Automated train preparation and operation: A target costing based approach for a regional line in Germany

Alessa Isberner[1,*], Florian Brinkmann[1], Justin Adam[2], Raphael Hofstädter[3]

[1] *German Aerospace Center, Rutherfordstr. 2, 12489 Berlin, Germany*
[2] *TU Berlin, Railway Operations and Infrastructure, Salzufer 17-19, 10587 Berlin, Germany*
[3] *ALSTOM Transport Deutschland GmbH, Linke-Hofmann-Busch-Strasse 1, 38239 Salzgitter, Germany*
[*] *Corresponding author. alessa.isberner@dlr.de*

EXTENDED ABSTRACT

By outlining highly automated railway operation scenarios where no activities by operating personnel is required on the train the project ARTE aims to examine aspects of automation from different perspectives. One of them is that the lack of operating personnel such as train drivers can lead to cancelation and delays and further to dissatisfaction with the railway mode from a customer perspective as well as penalty payments and an unprofitable operation for the operator. Also, automation promises higher frequency of trains during the day and more reliable train services at night by presumably lower operating costs and better usage of infrastructure. However, in order for these new technical solutions to catch on and be implemented in the market the cost efficiency has to be evaluated and proven. This extended abstract gives an insight into the target cost-based approach that has been developed to evaluate an economically feasible implementation of automation technology for regional railway. The aim in this project was however not to change basic functions and system architecture of rail operation, but to automate existing tasks. Even though basic functions remain the same, automatization of railway operation leads to a change in human task allocation on the side of rail workers. In this project the focus was on the train driver, precisely on all tasks performed by the train driver today including preparatory as well as follow up tasks. To evaluate the operational implementation of all of the tasks

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performed by a train driver today, each task was analysed. The aim of the initial analysis was to examine to what extend each task can be replaced by automation technology. Tasks where automation is not yet possible have been assigned either to local staff or to a remote operator if they can be done from remote but have to be initialised or supervised by a person. Local staff can be either a person with a maintenance background with special technical knowledge who performs tasks directly at the train outside of passenger journeys. Or a train attendant when the tasks are performed during the journey itself when passengers are on board. This analysis of each task and the relocation in the future with automation technology is needed as a first step to visualise not only the shift of functions but with it the shift of cost drivers for the performance of the railway operation. To evaluate the economic potential according to the results of the analysis done this shift of functions from humans to technology has been monetized. Different approaches from the literature were discussed to estimate how expensive automated train operation would be. As however there are not yet reliable market prices for automation solutions for the individual tasks of a train driver available the further economic analysis focused on examining how high cost for the automatization technology can be to ensure that the business case is at least on the same level as the status quo. In the literature target costs refer to the so-called allowable costs of a product. This involves determining what proportion of the added value of a product is accounted for by the individual components. The labour costs for the work today performed by a human train driver can be understood as a first approximation of the cost that the technology which will do the same tasks in the future may also cause. Therefore, a target cost-based approach has been developed to estimate the costs that can be spent for new technology instead of human labour. When adapting this approach to a railway operator, the relevant components of the product correspond to the manually performed process steps of preparation, operation and post-processing of a train ride. In a first step therefore the activities of the train driver have been analysed and relocated according to the automation solution. In a second step each task was assigned the value of how much time of a working shift is allocated it. Each task has then been monetized with the individual personnel cost of the train driver or in case of a relocation of the task to the personnel costs of the responsible job profile. Values for the personnel costs can be taken from a specific company if they are available. For the purpose of creating a reproducible methodology however publicly available data from collective agreement pay scale values have been used along with surcharges and working schedule efficiency values from the 2030 Federal Transport Plan of Germany. Applying the cost values to the tasks of a train driver today and to the relocated tasks done by humans in the future scenario it results in a difference in costs per

year. The amount of this difference in costs can then be seen as the target cost for the automation technology needed to replace the physical train driver. To cope for uncertainties in the calculation for technologies which are not yet established in the market sensitivity analysis on individual aspects can be done. In this case a sensitivity analysis has been done on the number of remote train operators needed to supervise a certain operational programme. The application of the methodology to a specific use case showed target costs which can be understood as a lower limit for the automation of the defined tasks. It can thus be used to support decision making when assessing the economic viability of automating regional railway lines. As the framework conditions may differ in other applications, the target costs must be determined on a case-by-case basis. For this purpose, detailed methodological instructions for calculating the target costs with the individual circumstances for each railway undertaking have been described. This includes detailed brake up of work tasks depending on an undertakings business case. As a conclusion this contribution presents an approach for evaluating the cost-efficient implementation of new technology to increase efficiency through the automation of railway operations.

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