record entity links together elements which have a logical and physical relationship for the processing of transactions by a system application program.

• *Key*: The Key entity is used to retrieve a record from the database. There are two types of keys: Primary and Secondary. The Primary Key must be unique. However, many secondary keys may be set up for the record.

• *View*: The View entity provides application programs with a restricted "view" of data elements. This facility is used to implement security features such as restricted access through the SMS.

• *Screenset*: The screenset is used to specify the layout of a structured set of screens. For example, the UIS component makes use of screenset entities to determine the format of presentation to terminal users.

• *Access Definition Table*: The ADT is an entity which defines the navigation paths used by the database system (IMS) to retrieve and update the information. It defines the access paths (keys) and rules by which a database record can be read or written and also defines the mapping of the fields from the database record into view fields and vice versa (field mapping).

• *Printer Definition Table*: The PDT is a definition of the print lines to be used when printing reports.

• *Subschema*: The subschema entity is used to reference all the FSA components used by a transaction and contains a list of relevant PDTs, ADTs, Screensets and Views.

• *Element Prompt*: An element prompt is used to cue the user to input certain information on an application's screen or to describe a field on a screen or in a report.

• *Text*: A text entity is used for screen headings or for reports narrative. The text is identified by its application and its numeric code and can be held in several languages on the system. Text is limited to one line only of up to a maximum of 132 characters and for the screen has a maximum length of 35 characters.

• *Error Message*: An error message is used to help the user determine the cause of a problem. It is also used to give the user other information, such as confirmation that a transaction has been successful or a prompt such as "Press Enter for more information."

• *Description*: The description entity is used to describe all other Data Dictionary entities apart from Prompts, Errors and Texts. The description input is automatically prompted for after the input of any entity for which a description may be required.

• *Action Code*: The action code is entered on the action line to initiate a transaction and is referenced by the UIS component to select which program to dispatch and which subschema and screenset to use.

• *Program*: The program entity is a description of the program and a list of all views used by the program.

• *Database*: The database entity is a collection of data which may be spread over several storage devices.

4.1.3 FISM Entity-Relationship Diagram

To appreciate the complexity of the Data Administrator's task, we present in *Figure 5A* an E-R diagram of the FISM project as a whole. This diagram is a collection of intertwined relationships between 45 entities and, though comprehensive, is hard to read. Therefore, to illustrate some of E-R concepts we will focus on the part of the E-R Diagram which deals with *Customer/Account Files*. This is presented in *Figure 5B*.

The Customer and Account related entities illustrate the following user requirements:

• A customer may have many Safekeeping Accounts, Cash Accounts and Investment Advisors associated with it.

• A Safekeeping Account may be linked to many Cash Accounts and a Cash Account may be linked to many Safekeeping Accounts.

• Each Safekeeping Account has only one Investment Advisor.

• Each Safekeeping Account and Cash Account are identified to a particular sub custodian

• Each Customer and Safekeeping Account is associated with many Bank units (operating, marketing, administration, etc).

Figure 5A: FISM Logical Entity-Relationship Diagram

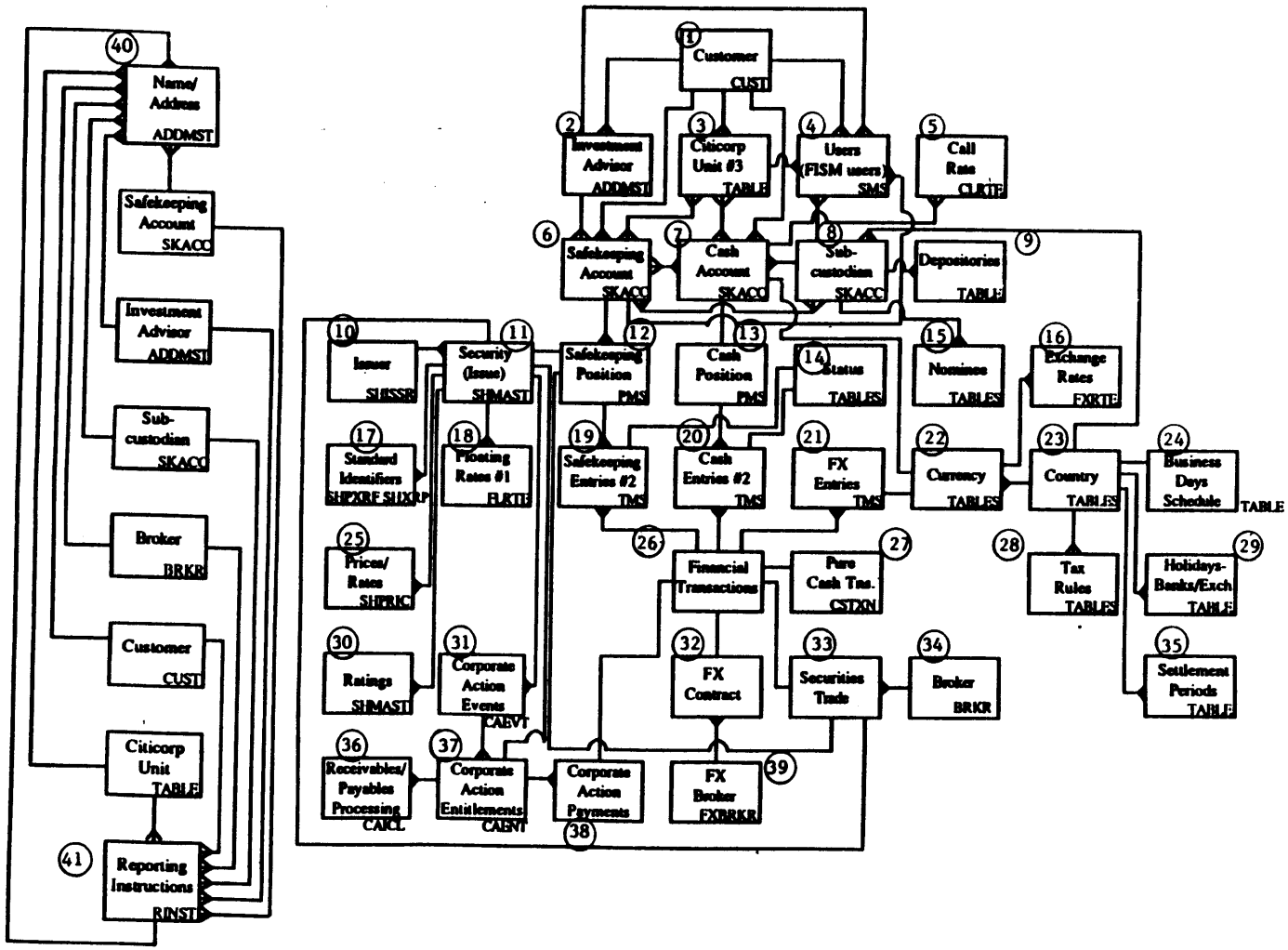
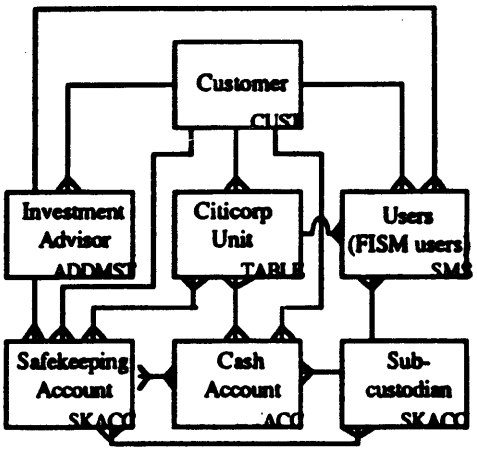


Figure 5B: FISM Customer/Account Files



Based on the above requirements, the FISM development team is allowing for the identification of many bank units in both the account and customer files. Additionally, FISM will create a shared file for Investment Advisors in order to eliminate duplication and to better control Investment Advisor updates. Although each cash account can be denominated in only one currency, FISM will be able to associate many cash accounts to many safekeeping accounts on a sub custodian and system wide basis. Through the FISM account structure, users will be able to create accounts associated to a specific customer as well as *omnibus* accounts which will aggregate holdings at the sub custodian level.

4.2 The Data Administrator's Function

A Data Administrator must perform the following functions:

• *Link Data to Applications*: The DA must understand the data in the business database and the way in which the applications use the data.

• *Oversee Database Design*: The DA must also design the logical and physical characteristics for the business database taking into account the ways in which the applications use the data.

• *Maintain Database Integrity*: Maintain the integrity of the database through the use of utilities which restore and recover the database when necessary.

• *Monitor Database Use*: The DA must monitor the use of the database and reconfigure it to meet changing needs.

• *Understand the Tactical requirement*: The DA needs to understand, in a tactical sense, where the business is headed and ensure that future needs, whatever they may be, will be met.

• *Maintain Data Dictionary*: The DA must also monitor the definition of data in the data dictionary, ensure its integrity, control access to entities and provide dictionary reports.

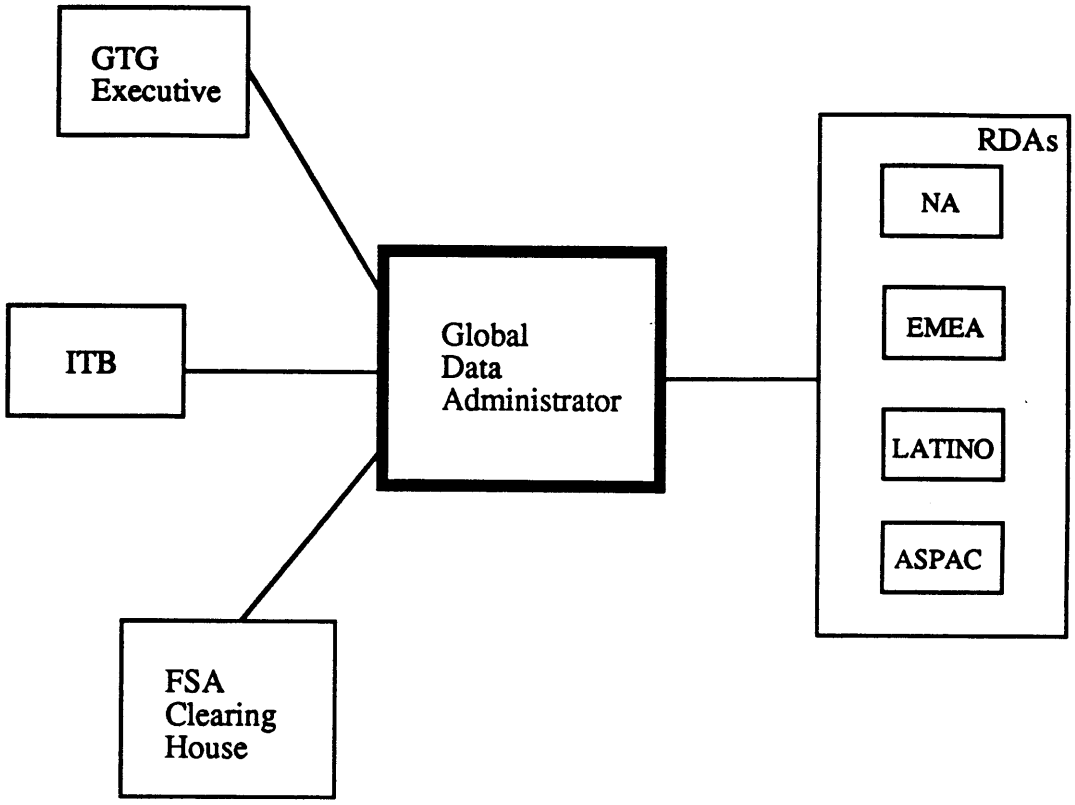
4.3 GDA as an Information Disseminator

The GDA's central role in the data administration process makes the person also a good hub for the distribution of information related to data administration. Thus the GDA acts as a clearing house for information between the following groups (see *Figure 6*):

• *Information Technology for Banks* (ITB): Based in London, this firm is the developer of the FSA platform. The bank has licenced the use of ITB's software.

• *GTG Executive*: Also based in London, this person is the head and chief spokesman of the Global Technology Group. The GDA directly reports to the GTG Executive.

Figure 6: Central Role of the GDA



• *FSA Clearing House*: This group acts as a clearing house for the FSA platform. Some of the functions of this group include putting together new FSA releases and reporting bugs bank to the developers.

• *Regional Data Administrators*: The RDAs are the GDAs counterparts in the four bank regional centers. The RDAs are responsible for maintaining the Data Dictionary at the regional level. In addition, they coordinate with the GDA for changes to the corporate Data Dictionary.

4.4 Principal Functions of the GDA

In addition to the information dissemination role, the GDA is principally responsible for the following functions:

• *Standards and Procedures*: This includes definition of the standards and procedures, obtaining the necessary sign-offs from the RDAs and the GTG Executive for changes in data structures and periodic distribution of status to all organization with which the GDA maintains a formal liaison.

• *Items Requiring Centralized Control*: Centralized control is required for security. Accordingly, the GDA defines profiles for use by the Security Management Service (SMS). These profiles are used both by the GTG Data Dictionary and the regional Data Dictionaries maintained by the RDAs.

• *New Release Coordination*: The GDA verifies the contents of new releases of FSA, the Data Dictionary and Data Dictionary related programs.

• *Maintenance of the Global Data Dictionary*: The GDA coordinates the maintenance of the FSA's Global Data Dictionary currently maintained in Hong Kong. The global data dictionary contains only those data elements or data types which are used across regions; these are marked as "COMMON." The RDA maintains the data elements which are specific to applications within their individual regions. For example, FISM-specific data elements are maintained by the New York RDA. If more than one application requires the use of the same element, then the GDA is notified so that he or she can determine if the entity should become COMMON[38]. If it becomes COMMON, then the RDA relinquishes control of the maintenance of that entity.

While the GDA has overall control of all the Data Element definitions, in our talks with the New York based RDA, we gathered that she would prefer if the control were to be done by subject area with separate persons being in charge of each subject area.[39] She felt that effective data administration required the DA to have both a system architecture and a user perspective. Thus, for example, the person responsible for data administration for securities would have a good background in securities handling. She felt that such an approach would result in more meaningful data structures and data entity definitions in the Data Dictionary because the person performing the DA function would now also have a solid understanding of the business application.

4.5 Data Administrator's Conference

[38] If the entities are not identical, then some form of agreement would have to struck which would either modify both entities to some common standard or modify one entity to, in effect, become identical to the other entity.

[39] By subject areas it is meant different areas of business, each of which have their own data requirements. Some examples are: Securities handling, Bank reporting, Cash management and Consumer banking.

At present, each region has a regional data administrator (RDA). This person manages the data administration needs for the region and coordinates special requirements, like definitions of new data elements, with New York. Communications is key for the success of such an arrangement. Thus the administrators meet once every six months to discuss issues of common concern. The last such meeting was held in January 1990. Some of the discussion topics at this meeting included:

• *Workable Control Procedures*: These included detailed procedures for addition, deletion or amendment of any entity in the corporate Data Dictionary, periodic synchronization checks between the regional and central Data Dictionary, Release Control procedures for new FSA releases, SMS profile definitions and distribution of global and regional standards and procedures.

• *Documentation*: Various deficiencies in documentation were noted. Specific persons were assigned the responsibility to ensure that the documentation was brought up to standard.

• *Various problems in the Data Dictionary*: These problems ranged from incompatibility with specific import formats to inconsistent data element usage and definition. For example, there was much discussion on what a *Transaction Reference Number* (TRN) should look like. Two alternatives were proposed which are presented in *Figure 7*. The New York based RDA proposed a Gregorian date (YYDDD) based TRN which would allow for a 6-digit sequence number, thus permitting up to 999,999 unique TRNs per application per department per day. The Hong Kong RDA proposed a TRN format which was Julian date based (YYMMDD) allowing for only a 5-digit sequence number; this would permit up to 99,999 unique TRNs per day. From New York RDA's perspective a higher limit on the sequence number was warranted because of the larger volume in New York, whereas the Hong Kong RDA felt that the clarity of the Julian format justified sacrificing one of the sequence number digits, especially since the volumes at the non-New York locations were comparatively small.[40] The final resolution was to <u>not</u> impose a specific format, but instead to agree on the following guidelines:

- The TRN should be *16 characters in length.* Thus they agreed that the COBOL data type for the TRN should be "X(16)".

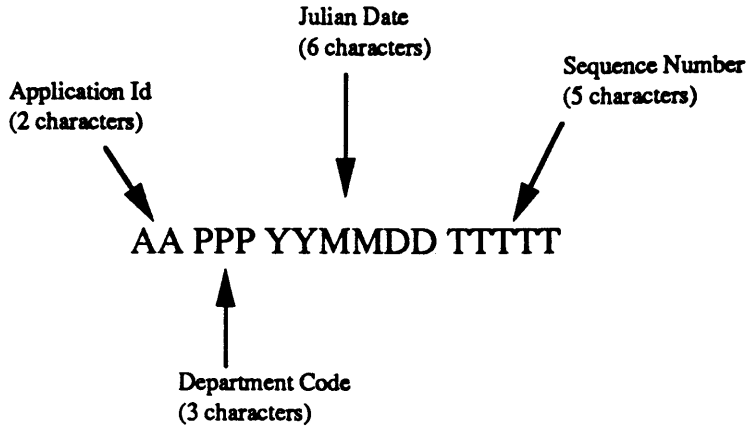
- The TRN should be *unique.*

- The TRN should be *large enough* to accommodate current and anticipated volume in the future.

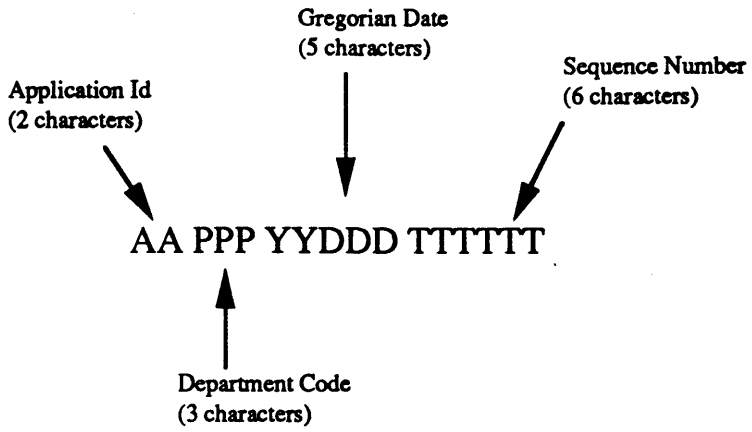
[40] New York transaction volume for corporate events is at most 50,000 per day across <u>all</u> applications and departments. Thus a upper limit of 999,999 for the sequence number per application per department was considered sufficient "for all time to come" by the New York RDA. Transaction volume for the other regions is much lower, typically 150 transactions in all per day.

Figure 7: Transaction Reference Number

Alternative 1



Alternative 2



Resolution:

TRN Should be
- 16 charcters total
- Unique
- Large enough to accomodate present and future volumes

Customizable CAP will be written to allow for site-specific TRN generation

The actual format of the TRN was left up to the region as long as it conformed to the above guidelines[41]. For FISM it was agreed to write a Common Application Process which would be used for all TRN manipulation. The CAP would be street side customizable to accommodate regional preferences for the internal TRN format.

• *CASE Tools*: The Data Administrators in cooperation with the GTG are seeking to standardize on a CASE tool for the purpose of automating many of the data administration functions which are currently done manually. For example, drawing a the entity relationship diagram of FISM can take hours to draw, if done manually. And indeed, it does take hours as was confirmed by the New York RDA. In addition, normalizing[42] of the data dictionary is also very difficult to do in the absence of a CASE tool.

At the end of the conference, the group came up with an "Action Item" list which assigned specific responsibilities to persons for resolving the various issues which arose.

4.6 GDA responsiveness

Requests to the GDA from the regions have to be generally be met within 36 hours. If the request, say for a new data element, is either inconsistent or duplicates a definition which already exists, a resolution is sought through dialogue and/or mediation. The mediation process may involve bringing in parties like the Corporate Technology Office into the discussions to provide an independent opinion. This mediation process has worked well since its inception approximately two years ago. When pressed to elaborate on this point, the New York RDA stressed that "ultimately, every problem is solved because cost-benefit principles are applied to it." The debate is always an ideological one: of figuring out the best way in which to balance the ideal theory of data administration versus the practical implications of having development dispersed around the world. "The struggle," as she put it, "is of a conceptual nature." The solutions themselves always take into account the following:

• How pragmatic is the proposed change from a business standpoint? In particular, what are the financial ramifications of the proposed solution?

• What is the size of the audience that will gain from the proposed change?

• What is the impact of the change on overall system efficiency?

The following example illustrates an instance where the above principles were applied. In the last DA meeting considerable discussion was devoted to Data Naming standards. While standard COBOL names may be up to 32 characters in length, the FSA limits the names to 14 characters. This is because of the evolution of FSA itself. FSA was originally written by ITB for a file system environment called DATACOM which imposed this limitation. This has since carried through to FSA version licenced by the bank. Since 14 characters are insufficient to convey full meaning of the data name in some instances, a 35 character area called the "Description" field was included for each element in the data dictionary.

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[41] This is not a problem so long as the TRN is unique and 16 characters total length. As we have already mentioned, current and anticipated future volumes are such that a 5 digit number in the regions and a 6 digit number in New York would suffice to provide unique sequence numbers for transactions "for all time to come."

[42] Normalizing data simply means removing redundant information from the data. This may involve identification and removal of data items which either appear in duplicate or conflict with some other data item under the given semantic of the data.

However, this field allows the description in one language only; currently this is English. The Latin American DA wanted some provision for making available the description in Portuguese for use by Brazilian programmers. This entailed adding another 35 bytes for the Portuguese description. However, the cost of adding these extra, potentially unused[43] 35 bytes was determined to be greater than the gain to the small programming group in Brazil. Thus the extra Portuguese description field was ruled out. However, the DAs agreed to issue a standard syllable list from which data names were to be built in the future. It was hoped that this standardization would assist programmers in Brazil better understand the intended role of the data name. But given the limited 14 character data name size, the use of the syllable list was made optional. The DAs recognized that this was not a long term solution. Thus an entry was made in the action item list for the GDA and ITB to jointly explore what might be done to implement multi-language support of 35 character descriptions over the longer term.

4.7 Standards

The DA meetings strive to set corporate wide standards for Data Administration. However, at times problems arise as a result of having to meet the varying needs of different regions. Very often the lowest common denominator is selected which generally results in some inefficiencies. For example, while standard COBOL Names may be up to 32 characters in length, the FSA Data Dictionary, limits Data Names to 14 characters. Regions like ASPAC already use 32 character COBOL names for non-FSA projects and would like to see this practice extended to the FSA environment. But because of the FSA Data Dictionary requirements, they are forced to limit all FSA related data names to 14 characters. This often results in somewhat cryptic names as a result of having to truncate, concatenate or exercise some other measure of economy in name length.

4.7.1 Semantics

One big problem which arises is getting agreement on specific semantics. For example, the regions may differ on what is the precise meaning of an Account, Product or Customer. Is a T-Bill a product? Or is it an account? Should a security transaction be treated as a product? ASPAC considers an Account to be a type of product. Differences like these are resolved through dialogue and/or negotiation. In this instance, (Generic) Account and Portfolio Account entities were created to accommodate different business needs, especially as related to aspects of position and balance maintenance. For example, a Checking Account is usually a homogeneous accumulation of a specific currency. A Portfolio Account is usually a conglomeration of securities which are not necessarily based in a single currency or even valued in the same manner. Semantic problems, such as these, point to the need to perhaps have Data Administration organized by subject (in this case "Accounts") so that the persons responsible have a good understanding of the nature of the underlying business whose data elements they are attempting to define.

4.7.2 Resolution of Differences

Differences between regions often arise, especially in the naming of standard data entities for inclusion in the Data Dictionary. The differences may be of many types, however most fall into one of two categories:

• *Redundancy*: Redundancy refers to the situation where the same business objective is served by two or more entities. In the FSA environment, redundancy occurs in two ways.

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[43] The Brazilian unit is expected to make use of a limited number of entities. However, a Portuguese description field, if added, would have to be added to all entities, regardless of whether or not they will be used by Portuguese language programmers.

1. When developing records for applications, VSAM requires that the elements of a key be contiguous. Therefore, multiple versions of a given element may exist in the dictionary to accommodate the various sorting orders of the same data grouping within one record.

2. When using prompts, error messages or text lines in the FSA data dictionary, FSA requires that a 2 byte Application Code prefix the ID of each prompt, error message or text line. Thus reuse of the same prompt (e.g. "Press Enter to Continue"), error message (e.g. "Invalid Operation") or text in a different application group is not possible. Therefore there is potential for multiples of these types of entities because they must be recreated in each application group in which they occur.[44]

• *Synonym*: In this case, we have multiple names of the same underlying entity. There are often situations where synonyms are intentionally created. For example, when the FSA platform was licenced from ITB, it came with a set of naming standards which were different from the standards in use at the bank. While the ITB element was called "CURRENCY," the bank's standard called for the same element to be named "CURRENCY-CODE." This problem was solved by creating CURRENCY-CODE to be a synonym for CURRENCY. Thus the general approach is as follows: if a element does not comply with the bank's standards then simply create a synonym with exactly the same attributes as the non-compliant element. From then on, enforce use of the synonym. The non-compliant element, in effect, ceases to exist.

Resolution is most often by dialogue, but if necessary an arbiter is brought into the discussion to provide some independent input into the resolution process. As already mentioned, very often the CTO serves as the mediating party.

4.8 Multi-lingual Capability

Because the data dictionary is to be used by all the regions, multi-lingual capability is very important. For example, Data Element descriptions should be stored in a variety of languages. While text messages exist in different languages, the data element descriptions themselves are currently only in English. While this generally does not pose much problems for the EMEA or ASPAC regions,[45] LATINO does experience some problems since their working language is either Spanish or Portuguese. As already pointed out, the cost of implementing multi-lingual descriptions is thought to outweigh the benefits. Temporary measures such as a recommended syllable list from which to pick data names have been instituted. However, in the long run some form of multi-lingual description will have to be made available, especially as the programming staff in the LATINO region grows.

4.9 Unique Securities Identifier

The bank has come up with a solution to two very difficult problems: (1) How to deal with the problem of different security numbering systems, and, (2) How to deal with the problem of different securities being identified by the same number.

The bank maintains a Security Cross Reference database which essentially maps every security into a unique FISM number. The FISM numbering system also serves to distinguish between similarly numbered

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[44] The DAs are working to identify common prompts, error messages and text fields so that they may be moved to "COMMON." Once moved to COMMON, they will be available to all application groups, thus eliminating redundancy from this source.

[45] Within the EMEA and ASPAC regions English is either the native tongue or else it is the common working language for systems development.

securities having different characteristics. For example, restricted vs. non-restricted securities generally have the same type of numbering system;[46] their trading prices are however generally different. FISM ensures unique numbers for these two types of securities. A copy of the Data Element definition for the Security Cross Reference Header appears as *Figure 8*. The element name "RESTRICTED-IND" is used to indicate whether the security is restricted or non-restricted. We also draw your attention to the application group column. Note that the Security Cross Reference Header consists of elements from the COMMON application

[46] This is because ultimately the restricted securities will convert to regular, non restricted securities after the contracted time has elapsed.

Figure 8: Security Header Cross Reference

ELEMENT NAME	OCC	LENGTH INT	LENGTH EXT	FORMAT	APPLIC GROUP	DESCRIPTION
SD-RECORD	1				CO	STANDARD IMS HEADER RECORD
INPUTTER1	1	8	8	X	CO	USER-ID OF FIRST INPUTTER/CHANGER
INP-DATE1	1	8	11	N	CO	INPUT/CHANGE 1 DATE
INP-TIME1	1	6	8	N	CO	INPUT/CHANGE 1 TIME
INPUTTER2	1	8	8	X	CO	USER-ID OF SUBSEQUENT CHANGER
INP-DATE2	1	8	11	N	CO	SUBSEQUENT CHANGE DATE
INP-TIME2	1	6	8	N	CO	SUBSEQUENT CHANGE TIME
AUTHORISER	1	8	8	U	CO	USER-ID OF AUTHORISER
AUT-DATE	1	8	11	N	CO	AUTHORISATION DATE
AUT-TIME	1	6	8	N	CO	AUTHORISATION TIME
HIST-DATE	1	8	8	N	CO	DATE WRITTEN TO HISTORY
HIST-TIME	1	6	6	N	CO	TIME WRITTEN TO HISTORY
HIST-VERS-NO	1	4	4	N	CO	IMS HISTORY VERSION NUMBER
IMS-REC-STAT	1	3	3	U	CO	IMS RECORD STATUS
IMS-LAST-STAT	1	3	3	A	CO	IMS LATEST/OVERALL RECORD STATUS
IMS-UPD-TIME	1	6	6	N	CO	IMS UPDATE TIME
VRS-NO-ARV-LST	1	4	4	N	CO	ARCHIVE VERSION NUMBER
VRS-NO-HIS-ELY	1	4	4	N	CO	PURGHIS EARLIEST VERSION NUMBER
SD-FILLER	1	16	16	X	CO	SD HEADER FILLER AREA
BOOKING-OFFICE	1				CO	HEADER RECORD BOOKING OFFICE
COUNTRY	1	2	2	U	CO	HEADER REC BOOKING OFFICE - COUNTRY
COMPANY	1	3	3	U	CO	HEADER REC BOOKING OFFICE - COMPANY
OFFICE	1	3	3	N	CO	HEADER REC BOOKING OFFICE - OFFICE
FILE-SHXRF	1				FM	R-SHXRF LESS SD & FILLER FISM
KEY-SHXRF-1	1				FM	SEC HEADER CROSS REF KEY 1 FISM
SEC-ID-TYP	1	2	2	U	CO	SECURITY ID TYPE FISM
SEC-ID	1	14	14	U	FM	EXTERNAL SECURITY NUMBERS FISM
RESTRICTED-IND	1	1	1	N	FM	Y/N RESTRICTED ISSUE FISM
VSAM-VERS-NO	1	4	4	N	CO	IMS HISTORY VERSION NUMBER (VSAM)
APP-REC-STAT	1	3	3	U	CO	APPLICATION RECORD STATUS
FSM-SEC	1	14	14	U	FM	FISM SECURITY NUMBER FISM
SH-APPREC-STAT	1	3	3	X	FM	SCRTY XREF SPEC. APP-REC-STATUS
FILLER	40					FILLER

group ("CO") as well as the FISM application group ("FM"). The entity "FSM-SEC" which appears towards the end of the record is the actual unique FISM Security number.

Currently, the unique security number facility is used only for the FSA and FISM projects. However, as already noted, the bank is moving towards expanding the use of FSA to the bank's other sectors, namely Investment and Consumer Banking as evidenced by the recent consolidation of the GTG function across banking sectors.

4.10 Data Modelling/CASE Tools

The bank currently uses no corporate-wide standard Data Modelling tool or facility, although the CTO and GTG are actively in the process of identifying a suitable product to adopt as a corporate standard.[47] A CASE tool called Automate/Plus is reportedly a strong contender because it is already in use at the ASPAC region serving their local Data Modelling needs.

4.10.1 Developing a Corporate Standard

While Automate/Plus is not the ideal tool, it does appear to have a number of features which are considered key advantages. For example, Automate/Plus is an integrated program. Thus, the bank will not have to purchase separate modules for each major function; they are all present in one integrated program. In addition, since ASPAC already has Automate/Plus "up and running" the organization has acquired some degree of confidence in the product. Among the concerns with Automate/Plus are the lack of international support from the vendor, lack of multi-user support, poor printing facilities and a host of other inconveniences which, while circumventable, were somewhat cumbersome to deal with in some instances.

The DAs identified a number of issues which need to be addressed before a corporate wide CASE tool can be adopted. These issues include:

- *Pricing*: It is common for the same software to be priced at markedly different price levels in different regions. This is a significant issue because the bank needs to purchase many copies of the software, thus magnifying the effect of price differences. The DAs felt that some method for equalizing cost from region to region will have to be arrived at in order to make the imposing of a corporate wide standard viable.

- *Leverage with ITB*: Currently ITB does not support any standard interface to a CASE tool. Entity definitions are manually loaded. The DAs felt that if the bank were to agree to one CASE standard, it would give them the necessary leverage to persuade ITB to write a standard interface to the CASE tools. This would permit automatic loading of the entity definitions output by the tool's data modelling section into the Data Dictionary manager.

- *Portability*: How portable in the CASE tool between DEC and IBM platforms? Not only should the tool be supported on both platforms, they should also share common data formats for full interoperability.

- *Methodology*: The bank must first decide upon a methodology before selecting a CASE tool.

4.10.2 Minimum Attributes for a Standard

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[47] This is a good example of the CTO playing a consultive role to GTG.

The DAs concluded that a CASE tool must have at the very minimum the following capabilities before it could be considered for adoption as a standard.

• *Data Analysis Support*: This includes automatic Entity Relationship diagram generation, Third normal form analysis,[48] and Entity Attribute matrix generation.

• *Process Analysis Support*: This would permit the user of the tool to automatically generate a data flow diagram and also to perform a functional decomposition of the system.

Once a data modelling facility is adopted, it would give the data administrator the ability to pictorially define the various entities in the system and their inter-relationships; the tool itself would generate the data element definitions and feed the data dictionary. The New York RDA showed me an impressive listing approximately three inches thick and weighing several pounds. This was reportedly a printout of the just the FISM dictionary. Naturally, normalizing (i.e. removing redundancies and synonyms) is very difficult, given the sheer volume of data to be processed. However, if one were to enlarge the scope of normalizing to include yet other components like FSA, the task becomes virtually impossible without some form of automation. A CASE tool would perform normalization automatically whenever new elements are added.

The ideal system was identified as one where the users did the data modelling through a user-friendly "upper case" tool.[49] The users would also use the tool to describe the process which manipulates and transforms the data. The CASE tool would then transform the data model into suitable entries for loading into the Data Dictionary, performing full validation and conflict checking in the process. The system's lower case section would generate the application, perhaps in 4GL code, using the process description supplied by the user.

4.11 Lessons from Cosmos

We tried to identify some of the lessons from Cosmos as applied to Data Administration.

4.11.1 Coordination

Clearly, having a GDA to coordinate usage of data elements across regions is crucial when implementing a Global Financial System. It may be fair to say that in Cosmos, the lack of such a person contributed greatly to the disparity between regional systems. Put another way, had their been a GDA, perhaps the disparity may not have grown to the extent which it did.

But recognizing the infeasibility of having one GDA attending to all the regions' needs, it becomes necessary to have RDAs perform this function. Thus we have a blend of centralizing parts of the data administration process which appear to be common across regions and decentralizing others which are unique to regions. But such an arrangement necessitates tremendous coordination to be successful. The bank has attempted to address this issue through getting the data administrators to communicate on a regular basis, for example the regular DA meetings. It is interesting to note one of the amendments to

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[48] In this form, all redundancies and other inconsistencies in the data dictionary have been identified and removed. The data is said to be "normalized."

[49] Tools which are part of the CASE front end are frequently referred to as Upper Case tools while the tools which comprise the back end are referred to as Lower Case tools.

the Control Procedures in the January 1990 Data Administrators meeting held in New York. The amendment reads as follows: "RDAs are CONSULTED. i.e. not advised, in this process."

4.11.2 Maintaining Control over product evolution

The problem of data administration involves keeping track of literally thousands of separate definitions. Moreover, these definitions are linked in complicated ways. It is clear that in Cosmos there was no formal or informal data administration procedure. As a result the bank as a whole lost control over the evolution of Cosmos itself.

The bank clearly does not want to repeat the mistakes made with Cosmos. Thus I was surprised to find that they have been so late in adopting tool technologies such as CASE. The use of such tools are considered almost essential in an organization, such as the bank, whose data dictionary is as large and complex as it is. While bank clearly recognizes this and is actively on the look out for such a tool, it is some wonder that they have managed to get this far without having some sort of automation for the data administration function.

CHAPTER 5: ROLLOUT ISSUES

FISM deployment presents a variety of problems, all of which are magnified due to the global scale. The financial industry in general is very conservative. In addition, they have become somewhat skeptical of any large scale technology deployments, especially ones which purport dramatic efficiency improvements. This is well illustrated by a recent debacle at a large international bank headquartered in New York. The bank had developed a new, large custody system. On cut over day, they reportedly "threw the big on switch" with some disastrous results. Not only did the new system not work, their ability to revert to the old system was also limited. The bank lost a great deal of money and its reputation was tarnished. The company which wrote the software is now out of business. And so the industry appears skeptical of FISM. A recent article in American Banker[50], while conceding that a successful FISM deployment was within the realm of possibility, nevertheless voiced deep concerns over issues such as the need for global coordination and performance degradation as a result of employing FSA type "middleware." Is the press justified in their criticism? In light of numerous past failures, perhaps the skepticism is only to be expected. But more importantly, are they wrong? We will only begin to know what the answer might be after FISM has been operational for a few years. However, we discussed with the manager in charge of global deployment some of the things the bank has done to learn from the past failures of others, most notably the decision to roll out the FISM system in phases. In our discussions with her, we also identified some areas which we thought were potential problems which the bank would still have to address. Perhaps it is the determination to avoid past mistakes coupled with close attention to the remaining issues which will ultimately be responsible for FISM's success. However, the jury is still most definitely out.

5.1 Global Coordination

This is an area where the bank feels it has a good, firm handle on things. They already have in place a very extensive world wide communications network. Adapting this network to meet the communication needs of the FISM system is considered relatively straightforward. In addition, the organization is culturally very attuned to operating on a global, decentralized manner. Cooperation between regions for the FISM development and deployment is actively promoted through regular meetings between the various regional participants. However, periodically issues arise which test the bank's ability to coordinate global deployment. For instance some operations in FISM are done in batch.[51] The end of day processing for these functions may occur at different times for different countries within the same region. Recently EMEA/London requested New York to consider adding a capability which permitted their European offices to perform end of day processing on the London based FISM at a different time from the London office. A resolution to this problem is reportedly under consideration.

5.2 Release Engineering/Control

There are several aspects to release engineering and control which are discussed separately.

5.2.1 Release Procedures

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[50] "Global Link of Accounts -- A Bold Risk..." by Richard Layne. American Banker. Friday, March 2, 1990.

[51] Some of the operations which are done in batch include Contractual Settlement date processing, Corporate Actions, Vendor Tapes merging, Report generation, Feeds to other systems and Backups.

The bank should create procedures for building tapes, creating release notes, etc. At the very minimum, these should be written down. It would be preferable to employ some form of automation to enable this task to be performed repetitively and with ease. Software capable of performing such a function is reportedly being investigated.

5.2.2 Packaging

How should the bank package FISM for distribution? Should it look the same for all regions? How about for external customers? What is the form of the packaging for them? What constitutes an ideal release package? We agreed that some elements of a good release package would be the following:

• *One Release Package*: The release package for the FISM core should be the same, for internal as well as external delivery. Special cases should be handled by add-ons to the core, i.e. the core itself should never have to be modified to accommodate one particular customer. This capability is present in FISM through the street side customization capability.

• *Procedures*: Clear installation procedures should identify the most common installation parameters. Perhaps using default actions where safe and appropriate is desirable since it will enable the installer to have a better picture of the installation process without having to worry about those parameters which are not so crucial to the installation. The capability to alter defaulted parameters at some later stage should also be present.

• *Demonstration Programs*: The release package should not rely on release notes alone. "Demo" programs should be included which highlight common functions. New features or features which have changed since the last release should be highlighted, both in the release notes as well in the demo programs.

5.2.3 Documentation

Documentation was an area of great concern. The documentation should be at two levels. The first level should be *design documentation* targeted towards illustrating the functional needs. The second level of documentation should be the *user documentation*, containing several illustrative examples and less technical in nature since it would be targeted to the users of FISM. As such, the primary FISM documentation which currently exists happens to be design documentation. The bank has hired writers who will be responsible for writing the final user documentation using the design documentation as input. There was some discussion about documentation; what follows is a list of issues which we felt should be addressed in any documentation effort.

• *Process*: Good documentation should not be generated after the fact. Ideally, it should be developed as the system is designed. It would be ideal to have the writers participate in the design effort, particularly when it comes to the design of the user interface. If documentation starts at the beginning of a product's life cycle, it can play a significant role in the design process itself. If the documentation is done at the end of the product design then the writers can only post warnings around the product's shortcomings. In addition, relying on documentation to make up for the product's inadequacies is unrealistic.

• *Style*: Documentation should be simple to read and easy to use since it is most likely to be read under stressful conditions, e.g. when the system has crashed or the installation procedure has failed. Thus the use of extensive indexes and tables of contents is highly recommended.

• *Expectations*: This really ties back in with the process of generating documentation. It is unrealistic to expect good documentation to convey information which is totally counter to the user's expectation. For

example, an auto maker may decide to switch the gas and brake pedal. But no amount of documentation is expected to convey this totally counter intuitive idea to the user. In fact the documentation process should reveal such inconsistencies in the product design.

• *Who writes the documentation?*: Good designers and implementers of systems are not necessarily blessed with like writing skills. Implementers also have several biases and tend to make assumptions about the reader's familiarity due to their close and extended involvement with the product's design and development. Having an independent, professional writer write the documentation would ensure that the end user's perspective is always kept in mind.

And finally, how does one deal with the fact that *many users would prefer not the read the documentation at all!* This is commonly expressed as "when all else fails, read the documentation." Perhaps this too ties in with the how the process of documentation can influence the product's design to make it truly simple and easy to use. The global deployment manager felt that one solution would be to provide context sensitive, on-line help. However, such a facility is not currently available in either FISM or the FSA platform.

5.3 Frequency of Releases

How often should the system be updated? The bank would like the same version of FISM running at all its locations worldwide at any given time. This would ensure compatibility in operation and data interchange. This means that if FISM is updated to accommodate one region, the others would have to install the new release whether or not they wanted the new features. This implies that there will be a need to have some sort of an understanding between regions to make this possible. The larger issue is the balance between stability and enhancement of the software, that is, the bank wants to avoid another Cosmos-like experience. Some formal policy is reportedly under consideration in this area.

5.4 Source code control

Source code control involves a number of distinct capabilities and activities. Firstly, the source code control system (SCCS) must permit any prior release to be reconstructed. Most SCCSs store the source code baseline along with changes as they are applied ("the deltas"). A prior release can be reconstructed by simply applying all deltas up to and including the requested release. Secondly, the SCCS must supply the relevant procedures to build a release. This entails procedures that list and copy relevant files from the SCCS to a release tape, etc. Thirdly, the SCCS must coordinate updates to the source between different development personnel. Thus, for example, if one programmer has a module checked out for update, other programmers should be permitted only "read access" to that module. Finally, the SCCS must maintain and enforce a good history of the source code as it is changed. In particular, when a programmer checks a module back into the SCCS, he or she must be required by the SCCS to enter in a reasonably detailed description of the nature of the changes made.

Currently, there is no strict source code control system in place. The bank is looking into several offerings by independent vendors of such software. A software vendor based in Massachusetts is reported to be the strongest contender.

5.5 Phased Deployment[52]

Mindful of the fact that previous attempts by other banks to introduce large processing systems "overnight" have all failed, the bank has opted to bring FISM on line in phases.

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[52] Source: Internal company newsletter, January 1990.

Phase I of FISM started user testing in November 1989. In this phase, FISM replaced 17 stand alone systems in Global and Domestic custody and record keeping services. By early December 1989, all tables and static files had been turned over to users for acceptance testing. Ultimately, Phase I will form the base to replace the Cosmos Global Custody system in New York. At present, users have begun testing data files. Soon major portions of the Securities, Cash and Foreign Exchange modules will be available for testing the transaction process.

In December 1989, the bank also started deploying FISM Phase I in London to replace their Global Custody systems, LASS. Later in 1990, an acceptance tested version of FISM will be presented to the Asia and Latin America regions for live installation.

The following is a summary of the phased deployment:

Phase I:

- *Step 1*: Develop and deploy the core FISM in New York
- *Step 2*: Deliver core FISM to regions
- *Step 3*: Collect requirements (for enhancements) from the regions. Establish list of enhancements common to all regions.

Phase II:

- *Step 4*: Enhance core FISM with common enhancements.
- *Step 5*: Deliver enhanced FISM to all regions. Region specific support will be implemented by regions through street side modules.

CHAPTER 6: CONCLUSIONS

As we have already noted, FISM is still in the initial stages of deployment and thus it is too early to tell whether or not the system will ultimately enable the bank to achieve its business objectives. However, in our case study, we have encountered several notions which appear to either be intuitively right, or at least are important enough to warrant serious thought by any organization contemplating the design of a Global System. We summarize the key points below.

• *Design should be driven by business objectives*: The design of the Global System should be driven by the firm's overall business objectives. In deciding whether to distribute function or processing or possibly both, the firm should examine its own organizational structure, culture and capabilities to decide the form of Global System to be adopted. In the case of the bank we have studied, the business objectives were clearly to reduce costs and improve quality of their custody operation. Examination of the organization's structure revealed it to consist of highly decentralized and autonomously functioning units. In addition, the geographically dispersed markets for the Global Custody services dictated a system which would have to effectively meet the needs of multiple markets. However, the need to control the evolution of the system required some degree of centralization of the development function. The preceding requirements on the system design imposed by the overall business objectives led to a decision to centralize the core development. The ability to respond to local market needs was provided for by a "street side" customizing capability. Costs would be reduced through centralized the development and maintenance. Quality would be improved by providing a real-time, on-line capability which had previously not existed, a consolidated view of global portfolios, custom report capability and overall better quality of data through elimination of redundancy.

• *Flexible Architecture*: Operating in a global environment requires the design of global systems to be flexible. Firstly, global environments consist of countries or regions which have their own local business practices, rules and regulations. The global system needs to be able to simultaneously work in all of these different environments. Secondly, the rapid changes that are occurring in the global operating environment itself require the system to be flexible. For example, the recent events in Eastern Europe indicate very rapid changes taking place in the social and economic environments of these countries. Firms with flexible global systems will be the ones in the best position to take advantage of new and emerging business opportunities in these markets.

• *Strict control over product evolution*: When operating in a global environment it is easy to loose control over the product's evolution, as happened with Cosmos. The firm must put in place controls to ensure that this does not happen. In the case of the bank, the decision to centralize the core development was clearly a result of their experience with Cosmos. The bank also realized that it must have a strict control over the data. Thus they have paid great attention to the data administration task, ensuring firm controls at both the regional and global levels.

• *Learn from the past*: Organizations must learn not only from their past experience but also from the experience of others. Given the recent failure of a large bank to implement a Global Custody system due to too sudden a transition, the bank has decided that it would be best to have a gradual phase-in of FISM. Thus an extensive rollout strategy has been devised to ensure that at any one time the perturbation to the system as a whole in limited and that recovery or fall back is possible at all stages.

• *Make vs. Buy*: Organizations are frequently faced with this choice when it comes to acquisition of key technologies. With technology changing so rapidly, it is important for organizations to examine available, "off-the-shelf" solutions to see which ones can be better acquired rather than developed in-house. Acquisition of key technologies can also prove to a source of significant competitive advantage if it enables the firm to get its product faster into the marketplace. In addition, the technology marketplace

itself is moving towards "islands of specialty." Specialized consulting firms can very often offer ready solutions which would be very difficult, if not impossible, to develop in-house. Finally, acquisition of key technologies enables the firm to better focus on its key business objectives. To this end the bank has licenced a key technology--the FSA platform. In addition, it has adopted a proven Data Base Management product from a reputable vendor.

• *Accounting Systems*: The accounting system for global systems must be designed to provide the right incentives for managers so that their interests are aligned with the organization's. An appropriate systems of chargebacks for use of shared technology is desirable. The bank has chosen to share equally the cost of the FSA platform between regions, but the layered products, such as FISM, will be essentially given away "for free" to the other regions. Given that each region already has its own profit and loss responsibility, an appropriate transfer cost might be arrived at for layered products. This should not be very difficult because the bank plans to market layered products to other banks and financial institutions anyway and this effort would require setting an appropriate price based on external market conditions.

• *Backward compatibility*: We have already mentioned that it is crucial for the organization to have the ability to have a fall back position at each stage of the deployment. The recent failure of another bank's Global Custody system was mainly due to the fact that such a fall back was lacking. However, the system should also be designed such that the existing data bases can be migrated over smoothly. Great care must be taken to provide for the appropriate conversions from the old to the new system. It may also be necessary to operate both systems in parallel during the transition phase to ensure smooth migration of the data.

• *Documentation, Packaging and Release Control*: The documentation should be developed along with the system, not after the system has been designed. Ideally, the documentation process should play a key role in the design of the system itself, identifying potential inconsistencies before they get built into the system. The documentation should also be written by people who are skilled at the art. Designers of systems are often not best suited for this task, though often they are the ones who ultimately end up writing most of the documentation. The documentation itself should be targeted to the audience it will serve. We have identified that two broad classes of documentation should be present: design documentation and user documentation. The former targeted towards developers and the latter towards end users. The system should also be delivered in one standard package. Custom configurations should be provided for as "add-on" modules to the standard package rather than through modification of the package itself. Finally, release control procedures should ensure that the package is complete, consistent and has installation procedures and other aids such as demonstration programs to assist in the installation process.