Wisconsin's Computer System for Integrated Operations

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A principal reason for the Wisconsin Department of Transportation's leadership position is that it has developed computer applications in which over 1,000 computer procedures are presently in operation. Because of the large volume of work planned under the Integrated Operations System, the computer system of problem-solving is an absolute necessity. The computer planned for use is a multi-processor 360 model 65.

The system is represented graphically by a wheel. The spokes designate the major computer-based systems. The next portion, which is connected to the spokes, represents the various systems to be completed within each of the major systems. The external rim of the wheel designates the different data-based constants or controls that make possible the linking of the numerous subsystems. The wheel indicates the vast amount of varied information that can be supplied to management. This computer system makes it both feasible and possible in the future to correlate data within a single computer system. This is the most obvious and necessary use of the system, because it will give the user the data from many different subsystems in the most usable format, an important condition to the decision-making process.

•THE DEPARTMENT OF TRANSPORTATION is building its future around two basic philosophies: use of the systems approach, and utilization of automated equipment to modernize its organization. The systems approach is the technique used in planning for the Integrated Operations System (IOS). From the IOS came the computer-based Financial Operation System (FOS), the Highway Network Data and Information System (HNDI), and the Project Development System (PDS). The design, development, and implementation of these systems has been a long, sometimes frustrating, and sometimes gratifying experience. To those of us who have been developing these systems and to those who have been using them, it would seem that our systems have caused more problems than they have solved. We have all sometimes felt a desire to return to the "good old days".

Wisconsin, with its IOS and advanced use of data processing, is recognized as a leader in the field. What does this mean? It means that we have taken the initiative to develop new ways to solve problems. It means that we have learned by our mistakes. The type of frustration that we have all felt is that of challenge and not that of the "good old days". In the good old days the attitude was, "Well, that's the way it's always been done" or, "That's close enough for government work". I prefer the challenge of today.

We still have a long way to go before we can say that the job is done. When we consider advanced technology, we realize that we will never be completely caught up. The success of the systems approach has been not the computer programs or the new procedures, but the continuing development of the people involved, individually and collectively. We also have the knowledge gained by our experiences, which gives us the ability to do a better job today and prepares us for the problems of tomorrow. My evaluation of our systems approach is one used in the promotion of the state of Wisconsin: "We like it here".

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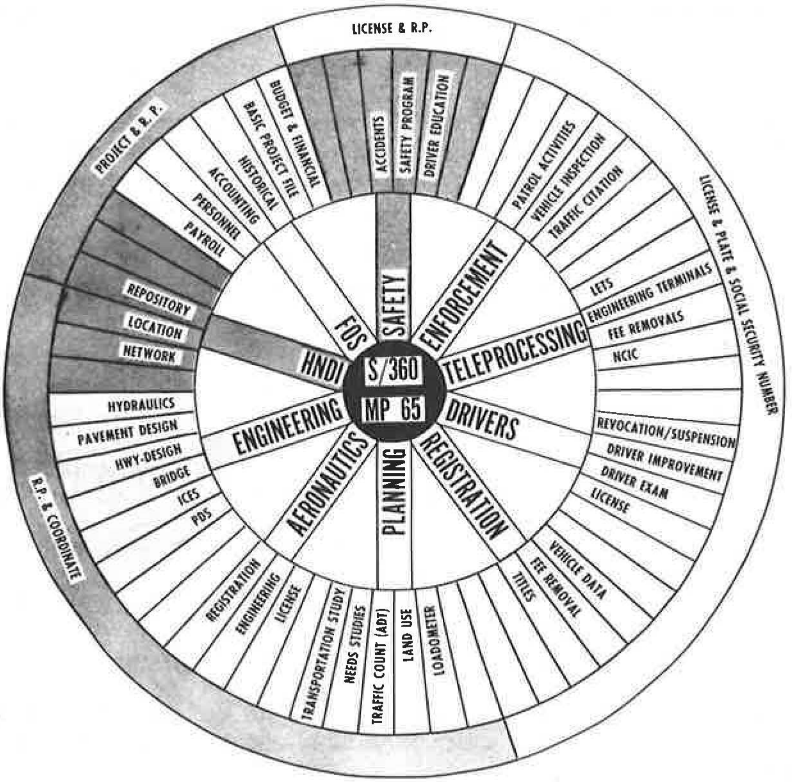

Figure 1. Wholly integrated transportation system.

The automated equipment we are using is not limited to the computer but includes new testing equipment and new survey equipment. One of the primary reasons we have realized the fullest benefit from use of the computer is that we have used the computer as a tool—a tool to assist and help man perform his tasks more efficiently.

INTEGRATED SYSTEM FOR TRANSPORTATION

A wheel best describes the overall concept of what we are doing and where we are going (Fig. 1). This concept shows that the Department of Transportation will have a uniform integrated data base system that will provide accurate, timely, and meaningful data that we can use to make decisions. This data base will be developed around the capabilities of an IBM system 360 multi-processor 65 (MP65). Thus, the computer is the hub of the wheel. The spokes of the wheel are the 10 major data processing systems defined for the department. Some of these systems have been very well defined, as in the case of FOS and HNDI. Others are, at this time, in various stages of development and will change as development continues. Some of the systems, like the FOS, are highly integrated while the engineering system can be best described as a series of individual or independent systems such as COGO and divided highway. As development continues, new spokes may be added or spokes may be deleted. The ideal system would eliminate as many unnecessary systems or procedures as possible.

The rim of the wheel designates the subsystems of each system. These subsystems are again divided into logical segments for development and implementation. For example, the accounting subsystem is divided into 15 procedures, each procedure being defined as a computer run that can contain a variable number of programs.

The tire of the wheel represents the data base constants, which are elements of the data that allow us to manipulate data within and among systems. These are the factors that hold the wheel together and allow us to correlate all information available concerning a particular problem.

The manipulation of data within a single system is not new, but the concept of having data from one system feed into another system is new. This means that one system, to operate, is dependent on another one. We still have a lot to learn and need new hardware and software to make this capability fully possible. We have, however, taken the "one small step for man" in this direction.

Let us take a look at how this concept may work in the near future. Suppose that we wanted to evaluate a specific section of highway to determine its relative safety. We would build a data model of that highway as follows:

1. Establishing the limits of our model by using the reference point system, we query the accident file of the safety system for all accidents in our model area.
2. From the planning system, we can get traffic volume and traffic characteristics data.
3. The accident data contains the driver's license number and vehicle plate number. This allows us to query the driver file to get the records of all drivers involved in the accidents.
4. Once we have the plate number, we can query the enforcement system, vehicle inspection file, and get vehicle inspection records.
5. Using the plate number, we can also query the registration file and get the records of the vehicles involved in the accident.
6. From the engineering system, we can get details on alignment and bridge characteristics.
7. Through the capabilities of the HNDI system, we can get details of the highway such as surface type, width and condition, width of shoulders, and other standard highway characteristics.

Once we have developed and tested our model we would then have a means to perform our analysis. We could change the traffic volume factor to see what effect this would have in conjunction with the other factors on the accident rate of this highway. By manipulating these factors, we could tell what best course of action could be taken to lower the accident rates. For example, we might find that increased driver training would do more to reduce accidents than reconstruction of a highway. Or, if large percentages of the vehicles involved failed to pass vehicle inspection tests, it means that more stringent vehicle inspection and enforcement would do more to prevent this type of accident. These types of analyses would then be the basis for developing a balanced program budget that would give us the greatest return for our investment.

By establishing minimum values for these factors, we could evaluate the entire files to find locations that are critical—perhaps before they exist and not after. This type of analysis is impossible today but not in the future. Utilization of techniques such as these will allow us to get the best results for the money available and to have some standards on which to base consistent long-range goals and objectives. Equally important to the hardware and software capabilities needed is the training of managers and technicians to utilize these new capabilities.

WISCONSIN'S COMPUTER SYSTEM

At present the Wisconsin Department of Transportation is utilizing five computer systems. These systems are in separate locations and are not compatible. So, if we are to implement an integrated system, we must have a compatible computer system. This compatibility is being accomplished by the installation of the MP65 system, which will be operational by February 15, with conversion from all existing computers completed by July 1, 1970.

Why the MP65 Computer System?

Of special significance is a requirement of our integrated systems that the data be stored on-line with the computer and available 24 hours a day, 7 days a week. A highly sophisticated computerized file is of little value if someone turns off the power or the system fails for any reason.

Some of the significant differences between our present computer and the MP65 system are as follows:

1. The MP65 gives us a more efficient system in that it provides a single supervisor program, advanced software techniques, and more efficient hardware. With the use of MVT (multiprogramming with variable number of tasks), it gives growth potential and compatibility.

2. The MP65 has special operating characteristics as compared to a single-computer system. As the name implies, the MP65 is two central processing units working together. It has seven data channel paths, large main core memory, and dual control unit paths to I/O devices. This means more efficient utilization of the power of the central processing unit—more throughput.

3. The failure of one processor will not cause the system to fail, as the other processor will automatically pick up the work of the first. The core units are separate modules from the processor, and again failure of a single position or module of one memory will not cause the entire system to fail. Because of this configuration we can continue to operate in a degraded mode while performing maintenance on or trouble shooting the equipment, thus eliminating downtime. For special operating needs, the system can also be operated as two separate computer systems.

4. The system is configured so that we can get to any one device from two channel paths, some of which is automatic, some of which requires manual switching. This not only provides backup but increases the overall efficiency of the computer. We can expect a throughput of one and a half to two and a half times that of two single model 65 computers.

In support of the normal computer hardware we are making maximum use of terminals so the users can have direct access to the computer and its files.

The 2260 terminal is used to visually display data stored in the computer. It is also used as a means to enter data directly into the system. A 1050 terminal connects our nine district offices and the bridge section to the computer. All engineering calculations are performed through the terminal as opposed to the batch methods. This gives the engineer the use capabilities of the large computer and the ability to have direct access when he wants it, just as if he had his own computer.

The volume of work or use of the computer increased when the terminals were installed as compared to when the same job was sent in by mail. In this case the turn-around time was reduced from 5 days to 10 minutes.

A teletype terminal is used by law enforcement agencies to query the driver and registration files for law enforcement activities. This would allow an officer, for example, to determine if the vehicle is stolen before stopping the car.

Some of the other major pieces of off-line equipment used in conjunction with the computer are

1. Calcomp plotter, 50-ft drum—used exclusively for plotting X-sections;
2. Calcomp plotter, 4- to 6-ft flatbed—used for general plotting such as bridge and culvert drawings; and
3. A two-dimensional digitizer for recording data.

Also, a special coordinate readout device is attached to a Kelsh plotter used to record cross-sectional data from aerial photographs.

WHAT DOES THE FUTURE HOLD?

First, we must implement existing systems and train our managers and technicians to utilize these new tools. Then we must continue to develop new methods and procedures to keep pace with new problems and some of the old ones that still remain. The future holds new and exciting adventures for those who are willing to accept the responsibilities. This outline gives an idea of some of the concepts and philosophies used by the Bureau of Systems and Data Processing in its part of the development of the department's Integrated Operations System.