CIS for Bangladesh Railway

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With development of railway network in Bangladesh, requirements for railway transport such as safety, comfort, high-speed, convenience and economy is greatly increased. In order to meet the requirements, a comprehensive information system (CIS) should be carefully planned, designed and implemented. The concept and configuration of a CIS is put forward in this paper. The paper gives how a CIS completes the tasks to ensure railways to be safe, comfortable, high-speed, convenient and economical. The main functions of CIS and related technical issues are also described in this paper. Thereafter the need of a Decision Support System (DSS) for Bangladesh Railway and its role in making informed decisions by the Bangladesh Railway officials are discussed.

The Concept and Configuration of CIS

In a CIS, a rail network is considered as an integrated system from rail bed including bridge and tunnel, rails and points to vehicle, locomotive and train operation. At any time, by using CIS, an official of a railway network can know the situation of rail network and train operation on the network. Based on a CIS, the head of a railway network can make decision. The operators can make their train plan, automatically generate train graphs, supervise, dispatch and command train operations on a rail network. Apart from the daily train plan, an operator can easily add a new train plan according to the increased transport requirements known from the data available in the CIS. If a train is late for some reason, train operation can be automatically adjusted to its normal situation within a short time. If there is something wrong with a line or a train, by the help of CIS, maintenance can be easily organized and completed. It is also easy to have statistics and analysis of train operations as per requirement.

The rail network is an independent system that connects with other systems such as other government systems, other transport systems and Internet, etc. It must provide the related information for the above systems. In a rail network, there are the six parts: 1. the data center and control center (the headquarter); 2. the depots (cars, vehicles and locomotives); 3. the logistics centers (materials for rails, bridge, tunnel and rolling stocks, etc.); 4. the maintenance centers; 5. the stations (marshalling yards, normal station, junction station); 6. the wayside systems. As a system, the six parts are coordinated by the control center to complete the transport task of passengers and freight. Therefore, a CIS becomes the core of a rail network. Based on the CIS, the control center is able to get all the required data from the six parts, and command the system to operate safely and efficiently.

A CIS must have a telecommunication network covering rail network. Since trains are in motion on the rail network, a mobile telecommunication network is also needed to ensure the communication between a station and a train, and the two following trains in the same direction. All the stations including the junction stations and the marshalling yards, the maintenance centers, the depots, the logistics centers and the wayside systems should be connected by the telecommunication network. By the mobile communication system, each train should be connected to the network. Through the data center, the railways headquarter can also provide related information to other systems, such as government information systems, Internet, the public information system and other transport information systems, etc. At the same time, the outside systems can also provide required information of passengers and freight for rail system. For example, people can book tickets by Internet, people willing to deliver goods can select freight agents and send their goods to the agents who give the related data to the stations.

Databases for CIS

For a CIS, there are databases to support its operation. The databases can be divided into the two types: static databases and dynamic databases. The static databases include data for a rail network and rolling stock. The data in the static databases cannot be changed with time and train operation. For example, after the line maintenance is done, or new vehicles and locomotives are bought, the corresponding data in the databases are modified. The static databases include mainly the data for block, station and rolling stock. The data for each block between the two stations should include: the length of each block section, the slope and curve radius of the section, the position, the feature and number of each signal, the length and the related feature of each track circuit, the position and the feature of each sensor in the block, the length, the highness and the feature of each tunnel and each bridge etc. The data for each station should include: the length of each track, the position and related feature of each point, the position, number and the related features of each signal, the length and the related features of each track circuit, the describe data of each route (train route and shunting route), the layout data of the station etc. The rolling stock database includes data for locomotives and cars. The database for each locomotive and each car include: the data of locomotives or cars' features, manufacturing data and place, maintenance recorder etc.

Dynamic databases are established in a certain time unit, or with train operation. It includes train dynamic database, line dynamic database and station dynamic database. Each train has its dynamic database. Train operation, from start point to its destination, is recorded. It includes train speed, its start time, arrival time, departure time and stop time at station, the route states at station, the real-time state of locomotive and its cars during the whole operation, the other related train operation data etc. Each station has a dynamic database in 24 hours. All the events taken place at station in 24 hours are recorded. For example, route establishment, train arrival and departure, the state of each signal and each point machine, the time and its contents of the station device maintenance etc. must be recorded into its database. The past situation at station can be played back on the screen at any time based on the database if necessary.

Each block has a dynamic database in 24 hours. By the sensors installed along the rail line, the state data of the line are recorded in a certain time unit. Particularly, the line state must be monitored after a train passes it. Based on the dynamic database and static database of a block, the safety state of the line can be reflected, and maintenance can be done in time to ensure safety of train operation.

Management System of CIS

From the above description, a CIS is a complicated system that involves every aspect of the rail network and its operation. The management system of a CIS is the key to ensure its normal operation. On the telecommunication network, there are the non-safety data and the safety-related data for real-time control of train operation. Every second, the data from the various kinds of sensors along the line and vehicle and locomotive are collected into the dynamic databases. A great number of files are generated during CIS operation. The files need to be managed efficiently by the management system. Data sharing and a common platform should be ensured and established. Dispatching of application software execution is accomplished by the management system.

The objective of the data management is to make the obtained data be in a uniform standard. It is a prerequisite for data-sharing between different software systems. After the static databases establishment, the main task of data management is to process dynamic data from different systems of a CIS during its operation to build dynamic databases.

For any information system, its file management system is the key to the efficient operation of the system. In a CIS, files are managed hierarchically in line with its type and features. It is ensured that all the files are easily searched out.

Development of Application Systems

Based on the databases and the telecommunication network, there are many application systems that are developed for Railways around the world for Railways. A few software application systems are discussed here:

Decision-making supporting system is developed for the officials of Railways. The system is based on experts system and database. Its task is to help decision-maker to select the optimum schedule in terms of efficiency and safety, etc. Train planning system is based on the requirements. Its task is to make automatically train plans by software in line with the transport requirements of passengers and freight. Every minute, the transport requirement data about passenger and freight can be sent to a CIS. Train graph system is the foundation of train dispatching and commanding. According to train plan and data from the databases of block, station and rolling stock etc., train graph can be generated automatically by train graph application system. Train graph generation, real-time train-graph management and train graph adjustment can be accomplished by the system. In a normal situation, initial train graph is the same as final real-time train graph. It is very often for train graph to be adjusted according to the real situation.

The task of dispatching and commanding system is to dispatch and command train operation according to train graph. The orders of train operation are sent to stations and train drivers. The results of the order execution are fed back to the control center. All the trains on the rail network can been dispatched and commanded by the system at the control center. The operation situation on the rail network can be supervised on the screen at the control center.

Vehicle management information system is developed to manage all the wagons and car running on the rail network. Based on the static database and dynamic database of rolling stock, the state of each vehicle is supervised. The optimum usage and circulation, allocation of each wagon and car can be made. During the train operation, each vehicle can be traced. At the same time, instead of the fixed time maintenance, the state maintenance can be implemented to reduce maintenance cost and ensure train operation safety.

Conclusion

A CIS is the foundation of a modern rail network. Without a CIS, it is not possible for a rail system to operate efficiently. As one of the sustainable transport systems, Bangladesh Railway's operation must be based on a CIS. It is necessary for a CIS to be planned, designed and implemented for Bangladesh Railway.

Once a CIS is developed for Bangladesh Railway, then on top of the developed CIS a Decision Support System (DSS) should be developed to leverage maximum benefit for decision makers of Bangladesh Railway. The other application systems discussed above will be the source of data for the DSS. A Decision Support System (DSS) is intended to support Bangladesh Railway management in decision making. The DSS first and foremost would provide Railway officials an effective system with which to plan, develop, and manage their activities and resources. The initial vision for the DSS is to create a system that is capable of supporting a common database of information required by Bangladesh Railway officials; providing better planning and administration tools. The DSS would accomplish the following:

* Provide the capability to develop credible information on which to make informed decisions concerning the management of Bangladesh Railway.
* Provide comprehensive, accurate, user-friendly database helpful in the management, administration and maximum utilization of available resources for successful implementation of the activities of Bangladesh Railway.
* Provide data and models to evaluate alternative management and functional strategies.
* Provide a functional system that can be used by decision-makers and others, and be maintained and upgraded by Bangladesh Railway.
* Promote information sharing among different units of Bangladesh Railway and other government agencies.

A DSS enables users to run business intelligence (BI) software without having extensive knowledge of input and output data structures. DSS linkages to the database allow users to display input and output data via a GUI and to perform data analyses with the visualization tools that are typically an integral part of the interface. The key element of an IDSS is the integration of the system of models, databases, and interfaces to help the user analyze different scenarios. These combinations of data, model output, and data visualization were not previously possible without current computer capabilities. This integration of the DSS components into a logical and easy-to-use framework is the core of the decision-making process. Given the complexity of the activities of Bangladesh Railway, the need of an IDSS has become increasingly apparent ■