Railway Track Maintenance-Role and Scope of IT

A white paper

Table of contents

Executive Summary

With all the railway tracks in the world, we could have made 3 different track-routes between Earth and the Moon. Huge investments would have gone in building such infrastructure base, but what is surprising is the kind of expenditure involved in maintaining these resources. We spend in excess of $10 billion (annually) in just maintaining the global tracks. What makes the whole activity complex and costly is the various parameters involved in decision making-from engineering evaluations to business level constraints (e.g. safety levels). This naturally provides a huge opportunity for any IT-enabled solution (in the form of a product or customized implementations) that would help the rail road companies in efficient and effective resource allocation and decision making.

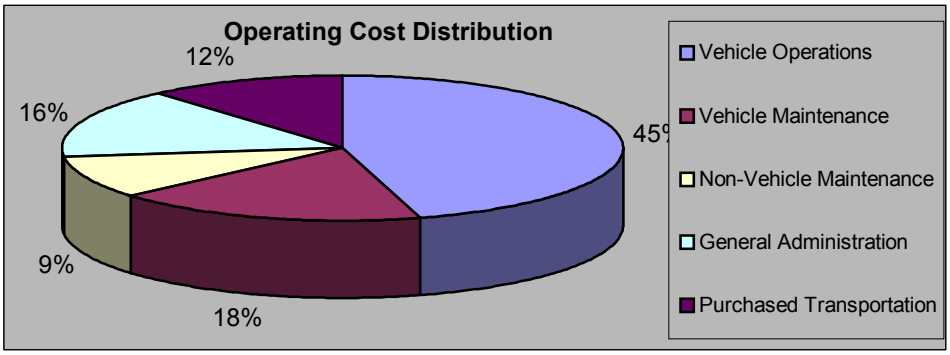
Track Maintenance

Railway tracks form a very critical part of any rail company's asset base, as it provides them with the required business operatibility. The safety and hence the need for maintenance of this rail resource cannot be over stated.

Track maintenance refers to the comprehensive set of activities involved in ensuring that the railway tracks meet the required safety and quality standards. This includes inspection, track-data collection and possible renewals. With increasing pressure on rail operators to increase operational efficiency, track maintenance is required to be cost-effective too.

78% of track maintenance costs is just labor costs- huge opportunity for automation solutions

The American Public Transportation Association (APTA) has identified that the non-vehicle maintenance expenditures (almost half of which is just track maintenance) form nearly 9% of total operating costs and 78% of that is just labor cost. Such a high level of labor-cost contribution (and the repetitive nature of the job) strengthens the case for automating the process.



Track maintenance (as compared to vehicle maintenance) is a rather complex activity due to the geographical spread of the asset. Unlike vehicles which can be brought to sheds or other common points for inspection; for tracks any inspection, repair or data collection requires physical movement of man and material, adding to the cost and time involved in the task.

An understanding of the individual sub-tasks involved in track maintenance would help us identify the possible options to build solutions. A very simplistic depiction of the complex web of various sub-activities and decision points, is shown below:-

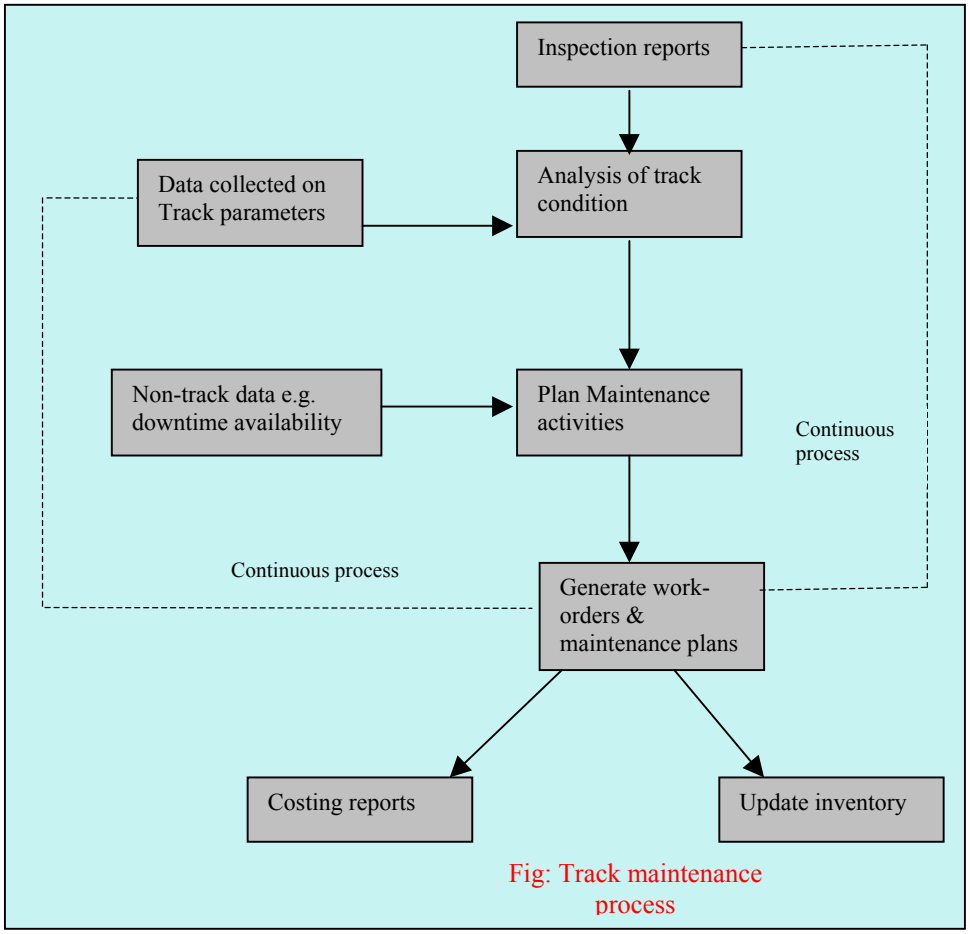


Fig: Track maintenance process

Technology has been deployed in areas of data collection, inspection and track-upgradation.

IT in Track Maintenance

Most of the advancements in terms of automation and mechanization, have been in the sub-activities of

- Track data collection and inspection
- Renewal and up gradation activities- ballasting, leveling, tamping machines

Most of the rail companies in Europe, N America and Australia have special cars that collect track-related data and also aid in high-speed visual inspection. These high-speed recording cars (with speeds up to 200Km/hr) are fitted with sensors to check track-alignment, track-surface conditions etc. In certain cases they also have an onboard analysis system that makes the task of data-collection and analysis a real-time activity. Many a software solutions like DynaTrack, RailScan,ORIAN are available in the market, which help in the *data collection and analysis phase*.

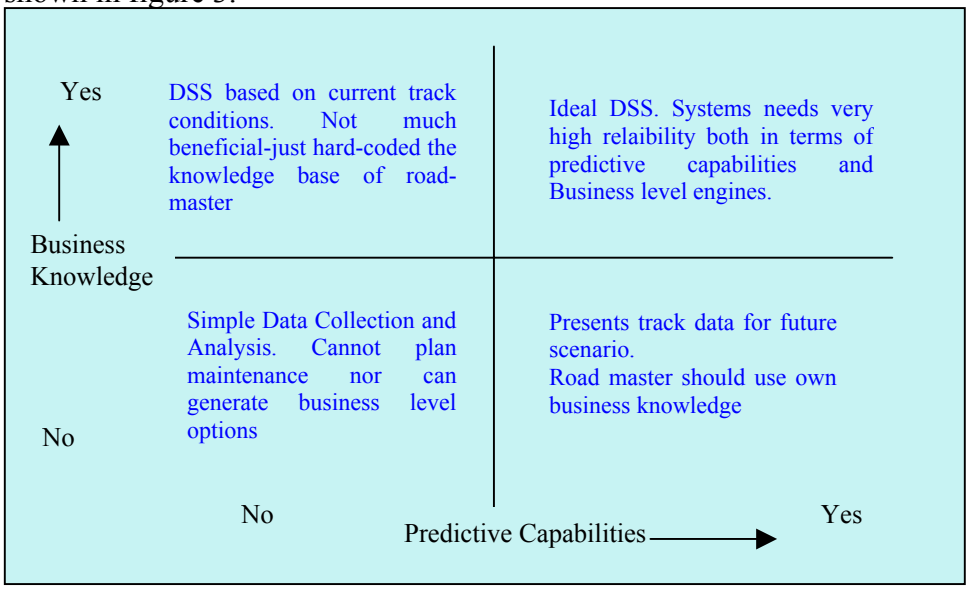
Unplanned (or reactive) maintenance is still the order of the day.

Although this represents a substantial labor-cost reduction, but a lot of potential cost savings are missed out due to unplanned activities. Such speedy data collection and inspection though helps in low-reaction time for maintenance but the overall process still remains very reactive and unplanned.

The need of the day is a system that could help the road-masters (as referred to track segment 'owners' in US) identify future maintenance needs (*An Engineering Solution*) and/or help them plan maintenance activities accordingly (*A Decision Support System-DSS)*.

Solution Space Map

A product mapping of available and potential software solutions that aid and assist in track maintenance (based on the level of functionality) is shown in figure 3.



One parameter of segmentation in the above matrix is the predictive capabilities in the solution. BNSF CEO Matt Rose had referred to the need of such capabilities in the planning process to substantially improve the operating efficiency in the recent AREMA conference. Such capabilities would help the maintenance managers predict track conditions, forecast maintenance needs and thus plan and predict resource allocation.

The other parameter is the one that refers to the domain knowledge that any rail operator would have acquired with the experience in the activity of track-maintenance. Such knowledge is essential to judge the resource requirements based on the physical and technical track-information available. A system (or solution) that would have inbuilt engine to trap such business cases would essentially act as a *Decision Support System (DSS)*. To build such a DSS requires that the business-knowledge be matured and acceptable at a common industry platform, so that the reliability and the user confidence is high.

DSS requires maintenance knowledge to be standardised, tested and globally accepted.

Industry Analysis

With the above framework in mind lets look at the challenges facing the development (and more importantly the deployment) of such Track Maintenance Management Systems (TMMS). The ideal point to start would be to have a brief look at the trends in the industry.

The rail operators need to maintain certain minimum level of safety standards as prescribed by the respective regulatory authority (e.g. FRA in US) and the rail companies traditionally supervise the whole gamut of activities involved themselves. A few rail companies did experiment with the format of outsourcing the task to 3rd party contractors, but the experience has been so dissatisfactory that the model is almost shelved now. At the most few vendors take small contracts to replace, upgrade, maintain or test tracks. A few possible reasons could be the criticality of condition of the tracks for profitable operations and also the level of costs involved. In the absence of sophisticated and assured delivery from 3rd

party vendors, rail companies prefer supervising the activities on their own.

The operating efficiency of rail operators has been under question and pressure due to the increased challenge and competition from other players not only in the rail segment but other segments of transportation. This means that the rail operators need to spend each dollar in the most effective manner and hence we would be tempted to assume that the market would be eager to have a Decision Support System (DSS). A DSS would help the managers and road masters evaluate (financially and technically) and choose between the various possible options (generated by the system) ensuring that the operational efficiency sees improvement.

In the absence of confidence required to deploy a DSS it is best to provide more(and reliable) information to the road master to take better decisions.

But the business level knowledge; as understood by accepted norms of maintenance activities for given or predicted track conditions; has not really evolved. There is still no consensus and confidence in the 'suggested' maintenance options (for given set of conditions). Moreover the IT sophistication has been very low in this sub-segment of rail industry. Other rail activities like signaling, passenger booking has seen a drastic adoption of IT, but track maintenance has at best been a low preference option to deploy IT solutions.

All these trends map into one conclusion- market is not really ready to adopt a Decision Support System (DSS) based TMMS. The road –masters would like to have tools to predict track scenarios so that they could use their own judgments to plan various maintenance activities. Thus the kind of solution presently desired by the industry would be an engineering solution, which uses the track information database to predict future values of track parameters.

One such solution is the Track Predictive Indices (TPI), which has been co-developed by TCS and BNSF. TPI predicts values of five track indices

and creates various reports both at the user and manager level. The BNSF CEO said in the AREMA conference 2002 that the biggest challenge in maintaining assets is predicting future needs for capital and operational expenditures, and TPI assists in doing just that.

IT solution offered to a rail company should be aligned to the needs and also the past experiences(in IT deployment).

Segmentation

The various rail companies form a motley group in terms of their levels of IT implementation sophistication (in track maintenance) and this implies that a blanket marketing or product development approach might fizz out. It might prove to be an overkill for a small and inexperienced rail operator and might be a solution too-small-too-late for the larger and more IT enabled companies.

Instead it would be better if the IT vendors are able to identify and classify the customers according to their IT sophistication and also extrapolate the specific solution that would make most sense to each particular segment.

One such classification (with possible solutions) has been highlighted below

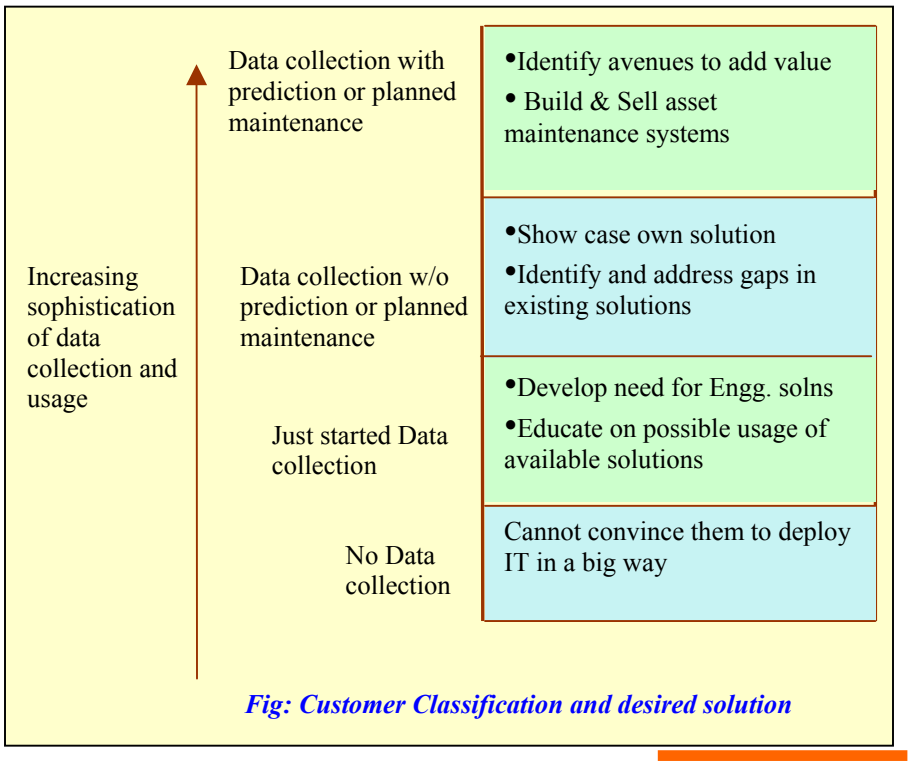


Fig: Customer Classification and desired solution

It will take time before we see large scale deployment of DSS in railway-track maintenance. Meanwhile engineering solutions seem to be the best offering.

The Road Ahead

Since the present market dynamics are not suitable for a DSS with predictive capabilities, the industry needs to gradually mature in its level of IT sophistication. One approach would be to bring together rail companies with seemingly similar maintenance needs, so that the "business-knowledge" is trapped and then collaborating with an engineering solutions provider to incorporate prediction into it.

But to help the rail companies graduate from their present level of IT usage and confidence, to the level where such a DSS becomes acceptable, a TPI kind of a solution would prove to be the best bet. It would help these rail companies incorporate and derive benefits from predictive (and planned maintenance) capabilities. It can thus act as a bridge to graduate from the present level of low IT deployment, to the totally IT enabled maintenance solutions.

About the Author

Wribhu Tyagi is a Consultant with the Transportation Industry Practice of TCS. He holds a Masters degree in Business Administration and a Bachelor's Degree in Mechanical Engineering.

About TCS

TATA Consultancy Services (www.tcs.com) is the Asia's largest independent software and services organisation. With clients in over 55 countries and100 branches globally, TCS is truly transnational in character and reach. We presently employ over 20,000 consultants and serve hundreds of clients, providing IT and business consulting services to organisations in government, business and industry in India and abroad.