Master's Theses, Capstones, and Projects

1-1-1991

Cost justification of data compression in Ameritech

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Cost Justification Of

Data Compression

In AMERITECH

by

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An Applied Management Decision Report

submitted in partial fulfillment of the

requirements for the degree of

Master of Business Administration

Cardinal Stritch College

May, 1991

APPROVAL PAGE

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_____ May 2, 1991 _____

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Abstract

American Information Technologies (Ameritech) owns the
Bell Operating Companies (BOCs) that provide local tele-
phone service in Illinios, Michigan, Indiana, Ohio, and
Wisconsin. Ameritech plans to reduce costs by developing
common application systems for the Ameritech BOCs, by
reducing duplication of effort, and by deploying common
technologies. The deployment of common systems and tech-
nologies will result in standard methods and procedures
throughout the Ameritech region.

One piece of the common technological platform relates
to the justification of a standard software package to be
used by all BOCs to compress their data base management
system segments. Each BOC currently has some method of
compressing segments. Because each BOC maintains control
over their own software expenditure budgets, justification
must be provided as to the benefits of the conversion to
some common data compression platform. The costs and
savings of the conversion must be quantified to determine
what serves the interests of Ameritech best, rather than
the interests of an individual BOC.

The researcher will discuss and evaluate the alterna-
tives of doing nothing, using the software package licensed
on the most computers in Ameritech, using the package used
in the most Ameritech BOCs, using the package used to com-
press the most data bases, and developing the software in-

house. The researcher will show that the best alternative
for Ameritech would be to choose the software package
licensed for the largest number of computers.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

American Information Technologies (Ameritech) owns the Bell Operating Companies (BOCs) that provide local telephone service in Illinios, Michigan, Indiana, Ohio, and Wisconsin. Ameritech formed a subsidiary named Ameritech Applied Technologies (AAT) by transferring the data processing organizations from the BOCs to the new company.

AAT is charged with supplying data processing services to the BOCs in Ameritech. A secondary goal of AAT is to reduce internal costs. AAT plans to do this by developing and deploying common application systems and technologies to the Ameritech BOCs thus standardizing methods and procedures throughout the region and reducing duplication of effort.

Before American Telephone and Telegraph (AT&T) agreed to divest itself of the BOCs in 1984, AT&T and Bell Laboratories had undertaken projects on behalf of and funded by the BOCs. These projects included the development of application systems that produced the desired results but were flexible enough to handle the various requirements of the operating companies. AT&T concentrated its efforts in those areas where agreement could be reached with the majority of the BOCs. The remaining areas were left for local operating company development and decision making.

1

Following its divestiture from AT&T, Ameritech management, realizing that the deployment of common systems and technologies (and the subsequent standard methods and procedures) had the potential for significant cost-saving, started to address those areas that AT&T had left to local control, development, and prioritization. It was quickly determined that the operating companies had such varied environments that development of common systems that would meet the needs and the environments of the five companies was extremely difficult and time consuming.

After divestiture, the original method for the determination of common software products was by consensus of a committee of technology mangers from each of the BOCs. The consensus method was also used to develop a common approach to methods, procedures, and application systems used within Ameritech. This method tended to alienate the groups against one another as companies that had already deployed the same product would form a coalition against the selection of any other product.

Before AAT was formed, each manager was a member of one of the BOCs and had no compelling reason for ensuring that the group's decision was best for Ameritech. Because each manager had a personal stake in the outcome, decisions were rarely reached and when decisions were made they were very obvious (only one company used the technology or a majority of the companies had a particular software product).

AAT was formed because Ameritech management realized that each BOC performed similar functions within their data processing organizations. They recognized the potential for cost savings that could be gained by reducing the duplication of effort throughout the Ameritech BOCs. They were so convinced that this was the right direction and so determined to make this work, that they published a statement of direction in the Ameritech Standards for Information Systems stating:

> The direction for the Ameritech computer operating environments will be to promote standardization of support, development, and computer operations while accommodating changing technology and flexibility in the use of various vendor hardware and software. This direction supports identification of Standard Operating Environments that provide for use of a select set of hardware and software already well deployed and supported throughout the region and also allows for expansion through the use of other hardware and software where a cost-benefit study clearly proves that benefits will accrue through their use.

DESCRIPTION OF THE CURRENT SITUATION

AAT was formed by transferring the data processing technology support and application development organizations from the BOCs to this newly created subsidiary. Also transferred into AAT was the application development organization within Ameritech Services that had been created to perform the internal development and maintenance of the first Ameritech common application systems for the BOCs.

The data processing sites themselves and the hardware and software assets in them were not transferred to AAT. The data center operations organizations in each of the states, consisting mainly of non-management people governed by union contracts, remained under the control of the BOCs. Although the intent was to bring these organizations and assets under the control of a single group, the time frame for addressing these areas was such that the formation of AAT had to be done in two steps. Their intent was not communicated to all managers involved and this caused problems in determining whose best interest should take priority.

Once AAT was formed and the data processing people were in the same organization, the next phase was possible. The plan for reducing duplication of effort in the technology areas started by the designation of a technical specialist team in each of the various data processing technology

areas. The technical specialist team would be physically located in one of the five states and be responsible for supplying assistance and expertise to the other organizations using the technology. The knowledge to operate and use the technology would be located wherever necessary, but the in-depth knowledge of the technology (problem solving, planning, software selection and deployment) would be located in a single place. This would reduce the number of people involved in the administration and support of the products in the technology.

Just as AT&T and Bell Labs and now Bell Communications Research (BellCore) had established a standard operating environment of hardware and software and releases under which systems that they had developed would operate, Ameritech needed to establish an Ameritech operating environment that addressed those areas not controlled by the central development organization. Ameritech needed to move control and decision making out of the BOCs and into an organization that would be looking at Ameritech's best interests instead of the best interests of a single BOC. This is another reason why AAT was formed.

Because the term Standard Operating Environment (SOE) had different connotations depending on the person's perspective and background, Ameritech management sought to define the various levels of SOE in the Ameritech Standards for Information Systems (1988):

The Ameritech Corporate perspective of an 'SOE': The purpose of an Ameritech SOE is to ultimately produce a working environment where the same task is executed in a very similar (if not the same) manner throughout the Ameritech corporation, including all of the operating companies. A similar manner would include standard practices, standard workstation equipment, standard workstation functions, and standard interfaces to other Ameritech work groups and Ameritech customers.

The Ameritech Applied Technologies perspective of an SOE: The role played by AAT in the Ameritech SOE is to produce standard mechanization interfaces (common systems and/or common interfaces to systems) as well as common workstation equipment and functions. AAT performs this task by providing common applications (or common user application interfaces) that run on standard equipment, that have standard user interaction interfaces, and use standard vendor software and hardware to execute. Further, the common systems are produced and maintained in a standard manner across the Ameritech companies. In addition, AAT is responsible for evolving to standard or similar data centers and communications networks across the Ameritech companies. (p. 1)

One of the many areas to be addressed by specialists in the Information Management System (IMS) technology area is the compression of IMS data base segments. Data compression was one area that AT&T did not set a standard on. It was one of the areas left to the operating companies to justify and decide upon. Systems developed by AT&T and Bell Labs had to be flexible enough to allow use of any compression package that the BOCs had chosen to use.

Data compression (Bandyopadhyay, 1989) is a process of data encryption to reduce the physical amount of data kept on the data storage media. The simplest method of data compression is the replacement of repeating characters with a smaller 'code' that can be used to expand the data to its original form. As an alternative, the compression program

could be set up to eliminate trailing blanks for example. The expansion function would always fill out (or pad) the stored data with blanks. There are several packages being marketed that give very good results in data compression.

Each BOC had selected an approach to data compression that met their needs at the time. Michigan Bell, Ohio Bell, and Indiana Bell each had acquired a package from Informatics called Shrink/IMS. Illinois Bell had deployed a software package from BMC Software named DataPacker/IMS. Wisconsin Bell had purchased COM-PRES/IMS from Data Base Technologies.

The IMS technology organization in the Illinois branch of AAT was chosen to become the specialists in the data base systems area. As such, this group was responsible for establishing the Ameritech Operating Environment (AOE) in the data base area. The AOE would consist of the environment dictated by BellCore as a base with additional products as necessary to address those areas left open to the BOCs. The Illinois branch of the IMS technology group had responsibility for selecting the common data base data compression package.

IDENTIFICATION OF THE PROBLEM

In order to establish a common direction for the IMS
technology groups and common system developers, the IMS
technology specialists needed to decide which software
package was to be used as a common platform. This platform
would be depended upon by both the technology groups and
the common system developers. Both groups would need to be
trained on only one way of doing things. This knowledge
would be applied when new computers were acquired and the
environmental software installed. It would also be applied
when new application systems were developed and deployed.
The developers would know what kind of environment to
expect at the installing location and could rely on that
environment in making decisions. This environment is
called the AOE.

The problem being addressed in this paper deals with the
selection and justification of a common data compression
package for use by all of the Ameritech BOCs. This is not
a matter of justifying that the use of a data compression
package was beneficial. This had already been done at the
time that the various packages had been acquired by the
BOCs. The problem at hand is a matter of justifying that
the use of a single data compression package in all Ameri-
tech computers was beneficial for Ameritech. This paper

addresses the compression package currently deployed at each location, conversion costs (cost of software, number of applications to convert), economies of scale in a common environment, and reduction in costs due to discounts for additional licenses of the chosen product.

With changes in technology, computers are becoming bigger and faster. At a certain point, companies could cost justify the acquisition of a larger computer to replace one or more existing computers. This paper makes no assumptions about the replacement and/or consolidation of computers in Ameritech or a BOC. A consolidation could reduce the number of licenses or it could increase costs due to licensing the product for a bigger computer.

It is further assumed in this justification that the common data compression package will be licensed only on those computers that currently have a data compression package on them. For the development of conversion costs, the applications systems and data bases currently being compressed will be converted to the common data compression package. The savings that could be gained by converting existing data bases that are not currently being compressed will not be addressed in this paper. These savings could be realized through the use of any of the products used by the BOCs today.

ANALYSIS OF THE PROBLEM

The following issues need to be addressed to determine which selection would be best for Ameritech. The decision should deal with the people who are involved and the organizations that will be impacted by the decision. The financial considerations are always a major item in a decision of this magnitude. The technological issues are also a major factor in which package should be selected.

Human Issues

Although AAT had been formed to reduce costs by eliminating duplication among the BOCs, the employees were still being compensated based on the performance of the operating company of the state in which they were located. The AAT employees were being directed to make decisions based on the good of Ameritech as a whole but their bonuses were based on the outcome of their home companies.

This made deciding which software packages should be used on all Ameritech computers and which state should do the development of common systems very difficult. There was much pressure on members of each branch to select alternatives that the branch was familiar with and that would favor their own branch. Decisions were being made that could cause a branch to acquire additional software

and undertake costly conversions to use the standard package. This ultimately affected the profitability of the BOC and had a direct relationship on the amount of the bonuses awarded to members of that BOC and, therefore, the members of AAT who worked in that state. Decisions that could have such an impact were side-tracked by members of those branches even if, from an Ameritech perspective, the decision was the correct one.

It was difficult to admit that the "best" software package for Ameritech's use was not the same software package that had been selected and was being used by one's own branch. It was also difficult for a technician to select a package used by another company because it was likely that a coworker's or one's own job could be lost because the group had selected some package that others were more familiar with, causing the work to be shifted to another branch.

There were morale problems that would have to be dealt with. A technician working in a branch that was not selected to be responsible for that particular specialty would have to be prepared for the eventual elimination of that job in the branch. Career counseling would have to be done to determine whether the employee would be interested in jobs related to specialties of that branch. Alternatives would be to find employment in that technical area at another company or accept a transfer within the company to a position where the company had an opening. This usually

meant moving into a new technology area and changing one's career. This was a situation that most people, and especially technicians, did not look forward to.

Selection of the local company's product would ensure that the branch could supply the technical expertise required to deploy the technology throughout the region. When a company is in the process of eliminating duplication, the need for each organization to lay claim to the largest number of jobs possible becomes critical to the morale of the organization.

These were issues that were being worked on at a corporate level because these were not unique to the selection of a common compression package. Plans were taking place to shift people into careers and areas of the branches that were being emphasized based on the selection as the branch for the technology.

Organizational Issues

There was quite a bit of maneuvering done in order to have a branch selected as the technology specialist for each technology area. Because each of the BOCs had experience with large International Business Machines (IBM) mainframe and compatible computers, each branch claimed varying degrees of skill level in the many technology areas. Each branch had organizations in place to perform basically the same functions. In order to lay claim to the largest numbers of jobs, the head of each technology branch attempted

to develop a business case for why that branch ought to be the specialists in that technology. The five leaders of the technology groups were somehow able to designate a branch as being responsible for defining the AOE in each of the technology areas.

The technical specialists realized that Ameritech had a limited number of technology areas to be distributed to each branch and that many, if not most, of the jobs were duplicated in each branch. They also realized that the branch with the most expertise in a technology was not always the one selected to become the specialist branch for that technology for Ameritech. The five leaders designated branches to become the technology specialists based on the branch's experience level in the technology and the number of jobs projected for each branch. It was not in the company's best interests to target for elimination the majority of the technical jobs within a branch.

To the credit of the people involved, once a branch was selected to be the specialty branch in a technology area, the members of the other branches provided help and advice to the specialist branch. Some people referred to the help and advice from other branches as lobbying to ensure that their branch did not incur any excess conversion costs due to the decisions of the technology specialists, but, for the most part, the assistance was constructive and helpful.

If a decision was made to allow each of the BOCs to control which compression package to use, AAT must develop and

maintain expertise in each of the three packages in use. In addition to the system programmers who are needed to install the compression package and associated maintenance releases, members of the data base administration groups (DBAs) and application installers would be required to install each release of application software in a different manner for each company, whether or not the application system was developed by AT&T or AAT or BellCore. With the differences in compression routines in use, each installation of the system would be somewhat different and tailored to the technical environment of that company. This is contrary to the goal of the company to standardize rather than customize.

If a single package was selected and deployed on all major mainframe computers as part of the SOE, then the system programmers could work through the installation process once and use that experience to simplify and streamline the installation process on the remaining computers. They would be able to migrate the installed data sets to subsequent machines. They would be able to verify the installation process in a specialized environment and not impact important production work during the verification process.

The DBAs and application installers would be able to install each application release in a similar manner for all BOCs. The number of times problems are encountered should decrease because the environments are nearly identi-

cal. This standardization should result in an organization of fewer people. The same organization could handle the installation process for all five BOCs instead of having similar organizations in each BOC.

In addition the people could receive training once and be able to apply that knowledge to all computer sites. If each company had different packages, then training would be required on each of the packages before a person would have the ability to work on all computer sites.

Financial Issues

If the choice were made to allow each operating company to maintain the software that they have today, then no acquisition or conversion costs would be incurred. However, if this approach is extrapolated to all the other technology areas, then Ameritech will have what they have today, diverse technological sites that cannot be combined and no common technological platform on which common system developers can base their decisions.

Common system developers would have to customize their systems for each company. This undermines the purpose of having common systems. The developers would have to be aware of the technologies and the use of those technologies in each company and take each situation into account when developing their systems. A common technology platform alleviates this requirement from the developers and the installers of the systems.

As mentioned above, if a compression package was selected to be the SOE compression package, then several of the companies would need to acquire the common package and convert to it. All of the packages were in the same price range so none of them could be selected based strictly on price. See Table 1 for single computer licensing costs for each package. Annual maintenance fees are standard throughout the industry at twenty per cent of the purchase price beginning a year after purchase.

A major consideration in selecting a common package is the number of licenses that Ameritech had acquired to use the package. Mainframe computer software packages are generally acquired with the ability to execute the software on a single machine. Additional payments would be required to execute the software on other machines, generally at a discount from the cost of the first license. The discount would apply only to other machines at the same location as the first machine. Site licensing is not available for these software packages. Fees for subsequent licenses at the same location are also listed in Table 1.

Table 1. Licensing cost comparisons.

Compression Package	Single CPU License Fee	Subsequent CPU License Fee
Shrink/IMS	$25,000	$17,500
DataPacker/IMS	$15,500	$10,000
COM-PRES/IMS	$19,900	$14,900

COM-PRES had been purchased by Wisconsin Bell for both of their computers in 1987. DataPacker had been licensed for twelve of Illinois Bell's computers in 1988. Shrink had been deployed on both of Indiana Bell's computers since 1985, two of Ohio Bell's computers since 1986 and two of Michigan Bell's computers since 1985.

Conversion costs are directly related to the number of data bases currently being compressed and the number of application systems making use of compression on their data bases. Table 2 shows the number of application systems and data bases that made use of compression in the BOCs.

Table 2. Compression use in the BOCs.

BOC	Number of Applications	Number of Data Bases
Ohio	5	10
Michigan	2	6
Illinois	8	40
Indiana	5	10
Wisconsin	8	52

Technological Issues

Computerworld magazine, a weekly publication of Information System Management issues, uses the following areas to rate software packages: performance, diagnostics, statistics, compatibility, ease of use, support, and documentation. Statistics is not an area that is applicable to data compression packages. These packages do not produce statistical information regarding their performance because there is no direct method provided for that to be done. BMC Software and Informatics have developed additional programs that provide information on the performance of their packages. Therefore this category falls into the performance area for rating data compression packages. Compatibility and ease of use and support and documentation are grouped together in the following evaluation of the software packages, because these areas are so closely related.

Performance   When trialed by Illinois Bell in 1988,
Shrink, Com-PRES, and DataPacker obtained consistent com-
pression rates.   See Table 3 for a comparison of compres-
sion rates.   These rates represent the average amount of
data that was compressed from several of the data bases
used during the trial.   The Data Packer and Shrink packages
place some verification information at the tail end of each
compressed segment to ensure proper expansion and prevent
double compression.   This allowed COM-PRES to have a slight
advantage in its compression rates.   If one was able to
place a value on the peace of mind that the verification
feature provided, this category would be rated even among
the competing packages.

Many types of data compression algorithms are available.
The major types of data compression are textual (character
or string) substitution, Huffman encoding, and arithmetic
techniques.   Many variations of these algorithms are in
commercial use today (Shearer, 1991).   All three packages
contained several options in how they were deployed.   With
some front-end investigation to determine the number of
occurrences of the most popular phrases, such as "Wisconsin
Bell" or "Current charges," the packages could be tailored
to compress those phrases that occurred most often into the
smallest strings, thus achieving higher rates of compres-
sion over the standard method.   The string compression rate
achieved by the packages during the trial is also shown in
Table 3.

Table 3. Data compression rates.

Package	Standard Compression Rate	String Compression Rate
Shrink/IMS	53%	63%
DataPacker/IMS	55%	65%
Com-PRESS/IMS	55%	65%

This string compression feature requires externally built tables to perform segment compression and expansion. These tables must be linked into the data base definition. These tables must be carefully maintained and controlled. The loss of a single table could cause the entire system to be rendered inaccessible.

Because phrases change fairly often and because of the relatively high probability that the implementation of a single maintenance request could cause major problems in decoding the data, it was determined that the easiest, simplest, most straightforward method of deploying the software would be used. Standard deployment of the products (character compression) results in a type of textual substitution by removing blanks and repeating characters plus the compression of the remaining data with proprietary algorithms (Database Technology Corporation, 1984).

The tradeoff for data compression is the reduction in the amounts of data that needs to be stored versus the computer cycles required to compress and expand the data base segments. The hope is that the overall computer cycles used to compress and expand the data base segments are more than offset by the reduction in the number of input/output operations (I/Os) needed to retrieve or store the data (BMC Software, Inc, 1988). Because I/Os are hundreds of times slower than computer cycles, the use of compression packages can reduce overall processing time as well as reduce the direct access storage costs.

During the Illinois Bell trial, the amount of CPU time used by each of the packages was more than offset by the savings in I/Os due to the reduction in storage. There was very little difference in the amount of CPU time used by each of the packages. The difference was negligible and no package had an advantage over the others in this area.

Compatibility and Ease of Use   Each of the three software packages was compatible with the existing environments and they also could coexist within the same IMS environments. A data base could have one part of the data base compressed with one software product and another part compressed with another. This allows several alternatives to be examined with respect to the conversion to the selected software package.

From the standpoint of a developer, they would not even

realize that their data was being compressed. The compression package would expand the data into the same format as was used when the data was last inserted. For the DBA, IMS provides a system exit where the compression routine name can be specified. Each of the products under consideration used the standard exit point.

The amount of involvement from system programmers during installation is a major factor in the selection of a software package. If the installation of new releases is not straightforward, there tend to be problems that require even more time from the installers during the release installation process. Each of the three packages had similar installation instructions and had a fairly straightforward installation process. None of the packages had an advantage over another in this area.

The number of releases of application software per year really affects only the "do nothing" alternative. Under this scenario additional hours would be involved in the installation of each application release to tailor the installation instructions as it pertains to the compression package used by each company.

<u>Support and documentation</u> The number of releases of vendor software per year was not a major technology issue. It is desirable to have one or two releases of vendor software each year so that the package takes advantage of any new hardware or software facilities. The technology spe-

cialists would prefer that the vendors of software packages keep up with the technology that is available in the marketplace and occasionally supply additional facilities and capabilities. In other words, the vendor should be upgrading the product by supplying enhancements that make it easier to use. On the other hand, it is not desirable to have "too many" releases of software each year. This tends to indicate problems with the software. It also involves the technical specialists in too many upgrades to the software. In this instance each of the three packages was fairly stable and the vendor had been providing a single release of software per year.

The strength of the vendor's product line is one of the major considerations in the selection of a common package. If a vendor has many other products that are being used by a company, it makes sense to continue to do business with an existing, valued supplier. If a vendor offers a single product and relies on it for the majority of its revenues, discounts and package deals might be harder to negotiate. The stability and longevity of a single-product vendor might also be questioned.

BMC Software had the advantage over the other companies in this area. They provided Ameritech companies with other very useful data base products. They provided excellent support and had a good reputation. They also offered data compression packages for three other data base management systems used within Ameritech, so the potential for using

the more products from this company was high. Informatics was mainly a data compression company. They offered products to compress data in all the major data base management systems but offered only a few, minor products outside this technology. Data Base Technology offered only this single major product. The Ameritech companies did not use any of the other products from either of these two companies.

All three companies provided excellent documentation and support to their products. Their manuals were easy to read and understand. Their installation instructions were clear and they offered a toll-free, 24 hour telephone number through which they could be contacted with problems.

POTENTIAL SOLUTIONS

There are at least five potential solutions to the prob-
lem of selecting a common data compression package for
Ameritech. The first alternative is to do nothing. The
BOCs would continue to use the products that have been
deployed in each company. Alternatives two, three, and
four result from the selection of any one of the three
products already in use in the BOCs. Acquisition and con-
version costs would be the main difference among these
three alternatives. The final alternative is for an Ameri-
tech organization to write a set of programs that compress
segments for IMS data bases. This would eliminate any
acquisition costs. Following is a detailed discussion of
each alternative.

Alternative One

The first alternative is to keep the status quo. The
BOCs would continue to use the products that had already
been deployed. This alternative does not lend itself to a
reduction in staff, to a reduction in overall costs, to
standardization of methods, or to a consolidation of orga-
nizations. It would not follow the Ameritech statement of
direction regarding standard operating environments. In
fact, over the long run, costs for the additional people

and additional time and expertise required to maintain the environment would be higher than other alternatives.

In contrast to the deployment of a common package, there would be a need to retain the equivalent of one-half of one additional IMS system programmer in the IMS technology specialization group to install new releases of the three software packages, apply fixes to the software, maintain contact with the vendors, coordinate the application conversions to the new software releases, and deploy tested and packaged libraries to the BOCs. The equivalent of one-half of one additional system programmer would be needed to install the packaged libraries on the BOC computers. The equivalent of one DBA and one application installer would be needed in each BOC for every eight major applications to test application software against new releases of the data compression software, perform application conversions and tailor the installation instructions to the compression package being used in each location. There are 15 major applications in each BOC.

This can be summarized to one system programmer for all of Ameritech plus two DBAs and two application installers for each of the five BOCs. At a fully loaded cost of $65,000 per year, these 21 people amount to a cost of $1,365,000 per year.

Alternative Two

The second alternative is to choose the product that has been licensed to the largest number of computers within Ameritech, DataPacker/IMS. This would reduce the costs of acquisition because the smallest number of computers would need to be licensed with the common data compression product. In examining the factors involved in comparing software packages, the competing products and companies were evenly matched in most areas. The critical factor in choosing a product that is currently used in Ameritech is the cost of acquisitions and conversions.

If DataPacker was chosen as the AOE data compression package, Illinois Bell would have no acquisition or conversion costs. Wisconsin Bell would acquire the product for its two computers, which happen to be at separate locations, for $30,500. Michigan Bell and Ohio Bell also have two computers at different locations that are licensed for data compression. Because Indiana Bell's computers are co-located, they would be able to take advantage of the site discount and be charged $25,500 for acquisition costs.

Conversion costs are related to the number of applications using data compression and the number of data bases that need to be converted. For each application, a DBA would meet with two application installers to discuss the conversion, the benefits, the assignment of responsibilities, and the timing of the conversion on the test system, the training system, and the production system.

For each application to be converted, there would be 40 hours of preparatory work to be performed by the DBA and 16 hours of work for the application installer. The DBA would have eight additional hours of preparatory work for each data base to be converted.

Each major system (and all of those involved in these conversions for data compressions) has a testing system for the application installers to install new releases of the application software for verification of functionality, a training system in which users may be trained on the operation of the system, and a production system. During the actual conversions, there would be eight hours of work for the DBA for every 10 data bases (or each application, whichever is less) to ensure the timing and execution of the conversion jobs. This would apply to each of the three conversions for a system. During the training and production system conversions, there would be eight hours of work for the application installer and a user of the system to verify that the application system still performs correctly. Total conversion hours for this alternative are shown in Table 4.

The DBA Prep Hours is developed by multiplying the number of application systems to be converted for that company (Table 2) by the 40 hours of preparatory work and adding the number of data bases to be converted multiplied by the eight hours of preparation for each of these. The Appl Prep Hours comes from multiplying the number of application

systems to be converted by the 16 hours of preparation. The DBA Conv Hours is developed by multiplying the number of conversions (three for each application system) by the eight hours of conversion work. The Appl Conv Hours and the User Conv Hours represent the eight hours of conversion work that these groups must do for the training and production systems. Total Hours represent the sum of the columns in each row.

Using the acquisition costs described above and a standard hourly rate of $40 per hour, the total acquisition and conversion costs are $249,560 for this alternative. Additional ongoing maintenance costs of $23,400 starting the second year would be offset by the discontinuance of maintenance fees of $36,460 for the products being replaced. Total costs associated with this alternative are shown in Table 5.

Acq Costs represents the cost of acquiring the standard compression package for the computers in that BOC. Conv Costs are those costs associated with converting to the standard package. Add'l Maint is the additional maintenance costs that will be incurred. Disc Maint is the maintenance costs that will be discontinued following the conversion to the standard package. One-time Costs represent the sum of the acquisition and conversion costs.

Table 4. Alternative two conversion hours.

	DBA Prep Hours	Appl Prep Hours	DBA Conv Hours	Appl Conv Hours	User Conv Hours	Total Hours
BOC						
Ohio	280	80	120	80	80	740
Michigan	128	32	48	32	32	272
Illinois	0	0	0	0	0	0
Indiana	280	80	120	80	80	740
Wisconsin	736	128	192	128	128	1312

Table 5. Alternative two costs.

BOC	Acq Costs	Conv Costs	Add'l Maint	Disc Maint	One-time Costs
Ohio	30,500	29,600	6,100	10,000	70,100
Michigan	30,500	10,800	6,100	10,000	41,380
Illinois	0	0	0	0	0
Indiana	25,500	29,600	5,100	8,500	55,100
Wisconsin	30,500	52,480	6,100	7,960	82,980
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	117,000	122,480	23,400	36,460	249,560

Alternative Three

The third alternative is to choose the product installed in the highest number of BOCs, Shrink/IMS. Ameritech would have the most experience with this product throughout the company. The company could draw upon this wide base of experience to assist in the conversions and in the development of plans for the use of the technology.

If Shrink was chosen as the AOE data compression package, Michigan Bell, Ohio Bell, and Indiana Bell would have no acquisition or conversion costs. Wisconsin Bell would acquire the product for its two sites for $50,000 and Illinois Bell, with its twelve computers at three locations, would pay $77,500 for each location for a total of $232,500. Conversion hours would follow the same parameters as described in alternative two. These hours are shown in Table 6.

Using the acquisition costs described above and a standard hourly rate of $40 per hour, the total acquisition and conversion costs are $383,620 for this alternative. Additional ongoing maintenance costs of $56,500 starting the second year would be partially offset by the discontinuance of maintenance fees of $29,260 for the products being replaced. Total costs associated with this alternative are shown in Table 7.

Table 6. Alternative three conversion hours.

BOC	DBA Prep Hours	Appl Prep Hours	DBA Conv Hours	Appl Conv Hours	User Conv Hours	Total Hours
Ohio	0	0	0	0	0	0
Michigan	0	0	0	0	0	0
Illinois	640	128	192	128	128	1216
Indiana	0	0	0	0	0	0
Wisconsin	736	128	192	128	128	1312

Table 7. Alternative three costs.

BOC	Acq Costs	Conv Costs	Add'l Maint	Disc Maint	One-time Costs
Ohio	0	0	0	0	0
Michigan	0	0	0	0	0
Illinois	232,500	48,640	46,500	21,300	281,140
Indiana	0	0	0	0	0
Wisconsin	50,000	52,480	10,000	7,960	102,480
	282,500	101,120	56,500	29,260	383,620

Alternative Four

The fourth alternative is to choose the product that has been deployed on the highest number of data bases in the company, COM-PRES/IMS. This would tend to minimize the conversion costs but would result in the highest acquisition costs in this instance.

If COM-PRES was chosen as the AOE data compression package, Wisconsin Bell would have no acquisition or conversion costs. Michigan Bell and Ohio Bell would have acquisition costs of $39,800 each. Illinois Bell would pay $149,100 to license the product on its computers. Indiana Bell, with its discount, would pay licensing costs of $34,800.

Using the acquisition costs described above and a standard hourly rate of $40 per hour, the total acquisition and conversion costs are $484,720 for this alternative. Additional ongoing maintenance costs of $52,700 starting the second year would be offset by the discontinuance of maintenance fees of $49,800 for the products being replaced. Total costs associated with this alternative are shown in Table 7.

Table 8. Alternative four conversion hours.

BOC	DBA Prep Hours	Appl Prep Hours	DBA Conv Hours	Appl Conv Hours	User Conv Hours	Total Hours
Ohio	280	80	120	80	80	740
Michigan	128	32	48	32	· 32	272
Illinois	640	128	192	128	128	1216
Indiana	280	80	120	80	80	740
Wisconsin	0	0	0	0	0	0

Table 9. Alternative four costs.

BOC	Acq Costs	Conv Costs	Add'l Maint	Disc Maint	One-time Costs
Ohio	39,800	29,600	7,960	10,000	87,360
Michigan	39,800	10,880	7,960	10,000	68,640
Illinois	149,100	48,640	29,820	21,300	248,860
Indiana	34,800	29,600	6,960	8,500	79,860
Wisconsin	0	0	0	0	0
	263,500	118,720	52,700	49,800	484,720

Alternative Five

The fifth alternative is for Ameritech to write and maintain their own data compression routines. This would minimize out-of-pocket expenses for software acquisition.

In-depth technical knowledge about the theory of compression would be required for this project. It was estimated that a project to develop a product of this kind would take two data base analysts one year to produce. Although Ameritech had several experienced DBAs who could write a compression routine, none of them had the in-depth knowledge of data compression needed to write a set of modules that could match the compression rates achieved by the vendors' packages.

The company could hire a member of a software vendor's development staff to work with a member of the DBA staff to develop the routines. There are several drawbacks to this approach. It would take a high salary to lure a person of this caliber from a vendor's company. It would be quite difficult to determine that the company is getting what it is paying for in hiring this type of person. In other words, how does one verify the skill level before the person is hired. After the completion of this project it might be difficult to provide challenging work assignments to a person as technical as this.

As an alternative, a contract programmer or college professor with the skills needed could be hired to develop the software. At best, Ameritech would end up with a product

just as good as a vendor's product but would have ongoing maintenance responsibilities assigned to a very experienced DBA.

Even though the acquisition costs are not incurred with this alternative, development costs for two technicians for a year at $65,000 per year in fully loaded costs would amount to $130,000. These development costs would be allocated to each BOC based on the percentage of revenue generated for Ameritech. This is Ameritech's usual common cost allocation procedure. These percentages are shown in Table 10. The BOCs would still need to undertake the conversions to implement the software. Conversion hours for this alternative are shown in Table 11. Total costs associated with this alternative are shown in Table 12.

Table 10. Common cost allocation percentages.

BOC	Percentage of Costs
Ohio	20.19
Michigan	28.08
Illinois	30.32
Indiana	10.81
Wisconsin	10.60

Due to the critical nature of the compression software to the operation of the company, very thorough testing of the software would be necessary. With several releases of IMS software received each year, it would be necessary to assign one full-time data compression expert to test and maintain the software. It would be necessary to train and develop at least one person to provide part-time back-up to the expert due to the importance of the product.

The fully loaded costs of a single person to maintain the software is more than the ongoing maintenance costs of any of the data compression packages. For this reason Ameritech has determined that vendor provided software is justifiable over the short term because of the need to retain experienced technicians in a position to maintain the "home grown" software. It was found that technicians were not particularly fond of software maintenance and it seemed to stifle career moves because of the need for an experienced person to replace the person leaving. It also did not allow the company to consolidate as fast as it would like. For these reasons the company and the technical specialists favored a vendor software solution.

Table 11. Alternative five conversion hours.

BOC	DBA Prep Hours	Appl Prep Hours	DBA Conv Hours	Appl Conv Hours	User Conv Hours	Total Hours
Ohio	280	80	120	80	80	740
Michigan	128	32	48	32	32	272
Illinois	640	128	192	128	128	1216
Indiana	280	80	120	80	80	740
Wisconsin	736	128	192	128	128	1312

Table 12. Alternative five costs.

BOC	Devel Costs	Conv Costs	Add'l Maint	Disc Maint	One-Time Costs
Ohio	26,247	29,600	13,124	10,000	55,847
Michigan	36,504	10,880	18,252	10,000	47,384
Illinois	39,416	48,640	19,708	21,300	88,056
Indiana	14,053	29,600	7,026	8,500	43,653
Wisconsin	13,780	52,480	6,890	7,960	66,260
	130,000	171,200	65,000	57,760	301,200

CONCLUSION

There are several issues that Ameritech needs to address at a corporate level that will enable this and other standardization efforts to be implemented faster and smoother. Obviously, the selection of any of these alternatives does not address the organizational and human issues related to the redeployment of people into the specialist areas of the branch. This redeployment needs to be done gradually as part of corporate direction such that the specialist group is able to take responsibility for support of the technology from a branch while the management of the branch implements plans for the redeployment of the people currently working in the technology area. It is very important that AAT provide the same level of support to the BOCs after the consolidation to prevent complaints about the diminished support and service that resulted from the consolidation. These activities need to be repeated during the consolidation of each of the specialist areas.

Plans should be made to develop more of a corporate view of the standardization and consolidation process. This could be encouraged by changing the method by which bonuses are calculated to incorporate a component based on the progress toward this strategic initiative. This component should be balanced by a component measuring the conti-

nued excellent service supplied to the BOCs. A corporate view could also be encouraged by establishing organizational groups based on function rather than location. These groups would develop a level of understanding of the operating companies' environments and would establish priorities based on the corporate perspective. The managers of these groups would be held accountable and responsible for maintaining the level of service while making progress toward standardization and consolidation.

As far as this particular case of standardization, Table 13 summarizes the costs associated with each alternative for the first and subsequent years. Alternative two, the selection of the software package already licensed on the most computers, has two financial advantages for Ameritech. The selection of DataPacker results in the lowest one-time costs (acquisition or development plus conversion). It also results in a net saving in ongoing maintenance costs starting in the second year. The selection of a vendor package allows Ameritech to start the standardization process almost immediately, rather than waiting for the development of it.

The selection of DataPacker results in a saving of $51,640 over the development of an in-house compression routine, $134,060 over the selection of Shrink and $235,160 over the selection of COM-PRES. The extremely high costs associated with retaining three different software packages are mainly people-related costs.

Table 13. Summary of costs.

Alternative	Year 1 Costs	Year 2 Costs		Year n Costs
1 Do Nothing	1,365,000	1,365,000	...	1,365,000
2 DataPacker/IMS	249,560	-13,060	...	-13,060
3 Shrink/IMS	383,620	27,240	...	27,240
4 Com-PRESS/IMS	484,720	2,900	...	2,900
5 Develop It	301,200	7,240	...	7,240

From a technological standpoint, the BMC Software product offers very good rates of data compression and excellent support. The company supplies many other software products to the company in the data base management system area. The potential for acquiring more products from this company in the future was quite high. From this standpoint, the DataPacker acquisition made sense as well.

The IMS technology specialists should immediately obtain concurrence of the selection of DataPacker as the AOE data compression package and have this officially published in the Ameritech Standard Operating Environment document. They should form a team with representatives from each branch to develop plans for the acquisition, deployment, and conversion to the standard package. The technology specialists should obtain commitments on resources and time

frames as to when the conversions could take place. The team members should be informed of the necessity of careful planning and execution so as not to cause unnecessary outages to the production systems. Members of the team would be empowered to undertake conversions when convenient for themselves and their user groups. Managers of the IMS technology groups would be responsible for making plans for the redeployment of people without lowering the level of service supplied to the BOCs.

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