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Cycle Time Improvement by a Six Sigma Project for the Increase of New Business Accounts

M. White[1], J. L. García[1], J. A. Hernández[1], and J. Meza[2]

[1]Department of Industrial and Manufacturing Engineering
Institute of Engineering and Technology
Autonomous University of Ciudad Juarez

[2]Department of Industrial Engineering
Colima Institute of Technology

Corresponding author: {Jorge L. Garcia A., jorge.garcia@uacj.mx}

This paper reports the application of a 6σ project about the reduction of the cycle time for acquiring a new credit account in a finance group. The methodology used in this project was the DMAI technique of 6σ. The paper documents the analysis and tasks performed by the management team that reduced cycle time from 49 days to 30 days which resulted in an expected annual savings of $300,000.00. Also an increased customer satisfaction and an increase of sales is expected.

Significance: The 6σ literature of industrial applications is extensive, but the services applications are somewhat difficult to find. This paper is important because it presents an application of a technique used traditionally in manufacturing industries in a service process.

Keywords: Cycle time reduction, six sigma services improvement.

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1. INTRODUCTION

Six Sigma was conceived as a technique focused to reduce waste due to process inefficiencies in manufacturing, and for quality improvement in a product; nevertheless it is now used by almost all industries including service industries such as health care management. This is due to successful implantation programs (Krupar, 2003; Antony, 2004; Antony and Fergusson, 2004; Moorman, 2005; Frings and Grant, 2005; Kumar et al., 2008). Nevertheless, the industrial applications have had a better diffusion.

The literature is replete with many applications and success cases studies in different companies using projects applying six sigma and any technique from it. Table 3 illustrates the metric used to measure the impact and success and the approximation of savings for financial institutions. Table 3 also demonstrates the results and findings obtained by Motorola, Raytheon/Aircraft Integration System and General Electric, pioneers in six sigma application, implantation, and diffusion (Kumar et al., 2008; Kwak and Anbari, 2006; Weiner, 2004; De Feo and Bar-El, 2002; Antony and Banuelas, 2002; Buss and Ivey, 2001; McClusky, 2000; Anon, 2007a,b). The typical financial six sigma projects include improving accuracy of allocation of cash to reduce bank charges, improving the efficiency of automatic payments, improving accuracy of reporting, reducing documentation, reducing the number of credits defects, reducing check collection defects, and reducing variation in collector performance (Kwak and Ambari, 2006). Specifically Bank of America (BOA) is one of the pioneers in adopting and implementing six sigma projects that are focused to streamline operations, attract new and retain current customers, and creates competitiveness and productivity over credit unions. An important data is that BOA reported a 10.4% increase in customer satisfaction and 24% decrease in customer problems after implementing six sigma (Roberts 2004, Kwak and Ambari 2006).

Another financial institution applying six sigma processes is American Express. The main results were an improvement in external vendor processes, elimination of non-received renewal credit cards, and an improved sigma level of 0.3 in each case (Bolt et al., 2000; Kwak and Anbari, 2006). GE Capital Corp., JP Morgan Chase, and SunTrust Banks are applying six sigma to improve customer requirements and satisfaction (Roberts 2004, Kwak and Anbari 2006).

The objective of this paper is to report the experience and results of a financial company in applying six sigma methodologies for reducing the cycle time for approval/disapproval of credit for a new customer. The average time was originally 49 days. This was reduced to only 30 days for customers that represent 80% of the business for loans less than $100,000 dollars

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2. METHODOLOGY

The methodology (Table 1) for the six sigma application for this company was the DMAIC (Define, Measure, Analyze, Improve and Control) process (McClusky, 2000; Kwak and Anbari, 2006). The main steps and its activities are defined in the next paragraphs.

Table 1. Methodology for Six Sigma

Steps in Six Sigma	Main Activities
Define	Define the requirements and expectations of the customer. Define the project boundaries establishing some goal and objectives. Define the process by mapping the business flow, separating the job in its components for future analysis
Measure	Measure the process to satisfy customer's needs Develop a data collection plan and metrics Collect and compare data to determine issues and shortfalls
Analyze	Analyze the causes of defects and sources of variation. Fishbone graph, correlation analysis. Determine the variations in the process. Prioritize opportunities for future improvement ranking the most important and with better impact.
Improve	Improve the process to eliminate variations Develop creative alternatives and implement enhanced plan
Control	Control process variations to meet customer requirements Develop a strategy to monitor and control the improved process Implement the improvements of systems and structures

3. SIX SIGMA PROJECT

The results and findings are reported according to six sigma steps defined in table 1. Findings are reported in the following sub-paragraphs.

3.1. Define

The financial company where this project was applied operates in 24 states in the USA with three geographic divisions, West, East and Central. The main activity is the financing of loans to diverse types of clients. The company's main problem that there was an average of 49 days for approval or rejection of a loan application. Not only is this is unacceptably long for customers but it represents a strategic disadvantage for the bank. This disadvantage is due to the average time that competition can be projected is only 30 days. So, the main objective of this project was to reduce the time for opening a new loan account would be reduced fom 45 to 30 days.

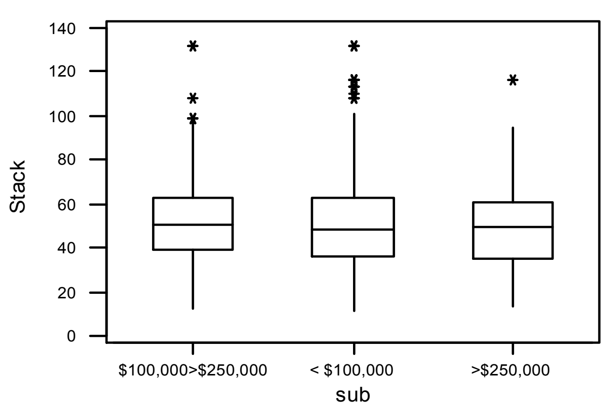

Figure 1. Amount of Credit and its Average Time

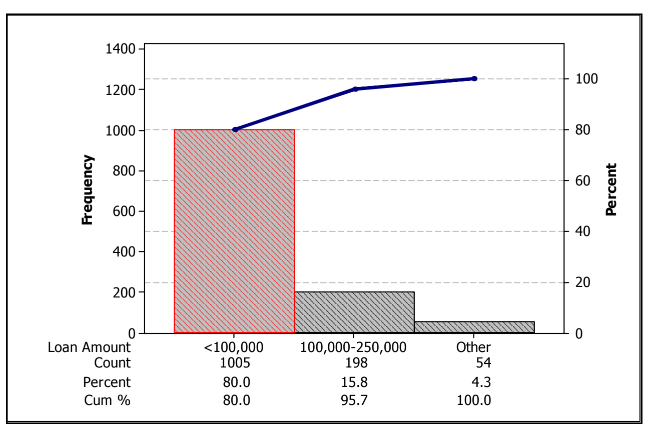

Figure 2. Loans and its Frecuency in 2007

The company classifies the loans granted based on the amount of money demanded. One would hope that a greater amount of credit would correspond to a longer approval time, due mainly to more information required. Nevertheless, figure 1 illustrates that the approval time is similar in all subgroups of credits. An analysis of the amount of credits for each type has been done, and the team found that 80% of the loans requested were less than $100.000. This is the primary reason that this category was chosen for analysis (figure 2).

New customers have complained that the process takes too long. So in December 2007, a customer satisfaction survey was distributed to 100 customers who had opened accounts during 2007. The pie chart of the responses (figure 3) from the 84 customers that responded to the survey. Obviously, there is a serious issue because only 25% of customers responded positively to the survey. As a follow up to the initial survey, the research team called the 84 original respondents and asked them what they thought the average new account time should be. Figure 4 is a Pareto Analysis illustrating the top four factors that the customers believe improvements could be made. These results help to confirm the teams suspicion that the process takes too long. The team then decided to place their efforts to reduce the time for processing a new account (ie. cycle time).

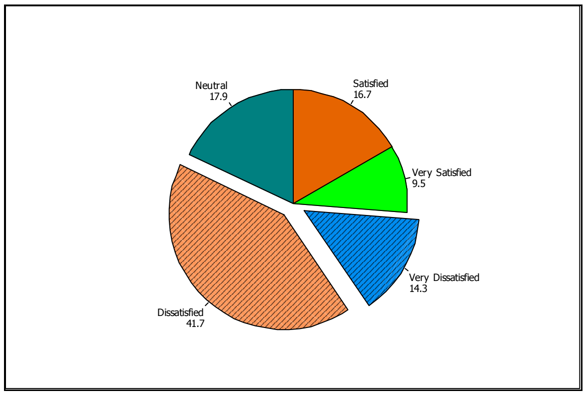

Figure 3. Satisfaction level in customers in 2007

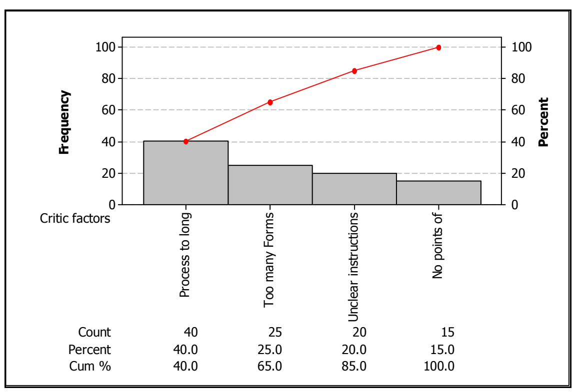

Figure 4. Factors to Improve

The team developed a detailed process map, which appears in figure 5. It shows that there are 3 departments (customer, branch, and region). Note that transactions move back and forth between these departments. For our primary metric, the clock starts when the new account application reaches the branch and stops when the customer is informed that the account is approved or not approved.

With that process map, the team identified steps in the process as value added (VA), business value added (BVA) and non value added (NVA). The resultant map is shown in figure 6.

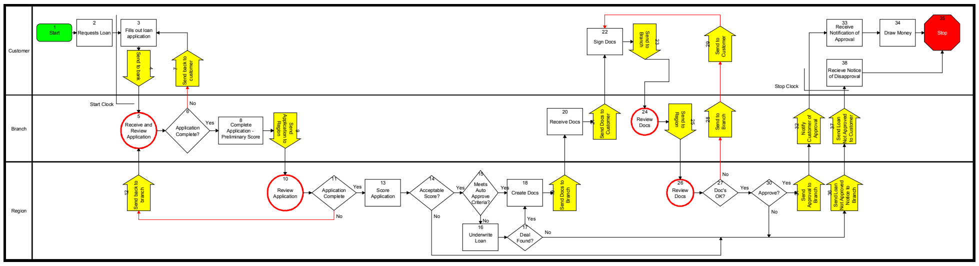

Figure 5. Detailed Process Map

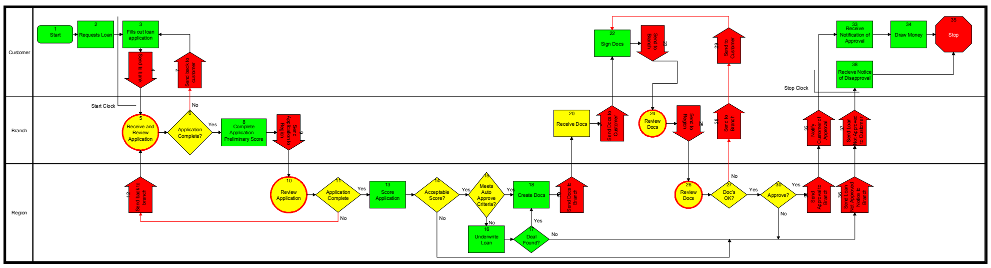

Figure 6. Process Map with VA, BVA and NVA Steps

In the Define phase, it was easy to verified that in fact that the company was not meeting customer requirements for new accounts. Customers expect a cycle time that averages near 30 days and our current process has a median of 49 days giving us a 19 day gap. In trying to narrow the project focus the team found that new account value did not seem to influence cycle time. Therefore the project was narrowed to only look at new accounts less than $100,000.00 and apply these findings to the other account categories. The team put together a primary metric chart of new account cycle time and developed a secondary account volume metric.

3.2 Measure

The team was looking to find the main problems related to long time cycle for opening a new account. Below is a cause and effect diagram for this process, focused on six main causes (figure 7). Lack of a standardized process, transit times and prioritization of new account activities were identified by the team as having an impact on new account cycle time.

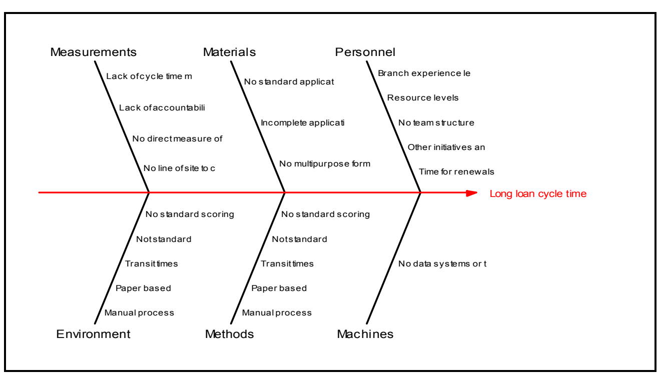

Figure 7. Fishbone Diagram

Using the X's identified in the process map and the fishbone diagram above, the team put together an XY matrix in an attempt to prioritize the potential X's that would impact new account cycle time. Table 2 Illustrates the process

Table 2. XY Matrix

Input Variables Xs	Output Variables Ys	Long Loan Cycle Time	Preliminary Loan Approval Cycle Time	Loan Volume	Bad Loans
	Output Rating	10	7	3	6
	Association Table				
Lack of Accountability		9	9		5
No Standard Loan Scoring		5	5		9
Incomplete Application		9	9		9
Inadequate Resources		5	5	5	5
Experience Levels		3	3		5
Lack of Cycle Time Measure		9	9		
Transit Times		9	9		
Size of Loan		5	5		
Credit History		3	3		9
Differing Forms		3	3		
Financial Environment		3	3	9	
No Line of Site of Loans		5	5		
Differing Branch Processes		5	5		9

Based on the XY Matrix, *Incomplete Applications, Lack of Accountability, Lack of Measures, Transport Time and Lack of a Standard New Account Scoring Process* are the top 5 X's based on the teams inputs. Table 3, table 4 and table 5 illustrate the scales used

Table 3. Severity Rating

Effect	Delay Days	Rating
Very Long delay	>5	9
Long delay	3<X< 5	7
Moderate delay	1<X<3	5
Short delay	1	3
No delay	No delay	1

Table 4. Frequency of Occurrence

Probability of Failure	Probability of Failure	Ranking
Very High	Very High	9
High	High	7
Moderate	Moderate	5
Low	Low	3
Remote	Remote	1

Table 5. Detect-ability

	Criteria: Likelihood the existence of a defect will be detected by process.	Ranking
Remote	Process will detect < 50% of the time	9
Low	Process will detect between 50% and 75% of the time	7
Moderate	Process will detect between 75% and 90% of the time	5
High	Process will detect between 90 and 99% of the time	3
Very High	Process will detect over 99% of the time	1

The team next conducted a failure modes and effect analysis (FMEA) which focused on the primary metric of long cycle time. To make the task easier the team redefined the severity, occurrence and detection ratings as follows. Using these criteria a FMEA table was constructed and appears in table 6. This table shows potential failure modes, potential failure effects, potential failure causes and the current process control that was used.

Table 6. FMEA

#	Process Function (Step)	Potential Failure Modes (process defects)	Potential Failure Effects (Y's)	SEV	Class	Potential Causes of Failure (X's)	OCC	Current Process Controls	DET	RPN
1	Review Application	Review error	Longer cycle time	7	1	Lack of scoring standards	9	Regional Review	7	441
2	Prepare Documents	Documents sit	Longer cycle time	5	1	Lack of measures	9	None	9	405
3	Score application	Wrong score	Longer cycle time	9	1	Lack of standard process	9	Regional Review	5	405
4	Send Application to Region	New account application sits	Longer cycle time	5	1	Lack of standard process	9	None	9	405
5	Send Documents to Branch	New account application sits	Longer cycle time	5	1	Lack of standard process	9	None	9	405
6	Send Documents to Customer	New account application sits	Longer cycle time	5	1	Lack of measures	9	None	9	405
7	Underwrite	New account application sits	Longer cycle time	5	1	Lack of measures	9	None	9	405
8	Review Application	Review error	Longer cycle time	7	1	Lack of branch resources	7	Regional Review	7	343
9	Review Application	Review error	Longer cycle time	7	1	Training	7	Regional Review	7	343
10	Approve Account	New account application sits	Longer cycle time	5	1	Lack of regional resources	7	None	9	315

X’s that appear to be important are related to new account scoring, lack of cycle time measures, lack of a standard process, training, and resource levels. These X’s are associated with the process steps of review, document preparation, scoring applications, underwriting and transporting documents.

To verify that the cycle time information was correct, records from the manually recorded times was compared to those entered into the electronic database. To verify the adequacy of gages, a proportions test and a data audit gage study was used. Results hat 1005 of the 1015 data points were exactly accurate. The remaining 10 points had either a transposition error, had been cancelled, or had not yet been completed, but were recorded as completed. The following proportions test shows the team’s gage with 90% accuracy (a lower limit). From these results the gage is at least 98.2% accurate (lower 95% CI) so it is deemed to be acceptable based on this performance (table 7).

Table 7. Test and Confidence Intervals for One Proportion
Test of p = 0.9 vs. p not = 0.9

X	N	Sample p	95.0% CI	P value
1005	1015	0.990148	(0.981956, 0.995266)	0

The bank´s ability to process a new account in less than 45 days is currently not good. From the capability analysis below, there is less than a 20% chance of meeting the upper limit of 30 days. The data distribution is right skewed and a Weibull capability study has been used. The mean cycle time is currently over 50 days and the median is about 49 days. Based on the capability study new account cycle time will exceed 45 days almost 60% of the time. See figures 8 and 9.

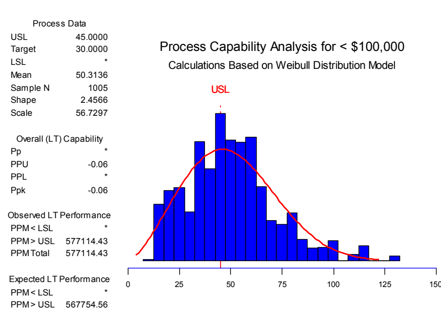

Figure 8. Weibull Capability Analysis

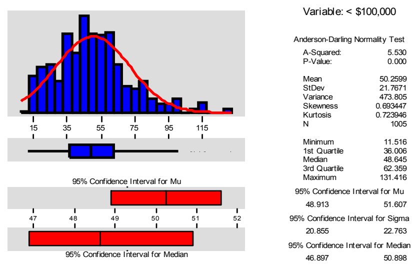

Figure 9. Graphical Summary of Baseline Cycle Time Data

After the measurement phase, the team defined and refined our problem statement and objective. The primary Y selected was cycle time. This measurement system that collects cycle time information was deemed adequate for use on this project. The results of the customer study suggested that the customer's would like a faster process. Based on survey results the team picked a cycle time goal of 30 days and an upper specification limit of 45 days. The initial process capability showed a median cycle time of 49 days and close to a 60% chance that a cycle time upper specification limit would be exceeded. This was far away from meeting the voice of the customers' needs. The team chose to track the median cycle time as the data was not normal. Table 8 illustrates the main Xs, technique that detects rank obtained in those techniques and the new variable name used here ahead.

Table 8. Table of Xs

X	FMEA Rank	XY Rank	Fishbone	New variable
Lack of standard process	3	6	yes	X_1
Lack of standard new acct. scoring	1	5	yes	X_2
Lack of cycle time measures	2	3	yes	X_3
Transit times	4	4	yes	X_4
Incomplete applications	x	1	yes	X_5
Lack of accountability	x	2	yes	X_6

3.3 Analysis

To further explore the Xs the team employed some graphical analysis. Here is a look at each X.

3.3.1 X_1 – Lack of Standard Process

This X is somewhat self explanatory. With many branches and employees, the processing of new accounts can follow many different internal paths. The basic requirements are given in Operations Policy No 2140, but there is no process map included in this policy and each branch may adopt a different process and use different forms to collect needed new account information in line with the policy. It was impossible to measure the influence of a standard process directly as there really is no standard process. The team collected cycle time data across 6 different branches in 2 regions to see if perhaps a particular branch has a better standard new account practice (shorter cycle time). A boxplot was created to see if there were cycle time differences between branches or regions (figure 10). Looking at the results of the box plots it appears that no region or branch has a lock on a better performing process. The process appears to be equally ineffective in all of the locations and regions that were examined. Figure 11 illustrates a boxplot by branch.

3.3.2. X_2 – Lack of Standard New Account Scoring.

This variable, like X_1, is a symptom of lack of a standard process. The team found no one branch or region that claimed to have a standard scoring method. Team members claimed that many non-credit-worthy applications make it deep into the process using resources that could otherwise be used on good applications. Historically 25% of all new accounts submitted are rejected and usually at the regional level. To address the differences in new account scoring an R&R study was run by sending 15 fictitious new account applications to two branch new account officers and two regional credit officers. The results appear in table 9 and it is easy to see that the total R&R has a contribution of 42.79% (0.51% due to repeatability and 42.28% due to reproducibility). This means that there is a lot variation between an operator and others.

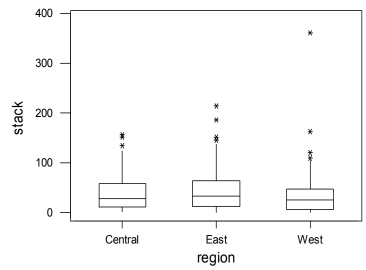

Figure 10. Boxplot of Cycle Time by Region

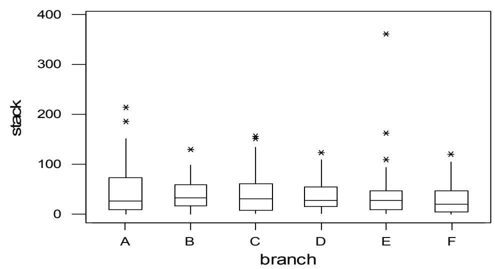

Figure 11. Boxplot of Cycle Time by Branch

Table 9. R&R

Source	Var Comp	Contribution
Total Gage R&R	309.77	42.79
Repeatability	3.71	0.51
Reproducibility	306.05	42.28
Operator	306.05	42.28
Part-To-Part	414.15	57.21
Total Variation	723.91	100.00

3.3.3. X_3 - Lack of Cycle Time Measures

To assess the extent of cycle time measures at branches or regional offices an e-mail survey was used. The question asked was: Please rate your use of cycle time to measure the effectiveness of the new account process using the following criteria (table 10). The distribution for the answers is in figure 12. The histogram confirms that not much cycle time information is currently collected. No branch or region performs any cycle time data analysis. Unfortunately the team cannot then see the impact of cycle time measurement on improving their Y.

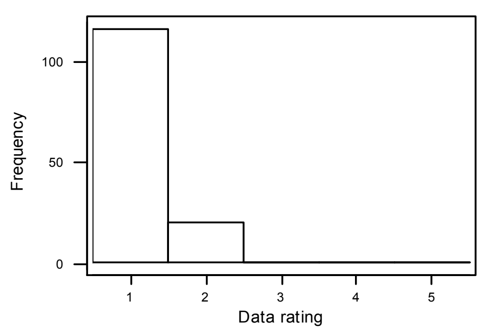

Figure 12. Histogram of Cycle Time Data Ratings

Table 10. Criteria for Cycle Time Data Ratings

1	Do not collect any cycle time data.
2	Sometimes collect overall cycle time information.
3	Cycle time data is sometimes collected at the top process level
4	Cycle time data is collected at the top process level and analyzed for improvement opportunities.
5	Cycle time data is collected at the step level and analyzed for improvement opportunities.

3.3.4. X_4 – Transit Times

This X appeared in many process steps. There was no data at the process step level to tell us how much time applications and new account documents spent in transit. The preferred method for moving applications and new account documents between the customer, the branch and the region is the overnight mail pouch. As shown in the process icon there are also some alternate methods for transferring documents. Four basic methods were identified: Interoffice mail pouch, USPS, FEDEX and UPS. To gain some insight into the cycle time of this step, two team members agreed to track new accounts between them over a one- month time period. A cover sheet was put in front of each new account package. The new account officers were to record the date and time a step was finished and the package was ready for mailing and the date and time the package was opened for further processing. All transport process steps were included.

As suspected, with a median of over 3 days, the transport steps do contribute to the overall cycle time. With 8 - 12 transport steps in the overall process the contribution to the overall cycle time would be about 24 days, close to 50% of our overall 49 days. Technology like FAX, E mail and the internet has yet to creep into this process. Looking further at this sample data we wanted to see if the transport step or mailing method were contributors. The descriptive statistics (figure 13 and the boxplots (figures 14 and 15) are as follows:

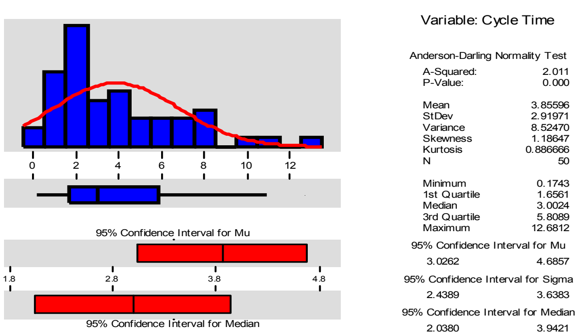

Figure 13. Descriptive Statistics for Transport Times

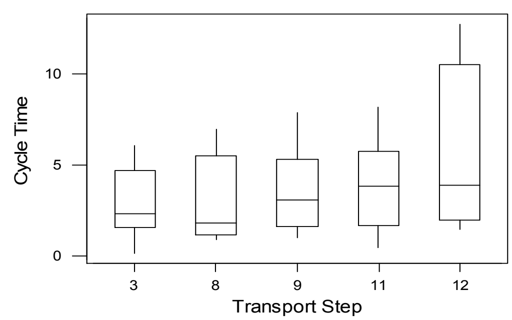

Figure 14. Boxplot of Cycle Time by Transport Step

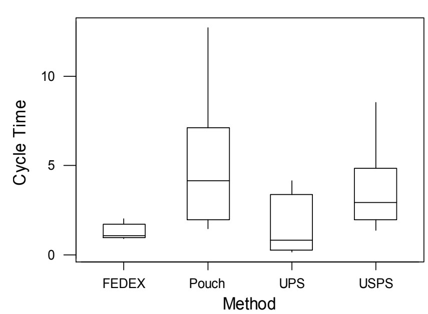

Figure 15. Boxplot of Cycle Time by Method

The boxplots show no major differences in step, although step 12 may have a bigger variance. Method appears to have some impact on the transport cycle time. As expected those processed using overnight mailing services (FEDEX and UPS) have shorter transport times than USPS or pouch methods, but these faster methods are not frequently used. This is consistent with the bank policy to use the mail pouch whenever possible. From the detailed process map using the above cycle time data, the sum of all transport steps was compared to the sum of all other process steps. The team found that 54% of the total time is in transport, leaving only 46% for other activities. Although this analysis is not completely accurate, as not all transactions pass through all steps, it does help confirm that transportation does contribute a great deal to the overall cycle time.

3.3.5. X_5 – Incomplete Applications

Having to return either applications or documents to the customer will add cycle time with a rework loop. These loops are shown on the process map and highlighted with red return arrows. Using the information from X4 above each return loop will tend to add at least 3 days to the overall process. The team originally had no data on the defect rate. The team requested that 3 branches collect data on either returned applications or returned new account documents to see the extent of the problem. The results indicate that only 67% are error free, 33% of applications are returned and 10% consist of new documents. It appears that the application process and, to a lesser extent, the document completion process could use some improvement.

3.4 Hypothesis Test

Every variable was tested to determine its impact. The next paragraphs illustrate that analysis.

3.4.1. X_1 – Lack of Standard Process

Graphical boxplots failed to show a region or branch with a better process than any other. For completeness the team checked for equal variances using branch and region as the variables. Figure 16 (by branch) and figure 17 illustrate the tests for homogeneity. The null and alternate hypotheses are:

Ho: Variances across branches are equal.
Ha: Variance of at least one branch is different than the rest.

Ho: Variances across regions are equal.
Ha: Variance of at least on region is different than the rest.

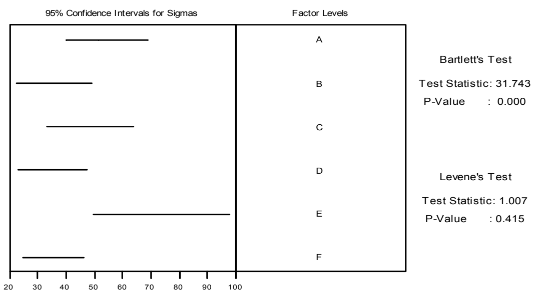

Figure 16. Test for Equal Variance by Branch

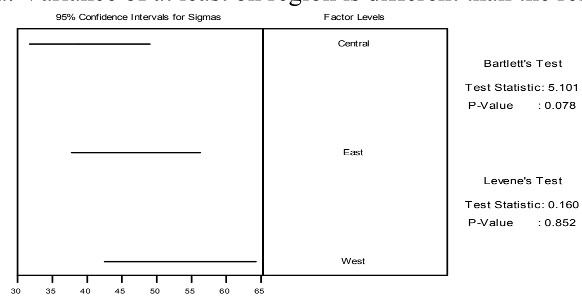

Figure 17. Test for Equal Variance by Region

Since the data are not normal, the Levene's test statistic is used. Since p>0.05 one cannot reject the null hypothesis and conclude that the variances are the same. To check for equality amongst medians a pair of Kruskal -Wallis Tests were used. The results are illustrated in figures 18 and 19.

Ho: Medians across branches are equal.
Ha: Median of at least one branch is different than the rest.

Kruskal-Wallis Test: stack versus region

Region	N	Median	Ave Rank	Z
Central	63	29.11	107.8	0.52
East	75	32.98	109.8	0.96
West	70	25.85	95.8	-1.48
Overall	208		104.5	

H = 2.23 DF = 2 P = 0.328

Figure 18. Median Tests for Across Branches

Ho: Medians across regions are equal.
Ha: Median of at least on region is different than the rest.

Kruskal-Wallis Test: stack versus branch

branch	N	Median	Ave Rank	Z
A	50	27.29	108.3	0.51
B	25	33.02	112.9	0.75
C	35	31.52	106.7	0.24
D	28	27.93	109.1	0.43
E	33	28.39	102.2	-0.24
F	37	20.04	90.1	-1.60
Overall	208		104.5	

H = 3.05 DF = 5 P = 0.692

Figure 19. Median Tests for Across Regions

Since p>0.05 for both tests the team concludes that the median cycle time of branches and regions are the same. Again this only leads us to believe that the process is broken throughout banks and there is no best practice to copy.

3.4.2. X_2 – Lack of Standard New account Scoring

To further look at the differences in scoring between branches and regions we wanted to check the following hypothesis:

Ho: Mean new account scores are equal at branches and regional offices.
Ha: Mean new account scores are not equal.

First new account scores were checked to insure normality. All data was found to be normally distributed. Next each operator in our mini gage study was checked for equal variances. The results indicate that the variance is the same. As suspected from the results of the gage study, there is a difference between operators in scoring new accounts. The regional new account officers scored new accounts about 30 points lower than the branches. The inconsistency in measures will have to be addressed in our solution.

3.4.3. X_3 – Lack of Cycle Time Measures

No further analysis of this X beyond the Pareto charts was done.

3.4.4. X_4 – Transit Times

To ensure that the transit method and process step were essentially the same with regards to cycle time, median tests were run. First the data was confirmed to be non-normal. Next a check for equal variances was run. The hypothesis tests are:

Ho: All mailing method variances are equal.
Ha: At least one method variance is different than the others.

Ho: All transport process steps are of equal variance.
Ha: At least one step has a different variance.

The variances were found not dependent on either step or method. Next the team checked to see if any of the median cycle times were different. The hypothesis tests were:

Ho: Median cycle times are the same for all mailing methods.
Ha: Median cycle time for at least one method is different.

Ho: Median cycle times are the same for all transport steps.
Ha: Median cycle time for at least one transport step.

The results of the Kruskal-Wallis tests are shown in table 11.

Table 11. Kruskal-Wallis Tests Results

Kruskal-Wallis Test: Cycle Time versus Method

Method	N	Median	Ave Rank	Z
FEDEX	5	1.0667	7.6	-2.89
Pouch	26	4.1288	30.8	2.70
UPS	4	0.8101	10.5	-2.15
USPS	15	2.9444	26.2	0.22
Overall	50	25.5		

H = 15.31 DF = 3 P = 0.002

Kruskal-Wallis Test: Cycle Time versus Transport Step

Transport	N	Median	Ave Rank	Z
3	11	2.314	23.1	-0.62
8	8	1.805	18.6	-1.46
9	10	3.086	25.4	-0.02
11	11	3.817	27.0	0.39
12	10	3.858	32.1	1.60
Overall	50	25.5		

H = 4.25 DF = 4 P = 0.374

With a $p < 0.05$ median cycle times are influenced by transport method. FEDEX and UPS had lower transport cycle times. There were however only 9 data points out of our 50 samples represented by overnight carriers. With a p values > 0.05 the median cycle times are not influenced by the transport step.

3.4.5. X_5 – Incomplete Applications

There was no direct data on how much additional cycle time was added due to rework. Also the team found that the largest problem was with returned applications. Using the detailed process map and cycle time estimates, we can roughly compare cycle times with complete applications with those that had to be returned. Since we are interested in changes in cycle time on the order of 5 or so days, we used Minitab's sample size calculator to determine the number of samples needed. For a delta of 5 and a standard deviation of 20 (taken from the capability study) the sample size was calculated (power = 0.9). Results indicate that we need about 170 samples of each to detect a 5 day difference if one exists. Using simple observation of the map, we estimate there is about a 10.5 day difference in cycle time between those applications that are returned to the customer and those that are not.

3.5 Improve

3.5.1. DOE planning and selection

There was not sufficient data to pursue this point. From the Analyze phase the team wanted to continue to explore the impact of X_2 – Standard Scoring, X_4 – Transport Times and X_5 - Incomplete Applications to see their relative impact on overall cycle time. The impact of improving each of these X's can be simulated through either a defect reduction (X_5) or a cycle time reduction (X_2 and X_4). In addition to incomplete applications we can also explore the impact of returned documents (already known to be smaller than returned applications). The following 24 full factorial design was selected (table 12).

Table 12. Full factorial Design

Variable	"-" level	"+" level
X_2 – standard scoring	0 time a regional level	Current estimates for time
X_4 – transport time	¼ the time for all transport steps	Current time for all transport steps
X_{5a} – rework application	33%	5%
X_{5b} – rework documents	10%	5%

However the reality of the inability to manipulate the levels of these factors (the team would not willingly force errors through the system that impact customers) prevented us from actually doing an experiment. An alternative would be to do a simulation of the process and use the simulated data, but that skill set is not available to us at this time. Because of the limitations on doing a DOE or regression analysis on real data, we were unable to develop a transfer function.

3.5.2. Using available data

From the process map, VA and NVA analysis, the analysis of the hypotheses tests, the decision was made to address the variables planned for DOE via an improvement plan and to use the hypothesis tests available to us on the data the process generates after the improvements are implemented. Since the team had no real data on the impact of the improvements other than estimates, the team had to depend on the rigor of the control plan to point out whether the improvements are having an impact and to react accordingly.

3.5.3. Improve Conclusions

The process map analysis suggests that changes to transport time, application error rate and document error rate would in fact impact this process by reducing overall cycle time. The team was unable to develop the $Y = f(X)$ equation. Improving the movement of applications and new accounts between customers, branches and regions is apparently the most important of the three variables.

3.6. Control

3.6.1. Improvement Selection Matrix

Potential solutions were put forth to address the critical X's. To address the reduction in cycle time for transporting documents the team suggested the use of e-mail together with the use of an Adobe Acrobat application or the development of a Web application that would make the process entirely paperless. To address the scoring variable it was suggested that the branches score the applications using a common criteria. Checklists were suggested for customers filling out the applications and for a list of documents needing to be signed to close the new account. The team used the solution selection matrix (table 13) to prioritize the potential solutions.

Table 13. Improvement Selection Matrix

	Document Transport Time	Complete Applications	Complete Documents	Scoring		OVERALL IMPACT RATING	COST RATING	RISK RATING	OVERALL RATING
Significance Rating	10	2	1	3	0				
Potential Improvements	Impact Rating	Impact Rating	Impact Rating	Impact Rating	Impact Rating				
E mail docs	8	0	0	0	0	80	9	9	6480
Purchase Adobe Acrobat	8	0	0	0	0	80	5	9	3600
Standardize Loan Scoring	0	0	0	8	0	24	9	9	1944
Standardize Application Form	0	5	0	5	0	25	9	7	1575
Document Checklist	0	0	0	6	0	18	9	9	1458
Application Checklist	0	6	0	0	0	12	9	9	972
Build Web Application	8	5	0	5	0	105	2	2	420

Based on the results of the Matrix, all potential solutions except for the Web based application will be pursued.

3.6.2. Action Plan

The team put together an action plan to attack the critical X's (table 14).

3.6.3. Control Plan

The team put together a control plan to maintain the gains of this project. Control charts will be kept for overall new account cycle time at the branch level and will be reported quarterly at the regional level. Other mistake proofing methods were addressed. Below is an example cycle time control chart. The subgroup is all new accounts closed during a business week. These charts will be kept by the new account process leads at each branch. Most have gone through YB training and have the competency to keep the charts up to date.

Table 14. Action plan

No.	Action Item	Issues / Barriers	Target Complete Date	Status
1	Buy Adobe License for Branches and Regions	Cost/Approval at Corporate Level	30/06/2008	Approved - Software due 7/15/03
2	Design Adobe Application Standard Application Form	Approval across all regions	15/06/2008	Complete
3	Design Application Checklist	None	15/06/2008	Complete
4	Design Document Checklist	IT support	15/06/2008	Programming complete
5	Setup control chart for weekly data	Need copy of Minitab in Dept	15/06/2008	Complete
6	Move application scoring to branches	Training/Approval	30/07/2008	Approved - Training 50% complete
	Complete follow up manpower study	None	15/12/2008	0% complete
7	Complete follow up Capability Analysis	Data	15/12/2008	0% complete
8	Train Branch Loan Officers on Standard Scoring	None	30/07/2008	50% complete
9	Develop Training Materials		01/06/2008	Complete
10	Develop Training Plan		15/06/2008	Complete
11	Train Branch and Regional Personnel on New Std Loan Document	Number to be trained	30/07/2008	50% complete
12	Develop Training Materials		01/06/2008	Complete
13	Develop Training Plan		15/06/2008	Complete
14	Control Chart Training	Already Developed	As needed	Complete

3.6.4. 2nd Capability Study

At the time this report was written not all of the improvements had been implemented at all branches. All should be in place by the end of the 3rd Quarter and full improvements should be seen in the 4th Quarter. A look at the primary metric chart shows that with improvements partially implemented some small movement in the primary metric is seen in August.

Although this is only one month of data and we would like to see larger decreases in cycle time in the future, we still checked to see if a statistically significant improvement had been made. If we compare the August data to the 2002 data we see that only 23 data points are needed to detect a 20 day change in cycle time. Next the team performed a hypothesis test on whether or not a change in cycle time has occurred. Checking for equal variances the Levene's Test found that August data is different than the 2007 data. The team will run a second capability study with Q4 data to ensure that all of the changes have been successful in reaching this projects goal.

3.6.5. Realized Project Savings

To date no savings have been realized as only some of the improvements have been implemented. Also this finance institution incurred a cost for purchasing a license for Adobe Acrobat of $25,000.00. Training costs for the new process are estimated to be about $30,000.00. Meetings with local controllers have firmed up that we will achieve at least the 10% savings in process labor. Thus, the net savings are projected to be $345,000.00 in the 1st full year of implementation (figure 20). The labor savings will be verified as part of the action plan in the 4th Quarter.

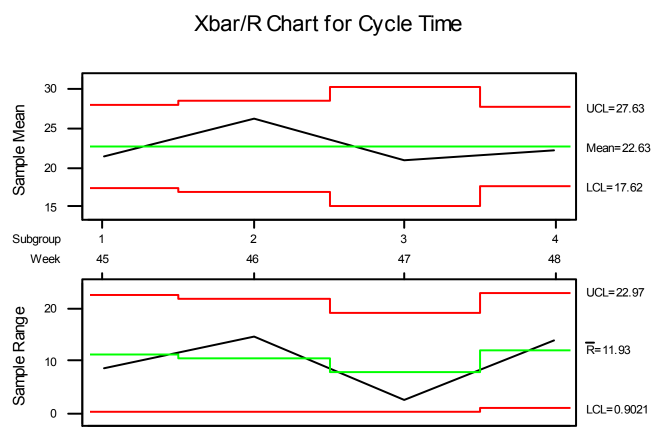

Figure 20. Control Chart for new account Cycle Time

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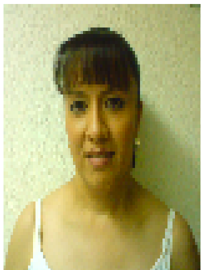
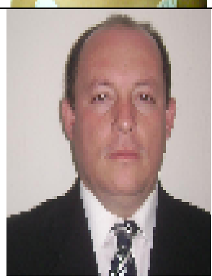
BIOGRAPHICAL SKETCH



Marcela White is a graduate Industrial Engineering from Autonomous University of Ciudad Juarez. She has the Green Belt Certification. Her areas of specialty include Total Quality Management and Supply Chain Management. He has more than twelve years experience in the maquiladora industry in Juarez region. Actually she works for a company in medical industry sector in Phoenix Arizona in logistic department.



Jorge Luis Garcia Alcaraz is a Professor at the Autonomous University of Ciudad Juarez. He has Bachelor and Masters Science Degree in Industrial Engineering from Colima Institute of Technology and also has a Doctorate Science Degree in Industrial Engineering from Ciudad Juarez Institute of Technology. His areas of specialty include multiattribute and multicriteria decision making, applied statistics, experimental optimization, design of experiments and mathematical programming. He is author and coauthor of several national and international journal publications.

Jesus Andres Hernandez Gomez is a Professor at the Autonomous University of Ciudad Juarez and Head of the Industrial Engineering Program at the same university. He has a Bachelor Degree in Industrial Engineering fron Autonomous University of Ciudad Juarez and a Master Degree in Business Administration and Specialty in TQM from Autonomous University of Chihuahua. His areas of specialty include quality improvement, statistical quality control and production management. He has more than ten years experience in the automotive industry.

Jorge Meza Jimenez he is professor at Colima Institute of Technology. He has a Bachelor Degree in Mechanical Industrial Engineer from Ciudad Guzman Institute of Technology, a Master Science Degree in Industrial Engineering from Aguascalientes Institute of Technology and a Doctorate Degree in Engineering of manufacturing Process from CIDESI (Engineering Center and industrial development at Queretaro). His line research is related to manufacturing processes and technological innovation.