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A CONCEPT PAPER FOR THE DEVELOPMENT OF A LOCO SIMULATOR

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A. MOTIVATION

Simulators are used to impart training to operators on complex equipment without the fear of damage to equipment and humans. Railways, across the world, have been using simulators for training locomotive drivers. However, the technology of simulators is available with only a few developed countries. Indian Railways had some time back floated tender enquiry for thirteen simulators at different locations. We understand that import of such simulators had been planned at an estimated cost of approximately Rs. 150 million each.

The technology to design and fabricate such simulators exists within India. Indian Institute of Technology, Delhi (IITD) has the necessary technical expertise to handle all aspects of the development of such a device. This technical expertise is now being offered globally by Hindustan Studies & Services Ltd to countries and companies who are willing to make the investments for this critical technology.

For any developing country, development of simulator technology will lead to large savings in capital costs and maintenance expenditure. There will also be significant foreign exchange savings. However, the more interesting and important aspect is the strategic importance of the technology for the country from a long-term perspective.

B. PROPOSED RAILWAY LOCO SIMULATOR

The proposed Railway Loco Simulator will resemble the real locomotive in all respects. Visually as well as physically the trainee will undergo the same experience as is done by the driver in real situations. He will see a scene as seen from a moving locomotive albeit on a projection screen. He will feel the same type of vibrations and jerks as are

felt by a driver in real life on the tracks. The trainee will have access to all the controls that are available in a locomotive. The trainee's actions on the control will alter his visual as well as physical experience. For example, when he applies brakes, he will feel sudden jerk and when he accelerates, he will see the track on the video screen move faster.

The basic device will consist of a mock-up of a cabin complete with all operator controls. The cabin will be mounted on a platform that will be shaken or vibrated. The platform will be actuated by coordinated motion of six actuators. The objective will be to vibrate the mock-up cabin in a manner similar to that expected in a real loco. The vibrations will be in all the three linear as well as angular directions. This will be achieved by an electronically controlled hydraulic mechanism. The actions of the driver in conjunction with an electro-mechanical model of the locomotive and rail system will be used to compute the motion that the cabin will have in the field in a similar situation. Recorded scenery of a railway track will be projected on a screen. The projection will be synchronized with the actions of the trainee.

The simulators will also be programmed to insert emergency scenarios, as needed, to test and train the driver. For example a simulated scene of a buffalo suddenly crossing the tracks can be used to test the response of the trainee.

The simulator will also have a recording facility to provide the instructor a report of the actions of the trainee during a particular session. Based on the feedback received from

the reports, the instructor will be able to take the trainee to sessions involving higher skills.

C. TECHNOLOGY

The critical parts of the technology for the above Railway Loco Simulator will be as follows:

a) Vehicle dynamic model of the locomotive. This will simulate the expected movement of the loco-cabin,

b) Electro-mechanical actuation system to actuate the cabin,

c) Electronic controls to excite the electro-mechanical system

d) Computer graphics interface to give the necessary visual effect to the trainee.

There is a strong interdisciplinary team at IIT Delhi with specialization in each of the above areas. The team has extensive experience in using each of the above technology components in a variety of other domains. Hence, the team is confident that there is no aspect of this technology, which cannot be developed.

D. BENEFITS

The benefits to Indian Railways can be summed up as follows:

- **Low capital cost** – The cost of the stimulator (excluding initial technology development costs), after it is developed, is expected to be about one third of the landed cost of the stimulator available in the market today.

- **Low maintenance cost** – Maintenance cost of an indigenously manufactured and fabricated simulator is expected to be nominal as compared to the charges payable to the foreign supplier for annual maintenance contract.

- **Better Adaptation** – The training software will be fully adapted to the local conditions. This means that the simulated conditions will resemble the real situations on the client country's tracks and that the visual experience of the trainee will be like operating a loco in the country concerned.

- **Easier Upgradations and Modifications** – As and when Railways make modifications in loco technology or signalling systems or in relation to tracks, making modifications to simulators will be easier. It will also be easier to upgrade / adapt to the ever-changing computer technology.

E. THE TEAM

The development of the railway loco simulator will be done as a technology development project of IIT Delhi. The inter-disciplinary team consisting of the following faculty members will be responsible for all aspects of the project:

a) Dr. Anoop Chawla, Associate Professor, Dept. of Mechanical Engineering

b) Dr. Sudipto Mukherjee, Associate Professor, Dept of mechanical Engineering

Dr A Chawla and Dr S Mukherjee are consultants to RDSO, Ministry of Railways, India and have been working on dynamics of the rail wheel interaction and other related problems. For their detailed resumes, please visit http://www.hindustanstudies.com/techteam.html

Hindustan Studies & Services Ltd will provide management and operational support to the above faculty members of IITD.

F. SCHEDULE

The project can be completed within a period of twenty-four months from the date of receipt of formal order and advance.