BUSINESS PROCESS MANAGEMENT OF CREDIT CARD OPERATIONS: A DISCRETE EVENT SIMULATION APPROACH

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ABSTRACT

Business process management leads to improved customer service delivery. Complex processes have dynamic aspects.Those can be explored for the understanding, analysing and designing of a better process through simulation models. This paper presents a case study of a leading bank usingbusiness process simulation within the context of a business process management approach to change and redesign a critical function within its credit card department to improve the credit card processing system. Simulation models of the current and proposed processes are developed. The goals are to understand the complex relationship between process parameters, credit card processing and waiting time, and productivity measures. We describe the simulation modelling approach in detail, present sample results and provide directions for further research plans for this ongoing research-in-progress paper.

Keywords: BPM, BPI, Discrete Event Simulation, Credit Cards, Bank

INTRODUCTION

Banks are now facing severe competition in the market place. Theybelieve that customers are the key to every kind of business success, an idea that forces them to become customer-focused. One of the most important tasks for a bank is to make loyal customers. However, the needs of customers are changing frequently and the philosophy of making loyal customers cannot be fulfilled without meeting those continuously changing needs. Business processes are the value-providing mediums for banks. Customer-oriented banks usually follow process-oriented service delivery (Aguilar, Rautert and Pater 1999).

Thispaper presents descriptions and contrasts between an existing and a proposed business processof credit card operations (briefly,card ops) with the help of computer simulation of a leading bank, hereafter termed ‘The Bank’. The Bank operates its business operations in all continents, but focuses in the Americas, Asia, Africa and the Middle East regions where ithas hundreds of offices. In most of the operating countries, a bank is either the market leader or the main competitor in the credit card market and thus manages assets of several billion dollars. One of its strengths is its excellent customer service.

This paper is based on one goal, which is to model and simulate two different credit card processing systems, and to draw conclusions about the usefulness of the proposed model. The criterion to assessthe usefulness of the proposed model is based on the reduction of credits

card processing time, which is given high importance for increasing customer satisfaction. The paper concludes by providing directions about future research plans.

BUSINESS PROCESS MANAGEMENT(BPM)

The study of Davenport and Short (1990) defines a business process as "a set of logically related tasks to achieve a defined business outcome". Aligning with this definition, process management makes a company capable of inventing better processes to improve its performance. Business process management is a systematic approach to continuously improve key business processes, such as manufacturing, marketing, accounting, supply chains and other core processes of a company's operations. Business process management is a well-established conceptin academia,and competitive as a manner of fine-tuning business process to achieve excellencein performance (Ko, Lee and Lee 2009). Business process management is thus closely related toBusiness Process Improvement (BPI) initiatives. BPI is an approach to increase the effectiveness and efficiency of business processes that provide output to customers (Harrington 1991) through incremental improvement.

BUSINESS PROCESS SIMULATION (BPS)

Simulation is a controlled approach to explore the dynamic aspects of a complex process.It can also be defined as a well-establishedtechnique of analysing a real system to study its behaviour without modifying and interfering with that real system. The application of simulation can be in diverse areas, such as aircraft building, ship manufacturing, and nuclear power designing, to business process improvement. The application and use of computer simulation in the context of process improvement initiatives are referred as Business Process Simulation (BPS) (Aguilar, Rautert and Pater 1999). BPS has been used in manufacturing for many years and is still being used (Hlupic 1999). However, its application in the service industry is spreading gradually (Profozich 1998) such as banking (Verma, Gibbs and Gilgan 2000)and hotel management(Aksu 2001). According to the author Greasley(2003), the use of simulation is limited not only to predicting the performance of the 'to-be process' before completion, but also to understand and capture variability in the 'as-is process'.

Table 1 – Support Provided by BPS in Process Change, Greasley (2003)

Phases	Steps	Supports by BPS
Assess 'as-is'	Build and communicate process map	Additional Support
	Measure and analyse process performance	Major Support
Build 'to-be'	Develop future process design	Major Support
	Enable and implement future process design	Additional Support

Simulation can be of different types, such as system dynamics, discrete event, continuous and stochastic simulation. In a discrete event simulation model, the state of the model changes at discrete time periods(Schriber and Brunner 2002). A DES model can be used to analyse what-if scenarios for a real world problem and provide valuable information for decision makers. For example, with a DES model of a bank's service delivery system, changing requirements from customers, new technology implementation, or a new service improvement tool can be evaluated before the investment is made(Banks and Nelson 2010).Most of the discrete event simulations are now implemented using a graphical user interfaceto make the model, referred to as Visual Interactive Modelling (VIM) (Robinson 1994), which makes simulation easier than before.

RESEARCH APPROACH

The data for the analysis are collected from a leading and private international bank. The bank's credit card department consistsmainly of the New Accounts Team, Embossing Unit, Maintenance Unit, Legal and Compliance Unit, and Fraud Detection Unit. All units are connected with each other throughE-CAPS (Electronic Card Application Processing System Software, which is dedicated and used primarily forcredit cards frontend), EBBS (Electronic Basic Banking system, which is also a frontend, dealing with all other departments from consumer banking to corporate banking) and Cards 400 (Unix-OS based database dedicated to handling all types of credit card transactions and a backend for the E-CAPS software).All the software manuals are analysed in detail to understand the complex relationships among the softwares. Guided interviews are conducted regularlyover a couple of months with individuals to identify details of the existing process; this interview included all the units from New Accounts Team to Fraud Detection. Employees are targeted at all levels from officers to managers as this helps in interpreting experiences of the respondents in detail. Focus group interviews, consisting of six to ten people, are also carried out at the same time to cross-check the findingsof the individual interviews. In some cases, to understand complex processes such as DeDup Check, CPV Check and others, a set of two peoplefromeach unitareinterviewed because small groups are sometimes highly effective in analysing complex processes.

The boundary of the credit card processing system is from credit card application receipt to credit card delivery. Supplementary units such as fraud detection, legal and compliance are thus excluded.

The first stageof the study involved representation of flow diagrams for credit card operations. Flow diagrams are used to guide the sequence of events triggered by the credit card application submission to credit card delivery. These diagrams provide the basis for the process logic for the simulation model, and thus help to capture the interactions among the system components that constitute the system architecture to provide output. In order to measure and analyse process performance, ARENA 13.5(Kelton, Sadowski and Swets 2009) is used to draw logical maps and analyse system behaviours over time periods. Collected data are put into the models gradually.

PROBLEM SCENARIO

The bank is the leader in the credit card market (almost 75% market share) in its country. Now, it is focusing on the customer service aspect of its business to increase the existing customer base. Reduction of customer waiting time for service delivery is one of those initiatives. However,this requires proper management of business processes from the front desk to card operations.

The bank's credit card sales are also notentirely promising in comparison with other types of loanssuch as Small and Medium-sized Loan(SME). Therefore, the bank is planning to improve the scenario of the credit card's market share to a better position by improving customer satisfaction with faster service delivery.

EXISTING PROCESS

This section provides an analysis and review of the research findings in Figure 1. With the objective of developing a proposed process, process improvement initiatives begin with the analysis phase, which involves the acquisition and transfer of knowledge from credit card experts who are executing card operations tasks.

The bank collects application forms from three sources, those of Direct Sales, Branches and Telesales. The Direct Sales Executive (DSE) collects credit card application forms and forwards them to the Sales Manager for initial screening. After this is completed and found to be satisfactory with the submitted supporting documents, the forms are sent to the New Accounts Team of Card Operations for E-CAPS (Electronic Card Application Processing System) entry. A single piece of paper containing DSE Code (i.e., each sales executive has a unique identification code) and name are attached to the application forms,for identification of the specific DSE if thisbecomes necessary in the card processing stage. Following the same procedure, the Customer Service Executive (CSE) representing a particular branch, sends a worksheet with CSE Code and Name. Similarly, Telesales Executive (TSE) contacts the potential customers over the phone and if successful, sends a worksheet containing Fields Sales Executive (FSE) Name and Code along with TSE Code and Name.

CreditCard Operations, which arecrucial to the card application processing system, have three main units, namely New Accounts Team (e.g., account opening, account closing, E-CAPS data entry, credit limit control and other tasks) Embossing Unit (e.g., production of credit cards, packing and sending to the courier agency for customer delivery) and Card Maintenance Unit (e.g., limits enhancement, limit reduction, card blocking, supplementary card providing and others).

When the new application forms reach Card Operations, applications are sent to the New Accounts Team, which gives data entry of the new applications in the E-CAPS. E-CAPS automatically generates 11-digit reference numbers, which are generated to track application forms in the later stages of the production system. After storing data in the E-CAPS for all applications received in a particular day, the application forms are sent to the Consumer Credit Unit (CCU), which decides credit limits and also performs other tasks as well as cross-checking credit agency reportswith a tracker sheet to confirm the number of applications actually sent. The tracker sheet contains all the reference numbers of the attached application forms. CCU performs credit decisions on the sent application forms, generating three types of decisions,those of Approved, Pending, and Declined. After assessment, all application forms are returned to the New Accounts Team of Card Operations. This Team sends the documents for a CPV (Contact Point Verification) check. CPV check is performed by the third party CPV Agency, who receives a payment for every checking. CPV checkers verify the phone number, office address, and residential address of the applicants and thethird party CPV agency sends all the applications forms back to the New Accounts Team after completion of the check. The Team adds additional information to the CPV reports,that of Customer Credit Limits, Credit Instructions and other information in the E-CAPS. Afterwards, the New Accounts Team runs De-Dup Check. This procedure cross-checks all new applications against the stored data to discover fraud cases, for example, customers applying for a second card without giving this information on the application form and previously rejected.

The De-Dup Check methodproduces two different types of decisions: positive De-Dup Check and negative De-Dup Check. The positive De-Dup check means that all the information

provided in the application form is essentially correct, and the application is not a scam. Applications with a positive De-Dup Check are aligned into the system, card account numbers, plastics and PINs (Personal Identification Number) are generated, and plastic and PIN are sent to the customer by courier. Finally both approved applications and declined applications are sent to the archive.

Consumer Credit Unit(CCU) performs some fundamental tasks.One of which is to provide credit limits and to make cross-checks for CPV reports. Thisis the most influential one, generating three statuses, such as Approved Applications, Declined Applications and Returned Applications. Approved applications are sent to the New Accounts Team with a tracker sheet to update the E-CAPS accordingly. In the case of Declined Applications, forms are sent back to sources for further checking.Returned Applications are sent to the New Accounts Team to update the system status as Pending.

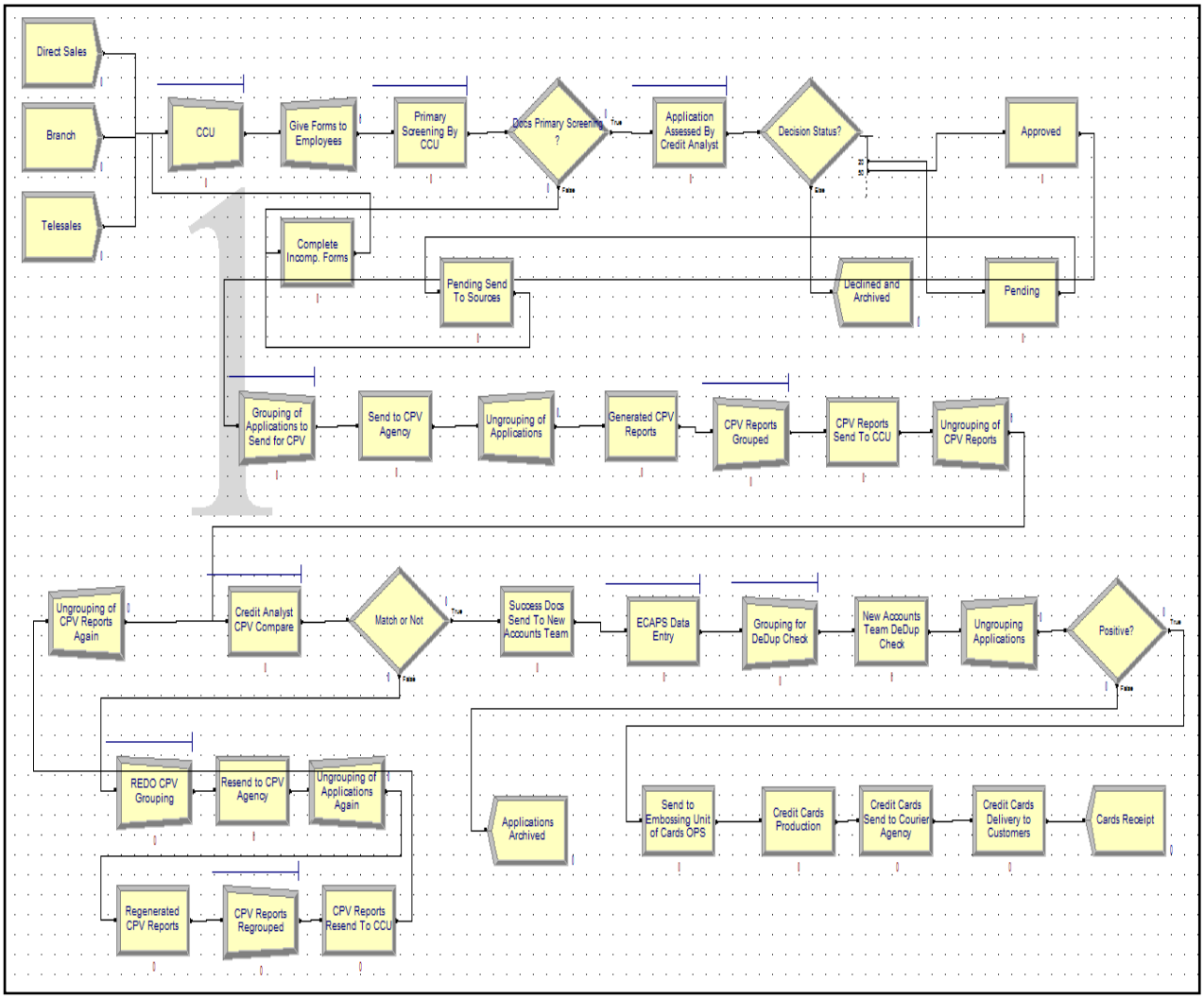


Figure 1: AS-IS Process of Credit Card Processing System in ARENA Simulation Software

Customers declare their residential address, office address, office phone number and residential phone number. The Bankwants to ensure that all the physical contact addresses are true and accurate,and to verify that customers have more than one contact. For example, if customers do not pay their credit card interest, it becomes necessary to remind them through letters or emails. In extreme cases, a third party is appointed to remind clients.

Contact Point Verification (CPV) agents provide three pages of information for each potential customer about proof of addressand phone numbers. Sometimes CCU cross-checks some of the reports on a sampling basis to ensure that a CPV agent or a third party has done their job perfectly. CCU calls some of the customers using the phone numbers given in the application forms which to ensure consistency of the CPV reports.

When application forms are submitted from the sources, the New Accounts Team doesinitial screening. The main purpose of initial or pre-screening is to ensure that all mandatory fields are filled out perfectly in the application forms, and thataccompanying documents such as passport copy, bank statement, salary certificates or pay slips are consistent with requirements. In some cases, it may happen that passport pages are missing; driving license is expired; bank statement is too old; and salary certificate is not properly signed, stamped and dated from the HR department. Screening separates all these documents from others.

Many supplementary documents are submitted along with the main application forms. Among these, some are particularly valuablein distinguishingbetween potential customers and fraud cases. One of those is bank statements. These confirm financial stability and ongoingincome flow into the customer's savings or current accounts. Bank statements are verified by a third party such as CPV reports to confirm their authenticity, as a precautionary measure. The bank provides a copy of the bank statement to the third party along with a letter requesting the respective branch manager to allow access into the customer's data. The agent takes this information along with the photocopy to the branch managers of the different banks.

EXISTING PROCESS FEATURES

The features of the existing process are identified using two criteria such as process flexibility and process effectiveness. All of those are explained in a nutshell in the following along with the reasons for the 'maker errors'.

Process flexibility measures the extent of elasticity that the credit card department possessesforprocessing numbers of special requests per month. Special requests come from loyal customers or those who regularly conducta huge volume of transactions and the bank attempts to establishthe fast processing of credit cards for these important customers. It is found that the credit card department is not flexible enough because of its ability to handle fewer than 30% special requests per month, whereas it receives on an average 30 special requests in every month. Process effectiveness is the extent of providing the right amount of output within an appropriate time period (Harrington and Harrington 1997) and its level is determined by the people who receive the output (Harrington and Harrington 1991). Process effectiveness depends on return on investment, reliability and other similar variables (Grover and Kettinger 1995). According to the credit card processing system, every input error represents a defect, which hinders the process from beingfully effective. Input error can take place at any of the units such as New Accounts Team (e.g., key-in data in the ECAPS etc.), Maintenance Unit (e.g., updating credit limit figures etc.), Embossing Unit (e.g., updating the number of plastic or PIN production etc.). The bank maintains a Six Sigma performance measurement system. It is found from the existing data that on average the bank's Process Accuracy Rate is 4.30, far below the target level of 6.00 (or, 99.99% accuracy) sigma. The process still has the capacity to be more effective.

To gain insight into process effectiveness, Figure 2 shows that the existing process is generatingvarious types of manufacturer errors, prohibitingit from being accurate and effective. This is an example from the New Accounts Team of Card Operations, where

similar types of errors occur almost every month. There are many other reasons behind credit card maker-errors as the applications move through different units before the final delivery. Many application documents have been lost in the past. Errors are generated from employee-relatedproblems, process-relatedproblems, system-relatedproblems and environment-relatedproblems.

Some examples of employee-related problems are boredom, high staff turnover, lack of recognition of employees. Problems related to the process are complex process, late delivery of the process, less adaptability of the process, less effectiveness of the process, lack of communication among units, irregular process review and more time-consuming procedures. Problems generating from the environment are irregular equipment maintenance and frequent interruptions of sales units. System-related problems are server breakdown, lack of sufficient user Ids and lack of warning during incorrect data input. A comprehensive list of the maker errors is provided in Figure 2.

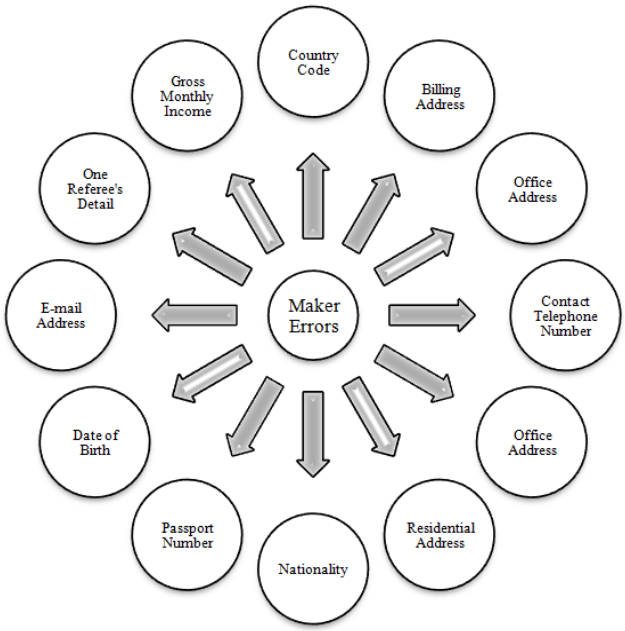


Figure 2: List of Maker Errors in the New Accounts Team for E-CAPS Key-in

PROPOSED PROCESS

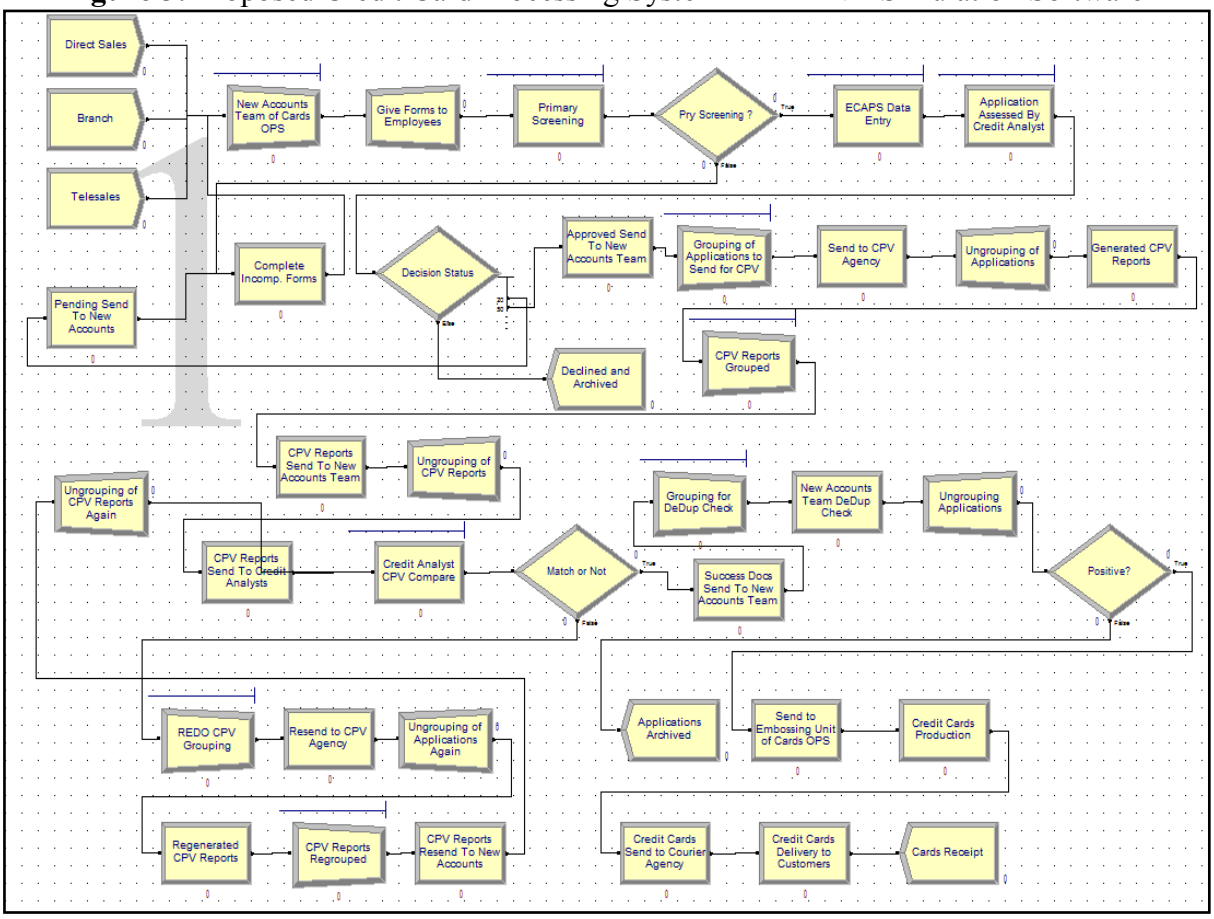
According to the proposed model, application forms from all sources are sent to the CCU. CCU makes a quick initial screening to locate application forms thatare withoutthe necessary supplementary documents such as passport photocopy, driving license, income statement, salary certificates. If a bank statement is provided by the customer, primary screening ensures that those papers are properly signed and attested to by the respective bank manager; and if a passport photocopy is attached, whether the passport is renewed, at least for the next couple of years; an income statement is provided, whether those papers are properly signed and attested to by the respective HR department along with date. Thisinitial screening process also goes through the main form to locate anything unfilled. In the new process, initial screening is done by the CCU.

Primary screening results in three different types of status such as Approved Applications, Pending, and Declined Applications. Approved applications fulfil all the requirements,but pending applications require further submission of missing documents from the sources. Declined applications are sent to the New Accounts Team for E-CAPS entry. After key-in

into the E-CAPS, the New Accounts Team generates the 11-digit reference number and writes it down on the corner of the application forms for future tracking purpose.

Approved applications are given to the third party CPV Agency for the verification of residential address, office address, office phone number and residential phone number, etc. After verification is completed for each potential customer, three pages of CPV reports are attached with each application form and sent back to the CCU for cross-checking. CCU picks up some of the applications based on random sampling, and cross-checks all the phone numbers and addresses, if possible. If CPV cross-checking fails, CCU asks for the verification to be done again. If it is successful, CCU sends those applications to the New Accounts Team for E-CAPS entry. E-CAPS entry makes them eligible for a Duplication Check. Duplication check further cross-checks application forms against the database, which contains full information of all customers who have submitted applications to the bank so far.

Figure 3: Proposed Credit Card Processing System in ARENA Simulation Software



Duplication checking reveals all the fraud applicants. Successful application formsare sent to the Embossing Unit. Embossing Unit downloads details,produces credit cards, and generates a Personal Identification Number (PIN) for each credit card.The Embossing Unit puts the credit cards in packets and sends them to the third party courier agency for delivery to the customers. Those, who live within the main city, receive packaged credit cards along with PINs in the same day. The whole process is shown in the above flowchart, figure 3.

SIMULATION DESIGN AND RESULTS

Historical data have been collected to validate the daily arrival pattern of credit cards.While application forms arrive daily in a scheduled manner,the distribution of inter-arrival times is random. This randomness is well-suited to exponential distribution. There are many other variables that contribute to the randomness of the arrival patterns, such as holidays and unpredictable events (e.g., disturbance in the ECAPS Software, Cards 400). To compare the arrival patterns with the Poisson distribution, a couple of months of data have been collected from the card operations department. It is evident from the following figures that historical data agrees with the Poisson distribution, andits assumption is well-justified.

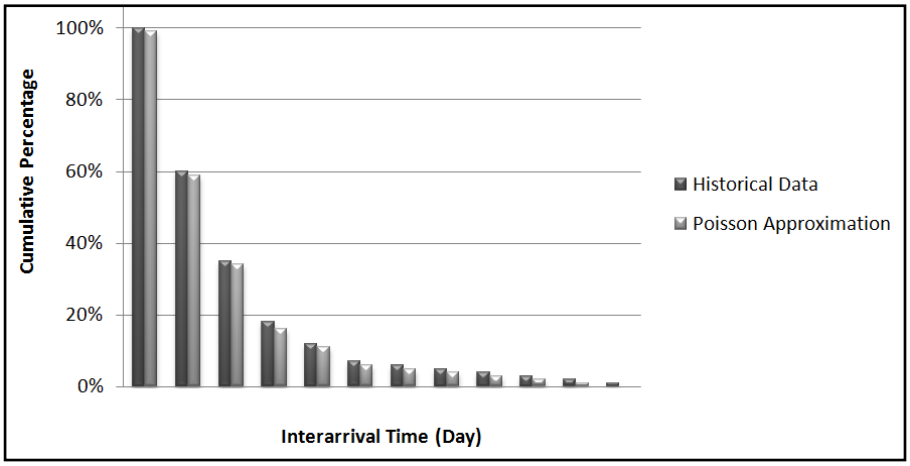


Figure 4: Comparison of Historical Data and Poisson Approximation

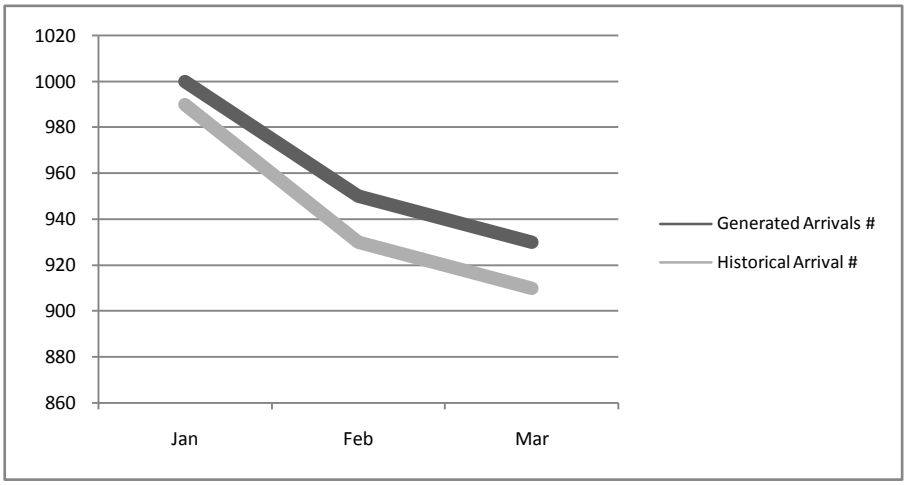


Figure 5: Comparison of Historical Data and Poisson Approximation

An important part in the simulation studies is the 'Number of Replications'. Most of the models are set up for multiple runs rather than a single run. Multiple runs are required to evaluate the 'true characteristics' of the model. The required number of runs is dependent on the desired level of accuracy for the model under consideration. If the desired level of accuracy is quite high, more replications arerequired. For the models (i.e., existing and proposed) in this study, the total number of replications is set at five.

There are some assumptions which are used in the simulation models. Some of the limitations and assumptions in simulation model development are:the bank operates 8 hours per day;the

study period spans over 16 months; arrival pattern of credit card application forms is evenly distributed; the model starts with certain warm-up periods to initialise the credit card machines;the model does not include fraud detection; and legal and compliance tasks.

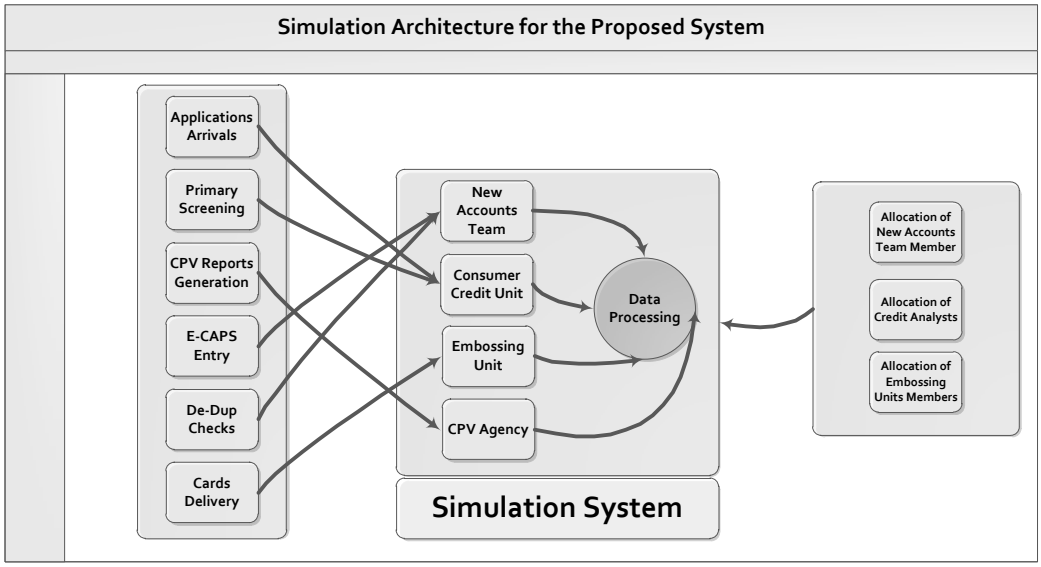


Figure 5: Simulation System Architecture for the Proposed Process

The main modules of the simulation system are Application Arrivals, Primary Screening, CPV Reports Generation, E-CAPS Entry, De-dup Checks and Card Delivery, which is obvious from the above figure. The modules are named after their functions. Each module is independent of others because of internal operations, status and objectives. However, they are interdependent based on information exchange and sharing. As shown in Figure 5, these modules include:

- Application arrivals take care of the incoming application forms from the three different sources
- Primary screening does the screening of the incoming applications to assess the forms quickly
- CPV reports generate CPV reports to verify the addresses and phone numbers of the potential customers
- E-CAPS entry makes the necessary information available to all areas of the department
- De-dup checking matches the application forms with the database to identify fraud cases
- Card delivery enables cardoperations to send the application forms to the customers

The New Accounts Team is one of the most important aspects of a Card Operations Department because of the tight scheduling and key-in sequence constraints, and the large number of concurrent activities within the limited timing. It is a real challenge to achieve a high volume of key-in requirements. New Accounts Team activities are closely related with the Consumer Credit and Embossing Units such as assembly-line processing.

Statistics of simulation output serve different purposes such as performance estimation, performance analysis. The developed simulation models generate the following indicators at the end of the simulation runs:

- **Service Time:** This is the amount of time required for a single application formto key-in in the E-CAP, Primary Screening, CPV Report Generation, Determination of Credit Limits, etc.
- **Application Forms Waiting Time:**Thewaiting time of an application form consists of the waiting period for key-in, the waiting time for CPV Reports Generation, Primary Screening and Credit Decisions.
- **Employee Utilization:** This indicator determines the extent of demand for resources (e.g., New Accounts Team, Credit Analysts) and is the percentage of the total time a resource is occupied by an application form.
- **Application Delivery Time:** This is the total ofservice time and waiting time for an application to be processed and ultimately delivered to customers through the third party CPV agency.

Table 2 –Important Physical Flow and Processing Activities of the Proposed Model

ID	Process	Activity Description
Primary Screening By CCU	Yes	To quickly separate documents
Assessed By Credit Analyst	Yes	To generate three types of status
Pending Send To Sources	No	To receive reviewed documents
Complete Incomp. Forms	Yes	To generate well documented forms
Send to CPV Agency	Yes	To generate CPV reports
CPV Reports Send To CCU	Yes	To cross check CPV reports
ECAPS Data Entry	Yes	To key-in data in the software
New Accounts Team DeDup Check	Yes	To check for fraud cases
Credit Card Production	Yes	To produce credit cards
Credit Card Delivery to Customers	Yes	To send produced cards to customers

Table 3 – Important Processing Operations of the Proposed Model

Process	Minimum	Mean	Maximum
Primary Screening By CCU (Minutes)	3	5	7
Assessed By Credit Analyst(Minutes)	20	30	40
Send to CPV Agency (Minutes)	30	40	50
Generated CPV Reports (Hours)	5	6	7
CPV Reports Send To CCU (Minutes)	30	40	50

From the simulation results, it is found that the proposed model takes almost five days from application form receipt to credit card delivery,while the existing process takes almost ten days to complete. The reduction in the credit card delivery system is possible in the new system because application forms are first received by the Consumer Credit Unit instead of the New Accounts Team. Consumer Credit Unit immediately screens the documents and provides application status. In this case, according to the proposed model, the New Accounts Team will key-in only those documents which are already approved by the CCU, which will undoubtedly save much time. The proposed model takes only five days to deliver the cards.

CONCLUSIONS

Academicians and practitioners consider business process management as a hot topic because of process improvement initiatives. Business process management leadsto excellent customer service and customer satisfaction. Using a real life case study, simulation models have been developed to evaluate and analyse alternative process configuration. The developed

simulation models can be used to evaluate different credit card scenarios. The models provide an estimation of credit card-processing performance indicators, such as process output, CPV reports completion time, employee utilization, and time required to process and deliver a credit card. The modelling process starts by analysing the different input data to provide appropriate probability distributions for arrivals, service and delivery time. Simulation modelsare developed using the input data distribution. Results from the simulation model are then analysed using the ARENA output analyser. Using the developed simulation models with the output analysis will enable bank officers and managers in identifying an operating strategy for improving customer service and customer satisfaction in this highly competitive banking industry because of the growing world-wide competition in some of the segments as an increasing number of customers demand better service.

FUTURE RESEARCH

There is a wide-spread use of simulation models in the service industry. It is important to determine whether the provided results from the developed simulation models are correct or wrong, and justification is provided through model verification and validation. A model is developed for a specific purpose, and its validity is determined with respect to that purpose. Research plans for these simulation models are to conduct 'Face Validation', asking people who have expertise in the system whether the model and its behaviour are reasonable(Sargent 1998). Another plan is to conduct 'Historical Data Validation' to use data to compare whether the model behaves as the system does(Balci 1995).

The designed simulation models provide the opportunity to pose specific questions about the credit card processing system. But the model can be re-designed further to get other insights and operational views. Some assumptions underestimate the full potential of the models in the reality. In this paper, costs are excluded in the modelling process. Incorporating these coststructures will make the models more realistic and useful. Itis also assumed that the number of employees in different units (e.g., New Accounts Team, Consumer Credit Unit, etc.) is fixed which may not remain constant throughout the day of any specific week.

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