Design and development history of Bridge Management System (ERA- BMS) software.

In line with the Road Sector Development Program (RSDP) , which was launched in 1997, that aimed to rehabilitate and expand Ethiopian Road Network , there was a big problem in finding data of Ethiopian bridges service condition while formulating different road rehabilitation projects. The prevailed absence of organized information about the service condition of bridges even unavailability of the bridge information as a whole, highly inspired a bridge Engineer working at ERA head quarter to think critically on the current situation and seek permanent solution that can enable to avail the required information about Ethiopian bridges at any time on the spot.

In order to fill this long stayed vacuum in the sector and to close the chapter where absence of bridge data and information in such big organization like ERA some how being obstacle for the road sector improvement plans, creation of bridge database and development of computer aided bridge asset management system has been found unavoidable.

Conveying this progressive idea, a self initiated Engineer took professional responsibility and started designing of prototype and modules for establishment of the Bridge Management system. This task was first of all started by deciding and preparing list of data types for bridges that could be collected at sites. Then after the second step was designing the way how to categorize and organize the collected data, which means creating the database to be run in computer. The next and very important task was then get in to design of data analysis module that requires different type of setup and criteria for a number of parameters concerning bridge structures, which is core and brain of the system. The later task was defining and determining type of reports to be produced from the database for any level information seeker.

In this regard, there was a keen interest to share experience and take lesson from other country's bridge database management practice. But, unfortunately, it was learnt that, no country in Africa except South Africa, was implementing such kind of asset management system. However some European countries, USA, and world famous big bridge construction firms are utilizing their own bridge management system.

On the other hand, there was attempt made to find any document and studies in the bridge asset management field in local Universities including AAU. Unfortunately, the Engineering faculties focusing mainly on design and construction of bridge structures but not on bridge repair, bridge condition survey and asset management system. However a single document was found in AAU that is a study on condition of bridges in some part of the country prepared for second degree dissertation in 1970s.

Many Road agencies considering bridge structures as vital part of the road only when a serious bridge failure happens which causes causality and notable accident. Otherwise,

they give very less attention for regular inspection and timely maintenance actions. This is true in many countries in the world and in Ethiopia as well.

ERA in its long history, since its establishment in 1951, in its organizational structures, has always set responsible office for bridge design, construction and maintenance under the top management level due to the fact that the work nature requires timely support and decisions. But, due to absence of standard and defined bridge inspection methods as well as inspection manual and data collection forms, no one could have told about quantity, type and service condition of Ethiopian bridges in general.

Therefore, this situation stimulated to get in to bringing changes and starting the database system by simply taking the worldwide experience referred as Bridge Management System (BMS). Then the designer decided to limit his task to the basic requirements and objectives of this world known system, which are Data collection, Data analysis and Data output.

- Under Data collection all physical, geographical, structural, historical and service condition queries are listed out and categorized.

- Under Data analysis, which is brain of the system, determination of weight for each part and component of bridge structure, weight for listed type of defects and its ranking (*this was taken from Bridge Inspection manual, which was prepared in cooperation with* JICA), determination of unit rate for defect repair, determination of bridge prioritization criteria for improvement action, and improvement intervention type was considered basically.

- Under Data output, which means Report output Very different type of reports is considered to be produced from the entered and analyzed bridge data. Basic reports are General and detail information of all bridges supported by photographs; as built drawings and Videos, identification of critical bridges and its cost estimate for improvement based on type of intervention, bridge asset value, etc

Having the elaborated idea on how the BMS should look like and getting self enthusiastically, possibility of development the BMS software for Ethiopian condition was believed to be achievable. Then the system design task was started together with a software developer, who was also volunteer to contribute in realization of this useful idea.

In line with this, JICA experts, who were working in ERA since 1999 in providing invaluable Technical Support specifically in preparation of bridge inspection manual and provision of a series of practical trainings to engineers in bridge inspection and repair activities, have also financially supported development and revision of the BMS software until 2012.

After completion of the ERA-BMS software development in 2004, official implementation was started in 2005 by approving and launching the proposal for the Nation wide bridge inventory and inspection project, which was the first in ERA history that enabled to have the bridge asset database.

Thanks to this in-house developed ERA-BMS software; ERA is now monitoring all relevant and latest information and database of more than 3,600 bridges and 30,000 Culverts. In the implementation process ERA is using bridge rehabilitation Master Plan that is prepared based on the collected and prioritized details of bridge service condition data.
The bridge/Culvert Inventory and condition survey activities are permanently taking place every year for each structure by visual inspection and in every 3 years for detail and major inspection in result of which prioritization of bridges based on the severity and measured defect quantity proceeding and updating of the database is permanently undergoing.

In this regard, all ten ERA branch offices are operating the software and administering their own bridge database on the other hand all ERA bridge databases is being centrally administered in Head Quarter.

In order to assure sustainability of the system and implementation of it in all ERA branch offices the software and all relevant manuals are disseminated to all ERA District / RNMD offices through provision of capacity building trainings by contractually hired local engineering firms who at the same time conducting Regular, Major and Emergency bridge inspection and update the database.

At the end, it would be fair to witness that this in-house developed BMS has brought radical change in the sector in introducing concept of bridge asset management to a number of Engineers through trainings, application of standard bridge inventory and inspection practice, availing current and computer based yearly updated database and information of bridges and culverts to all stakeholders at a moment, more importantly prioritization of bridges for improvement intervention prior to collapse and traffic interruption. In this regard significant number of bridges is under replacement or repair based on the inspection out put and the system recommendation since 2008.

Finally, it is possible to say that Ethiopia is one of a few countries in Africa pioneer to establish its own BMS and implementing it successfully. It is our wish that Ethiopian practice in the field could be conveyed and spread to other African countries.

With respectful,

JICA Bridge Experts,

These are individuals worked to realize Bridge Management System in Ethiopia.

Girma Worku, Bridge Engineer
BMS concept Designer

Yared Shewangizaw,
Software developer

Hideo **NAGAO** ,

Kazuyuki **ISHIHARA**,

Nobhiko **TAKAGI**, .

Yoshinori **OBATA**
2000 - 2010

Note:- *The Software for Culvert database management was developed by a hired programmer Ashenafi Worku in 2008 and the two software BMS and CMS was merged in 2015 .Currently Version 6 is under use.*