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Microcomputer Applications in Railroad Operations

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Railroad officials in North America are using microcomputers more frequently to complement the capabilities of their more formal computer systems. Applications range from simple word processing to complex modeling and real-time control. Within many railroads, however, serious debates address the need for microcomputers, the types of applications that are appropriate, the integrity of their data bases, and other important issues. Nevertheless, the rapid evolution of computer technology will provide a powerful impetus for railroads to install microcomputers or computer networks that give employees access to the kinds of flexible, powerful software that are now available for microcomputers.

Microcomputers and microcomputer applications are becoming more common within the U.S. rail industry. Applications range from simple word processing and filing to complex operations planning models. The power of the widely available software is a great attraction to managers and planners at all levels of the organizations. The impetus for acquiring microcomputers has generally come from mid-level managers and planners who see the microcomputer as a welcome alternative to the difficulties and frustrations of working with their railroad's management information systems (MIS) department. In a number of cases individuals acquired their own microcomputers, used them for company business, and eventually convinced the railroad to acquire additional microcomputers.

No consensus exists, however, concerning the value or appropriateness of microcomputers within the rail industry. Railroads, which have long been leading industrial users of computers, do not view microcomputers as providing an increase in computing power. Some MIS departments view microcomputers as a threat to the integrity of their company's information systems or a costly means of providing distributed computing capabilities.

In this paper various ways that railroads have used microcomputers are summarized and a number of issues that will determine the extent to which the use of microcomputers is likely to spread throughout the industry are identified. Because of the rapid rate of change in this field, the published literature alone cannot be used for a review of the state of the art. The information in this paper, therefore, is drawn from numerous informal conversations with railroad officials, most of whom shall remain anonymous. Although the debate over the role of microcomputers is still raging, identification of the issues is more important than identification of the protagonists.

Much of the information concerning applications has been obtained as a result of participation in various research projects sponsored by the freight car management program (FCMP) of the Association of American Railroads (AAR) (1,2). In particular, the Massachusetts Institute of Technology (MIT) rail group designed the MIT service planning model (SPM) to illustrate techniques of operations and service planning in cooperation with the Boston and Maine Corporation (3) and the Santa Fe System (4). To promote the use of this model by other railroads, FCMP provided support for MIT to (a) reprogram it for a microcomputer, (b) promote its transfer to individual railroads, and (c) provide support services to an SPM users' group. By the end of 1982 SPM had been acquired by six U.S. railroads [Boston and Maine; Burlington Northern; Consolidated Rail Corporation (Conrail); Illinois Central Gulf Railroad Corporation; Chicago, Milwaukee, St. Paul, and Pacific Railroad Company (Milwaukee Road); and Southern Pacific Transportation Company] plus the Spanish National Railroads (5). In addition many other railroads [including Delaware and Hudson Railway Company, Maine Central Railroad Company, Chessie System, Seaboard System Railroad (Family Lines), Chicago and Northwestern Transportation Company, Missouri Pacific Railroad Company, Santa Fe, Union Pacific Railroad, Soo Line Railroad Company, Grand Trunk Western Railroad Company, Elgin Joliet and Eastern Railway Company, and Canadian National Railways plus several foreign railroads] made inquiries concerning SPM, which inevitably led to discussions

of microcomputers. As a result of this experience an intimate perspective was obtained on the rail industry's use of and attitudes concerning microcomputers, as reflected in the remaining sections of this paper.

APPLICATIONS

Railroads use microcomputers for a wide variety of applications, ranging from the simple to the complex. These applications can be grouped into the categories listed in the following paragraphs:

1. Word processing,
2. Budgeting,
3. Filing and data base management,
4. Report preparation,
5. Analysis by using commercially available software,
6. Modeling, and
7. Real-time control.

Word Processing

Anyone who has access to a microcomputer eventually uses it for some kind of word processing, either for the preparation of simple memos or the preparation of complex reports. For an example specifically related to transportation, Boston and Maine's transportation department produces its weekly bulletins of train schedules and crew assignments on an Apple 2. In some specialized cases people have used microcomputers for all their word processing, thereby eliminating the need for secretarial services. For example, to provide support service for the SPM users' group MIT has relied on an Apple 2 to produce the SPM Users' Guide, a Teaching Guide, periodic newsletters, minutes of meetings, and technical memos. Unlike railroads' word-processing facilities, which improved the productivity of secretarial staff, microcomputers obtained for other purposes are often also used for typing of the first draft of memos or reports, bypassing secretaries altogether.

Budgeting

Almost all railroads have well-established budgeting systems; therefore, a railroad is unlikely to obtain its first microcomputers specifically to assist in budgeting. Nevertheless, any manager who has access to a microcomputer quickly learns about the wonders of Visicalc, Plan 80, and similar packages. Boston and Maine's transportation department used Visicalc for preparing the 1982 budgets for the department, for its two regional divisions, and the East Deerfield yard. Because of the success in using Visicalc for budgeting at headquarters, Boston and Maine obtained microcomputers for budgeting at the divisional offices (6). Others have used Visicalc for developing budgets for special projects or for estimating budgetary expenses for small groups.

Filing and Data Base Management

Like other businesses that use microcomputers, railroads have used the various commercially available routines for creating and accessing files. In addition to the typical applications for mailing lists and personnel records, railroads have used programs such as DBMaster to create files of train delays, collective bargaining issues, and inventories of spare parts or stores. Chessie uses a data base program to provide information to salespeople and assistant managers in forecasting sales. As with word processing and budgeting, the data base capabilities of microcomputers are unlikely to cause senior management of a railroad to buy a microcomputer, but managers who have access to the microcomputer quickly find ways to use such capabilities.

Report Preparation

Managers can assemble information from various sources easily, edit this information, and produce reports that can be photocopied and distributed like any other computer report. The great advantage of using a microcomputer for report preparation is that the manager can create and modify a report without conferring with or waiting for the MIS department. The disadvantage is that the user, rather than the MIS department, must produce and distribute the reports. The Boston and Maine, as a result of a cooperative research program with FCMP (1) has used the microcomputer to produce a number of weekly reports, including

1. An operating and service plan report that summarizes car use performance, the variances from the car cost budget, trip times, and other key indicators of operating performance and service levels; and
2. A summary of weekly train performance and transportation expense that is used to structure the weekly conference call among senior transportation officers.

The railroads in the SPM users' group stated that the microcomputer was used more often for generating reports than for analysis. Managers frequently use graphics packages in preparing these reports and in making presentations to senior management.

Analysis Using Commerically Available Software

As with budgeting, railroad managers first turn to Visicalc, whose structure is perfect for the kinds of spread-sheet analysis commonly demanded of railroad and other business managers. Applications have been numerous, varied, and creative. In many cases, managers who have little or no computer background have, for the first time, used a computer to assist them in the analysis that is a routine part of their jobs. Access to a user-friendly environment eliminated the barriers to using the more powerful, but more imposing, computers that have been available for many years.

Modeling

The transfer of the MIT SPM to seven railroads and the establishment of an SPM users' group provide the best example of the railroad industry's use of microcomputers for modeling. SPM, which originally required 800K core storage in a Fortran version that ran on a mainframe computer, was revised and reprogrammed to run on an Apple 2. The Apple version of the model, although slower, was actually more powerful and much more flexible than the Fortran version--in large part because the limited storage capacity and the slower processing time of the microcomputer forced programmers to be more creative and to use modular design.

The ease of transferring the program was a key factor in the successful transfer of the model. The Association of American Railroads (AAR) and five of seven railroads acquired an Apple 2 system in order to obtain the SPM. Because all of these users had the same computer, support services could be provided efficiently. The model runs on a microcomputer; therefore, the planners and managers who acquire the model are able, on their own, to devote resources to running the model and avoid the inevi-

table delays that would ensue if the model were transferred to the MIS departments for modifications to enable it to run on the railroads' mainframe computers.

Other models have also been developed for microcomputers. For example, the Soo Line developed a simulation model for estimating fuel consumption of freight trains (7) and Missouri Pacific developed a model for unit train costing (8). In many cases analysts or managers have bought microcomputers with their own money, then used their spare time to develop programs. The impetus for microcomputer models seems to come from younger managers and analysts; individual railroads do not seem to have made any special commitment to the development of models for use on microcomputers.

At the industry level the story is considerably different. AAR has considered preparing microcomputer versions of various models of track and train dynamics that have been developed during the course of a multiyear research program. As was the case with SPM, the microcomputer offers smoother transfer and greater use of models developed for the industry with support from AAR.

Real-Time Control

Canadian National has used microcomputers in real-time control in some of its maintenance shops, in some cases building its own microcomputers to serve the exact requirements of a particular situation.

Unresolved Issues

Despite the rapid growth in the number of microcomputers in use and the wide variety of applications, the extent of use, how soon, and under what conditions the microcomputer will be accepted by the rail industry are still unclear. At least two railroads (the Boston and Maine and the Canadian National) have welcomed the use of microcomputers and have people in many departments who use them for most of the applications described. Other railroads, such as the Southern Pacific and the Burlington Northern, have approved the acquisition of microcomputers for specific applications, such as being able to run the SPM, but have not encouraged their proliferation. Still others actively discourage or even prohibit the acquisition and use of microcomputers.

Concerns about microcomputers fall into several categories. Senior officials in MIS departments initially seem ill-disposed to consider the acquisition and use of computers that are viewed as small, slow, expensive, and unnecessary additions to their computing capacity. They also raise the issues of the integrity of the company's data base (different people will create different and conflicting data bases that are no longer accessible through the company) and the confidentiality of data that reside on floppy disks scattered across desks in dozens of open offices. People outside the MIS departments, however, look behind these rational reasons and perceive a reluctance to reduce the MIS department's power over information and computation. From this perspective, microcomputers offer the individual an opportunity to bypass the delays and inefficiency of dealing with a bureaucracy in order to produce a new report or to do some analysis.

Many senior officials regard microcomputers as toys that cannot possibly have any benefits to a serious organization. The majority of people who inquired about SPM said that their chances of acquiring it would be better if it ran on a mainframe rather than on a microcomputer. For example, to the senior management of the Spanish National Railroad the status and credibility of the model were lowered greatly because it ran on a microcomputer. In a similar vein, a number of professors working on transportation problems at MIT, Princeton, and elsewhere perceive microcomputers as too small or too slow to provide a serious alternative to larger computers.

Despite the negative reactions to microcomputers, whether based on rational reasons or simply on a fear of losing power, microcomputers will inevitably be used more widely in the rail industry. Two inexorable trends will overcome any resistance that can be offered by either senior managers or the MIS departments. First of all, the price of microcomputers is well within the means of college graduates who take entry-level positions in management and planning. These college graduates will increasingly have experience in using computers of all kinds and will be willing to purchase their own machines even if their employers are not. Management will be unable to prevent people from purchasing and using their own computers, and managers who are illiterate in the use of computers will be bypassed by those who are literate. The second trend concerns the technological improvements in microcomputers, especially in their speed, storage capabilities, and ability to communicate with other computers (of all sizes) in a network. Microcomputers clearly will not be toys, but important components of a larger system. The distinction between a microcomputer and a computer terminal will become increasingly fuzzy. For major corporations such as railroads the logic for linking managers in some kind of computer network will become overwhelming.

If distributed processing is inevitable, and most managers acquire something that can function like an independent microcomputer or tie into a computer network, how such distributed processing will be achieved is still unclear. On some railroads individuals acquired microcomputers to demonstrate the benefits of particular types of programs (usually in budgeting or planning by using something like Visicalc). The response of some railroads to these successful microcomputer demonstrations was not to expand the use of microcomputers but to acquire programs for the mainframe that have similar flexibility but more speed and capacity. This suggests that the use of microcomputers may be a temporary strategy that forces MIS departments to become more responsive, more flexible, and less centralized.

Canadian National has taken a different approach. It established a separate group that has the responsibility for coordinating the acquisition of microcomputers and software, thereby providing individuals with some guidance in setting up their systems and giving the company the ability to deal with vendors on a centralized basis. A third approach may be that taken by the Boston and Maine, which has acquired Apple 2 computers for its major departments and is coordinating them closely with Delaware and Hudson and Maine Central, both of which also have Apple computers. By linking these existing microcomputers with modems, a group of mid-level managers are evolving a microcomputer network suited to their specific requirements.

The evolution of technology may render some of these issues moot. For example, Burlington Northern hosted the SPM users' group in January 1983 to demonstrate how they have linked three Apple 2 computers to their mainframe in order to reduce the time and effort of creating input files for running SPM. At the same time the users' group will be discussing how to modify the SPM so that it will be compatible with the future, more powerful microcomputers (by shifting from Apple Pascal to UCSD Pascal, the users' group expects the SPM to be able to run much faster without having to further modify

the program so that it could run on a mainframe computer system). In short, the distinction between the microcomputer and the mainframe, both in terms of technical capabilities and in terms of use, is declining.

CONCLUSIONS

The impetus to use microcomputers in the rail industry has largely come from individual managers and analysts who have either been frustrated by their MIS departments or intrigued by the capabilities of microcomputerss. Most major railroads now have at least one microcomputer and some have dozens, most of which are being used in a wide variety of applications. AAR has encouraged the use of microcomputers to facilitate the transfer of research techniques and models and has supported a users' group for a large, complex microcomputer model (SPM) that was transferred to six U.S. and one foreign railroad.

People have sought microcomputers because of their ease of use, the availability of software, and the ability to control the microcomputer for their own purposes. People who have never before used computers have learned to use programs for budgeting, data base management, and word processing. In many cases, after being exposed to microcomputers, people are anxious to use the more powerful computers available to all large railroads; i.e., the microcomputer seems to entice people into using computers.

Despite the widespread use of microcomputers, how railroads will make the transition from the centrally controlled mainframe computer to a flexible network of computers, jointly controlled by MIS departments and individual users, is still unclear. Current concerns about the proliferation of microcomputers are not likely to withstand the dual impact of continuing technological improvements and declining prices of microcomputers. People who want to use microcomputers will simply buy them, whatever the attitude of senior management.

The rail industry is unlikely to use a great number of stand-alone microcomputers. Instead, railroads will acquire networks, either of microcomputers or of intelligent computer terminals. As microcomputers become more and more powerful, the distinction will become less important. Microcomputers will continue to provide an impetus to railroads to improve their computing capabilities and to make flexible, powerful software available to those who need it.

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