



## Automatic Train Operations (ATO) Design and Deployment through System Engineering

### ATO comes with great benefits...

Deployment of Automatic Train Operations (ATO) improves the safety, capacity and reliability of the network through the reduction of human interaction with the system.

It improves the train's energy efficiency through optimized acceleration, traction/coasting and braking control. It enhances the transport capacity of the infrastructure by allowing higher operational/average speeds and train frequencies at minimized headways and it improves the service quality for passengers by offering higher punctuality, higher riding comfort in terms of more comfortable acceleration/deceleration and more precise train station stopping.

As a result, it is increasingly becoming more interesting for rail operators to aim at operations at a higher Grade of Automation (GoA).

### ... but also poses a complex and challenging task

ATO deployment does not occur overnight in running rail transportation systems. There are multiple - often conflicting - constraints which must be satisfied, all at the same time. Since the network track system is not starting from scratch, the introduction of different ATO GoAs need to be carefully planned to avoid malfunctioning of old or new systems resulting in decreased services to the passenger.

This comes down to the fundamental question whether one should first modify the rail infrastructure or start with the modification of rolling stock. Here system integration is the key to a successful transition between the current network and the desired network, and the intermediate steps needed to minimize the disturbances in the daily services. Detail testing is needed for any automation step, and these steps will need the close and committed support of the employees.



These employees can be unsure about the future of their jobs, and this factor needs to be mitigated to assure a correct introduction of the new systems. Then, highlighting the value of their expertise and a clear planning and scope of future job responsibilities (e.g. relocation to other functions) shall be shared with them.

Knowledge from the actual employees to be translated to ATO control could require new sensors to be installed on train and identify the best performance driver to be used, and select the sensors needed could be challenging. (e.g. adjust speed because of track conditions, ice, leaves etc., based on driver's experience). Last, but not least, passengers concerns will require testing and advertising as the right strategy to create confidence, as not all people share trust in high degrees of automation.

### Methodology: ATO Design and Deployment through Systems Engineering

In order to create a better understanding of ATO - not only its technology- but more in particular how it needs to be integrated into new or existing railway systems, ADSE has developed a methodology for the Design and Deployment of ATO using a Systems Engineering approach. This includes:

- Identification and justification of the minimum expected performance of an ATO system by gathering knowledge from drivers and customers together with the ATO system supplier. What is the operational need? What are the desired changes? What is the added value as opposed to the required CAPEX and OPEX investments?
- Determining the effect on the operating environment. Which user classes are affected? How do the mainline and yard operation change? How does the system act in a degraded mode? And how about training, maintenance and network changes?

- Determining what parts of your railway system should be automated. What are the targeted system goals, how does the new system architecture look like? What capabilities should the automated system have and under which system states and modes shall the automated system be able to function?
- Procurement Support to put all of the above in a clear set of specifications, to support in the selection of suppliers, guide the development and implementation in order to realize the smooth commissioning of the system.
- Development of the appropriate operational scenarios in order to facilitate the transition between the current network and the automated network, including the definition of intermediate steps that each act as fully functioning transportation system.
- Safety and RAMS management (EN-50126) to identify the risks involved with increased GoA for your railway system and the mitigations required to develop a safe and reliable system.
- Coordination and management of the ATO testing campaign including the evaluation of the results of ATO systems testing from a functional and safety perspective.

ADSE is an independent consulting and engineering company. We serve governments, rail operators, infrastructure managers and manufacturers active in both heavy and lightrail. We are experts in rolling stock and railway systems. We do this by breaking down complex issues into concrete steps to achieve results that contribute to a safer, cost-efficient, sustainable and increasingly digital transport system. Hereto our engineers and consultants work at the office, along the track or in the workshop. Our specialist have broad knowhow and experience with the applicable rail TSIs and normative EN documents. Our projects span all phases of the lifecycle ; from procurement support, drawing up specifications for new equipment, designing construction changes and modifications to existing equipment, verifying the design against the specifications up to the realization of the commissioning of new or modified equipment. Contributing to safe, sustainable and more and more digital transportation systems is our passion!



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