Since 1991, KeyCorp has been developing its Service Excellence Management System (SEMS) to manage productivity and enhance service throughout its 1,300 branch banking franchise. The SEMS models measure branch activities and generate reports on customer wait times and teller proficiency and productivity levels. These reports help managers to identify reengineering efforts, schedule staff to better match customer arrivals, and enhance productivity and service. For branches using the models, customer processing time has been reduced by 53 percent, customer wait time has improved dramatically with only four percent of customers waiting more than five minutes, and at 94 percent of branches 90 percent of customers are waiting less than five minutes—improvements of 71 and 124 percent, respectively. The SEMS models are expected to reduce personnel expenses by $98 million over five years, yielding an internal rate of return of 3,500 percent.

KeyCorp (NYSE: KEY), headquartered in Cleveland, Ohio, is one of the largest bank holding companies in United States with assets of $66.8 billion and equity capital of $4.7 billion at the end of 1994. The financial services company comprises more than 1,300 branches across 14 states and affiliate offices in 25 states from...
Maine to Alaska. Through its full-service commercial banks and specialized subsidiaries, KeyCorp provides such services as consumer banking, investment management and trust, corporate finance, securities brokerage and private banking, and customized financial services to individuals, investors, and small, medium, and large companies.

KeyCorp boasts a long history of strong financial performance, reporting record earnings in 1994 of $854 million, an increase of $261 million or over 44 percent since 1992. Other key banking measures, return on assets (ROA) and return on equity (ROE), stand at an impressive 1.36 percent and 18.9 percent, respectively. Compared to 1992, these measures have displayed continued superior results with ROA increasing 20 percent and ROE up nearly 16 percent. Moreover, compared to its peer group, KeyCorp ranks in the top five in both of these important performance measures. During the past three years KeyCorp has increased its asset base by $11.7 billion or 21.2 percent, continuing an impressive return to shareholders. In fact, 1995 marked the 30th consecutive year of dividend increases to KeyCorp shareholders.

**The Evolution of the Financial Services Industry**

KeyCorp's performance is even more impressive because the banking industry is in a state of not-so-predictable evolution. Some might classify it as a revolution. Industry consolidation, increased competition, regulatory constraints, and increasing pressures on profitability present industry leaders with a multitude of major challenges. In the past 15 years, banking has seen a decrease from over 200 major banks (those with $5 billion in assets) to fewer than 50 (those with $50 billion in assets) today. In the next five years, industry experts project there will be fewer than a dozen major banks nationwide.

In contrast to the changes of consolidation and increased competition, banking regulations have not changed materially since the 1930s when they were introduced to solve the problems of the Great Depression. As a result, they fall short in aiding the industry with respect to the global competition of the 1990s. Regulations continue to limit the rate at which banks can enter new lines of business and offer new products, thus limiting the banking industry's ability to compete with such nonbanking entities as GE Credit, AT&T, Fidelity, Merrill Lynch, and American Express. These nonbank competitors continue to make significant inroads into the historically stable bank share of the US consumer's wallet. Further complicating competitive pressure is the entry of alternative delivery competitors, such as Microsoft with its popular PC-based home financial program, Quicken, potentially opening the floodgates for home banking services and thereby bypassing banks with a new payment system.

Bankers face increased competition within their traditional ranks, antiquated rules, and new, less regulated competitors with which to compete. To meet these challenges, KeyCorp must evolve from a traditional bank to a provider of financial services. Fortunately, KeyCorp has a long history of innovation. For example, it recently affiliated with Law Access Inc. and the Knight College Resource Group, estab-
lishing itself as the second largest origina-
tor of student loans in the US. KeyCorp pi-
oneered the securitization of student loan
portfolios for sale to secondary investors
and is a leader in this business. KeyCorp is
also a founder and equity partner in Elec-
tronic Payment Services, Inc., a holding
company for Money Access Service Inc.,
the largest processor of ATM transactions
in the US, and for BUYPASS Corporation,
a leader in electronic point-of-sale transac-
tion processing services.

KeyCorp's vision for the future is to be-
come the first choice of those seeking
world-class financial products and services.
In support of this vision, it has launched
First Choice 2000 to improve sales, reduce
expenses, and ultimately reconfigure its
distribution system. First Choice 2000 in-
cludes the inevitable transformation from
branch-based delivery to such alternatives
as ATMs and telephone and PC banking.
Despite the growing acceptance of elec-
tronically delivered banking, branch bank-
ing continues to dominate the industry.
While the industry evolves, banks must fo-
cus on delivering quality service by man-
aging customer wait times rather than
eliminating customer wait time altogether.

The Service Quality Initiative

The KeyCorp consumer banking fran-
chise comprises over 1,300 branches from
Maine to Alaska and ranks in the top five
in size within the United States. KeyCorp
branches are currently the most indispens-
able component of the consumer franchise
and will continue to play an integral part
as the corporation grows. Rethinking and
restructuring the retail branch franchise is
critical to KeyCorp becoming a world-class
provider of financial services.

KeyCorp Executive Vice-President
Robert G. Jones makes this point, "We
have 150 million moments of truth taking
place every year with tellers throughout
our branch franchise and it takes every
one of us at KeyCorp to make those mo-
ments of truth come out in the customers'favor" [1995]. Each year branch tellers at
KeyCorp perform 210 million customer
transactions. This represents 63 percent of
total customer transactions, a transaction
mix consistent with industry averages
[Gregor and Mara 1992]. The branch teller
is the primary branch contact, representing
95 percent of customer contacts at
branches at KeyCorp, and nearly 60 per-
cent of branch operating expense is di-
rectly related to personnel.

Because of the volume of customers and
transactions and the costs associated with
this service, branch managers must contin-
uously enhance branch productivity. They
must achieve what may be viewed as the
diametrically opposite objectives of im-
proving service (defined primarily as re-
duced customer wait time) and providing
cost-effective staffing. This balance be-
tween service and cost is supported by the
following research:

—According to a Louis Harris survey, US
leisure time has shrunk by 37 percent since
1973 [Murray 1989]. A scarcity of leisure
time and a culture that emphasizes speed
and convenience has caused consumers to
value shorter wait times. Thus, branches
that effectively manage wait times will
have more satisfied customers.

—According to Eugene Farm, a professor
of marketing at the Rochester Institute of
Technology, "People will pick one estab-
ishment over another because of a shorter
line” [Murray 1989].
—KeyCorp survey points to customer wait time as the most frequently cited reason for customer dissatisfaction.

**Approach to Managing Customer Service**

KeyCorp pioneered many of the practices that are helping change the industry. Among them is SEMS. In 1991, Society Corporation (which merged with KeyCorp in 1994) acquired Ameritrust Corporation, creating Ohio’s largest commercial bank. Since Society and Ameritrust had been direct competitors for over a century, considerable market overlap existed. The merged company needed to consolidate and divest branches, decide how to manage branch productivity and customer service, and develop more effective management information. Society and Ameritrust each had its own productivity and customer staffing measurement system. Both systems, unfortunately, were effectively staffing models that relied on manual data input and used industry or bank-wide averages instead of actual branch-specific data. The systems solved for a required level of staffing based on an assumed level of service and worked well for budgeting purposes but not for managing service. In addition, both systems were center-out systems, dictating to the field the answer to a staffing equation on a one-time basis for an assumed level of service rather than empowering branch managers to make their own decisions on a continuous basis to satisfy a more dynamic service level. Neither system integrated the human element in a way that isolated service quality variables under branch management control while designing out of the system uncontrollable variables.

Given the dynamics of consolidation, increased competition, and the bank’s continued expansion through merger and acquisition, Society (now KeyCorp) wanted to control service quality rather than allow it to fall victim to industry events and to do that it applied a systems approach.

**System Development Approach**

KeyCorp viewed the management of customer service as a holistic system with all components working together towards a common goal. It emphasized the interrelationships among the component parts of the system, affirming that modifying one component would affect the other and ultimately the outcome. In designing and developing SEMS, we incorporated the following goals:

—To empower line managers to manage the elements of service under their control and isolate and stabilize those variables outside their control;
—To create a measurement and feedback system that was continuous and could change with the organization;
—To automate the collection of data;
—To generate fact-based output; and
—To foster competition among branches and create pride and ownership in superior results.

We considered various alternatives but dismissed most because they failed to meet the objectives of automation, customization at the teller level, and continuous measurement in a cost-effective manner.

We did not try to modify the existing measurement systems because they were labor intensive and used bank-wide averages. We considered outside consulting resources, but they would not have provided continuous measurement, would have used averages instead of customized meas-
ures, and would have been too costly. Lastly, we did not pursue mechanical devices because we were concerned about cost and the accuracy of data. After evaluating alternatives, KeyCorp’s service management division decided to develop its own system.

KeyCorp management consciously excluded from its goals an end deliverable that included a staffing model. Unlike many industries, banking is a human system. Service is provided by and consumed by human beings. This means the environment is unpredictable and, if not managed properly, can quickly become unstable. To deal with this, KeyCorp wanted to provide managers with information so they could respond to the variations that inevitably occur in a people-intensive service business like banking. This fostered ownership in both the approach and the results. It avoided motivating managers to drive towards staffing-model goals regardless of results, thus abdicating responsibility for the service outcome and the staff changes needed to change outcomes.

Our first step in developing SEMS was to gain the involvement of top management and the commitment of every level of branch management. SEMS had to become a mantra and basis for branch management decisions and activities concerning branch staffing and customer service. KeyCorp had the commitment of Robert B. Heisler Jr., president and CEO of Society National Bank, KeyCorp’s lead bank. His unwavering commitment to SEMS tools and to the philosophy of information, knowledge, empowerment, and action behind it filtered down to create commitment in everyone from bank executives through branch tellers. Our next step was to form a partnership between the information technology group and the service management division to define the details of the solution and begin building the automated system.

Information Technology and Service Management Partnership

KeyCorp management agreed that it was not possible to manage that which cannot be measured. We needed to break down the elements of each customer session with tellers. This would allow us to identify each area of opportunity to improve performance and to identify which activities are within the control of branch managers and which are not. Through a working partnership, Information Technology and Service Management developed the Performance Capture System (Figure 1). Performance Capture created the foundation for all other components of SEMS. It captured data about each discrete component of the customer session, defined as time spent at the teller window. It collected the data systematically, thus ensuring data integrity, and did this in a manner that did not disrupt service or require manual input. It provided us with the ability to measure, on a continuous basis, individual transactions by capturing the beginning and ending times for each discrete component of the transaction—host response time, network response time, teller controlled time, customer controlled time, and branch hardware time. We could dissect transactions into their most basic components and compare categories of transactions. This allowed us to identify those components that offered the greatest opportunity for improvement. We could be-
Figure 1: Both PC/LAN and host-based systems are used to collect the data on a continuous basis for each discrete component of the teller transaction in a completely automated process. This advanced information-capture system provides accurate, timely information with no human intervention.

gathering data on customer session times at a level of data down to an individual transaction for a given teller on a particular day at a specific time, and therefore management could begin to identify all areas of opportunity.

The initial data gathered were quite revealing. They quantified individual problem areas and gave management a better understanding of the areas needing improvement and the magnitude of the change required. The first transaction report published in April 1992 was based on 15,000 transactions in five branches over 36 business days and reported an unacceptable 246 second average customer processing time.

At the same time, KeyCorp also performed a preliminary analysis to estimate the change in teller staffing needed to deliver service at a targeted level in a cost-effective and consistent manner. This analysis targeted a service objective for 90 percent of customers to wait less than five minutes on all days and utilized such inputs as an average processing time of 246 seconds per customer, the M/M/k model [Hillier and Lieberman 1995] steady state equations, and various estimates of customer traffic patterns. Queuing theory coupled with Bank Administration Institute staffing guidelines [Rhodes 1987] indicated that it would require an additional 502 tellers, a 30-percent increase at a cost of over $10 million, to meet the 90-percent objective. To accomplish its objective, KeyCorp could either increase the pool of tellers or reduce processing time. Adding teller staff was impractical for reasons of cost and because the branches simply could not physically accommodate that large an increase in staff! The enormous price tag put into
perspective the cost of poor performance and made management aware that better management of staff and reengineering of the customer session were needed to meet the service quality objective.

This preliminary analysis also pointed out an unacceptable response time on the part of the host computer for processing an information request from the teller system and unacceptable network response time (the time it takes to transmit an information request from the branch modem to the host modem), even though the average host and network response times were a seemingly low 2.0 seconds and 2.8 seconds per request. The variations from the average were enormous, ranging from immediate at times to upwards of 60 seconds per request. This affected absolute service levels and presented a barrier to consistent service. The analysis also identified major problems in transaction design and in the branch teller system.

Reengineering Customer Transaction Processing

Performance Capture provided the benchmark of 246 seconds per customer against which to measure the components of transaction time: host computer response time, network response time, branch hardware controlled time, and teller controlled time. Performance Capture also provided insight into conditions under which transaction processing time was extended. Service Management and Information Technology began to explore ways to reduce the 246 second customer session time through reengineering the transaction process:

—They stabilized the host computer response time and reduced it by over 90 percent. Using Performance Capture, they identified the conditions under which the host response was impaired and reengineered them. For example, they reduced host response time for teller overrides by moving the location of teller override data storage from a direct access storage device unit to the mainframe central processing unit. They eliminated data set lookup conditions that occurred under certain transaction conditions by adding global resource system software.

—Performance Capture identified which regions, districts, and branches had poor network response time. They evaluated and reconfigured the network bandwidth for the branches for which response time was much greater than average and reduced network response time by 50 percent. They also used Performance Capture to evaluate the conversion of the network protocol from BYSINC to SNA and full duplex to further reduce network response time by another 50 percent.

—They reengineered customer transaction processing screens to reduce the number of key strokes and the number of screens needed to process customer transactions. They also introduced speed screens for more common transactions, enhancing customer processing time by 10 percent.

—They used Performance Capture to evaluate and implement teller hardware upgrades for high volume teller workstations to improve teller productivity by eight percent.

In summary, reengineering worked to establish a stable and streamlined operating environment and to reduce transaction processing time by 66 seconds or 27 percent. After eliminating or reducing all the
transaction-processing impediments outside the control of branch managers, KeyCorp challenged its branch managers to better manage teller productivity and customer wait time. KeyCorp asked them to focus on (1) teller proficiency and productivity—how well tellers were performing their jobs—and (2) scheduling tellers so that they were available when customer traffic required them. To help them, Service Management developed and introduced the Teller Productivity program in July 1992 and the Customer Wait Time Model in July 1993 for Society National Bank, KeyCorp’s lead bank. The full rollout to all 1,332 branches was completed in April 1995.

Model Description

Conceptually, SEMS is made up of several fundamental modules that, working together, satisfy the need for the design of the simplest to the most complex software and hardware designs, resolve network and host response time issues, and provide managers with the insight they need to manage teller productivity and reduce customer wait time by increasing teller proficiency and improving staff scheduling. Since KeyCorp had stabilized the environment in which tellers operated and had reengineered various activities, the model focused on branch controllable elements of service. The major modules of SEMS are the teller productivity module and the customer wait-time module.

Teller Productivity System

We introduced the teller productivity module (Figure 2) to the branch management in July 1992. This module used the data captured by Performance Capture to allow branch managers to identify the number of customers being served at any time, the associated transactions processed, and the time required to process each. Moreover, the module reported this information at any organizational level from teller to branch to district to bank. This module required no manual data collection, ensuring data integrity, and provided access to results in one day. It also eliminated the need for any mechanical hardware investment and any inaccuracies in data collection. The data module compiled the data and provided branch managers with four reports to help them in staffing, scheduling, and identifying tellers who needed additional training.

Teller Processing Proficiency Summary: Report P1

The teller processing proficiency summary, report P1 (Figure 3), provides details on the number of customers each teller served, the total number of transactions processed, and the ratio of transactions per customer. The report also compares the teller’s average transaction processing time for a given set of transactions to the top quartile processing time of all tellers for the same set of transactions. This report enables managers to compare tellers performing the same set of transactions within a branch and region to help them to recognize top performers and identify those who need additional training.

Transaction Type Processing Time Summary: Report P2

The transaction type processing time summary, report P2 (Figure 4), provides managers with information about the most frequently processed transactions at their branches and the associated processing times. By sorting this information in de-
Figure 2: The data is processed through various steps to generate the four SEMS productivity reports. Each report, the teller processing proficiency summary, the transaction-type processing-time summary, the summary of customers and transactions by day, and the customer and transaction volume by weekday and by half hour, provides detailed information used in scheduling tellers.

scending order according to frequency of transaction, managers can better understand the needs of their branch customers and identify opportunities for software enhancements and strategies to move transactions from tellers to such alternatives as ATMs. Using reports P1 and P2, the manager has the tools to manage teller proficiency and productivity.

Summary of Customers and Transactions by Day: Report P3

Managers need a forecast of patterns of peak and slow customer activity to schedule tellers. The summary of customers and
Figure 3: Report P1 provides details on the number of customers served, the total number of transactions processed, the average number of transactions processed per customer, and the associated transaction processing time for a specific teller. The report also compares the teller’s average transaction processing time to the top quartile processing time and is used to determine teller transaction volumes and work speed.

transactions by day, report P3 (Figure 5), provides daily transaction volumes by day of the week and by calendar day to facilitate effective staffing for such peak days as pay day, social security check-cashing day, and other high-volume days.

Customer and Transaction Volume by Weekday and by Half Hour: Report P4

Report P4 (Figure 6) shows the average number of customers and transactions processed every half hour for a specific weekday. It also shows the average time taken to process a transaction and the average time for a customer session. Using report P3 and report P4, branch managers can determine daily schedules to match staffing levels with the anticipated transaction volumes.

Wait-Time Model

The teller productivity module provides

Figure 4: Report P2 provides in descending frequency details of the types of transactions performed at a specific branch, the average transaction processing time, and a comparison to top quartile. It is used to review branch activity and training and cross-selling opportunities.

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Figure 5: Report P3 provides the actual number of customers served and transactions processed for each day of the month. In addition, it lists the average number of transactions processed per customer and the average time per transaction and customer. The report is used to determine customer traffic patterns and assist in teller scheduling.

Figure 6: Report P4 provides the average number of customers served and the average number of transactions processed every half hour for the day of the week listed. It is used in conjunction with report P3 to assist in teller scheduling.
Figure 7: The wait-time reports provide management an objective tool with which to measure customer wait-time experiences and service received from regular lobby tellers through analysis of customer arrival and wait-time patterns on a specific day or during a particular time period.
the number of customers standing in line. The teller would subsequently have to enter this information manually into the system at a significant additional cost. While this method was simple, it was flawed in that it violated the objectives of access to results, automation, and low cost.

To solve this problem, we designed a statistical prompt screen that prompted the teller to collect the number of customers waiting in line at the beginning of each half-hour interval. This system came out of the partnership between Service Management and Information Technology. The statistical prompt screen automatically appears on the teller main menu screen at any desired time interval (currently every half hour). The prompt screen appears only at the end of a customer session; and it does not interrupt transaction processing or disrupt customer service. Once a teller in a particular branch enters the number of customers waiting in queue, the prompt does not appear until the next half-hour interval. If more than one teller enters the data, the system calculates the average of all the responses and uses it to determine an arrival pattern rate. The prompt screen also permits tellers to verify and correct the information they enter. Branch managers can adjust the starting and stopping times of the statistical prompt window to coincide with the branch opening and closing times. This simple system satisfied KeyCorp's objectives.

The framework of this model is a multi-channel waiting line model with a Poisson arrival rate and exponential customer service time, the $M/M/k$ model. It determines the expected steady state customer wait-time experience at KeyCorp branches for each half-hour interval. We made several heuristic modifications to the base model by using actual data and validating the results to customize the wait-time distribution to the KeyCorp environment (appendix). All the data inputs such as the number of tellers serving customers ($k$), the customer service time ($\mu$), and the customer arrival rate ($\lambda$) are derived from Performance Capture and validated with actual time study observations of 5,000 customers at 25 branches over 36 business days. Consequently, data integrity was not an issue and data were provided on a continuous and dynamic basis.

The number of tellers serving customers ($k$) is not an integer in the branch environment. For example, it can be 3.5 for the time interval 11:00 AM to 11:30 AM in any of the following situations:

—The branch has three tellers throughout the time interval and an additional part-time teller starting at 11:15 AM.

—The branch has four tellers at 11:00 AM; one of the tellers leaves for lunch at 11:25 AM and another teller begins to perform administrative activities at 11:20 AM.

Since the $M/M/k$ model requires $k$ to be an integer and since $k$ is a real number, we calculated two sets of wait time statistics $w(k^*)$ and $w(k^-)$ using $M/M/k^*$ and $M/M/k^-$ where $k^*$ is Integer ($k$) and $k^-$ is Integer ($k + 1$), and we determine the expected wait time $w(k)$ using a logarithmic interpolation algorithm between $w(k^*)$ and $w(k^-)$. To include a dynamic arrival pattern (for
example, in Alaska a vessel can disembark multiple customers at one time, or on a Social Security payment day a bus from a retirement community might bring multiple customers at one time), we developed a dynamic arrival rate compensation algorithm examining the difference between the number of customers waiting at the beginning of the half-hour interval and the expected length of the queue $L(q)$ for the half-hour interval to modify the expected wait time $w(k)$. To determine the expected wait time distribution, we further adjusted the $w(k)$ using a gamma distribution parameter estimation based on 200 half-hour interval observations, representing thousands of customer session observations. We validated the results at each step against 5,000 actual customer wait-time stop-watch observations. In at least 90 percent of cases, the value of $w(k)$ was unchanged with or without the described heuristic algorithms. Nonetheless, in the other 10 percent of the cases, the algorithms enhanced the value of $w(k)$ substantially and thus helped to establish the credibility of the wait-time reports with the branch managers. While these statistical tools and analyses substantiate the accuracy of the model from a management science perspective, KeyCorp has introduced the models at 1,332 branches without receiving a single complaint or challenge to the validity or integrity of the data. This experience is proof positive that the real-world user accepts the results as well.

KeyCorp recognized that the $M/M/k$ model does not capture the effect of balking, and without a practical, cost-effective means to collect data on an ongoing basis, it chose to estimate the effect of balking by actual time study observations at 10 selected branches on busy days. This analysis showed that balking was not a factor, probably in part because of the short wait times.

Using the data input from Performance Capture and applying the above algorithms, KeyCorp was able to measure and manage service to a targeted objective and measure the result. We developed the following reports to help branch management service level objectives.

**Wait Time by Branch: Report W1**

KeyCorp wants to foster pride and competition. Therefore, it provides each branch with information about the branches in its district regarding the numbers of customers served, tellers available to serve customers, customers waiting in line to be served, and the customers served in less than one minute, one to five minutes, five to 10 minutes, and more than 10 minutes (Figure 8). By integrating this information with teller productivity information, districts and regions can recognize outstanding performers and develop plans to improve underperformers.

**Wait Time by Day at Branch Level: Report W2**

Report W2 provides branch managers with the same information for their particular branches as report W1, but it provides the information for each day of the month as well as for the average weekday (Figure 9). By viewing customer wait times in conjunction with branch productivity reports, managers gain valuable insight into the staffing and scheduling changes required.

**Wait Time by Half-Hour Interval at Branch Level: Report W3**

Finally, report W3 identifies those in-
Figure 8: The wait-time-by-branch report provides the number of customers served, the number of regular lobby tellers available to serve the customers throughout the day, the length of time customers waited in line to be served, and the percentage of customers who waited less than five minutes. KeyCorp uses this information to evaluate the level of customer service provided in the district.

stances in which the branch daily wait time fails to meet the target (Figure 10). Management uses this report to identify failures to meet service standards, to understand why, and to rectify the problem. **Productivity and Customer Wait-Time Executive Reports**

We designed several reports using PC-based ACCESS software for top management. These executive reports, implemented in July 1993, are used primarily by regional, district, and area managers to plan continuous improvements in productivity and customer wait times. One of the most frequently used reports, “Branch-productivity and customer-wait-time district summary” (Figure 11), provides them with a graphical view of customer wait times and teller productivity numbers for all branches within a district. Comparing
KEYCORP

REPORT: W3

WAIT TIME BY HALF-HOUR INTERVAL AT BRANCH LEVEL

BANK — DISTRICT
BRANCH # — NAME
DAY OF WEEK, DATE

<table>
<thead>
<tr>
<th>TIME INTERVAL</th>
<th>CUST IN LOBBY</th>
<th>CUST SERVED</th>
<th>OPEN LOBBY Tellers</th>
<th>AVG CUST TIME (SEC)</th>
<th>&lt; 1</th>
<th>#</th>
<th>%</th>
<th>1 TO 5</th>
<th>#</th>
<th>%</th>
<th>5 TO 10</th>
<th>#</th>
<th>%</th>
<th>10+</th>
<th>#</th>
<th>%</th>
<th>% OF CUST SERVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:00AM-09:29AM</td>
<td>1</td>
<td>14</td>
<td>3.1</td>
<td>207</td>
<td>10</td>
<td>71</td>
<td>4</td>
<td>29%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>100%</td>
<td></td>
<td></td>
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<td>09:30AM-09:59AM</td>
<td>3</td>
<td>9</td>
<td>1.7</td>
<td>222</td>
<td>0</td>
<td>0%</td>
<td>3</td>
<td>33%</td>
<td>5</td>
<td>56%</td>
<td>1</td>
<td>11%</td>
<td>33%</td>
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</tr>
<tr>
<td>04:30PM-04:59PM</td>
<td>2</td>
<td>21</td>
<td>2.3</td>
<td>126</td>
<td>8</td>
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<td>13</td>
<td>59%</td>
<td>1</td>
<td>5%</td>
<td>0</td>
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<td>0%</td>
<td>95%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>ALL TIME INTERVALS</td>
<td>1</td>
<td>256</td>
<td>2.1</td>
<td>127</td>
<td>140</td>
<td>55%</td>
<td>84</td>
<td>33%</td>
<td>26</td>
<td>10%</td>
<td>4</td>
<td>2%</td>
<td>88%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 10: The wait-time-by-half-hour report provides the wait-time information broken down by day and by half hour at a specific branch. Detailed analysis can be done with this information to determine customer flow and staff-scheduling problems.

graphs from two periods shows productivity is improving and customer wait time decreasing.

Executive Information System (EIS)

We designed several graphical reports for top management and implemented them in February 1994 on KeyCorp’s EIS PILOT software (Figure 12). These EIS (executive information system) reports are used by regional, district, and area managers and by senior executives at the bank and corporate levels. They show customer wait times, numbers of customers served, and average number of tellers at the branch, district, region, or bank level. The EIS communicates data electronically using graphs and charts, and the information is updated daily. This level of detail with this frequency would not be practical in a paper environment.

Implementation and Internal Marketing

In addition to timely, accurate information, effective education improved decisions based upon SEMS. The SEMS educa-

![First Implementation Month Graph](image)

![Six Months Post Implementation Graph](image)

Figure 11: The above branches demonstrate the gains made using the SEMS system over a six-month time span. Significant improvements in both teller productivity and customer wait time were experienced at these five randomly chosen branches.

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Figure 12: Using the SEMS model, an individual branch reduced the number of customers waiting five to 10 minutes and over 10 minutes. The EIS reports provide timely, accurate information.

The program included a video and a one-day workshop for regional, district, and area managers. The workshop included group exercises covering three typical branches (rural, suburban, and downtown). Participants were asked to analyze information and outline actions to yield a targeted improvement in teller productivity while reducing customer wait time. These managers became the experts who, in turn, instructed the branch management teams. This accomplished two goals: (1) we educated district and regional managers in using the models, and (2) by instructing the branch managers, the district and regional managers demonstrated their support of the tools. This methodology was quite successful and well received. Only two percent of participants recommended any changes in post-training surveys.

We could teach managers how to use SEMS information in the classroom, but they did not really grasp the results of staffing and scheduling changes on customer wait times until we put them into action. We used simulation models based on Witness (an AT&T ISETL simulation software package) to bridge this gap. Through Witness, managers and executives saw first-hand the positive effects of SEMS recom-
mendations on customer wait time before implementing the changes. These simulations clarified actions and results and built enthusiasm for SEMS information tools.

While the problem of managing service in the banking industry is not unique to KeyCorp, the solution to the problem is. Performance Capture is the foundation on which we built SEMS models. By using heuristic algorithms, KeyCorp has customized the traditional $M/M/k$ model to accurately reflect the banking environment, including the availability of tellers and dynamic customer arrival rates. The statistical prompt allows tellers to capture real data regarding the length of the queue on the half hour, and by using additional heuristic algorithms, we obtain an accurate measurement of customer wait times.

Results and Impact

All 1,332 KeyCorp branches are using SEMS information. SEMS reports measure proficiency and service management for nearly 6,000 of KeyCorp's 29,000 person work force.

KeyCorp will save over $98 million between 1995 and 1999 as a direct result of the SEMS models. KeyCorp spent less than $500,000 for the system including training, giving it a 3,500 percent internal rate of return over five years. The project payback period was less than 10 days! Improving scheduling and reduced personnel has freed up an additional 15 percent of branch capacity, which KeyCorp can use to pursue value-added activities, such as new product sales.

As the branches improve their customer service, customers perceive KeyCorp as "easy to do business with." Among the improvements facilitated by SEMS from its inception in 1993 to the present date, branches serving 90 percent of customers in less than five minutes improved from 42 to 94 percent, the number of days on which 90 percent of customers waited less than five minutes improved from 55 to 89 percent and the number of customers waiting more than five minutes decreased from 14 to four percent. All of these advances contributed significantly to the startling 53-percent reduction in dissatisfied customers from 17 to eight percent, as determined by proprietary customer satisfaction surveys covering the same period. The results from the proprietary survey were confirmed by surveys conducted by the outside firm Walker Customer Satisfaction Measures Survey, which outlined 10 to 30-percent improvements in such customer-satisfaction classifications as "customer oriented, responsive organization, easy to do business with, and stands behind services."

Overall, KeyCorp has reduced customer session time by 53 percent, which, in conjunction with better scheduling and staffing, has created more satisfied customers. KeyCorp has improved its customer service and reduced its operating costs through application of performance drivers such as reengineering, improved management accountability, user acceptance, and system portability. Reports on teller proficiency and transaction processing have helped management to identify, reengineer, and eliminate process impediments. Reducing the response time of the host computers and the network and redesigning transaction processing screens has reduced customer processing time in more than 50 percent. As of August 1995, the average customer session time lasts 115
Figure 13: Significant reductions were made in customer-processing time over the 26 months listed.

seconds, a reduction of 131 seconds or 53 percent from the initial benchmark level of 246 seconds in April 1992 (Figure 13).

SEMS permitted branch managers to better manage productivity and customer wait time by eliminating the uncontrollable elements of service quality and focusing on actionable management performance measures. This empowers branch managers to focus on what matters at the closest point to the customer and take ownership of the results.

By validating the output of the model, KeyCorp has established its credibility with 1,332 branch managers and their teller staffs. Because the employees accept and endorse the model, KeyCorp incorporated its productivity measures into teller performance reviews, using them in determining compensation for its 6,000 plus tellers.

SEMS portability has allowed KeyCorp to leverage its benefits as it expands through merger and acquisition. Within a short time, KeyCorp transported the model to three different teller systems: Branch Teller IBM PC-based, ISC Erickson Intelligent Terminal, and IBM 4700 Terminal. The models can easily be transported to most of the over 10,000 banks in the United States and to other banks in the world. Virtually any service scenario that features a single line of customers and multiple servers using an automated system to key in data can benefit from the models.

Results Are What Matter

SEMS has been a "win-win-win" for KeyCorp: (1) management satisfies more customers at lower cost; (2) employees have the tools with which to manage service and expense and consequently feel more in control; and (3) KeyCorp shareholders reap the benefits of improved earnings.

Executive Vice-President Robert G. Jones points out that "KeyCorp had record earnings in 1994 of $854 million dollars, and we feel KeyCorp's unique approach to serving customers through our branch network has had a direct impact on our continuous success." Jones goes on to add, "with our vision to be the first choice of those seeking world-class financial products and services, SEMS positions KeyCorp to make great strides towards the goal to become their first choice by the year 2000."
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APPENDIX: Heuristic Algorithms

Teller Available Algorithm
A key purpose of the model is to determine the number of tellers available to actively serve customers at any given branch at half-hour intervals. Through observation and time study analyses, we found that we could not ascertain the number of open and available tellers from the number signed on to the teller system because they also perform noncustomer-related activities while still logged onto the teller system. We developed an algorithm to accurately count the number of tellers available, leveraging information from Performance Capture. Through time studies involving 5,000 customers at over 25 branches, we determined that in 98 percent of the cases, the time between two consecutive customers for any particular teller is less than 10 minutes if the teller is continuously available for serving customers. We calculated the number of open tellers using the following heuristic algorithm:

—Determine the number of open tellers using Performance Capture for any half-hour interval. For example, three tellers A, B, and C are open between 10:00 and 10:30.
—Use Performance Capture transaction data to determine if the time between two consecutive customers is greater than 10 minutes for open tellers. In this example, teller B does not perform any customer transactions between 10:12 and 10:30 and thus is considered to be unavailable for 18 minutes.
—Express the time available as a percentage, and subtract that amount from the number of tellers open. For the above example, \(3 - 18/30 = 2.4\). The result, the average number of tellers open in any given half hour, is given by \(k\). In this example, \(k = 2.4\) and \(k\) is a real number.

Arrival Rate Algorithm
Using Performance Capture, we determine the arrival rate for each hour at the branch level:
—\(C_b\) is the number of customers in the queue at the beginning of each half hour, and \(C_r\) is the number of customers in the queue at the end of each half hour. The teller enters both numbers directly in response to a statistical prompt.
—\(C_d\) is the number of customers served in each half hour (taken from the customer count collected by Performance Capture).
—The arrival rate \(\lambda = C_d + C_r - C_b\).

Furthermore, using time studies to evaluate at the interarrival time rate between customers, we determined that the interarrival time was distributed exponentially, hence the arrival rate is a Poisson distribution. We obtained the number of customers served directly from Performance Capture.

Customer-Service Time Algorithm
Performance Capture records the customer-service time for each customer by the start and the end of the customer function the teller uses on the teller system. Since each customer session begins and ends with human interactions outside of the teller system, including greeting the customer, customer identification, counting out cash, and thanking the customer, we added begin and end times to the average system time for each half hour. We determined these begin and end times using time studies for approximately 5,000 observations, which revealed that service times were very close to being distributed exponentially with a mean \(\mu\).
Primary Wait-Time Estimates \((M/M/k)\) Algorithm

The three primary inputs to the model, exponential service time \((\mu)\), number of available servers \((k)\), and Poisson arrival rate \((\lambda)\), are the normal inputs in the standard \(M/M/k\) model to determine the steady-state wait-time statistics for the half hour, such as:

—Probability of zero customers waiting;
—Average length of queue; and
—Average wait time.

The \(M/M/k\) model requires \(k\) be a nonzero integer and, because \(k\) as calculated by the "teller available algorithm" is a real number, we calculate two sets of wait time statistics, \(w(k^+)\) and \(w(k^-)\), using \(M/M/k^+\) and \(M/M/k^-\) where \(k^+\) is integer \((k)\) and \(k^-\) is integer \((k + 1)\). We used logarithmic interpolation between the two sets of statistics to arrive at the final set of statistics for the half hour.

**Gamma Distribution Parameter Estimation**

With the final wait-time average for a half hour established, our final step was to determine the appropriate distribution of wait times: the number and percent of customers waiting in each time interval. From empirical data, we determined that the gamma distribution was the best fit for the distribution of wait times per half hour, regardless of the parameters \(\mu\), \(\lambda\) and \(k\).

**References**


Jones, Robert G. 1995, internal communication, KeyCorp.
