ABSTRACT
Recent government budget restrictions have had a significant impact on administrative and support functioning at AADAC (the Alberta Alcohol and Drug Abuse Commission). In response to these restrictions, it was necessary for AADAC to completely re-engineer its SAS™ based corporate information systems. As a result of this re-engineering, corporate information system costs were cut by more than 90%, the number of staff was reduced and processing time was decreased by 66%. In addition, all transition costs were recovered within the transition year. These results were achieved by changing how corporate information was handled and by using different, more efficient computer hardware and software to do the job.

INTRODUCTION
AADAC provides a wide range of alcohol and other drug prevention and treatment services to Albertans through a network of units, clinics, and institutions across the province. Until the transition, AADAC used five systems to record corporate information. These systems operated on a mainframe computer and were written in SAS 5.18. The oldest of these systems dated back to 1978.

The systems all functioned in the same way. When a person entered an AADAC facility for treatment, a counsellor would complete the admission section of a form and send it to head office for processing. When the client finished the treatment program, the counsellor then completed the discharge section of the form which was also sent for processing. Those partial forms were bundled and shipped to Alberta Public Works and Support Services (PWSS) where they were keyed. PWSS would send back electronic transactional files with the keyed data. For one system, AADAC handled as many as 14 separate transactional files each month. The data from those files were then cleaned and the admission records matched with discharge records. Finally, the master files would be updated. The system generated reports on a quarterly basis. Under ideal conditions, one month’s update could be completed in 6 weeks. At that time, AADAC handled around 80,000 pieces of paper in one year and four staff were needed to maintain the systems.

Keying charges, mainframe storage, and processing costs made the systems very expensive, and each year the corporate information systems would exceed their budget allotment by 100%. These overruns were simply to maintain the systems and did not include enhancements or special projects.

As a result of government-wide budget reductions, AADAC decided to reduce the operating costs of information systems. The targeted reductions included reducing data processing expenses by 80% and eliminating one of the four positions dedicated to the information systems. These reductions had to be completed in a one year period. Clearly, AADAC could not continue to process information using the same approach to data processing and meet these challenges. A new and innovative way to process information had to be developed.

CHALLENGES TO CHANGE
There were several challenges presented as part of this transition. First, three rather than four people had to be able to manage the new system. Second, the system’s purpose was not to be affected by these changes and, if possible, the appearance and usability of the information was to be enhanced. Since the number of staff needed to maintain the system was to be reduced, the new system had to be designed in a way that it could be easily and quickly managed. Third, since no additional funds were allocated, all development had to be completed within projected systems expenditures. In addition, the new systems had to be developed while continuing to use the old systems. As a result, AADAC could only use the old systems for four months. After that time, AADAC could not continue paying for mainframe storage and processing costs and have sufficient funds to develop the new systems. So, not only did the new systems have to be operational, but all data had to be removed from the mainframe computer by that time. It was a daunting task!

THE INNOVATION
Recognizing this transition as an opportunity, we decided to take advantage of the situation and re-engineer all aspects of systems. Since the costs of storing the historical data on the mainframe or having the new data keyed by PWSS would be more than the reduced allotment, AADAC could not continue to use the mainframe computer—we had to move to micro computers. To be cost effective, staff would have to key and clean data from the system. We also had to take advantage of the micro computer platform and minimize the amount of effort needed to maintain it.

The new system design is completely different from the former design. Every line of code in the system is new and every historical record in it has been converted. This re-engineering marks the biggest single factor in the system—dumping the old systems and building new ones.
that closely match the organization with current technology.

Of the previous five systems, the Client Monitoring System (CMS) accounted for well over half of all expenditures. Since CMS consumed most of the data processing resources, it was the main focus in the systems re-engineering project. The purpose of CMS was very similar to another system, the Adolescent Treatment Information System (ATIS). We decided that it would make sense to combine these two systems. Two other systems, Impact and Planning Ahead, collected information concerning programs that AADAC no longer supported. The historical data from these systems had to be maintained in order to answer requests about clients who participated in these programs. The final system, the Community Education Services Information System (CESIS), was found to have limited usefulness and, as a result, we reduced it to a spreadsheet that is used by both head and field offices. CESIS, Impact, and Planning Ahead posed storage problems since they had considerable data—some dating back to 1982. The data was still required for reporting purposes, but it was too expensive to store it on the mainframe. As a result, the data had to be downloaded from the mainframe and stored so it could be quickly accessed for ad hoc requests.

The activities around processing and presenting CMS, ATIS and CESIS data were carefully studied and re-worked. Those functions that did not enhance the quality or usefulness of the information were discontinued. Activities that did enhance the system were re-engineered in order to decrease the amount of effort and time they took. This analysis was done with the knowledge that the new system would exist on micro computers that have their own limitations and that funds for the re-engineering project were very limited.

**Hardware and Software Choices**

AADAC chose to continue using SAS because of its portability across computer platforms. It provides a stable, affordable graphical interface and can be easily altered. The only SAS platform that was affordable and met our requirements was OS/2™. Since OS/2 was not part of the micro computer mainstream, we were concerned about developing a system that was based on a platform that may not be supported in the future. The portability of SAS made this a minor risk, however, since, if OS/2 was not supported, the new system could be simply moved to another platform.

The new system was built so it could operate on an OS/2-based Local Area Network (LAN) and allow all systems staff concurrent access to the system. The LAN currently has five 486-33 workstations with a 486-20SX server. The server is only used for storing files and as a printer server. Since all data processing was done at workstations, resources were spent on the server's hard drive and a high performance SCSI caching controller that would help to move the system and data files to the workstations more quickly. Very little of the server's resources are actually required by the system. By designing the system so the workstations did all the processing, a less expensive server could be purchased. The system will also operate on a variety of other types of networks or independently of a network.

The workstations have higher processing power and, since they only manage data for their own sessions, disk capacity was not a critical factor. The workstations have more Random Access Memory than the server so that some system modules can be held in memory for faster execution. Powerful processors were chosen for these workstations because all processing is completed by these computers.

The SAS requirements are: Base SAS is needed to run the system; SAS/AF is required to modify the system code, and; SAS/FSP is required for running the site list maintenance module. Since SAS Institute Inc. has a recurring licensing policy for its software, yearly fees for these SAS products represent almost all of the costs for the system.

**The System**

The system has two vehicles to process information: one for manually keying paper forms and the other to import electronic files containing copies of the forms. The electronic files require minimal data cleaning and no keying. At this point, there are only two facilities in AADAC that are sending their data electronically. By the end of the fiscal year, two more high volume offices will also be sending only electronic information.

Manually keying data combines the first three steps of the old system. When a data entry operator keys the form number, the system scans the transactional file for a match. If it does not find a matching form number, it scans the master file. If a match is found, it loads the information. Typically, the transactional file has about 3,500 records and the master file has over 130,000. The SAS data sets have been indexed so this search takes less than a second to complete. This process is completed when the data entry operator keys discharge information on an admission record or edits a record. The edits are done on the screen as the data is entered through custom SAS/AF applications.

By designing the system to include the edit and matching processes in keying, AADAC eliminated two major time consuming steps in processing the data. Another efficiency was realized by reducing the fourteen transactional files that were previously handled each month to two files. As previously mentioned, under ideal conditions it took six weeks to do an update. With the new system, we are ready in two weeks. The data is also cleaner (due to elaborate logic checks) and there is an accurate audit trail following the data.

The position that was downsized was responsible for two main duties: ensuring that all programs were up-to-date and responding to ad hoc requests from management. In order to replace the first duty, maintenance of the system was re-thought. A data base was designed that captured all relevant information about the facility sending us data.
When a facility changed its treatment programs, a new record would be added to this data base. This new record would contain all description of the type of data that can be accepted from that facility for a specified time period. This information is then automatically used by the macros that run the system. By maintaining the system this way, we are able to have a unique set of edits for each facility that contain the correct information for specific time periods. For example, if an agency sends us a form that is two years old, the system will automatically load the edits that were appropriate for that agency two years ago. As well, this method of maintenance allowed us to shorten the time needed to revise programs from several days to under five minutes.

This facility data file also contains the names of contacts as well as FAX and data line telephone numbers. In the next year, we will experiment with sending our reports out using these lines. By doing this, there would be no paper to handle; the system would produce the documents and distribute them.

As mentioned the downsized position completed the majority of ad hoc requests received. The remaining systems staff have an excellent understanding of the data collected but limited SAS knowledge. To replace the programming expertise SAS/ASSIST was added to the system. The data entry staff are now able to complete most of the ad hoc requests received.

One of the real strengths of going to the micro platform is the power over reports. The reports generated from this system are designed to look like any of the other reports generated by our Division. To improve the appearance of the reports, bit mapped images and a variety of fonts have been included in the reports. The content of the reports was also significantly revised. The reports now include more information and the number of pages printed was reduced by hundreds. The perceived success of this system will be based largely on the reception of these reports. For the most part, the consumers of the information will not know or care about the extensive system development work, but they will care about its products and its accessibility.

One of the issues with live systems is that they change. This fact can be inconvenient when one needs to replicate numbers exactly. The system audit trail has been designed so that we can accurately determine the exact point at which every admission or discharge record is added to the system. By using the audit trail, we can exactly replicate a report or ad hoc request next week or five years from now.

**HOW IT WAS DONE**

The decision was made to abandon all of the old systems, re-engineer CMS, and create a spreadsheet application to replace CESIS.

The spreadsheet built to replace CESIS was developed internally with existing staff. The spreadsheet was then distributed to AADAC facilities who key into the spreadsheet and then send summarized information into head office for processing. That summarized information is entered into SAS data sets and provincial totals are produced. In total, the cost of running the system for the past year has been under one hundred dollars.

The re-engineering of CMS combined with ATIS was the most critical aspect of the project. CMS itself had consumed most of resources for information systems and 88% of the keying volume. Its re-engineering had to be completed very quickly. The previous system was analyzed and a new one designed during the period from February to May. The first step was to redesign the form used for data collection form and eliminate as many redundant or unimportant elements as possible. A SAS consultant was hired in June to program the system. It was critical that the data entry components be operational by August 1st as there was not enough money to have any data stored on the mainframe after that time. This reality meant that the historical data had to be off of the mainframe, converted data sets needed to be set up, the screens designed, error checking and update procedures in place and tested by that time. The project was planned so that the other components of the system could be added on over the next few months.

SAS's flexible data structure and its tools for fast development were major factors in the design of the new system. This flexibility and speed were integral to the success of the project due to the time limitations and the fact that we were designing the interfaces to the system around feedback from data entry staff.

**Data**

AADAC collects data about two types of people: those who are in treatment for their alcohol or other drug problems (referred to as 'clients') and those who are in treatment for some else's substance use problem, such as a child or a spouse. These individuals are referred to as 'collaterals.'

CMS manages two streams of data: one for clients and the other for collaterals. These data streams are identical in many respects. Forms are structured into admission and discharge components and each part of the form contains a unique form number and identifier information. The form number and identifier are used to link admission and discharge records when the form is separated. Data for both clients and collaterals are received as a bundle of paper forms or as an electronic file containing a month's worth of records.

The design consisted of building two logically identical systems which store both the admission and discharge information in a single record. Admissions and discharges are identified to the system by routines which scan the contents of a record to determine its type. Hence, admissions, discharges and closed records are stored in a single database.

The client and collateral systems come together in only two points. Client and collateral data are mixed within an electronic data file. The reports integrate the client and collateral information.
Ergonomics

The ergonomics of the system were designed for ease of use, utilizing a Graphical User Interface (GUI). The manual data entry was targeted as the most critical user interface. In particular, speed of data entry was a major concern. An important consideration in the system was the fact that most of the users had only mainframe experience. The input personnel had never used a mouse. Finally, it was decided to use super VGA resolution for the system. Compared to VGA resolution, the input screen had much more area for data fields. A much cleaner layout was also possible.

In keeping with the OS/2 GUI, the system makes extensive use of icons for menus. Selection lists are used whenever feasible and push buttons are used for hotkey actions. Three data entry interfaces were built and tested for one week. The first interface was a mouse based WYSIWYG approach. The edit screens matched the form exactly. Data were entered by clicking on appropriate check boxes. The second interface was selection-list driven. Data entry consisted of clicking on a question and selecting from a list. The third selected interface was designed so that data entry staff did not have to look up from the forms while entering data. To compensate for the lack of PC experience, the system can be operated exclusively from the keyboard.

Quality Control

Quality control was regulated through data validation. Form specific data validation consists of the standard validation of data entered in fields and consistency checks between fields. Since information is received in one of three forms (admission records only, discharges only, or records with both admission and discharges completed), the data validation programs had to be flexible so that it could accurately validate records. If only the admission information is entered into a record, the system must not report discharge information as missing.

In addition, site specific data validation had to be included to monitor the specialized nature of the variety of treatment programs offered by AADAC. The validation programs must be able to monitor for each facility the following characteristics: nature of the treatment that facility provides; specified client characteristics, such as facilities that only treat women or adolescents; and the duration of specified programs.

The first level of data validation is performed by the input personnel. An on-screen status variable allows the input personnel to see if any errors exist. This stage is designed to catch the form specific and data entry errors.

Some errors require contact with field offices. Exception reports were designed to streamline this process by providing a summary of unresolved problems. These are grouped by site facilitating the resolution of multiple problems with a single phone call.

The final level of data validation is implemented by four programs designed to test the master data set. These tests provide a higher level of data integrity. They look for admission records for clients who were admitted several months ago and may have completed treatment. The report produces a list of clients that is sent out to facilities to verify if these clients should have a discharge record completed. In this way, the system can be kept current. Another report scans the master file for records that do not have admission information. In this way, we can determine if records were misplaced. Since the system uses the form number to match together admission and discharge records, a report was designed that scans the file for typographical errors made when keying. Finally, a program is run that checks for any data that may have gotten into the system that violates rules concerning the type of client or programs offered at each facility.

Output

Reports are formatted based in their final destination: internal or external audiences. Internal reports are two-sided and use low ink-demand fonts. Consideration is given to functionality rather than appearance.

External reports must be of presentation quality and extremely legible. Extensive use of proportional fonts of many point sizes is required. The summary reports must include a generated cover page with the AADAC logo on it. All external reports are generated using SAS data step techniques. The need to include and conditionally issue PCL-5 commands makes this a requirement. Macro variables were defined to store command strings to set specific fonts. Macros were utilized to simplify development and maintenance.

The Summary Report format uses extensive justification and cursor control routines. These were implemented in macros used within a data step. To facilitate LAN printing and prepare for future electronic report distribution, the reports are first written to disk. The file is then copied to printer.

Staffing and Training Issues

All job descriptions were rewritten for Systems staff. Systems staff attended courses for OS/2 and other microcomputer software to assist with the transition. Prior to implementation of the new forms in the field, Systems staff trained AADAC's field staff to use the new forms through teleconferences and on-site visits. A User Manual for completing the new forms was written and distributed to each office.

RESULTS ACHIEVED

System Operation

SAS's power and flexibility has allowed us to quickly and inexpensively develop the systems. The project was kept within budget and close to schedule.

The transition has greatly affected Systems day-to-day activities. Most significantly, keying has been much faster than anticipated. We now require approximately a half position to key and clean most of the data. As a result, one data clerk is doing more data integrity work.
This person is responsible for monitoring errors encountered in form completion and will be providing training to facilities that have inordinate numbers of errors. The other data clerk has been increasingly more involved with data presentation as well as in other projects undertaken in our Division outside of Systems. The effects of major changes like this one are felt long after the project has been completed. Since two additional facilities will be sending electronic data instead of paper records to be keyed, it is likely that staff duties will continue change.

The combined CMS and ATIS systems were reduced from handling 14 transational files each month to two. As mentioned, keying data was much faster than originally anticipated. The edits components are quick, very accurate and facilitate quick error resolution. The reports generated out of the system have been very well received.

Re-engineering CESIS to produce a summarized report of an office's activities was less successful. Going to a summarized report may have led to regional differences in recording data due to the loss of the previous systems' ability to verify specific projects. As a result, this system will be redesigned and implemented in April 1994. The costs of the redesigned CESIS system will not appreciably increase the operating costs of systems.

**Transition Year Expected and Actual Expenditure**

Table 1 details the projected and actual costs of information systems by fiscal year. Based on the rate increases in storing, keying and processing data from PWSS, AADAC projected that our information systems would cost $88,972 in 1992/93. All transition expenditures had to be within the projected cost estimate. For that year, the total system expenditure was $85,415. This figure includes PWSS charges for the first four months, purchasing computers, consultant fees, data conversion, training for Systems and field staff and travel. In the transition year, AADAC recovered the cost of re-engineering and saved an additional $3,557. In the current year, AADAC has actualized a savings of $131,239 over the projected costs of continuing to use the former systems.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Projected and Actual Expenditures during the 1992/93 and 1993/94 Fiscal Years</th>
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<tbody>
<tr>
<td>Manpower</td>
<td>Projected</td>
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<tr>
<td></td>
<td>151,128</td>
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<tr>
<td></td>
<td>0</td>
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<tr>
<td>Information Systems</td>
<td>88,972</td>
</tr>
<tr>
<td></td>
<td>3,557</td>
</tr>
<tr>
<td>Total</td>
<td>240,100</td>
</tr>
<tr>
<td></td>
<td>240,100</td>
</tr>
<tr>
<td></td>
<td>113,313</td>
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</table>

Table 2 details actual expenditures over the last three years. The actual savings in the current year have considerable. The cost of delivering information has been reduced by 94%, the manpower required to process data has been reduced by 28%, and the overall reduction is 52%. In addition the data processing costs for the 1993/94 figures include upgrades to the operating system, LAN, and purchasing additional equipment in addition to operating the corporate systems.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Actual Information System Expenditures By Year</th>
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<tbody>
<tr>
<td>Manpower</td>
<td>$141,642</td>
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<tr>
<td>Information System Costs</td>
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<tr>
<td>Data Processing</td>
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<td>Equipment</td>
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<td>Development</td>
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<tr>
<td>Sub Total</td>
<td>88,893</td>
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<tr>
<td>Total</td>
<td>$210,535</td>
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In response to budget restraints, the Government of Alberta has attempted to reduce operating costs. These reductions are intended to reduce the costs of administrative activities while not affecting service delivery. In response to these reductions, AADAC re-engineered its information systems. The targeted goals of this re-engineering was to reduce the operating costs of these systems by 80% and reduce the manpower required by 25%. The utility of the products from these systems was to remain unchanged or be improved.

Through program changes and re-engineering, AADAC reduced its information systems from five to two. The project was kept on schedule and all transition costs were recovered during the transition year. The time required to complete activities concerned with processing data was reduced by 66%. This reduction was accomplished through combining processes and simplifying activities. The number of staff was reduced by one position, the targeted amount. In order to replace this position, the systems were designed to automate many of the functions for which the downsized position was responsible. The reduction in information systems costs exceeded the 80% goal, and we realized savings of 94%. Overall, the total cost of corporate information systems in AADAC was reduced by 52% or $131,239 in the 1993/94 year.

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