

Processes and Obstacles in Adoption of New Technologies in Uncertain Environment: The Case of Egyptian Public Banks

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ABSTRACT

What is the relation between the process of adopting new technologies, and its impact on business value, in situations of high internal and external uncertainty? Whereas technology adoption is generally fairly well understood, the models do not seem to hold in situations of high uncertainty. In addition, the adoption of a new technology results from a sequence of individual decisions to adopt the new technologies, decisions being the result of the match between the uncertain benefits and costs linked with the adoption process. An understanding of the factors affecting this choice is therefore an essential step forward in order to study the adoption process of new technologies as well. The aim of this paper is to investigate the impact of this uncertainty, using a case study on the introduction of a new technology in a large Egyptian public bank. After exploring the most relevant uncertainty factors and their impact on the adoption process, the paper ends with a general discussion and conclusion.

Keywords: Technology Adoption; Knowledge Discovery in Database (KDD); Customer Relationship Management (CRM); Banking Sector.

1. INTRODUCTION

Research on technology adoption processes is relatively rare [1]. Earlier studies have mostly explained the process as one of political influence [2] or on the role of technology supporters or advocates [3, 4 & 5]. The most comprehensive of the process studies is a study of technology adoption in small firms by Langley and Truax [6]. They go beyond the political models and provide detailed descriptions of adoption processes in five firms. They also describe the contextual elements imposed on these processes but they do not address success of adoption.

According to the OECD [7] technology adoption processes are defined as processes that involve creating or reengineering products or services to meet new market demands by introducing new technologies to improve productivity, developing or applying new marketing techniques to expand sales opportunities, and incorporating new forms of management systems and techniques to improve operational efficiency [8].

Stoneman [9] integrated the idea that adopting a new technology is similar to or almost the same as any other kind of investment process under uncertainty and therefore can be analyzed and measured [10]. The investment decision of adopting new technology is characterized by 1) uncertainty over prospect profit, 2) irreversibility that creates at least some sunk costs, and

3) the opportunity to delay [10]. The primary implication of this way of looking at the adoption of any new technology' problem is that there is "option value" to waiting: that is, adoption should not take place the instant benefits equal costs, but should be delayed until benefits are quite above costs [11]. Therefore, an effective implementation of a new technology requires managing its adoption as a process as well as including the following aspects [12]:

- Estimating the impact of the new technology,
- Identifying the required changes that would be consistent with the adoption process to gain the effective use of the new technology, and
- Motivating its pilot use and later its adoption.

The potential risks (e.g. use, development, and marketing of a new technology) linked to the uncertainty about the benefits of such technology are one of the factors slowing down the rate of diffusion [11]. Meanwhile, the rapid technological developments and advances of the past 30 years have catapulted the world into the era of "cyberspace" and have also made a variety of significant impacts on the business value in modern society. But taken into account, the high external and internal uncertainty factors (e.g. governmental policy, competition, economic, cultural, and social variation) have not produced efficient and effective curriculum that enable them to cope with challenges of highly sophisticated technologies.

In this paper, we try to explore the impact of a highly uncertain environment on the adoption of a new technology. Our analysis is based on a case study that is based on interviews, questionnaires and direct observation in an Egyptian public bank. The outline of this paper is as follows: Section 2 is about the adoption of new technology models, whereas section 3 describes the case study on the adoption of a new technology in an Egyptian bank. Section 4 discusses the results of the survey we conducted in the Egyptian bank; to identify causes for the main problem as well as to illustrate certain parts inexplicable in technology adoption models in situation of a highly uncertain environment. Section 5 provides a conclusion along with drawing attention to the future work.

2. ADOPTION OF NEW TECHNOLOGY

In modeling the adoption of new technology, the opportunity to adopt a new technology is equivalent to a call option with an exercise price equal to the

investment outlay, and the underlying asset is the new technology process [13].

Earlier studies considered users' perceptions as critical factors that influence user acceptance of adoption of new technologies and the use of these new technologies [14,15]. Perceived usefulness and ease of use have been shown to be prominent in the adoption of new technologies diffusion with the former being a more important factor than the latter [14, 16 &17].

As Davis et al. [15] showed in their new technology acceptance model; user satisfaction, perceived benefits, and problems are the two main influences that affect the adoption and usage of new technology. Also, the theory of reasoned action provides a theoretical basis for the link between attitude and behavior [18]. Both models suggest that satisfaction leads to usage rather than usage stimulating satisfaction. Although the models provide insights into the user acceptance of new technology, usage was the only aspect of acceptance they considered in their studies [18].

Jensen [19] has investigated the issue of technology adoption under uncertainty. He considered a duopoly where the value of the new technology is stochastic. He presumed that the innovation could either succeed or fail depending on the reduction of marginal costs.

In building their model, Elberfeld and Nti [20] considered two main concepts. First, they considered a more general type of uncertainty, since the marginal cost of the innovating organizations can have more than two realizations. Second, they considered the competition among organizations. Elberfeld and Nti [20] proved that all organizations benefit from an increase in cost uncertainty. Since profits are convex functions of variable costs of the new technology and organizations are affected differently by a change in uncertainty; they assumed that the uncertainty about the technology is common to all potential adopters, and organizations make the adoption decision simultaneously.

Jensen [21, 22] analyzed that the impact of an organization's capacity to obtain and evaluate information. The analysis showed that a greater information capacity implies not only faster learning but also a more stringent adoption criterion, which tends to push organizations adoption later.

Balcer and Lippman [23] presumed that the value of the currently available new technology is known with certainty, but that the organization faces uncertainty about the arrival of a better version. Their analysis revealed that the announcement of a new discovery could lead to a delay in the adoption of the current technology.

As shown by Hendricks [24], uncertainty about the new technology capabilities of the rival organization tends to slow down the first adoption of a new technology. In the Fudenberg and Tirole [25] model, they found that this type of uncertainty prevents a complete dissipation of the potential first-mover advantage.

3. CASE STUDY: ADOPTION OF NEW TECHNOLOGY IN EGYPTIAN BANKS

To understand the uncertainty factors in our case study, we begin with a general discussion of the changes and resulting problems faced by Egyptian public banks, and a description of the new technology introduced within the bank we studied to deal with these changes and problems. We follow with a chronological account of the technology adoption process within the bank, paying specific attention to the impact of internal and external uncertainty forces.

During the last thirty-five years, two important changes have taken place in the Egyptian banking sector; one in the 1970s and one in the 1990s.

The first important change took place in the 1970s, when competition among banks and financial service firms increased considerably. The increased competition has placed new emphasis on the value of customer retention. In relation to this phenomenon, Vitria [26] states, "the cost of acquiring new customers continues to rise as the competition forces provides to offer increasingly better incentives. This encourages customers to move from service to service, without giving the banks a chance to recover their acquisition costs".

The second important change took place in 1991, when Egypt introduced an extensive Economic Reform and Structural Adjustment Program (ERSAP). The economy changed from an inward-looking centrally planned economy, dominated by the public sector, to an outward-looking economy led by the private sector. Liberalization and privatization of the financial sector in general and of the banking system in particular, were crucial to the intended transformation of the economy [27].

Egypt's transforming economy was following the same path of globalization processes across the world. This worldwide globalization of financial markets has led to creating strong relationships among financial institutions [28]. As a result, the financial institutions today face a fast-paced, dynamic, and competitive environment on a global scale. Given such a competitive environment, the financial services sector, as well as the financial institutions, is required to examine their performance because their survival depends on their productive efficiencies with their customers. Early studies [cf. 29, 30] demonstrated that in particular, in the banking sector, inefficiencies are more important than scale and scope issues.

The ERSAP led to a consolidation within the banking sector, as smaller public banks were unable to deal with the new competition from the private banks. In addition to scale and efficiency issues, the competition was also based on offering customers more innovative and sophisticated banking services and products. The new banks were better able to offer these new services and products, partly because of the more modern infrastructure of these banks and partly because the existing public banks were less open to introduce these

new services and products such as online banking services.

THE NEW TECHNOLOGY: KDD FOR CRM

In order to counter the strong competitive forces faced by the banks, many banks reacted with so-called Customer Relationship Management (CRM) initiatives to better serve existing and attract new customers. Within the bank studied for this case study, a particularly advanced new technology was introduced, called Knowledge Discovery in Databases (KDD). This part continues with a brief overview of KDD notion and importance and ends with the case study account of the technology adoption process within the bank. Because of the impact of internal and external uncertainty factors plays a vital role in accomplishing the desired consequences; a particular attention is given in this issue.

Nowadays, the great forward leaps of technology leave no shortage in sources of information which organizations can use to run their business. Current hardware and software technology allow efficient and inexpensive reliable data storage and access. Businesses are “drowning in information” while starving for the insights that will allow them to make better decisions [33]. The traditional method of turning data into knowledge using manual analysis and interpretation is slow, expensive and highly subjective. Whereas adopting a new technology to do the same is efficient, economical, and faster which is exactly the case with adopting KDD that focuses on finding understandable patterns interpretable into useful knowledge [34, 35]. Furthermore, KDD identifies the overall process of knowledge discovery from data. A process which includes: how data is stored and accessed, how algorithms can be scaled to massive datasets while still running efficiently, and how results can be interpreted [35, 36].

As well, competition, deregulation, and the applications of adopting new technologies in large organizations, such as banks, have contributed to the growth of customer's power. Customers may switch banks on a whim. To win new customers and retain existing customers, organizations may adopt new technological solutions, such as KDD and CRM, in order to analyze the customers' behaviors and needs.

Forecasting which customers are probable to leave, and then designing cost-effective strategies to convince them to stay are extremely difficult for most organizations. Egyptian public banks need to classify and analyze volumes of data that are often difficult to access and combine because of the lack of ability to support the complex KDD processes analytical tasks that are essential to ensure customer retention [37]. An effective KDD for CRM would increase the quality of customer relationships, thereby increasing retention in several ways [31].

Next, we describe the case study account of the technology adoption process in one of the largest public

banks in Egypt, taking into account the impact of uncertainty factors.

In early 2000 the Board of directors held a series of intensive meetings to discuss major problems the bank was facing at the time. The problem that had been discussed and analyzed took the board of directors about six months; the problem that had to be solved was how to increase customer satisfaction and retention. The board took many resolutions, out of which was how to find out the best and new technology and to obtain a solution for that problem.

The board members began meetings with the IT staff in the bank to study the current situation at the administration and to pay specific attention to customer's service system in order to provide all kinds of information to them. The IT manager exhibited detailed information regarding the existed systems explaining the weaknesses of the systems to the management, suggesting the adoption of new technology, and showing its expected benefits. The most important problems and weaknesses related to technical adoption processes that were facing the IT administration were as follows:

- **Using available large volumes of data** with rich description, to perform reliable inference of useful patterns. There is customer data available dating back to 1985.
- **Using available prior knowledge** about the domain such as important field's relations, user goals, and patterns already known. Prior knowledge can significantly reduce the search in all knowledge discovery processes.
- **There are sometimes difficulties** because data is stored in such a way that it is not compatible with newer systems that support to adopt new technologies.
- **Integration with other new IT systems** is of major necessity.

On July 2000, the bank with the IT department prepared a study stating the specifications of the weak points and available capability of the bank at that time for the adoption of a new technology process. As well, the study included the bank problems and board of director's proposals, which believes in the principles of the adoption of a new technology that may contribute to solve the bank problem and the different changes needed to adopt such technology.

Within four months, the bank received many offers from various specialized local and foreign companies in the application of technological systems for the banking sector, (e.g. North Africa, Microsoft Egypt and NCR). Most of the mentioned offers concerned with the application of Knowledge Discovery in Databases for Customer Relationship Management and how far KDD applications and tools participate and increase customer satisfaction and customer retention.

On November 2000, the bank signed an agreement with an international and specialized company to assist

the bank in adopting this new technology (KDD application and tools) in order to increase CRM and to begin the application of the system stage by stage, starting from January 2001 to December 2005. These stages were as follows:

- Customization and extension of banking patterns, according to the characteristics and needs of the bank.
- Development of the bank's data warehouse.
- Development of the appropriate data marts.
- Definition of the data mining tasks: Identification of the measures to be estimated using goal and business object models; understanding of the data to be mined using object models and business rules.
- Generation of data mining results.
- Translation of DM results to rules and integration with the previously developed business knowledge.

In February 2001, unexpected governmental compulsory resolutions took place that belongs to the banking sector such an amalgamation and privatizing the public banks. The government resolution was taken due to recent economical changes and problems facing Egypt at that time.

In addition to tough competition among the private banks and the foreign ones, which began to attract more customers, due to the fact that they offer better services and products with less cost in comparison with the offers that the public banks have. Further, as educational levels rise, customers are more able to discriminate between different financial services and products as well as cultural development of bank's customers added to the problems, and lead them to switch from the public banks to the private and foreign banks.

These governmental resolutions forced the bank to become amalgamated with another bank, which in return added more technological problems and obstacles to the bank in result of the amalgamation (e.g. the increasing of the customers' number and low technology standards and infrastructure). The new situation of the bank caused postponement on the implementation of the first stage of the preparation of the data warehouse for more than six months to have sufficient time to know the new number of customers and manage their data.

The events of September 11, 2001 and the subsequent measures taken against some of the Arabic and Islamic states, resulted in strong tensions between the Islam and Western world. As a result, many Egyptians switched banks, leading to a strong growth of Arabic and Islamic banks at the expense of Western Banks. These events negatively affected the adoption process and added to the main problem in the bank. Because of there was no need anymore for additional adoption process's efforts at that time, the bank postponed the adoption for an additional five months until the bank completed the study of the effect of these events in both domestic and international banking sector markets.

In March 2002, the bank, with the cooperation of the contractor, began to outline the data warehouse structure after all customers' data had been collected, and been cleaned from noise, as well classifies it into various categories to fit with the nature of data warehouse structure. This stage took about ten months. During that period of time new problem appeared linked with the adoption process, which delayed the completion of this stage to become successful and active. This problem is considered a major challenge faced the bank because at that moment most of bank's branches are not centrally connected and do not interact with each other, which caused another delay to complete and process that stage for another additional eight months to connect all bank branches with each other.

On August 2003, we surveyed the existed situation with the bank customers, the front office desk employees, the IT staff and the CRM staff via distributed questionnaires and interviews to identify the major problems they are facing during their work and whether the existing systems are satisfying their task needs. In addition, we attempted to explore whether their future expectations of the adoption of a new technology are beneficial and will remove the obstacles that may affect the adoption process. The questionnaires gathering and analyzing the results along with obtaining the initial results took eight months. The questionnaires were distributed as follows:

- CRM department: All staff in the main building in Cairo branch, 28 samples.
- Information technology and computer centre department: All staff in the main building in Cairo branch, 30 samples.
- Employees (front end employees): All staff in the main branch in great Cairo, 172 samples.
- Customers/clients: 560 samples.

On March 2004, the bank set the required compatible strategies with the specified goals of the anticipated results of the adoption of this new technology, and the most required internal changes which match with the conditions available to adopt this technology (i.e. new infrastructure and PC's).

On November 2004, the IT department downloaded customers' data up the KDD/DM tools interface to discover new patterns which may participate in solving the bank major problem. The downloading and obtaining the initial results took another four months.

On March 2005, the initial results have been presented to the board of directors of the bank. In return the bank board of directors took various decisions out of which starting offering new services and products to its customers, depending on the discovered knowledge given by the adaptation of a new technology.

On May 2005, the bank began to offer these new services and products to its customers. Next on September 2005, regarding a new questionnaire to be prepared and sent to the bank's customers to measure their satisfaction, for the time such new services and

products begin offered based on this adoption of a new technology. Through this questionnaire the bank may search the actual results in comparison with what was planned for and expected, before the adoption of a new technology, to identify the most important obstacles and problems the bank is facing recently. Figure 1 illustrates the summary of a roadmap of adoption process steps within the bank and the uncertainty factors that were faced during the adoption process stages.

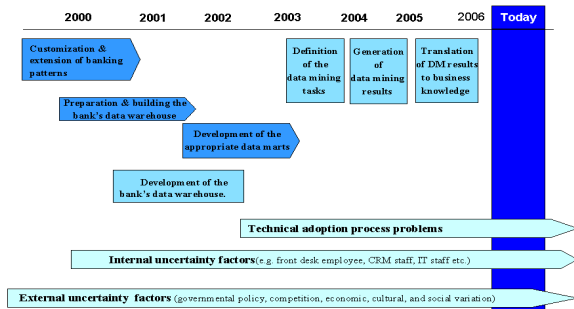


Figure 1: Adoption Process' Roadmap and Challenges

4. CASE DISCUSSION

As we previously indicated, it was not that easy for the bank to adapt the new technology to increase customer satisfaction and retention, because there were different external and internal uncertainty factors within the adoption process stages, the bank could not well define them to achieve its goals. Hence, to illustrate the problems with adopting KDD for CRM in an Egyptian public bank, and which certain issues inexplicable of technology adoption process, we conducted a survey to identify the main problems in the bank as well as the main obstacles that the bank is facing to adapt a new technology process. The survey was conducted among customers, CRM specialists, and IT specialists within the bank¹ [38]:

The customers' point of view: The survey analysis for the customers' satisfaction considered five aspects, namely interior design, reliability, responsiveness, assurance, and empathy. From the survey analysis the following conclusions can be drawn:

- Most of the customers are not satisfied with the interior design of their bank.
- The bank does not keep its promises to retain its customers.
- The Lack of provided services with acceptable speed.
- The bank's employees fail to provide prompt services.
- The bank's employees do not instill confidence.
- Customers feel safe and courteously behave when dealing with the bank.

- The bank does not give individual attention to the customers.
- The customers do feel that their interests are not seriously appreciated.

The CRM department's point of view: The CRM staff has complaints about the inaccuracy of the systems they use, the lack of user-friendliness of said systems, and the constant need for assistance from the IT staff.

The IT department's point of view: The systems and applications currently in use are unable to provide all the necessary customer data and information in an adequate and accurate way.

Next, we present the survey results on the obstacles of the adoption of a new technology from the point of view of the CRM and IT departments. The CRM department is, in general, not acquainted with KDD. The IT department is not satisfied with the current level of service they deliver. The IT department strongly supports the application and use of new techniques to improve their service level. Both departments listed the following obstacles to the incorporation of adopting a new technology:

- the lack of information on expected profitability;
- the lack of capital;
- the lack of information on customer needs and requirements;
- the lack of information on all services offered and accepted by customers;
- the lack of information on service quality standards and new markets; and
- the lack of information on modern technologies.

5. CONCLUSION AND FUTURE WORK

The paper aims to provide deep understanding of the effect of external and internal factors surrounding the adoption of a new technology process in the situation of a highly uncertain environment. Traditional studies on the adoption of new technologies widely focused on technology diffusion in relatively stable environment. Our analyses confirm most of the theoretical and empirical predictions about the adoption of technology advanced in the literature. Our primarily results support that the understanding of external and internal uncertainty factors enable the organizations to better innovate and business impact. In addition, it confirms the convention wisdom about the determinants of adoption process. Given the recent dynamical changes occurring in uncertain environment, we can conclude that without such attention to the adoption process linkage with the external and internal uncertainty factors that differ from country to country (e.g. governmental policy, competition, economic, cultural, and social variation) a technology adoption effort could be failed without any fault from the technology itself.

We believe that this problem could be handled by introducing a new modified version of an extended technology adoption model that takes uncertainty

¹ Full details of the survey results have been accepted at the Symposium on Professional Practice in AI, Santiago Chile, August 2006.

factors into consideration in the near future in Egyptian public banks to enhance CRM, in particular for customer satisfaction and retention. The future work is to analyze the effect of adoption process of this new technology according to the extended technology adoption model. We expect the final results will be available when the bank has completely adopted KDD by the end of 2007.

The diversity of external and internal factors needs to be further scrutinized so that appropriate policies can be drawn to further their impact on adoption process. So far, the already sparse studies in the Egypt context, concentrated on the conventional premise of KDD adoption process. This paper provides new evidence on the subject in Egypt context.

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