



Lodz Agglomeration Railway emus FLIRT

Andrzej Wasilewski, Janusz Malinowski

Łódź Agglomeration Railway vehicle fleet management system in scope of its disposition, technical maintenance and cost control

Łódź Agglomeration Railway is one of regional carriers in Poland operating in Łódź Province situated in the centre of Poland. The essential aim of establishing Łódź Agglomeration Railway (ŁMR) was to handle Lodz's agglomeration with a population of 1.1 mln residents, Łódź City has 0.7 mln residents. Transfers served by ŁMR go beyond the area of agglomeration connecting Łódź with the closest cities. Altogether the range of impact of Łódź Agglomeration Railway there are 1.5 mln residents that have to the closest stop no more than 5 km. In the distance up to 1 km from the closest stop live 0.9 mln residents.

Key words: customer service, customer satisfaction, rail stations, qualitative exploratory research.

Concept of Łódź Agglomeration Railway incurred in 2008 within the framework of work package aimed at restructuring Łódź railway junction and preparing it for the role of multimodal hub as one of crucial components of high speed railways system in Poland. Łódź Agglomeration Railway commenced its activity in 2014. It was organised from scratch with use of the best European experiences. Investments as part of construction of the agglomeration railroad system were financed partially from EU aid funds. The system's construction was divided into few stages. In the 1st stage, trains on existing lines were started, of which some trains were given a greater modernization. In stage 2, which will be finished in 2022 a process of modernization of existing lines and a structure of cross-city line between

the eastern and western part of the city with tunnels underneath the city centre will be completed. In Stage 3, in the perspective of 2030, new parts of the line in the Łódź region will be built and the length of trains routes compared to the current ones will increase of about 50%. Łódź Agglomeration Railway are now a carrier that holds the most modern means of transporting in Poland. The whole managing process is supported by computer systems spreading through all areas of the company's activity. As a result the company's assets, including electric multiple units are used in the very effective way and operating costs are one of the lowest in Poland.

Łódź Agglomeration Railway Co. drew up and implemented to usage the comprehensive and innovative rolling stock management system:

- 1) vehicle fleet management system enables:
- 2) fast and cost effective current technical control,
- 3) supervision of its location,
- 4) supervision of engine drivers and conductor's teams work,
- 5) operating and servicing means of transport in the modern technical support.

Additionally the system enables:

- 6) current inspection of filling on trains, that backed up with data from the sales system enables constant verification of trade offer and allows a better management in forming and fitting into passengers' needs.

The entire system is designed according to modern management methods and based on IT technologies. Thanks to that and

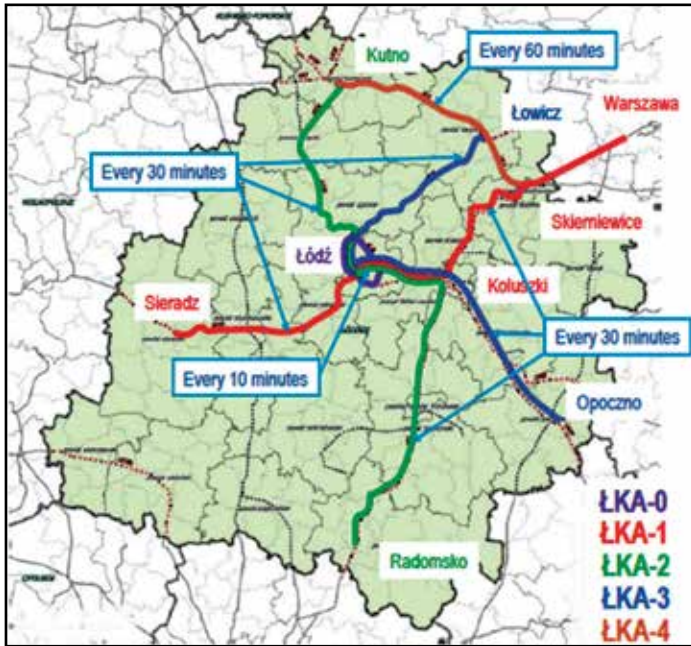


Fig. 1. Łódź Agglomeration Railway after a tunnel construction

innovations applied in the technical support, the Company can vaunt the fleet of vehicles, which reliability is specified on the level of 98% and the technical readiness on the level of 99%.

Rolling Stock

Łódź Agglomeration Railway has only modern FLIRT3 electric train sets, produced by Stadler company. Reliable, high quality and truly interoperable rolling stock meets strict norms of safety, ecology and modern technology requirements. Vehicles' boards are spacious, well quietened and luxurious for passengers. They are equipped with the air-conditioning, ticket machines, LCD monitors, an electric sockets, anti-theft cameras and devices enabling the free access to Wi-Fi. Bicycle racks, handles to carts and baby-care mats are also placed there. A length of one vehicle is 45.7 meters. Each part holds 278 passengers and has 120 seats. Flirt3 reaches speeds up to 160 km/h. Thanks to a new lightweight aluminum base, similar to applied in avia-

tion, trains included in ŁMR means of transport are lighter, resulting in lower operating, energy and maintenance costs.

Railway Transport Office after the review of the vehicle's tests' results, released the first in Poland authorisation for placing in service of the vehicle which is TSI conform held for conventional railways. It was received by double-set electric multiple-unit FLIRT3 produced by Stadler Poland.

FLIRT3 vehicles were equipped with the interoperable A-class on-board Train Control System (ERTMS 2), as well as universally exploited in Poland B-class system (SHP and Radiostop). Installed vehicle devices enable the ride of the electric multiple unit on lines equipped with ERTMS/ETCS of level 1 and 2.

On-board equipment was designed and made with fulfilling system requirements i.a. from UNISING SUBSET-026 version 2.3.0. Testing a vehicle against the compliance with the rail grid, in particular in the compliance of a technical description and exploitation of railway vehicle with the infrastructure and permanent installations, were made with the positive result of the Central Rail Line (CRL, the railway line No. 4, E 65) at section between Grodzisk Mazowiecki and Zawiercie.

Modern and innovative technical support

Łódź Agglomeration Railway as one of the first in Poland preparing the tender for trains' delivery included also their later service in their own technical facilities that is now building. A technical facilities of Łódź Agglomeration Railway is one of the most modern objects of this type in the country and Europe. Its innovative equipment enables current servicing Łódź Agglomeration Railway's rolling stock units. It is located in area of 4.5 hectare on premises of the Łódź Widzew station. An official foundation stone-laying ceremony took place on October 11, 2013, and the object was opened on December 11, 2014. The technological hall was equipped with specialist devices used for repairs and a current vehicles' operation like:

- ◆ rolling stock wash working in the system of the closed water cycle with sewage,
- ◆ lathe for wheeled sets,
- ◆ laser station for the measurement of wheeled sets,
- ◆ weighing instruments able to provide individual axle weight or axle group measurements (weight),
- ◆ stationary system of filling sandblasters in track vehicles,



- ◆ traction trapdoor,
- ◆ elevators of wheeled vehicles,
- ◆ stationary system of cleaning toilets in railway vehicles,
- ◆ installation of vehicles' de-icing,
- ◆ crane.

All applied devices are used for both an environmental protection, and a safety of workers. A separate railway arrangement with the system of junctions controlled automatically is leading to the technical facilities. Two parking paths are located behind the building, four are leading to the interior of the hall.

Innovative and modern Maintenance Management System

By implementing in ŁMR concept of business administration based on principles of the value chain the adopted as the activity principle the conductor model i.e. alliances and outsourcing philosophy. It means such a configuration of the company's value chain, which instead of integrating, coordinates and controls all actions decides to move these activities outside to suppliers and cooperators.

Outsourcing of maintenance services commissioned to the external entity let directly to limit to the minimum in ŁMR defects appearing in the business administration (so-called *muda* – Japanese „loss“): overproduction, unnecessary move, expectation, unnecessary transport, overstocks, defects, exaggerated processing. Commissioning external maintenance of rolling stock is the latest trend in planning and organizing the train carrier work.

Maintenance of the Łódź Agglomeration Railway rolling stock is carried out pursuant to the agreement signed for 15 years of the maintenance with the external entity, that is a producer of rolling stock – Stadler company, including:

- ◆ equipping the Technical Back with devices guaranteeing adequate service of maintenance of railway vehicles at the P3 level,
- ◆ equipping the office and staff facilities and Orderer dispatcher facilities,
- ◆ training the Orderer workers from the operation of devices mentioned in point 1,
- ◆ performing maintenance in scope of level P4 in the place indicated by the Contractor,
- ◆ keeping means of transporting clean,
- ◆ maintenance and service of ticket machines installed in vehicles.

The transparent agreement guarantees the high quality of services and their constant improvement. The quality is based on construction of common brand between carrier – entity keeping means of transport.

The completion of maintaining entirety by the external company causes that on the carrier side only management processes are carried out – a course of vehicles and their technical condition are controlled, turnaround of train are prepared, a functioning of traction and conductor's squads is organized, timetables and a trade offers are prepared.

Enforcement process of the vehicles maintenance by the Stadler company and the flow of information are presented by the following schemas.

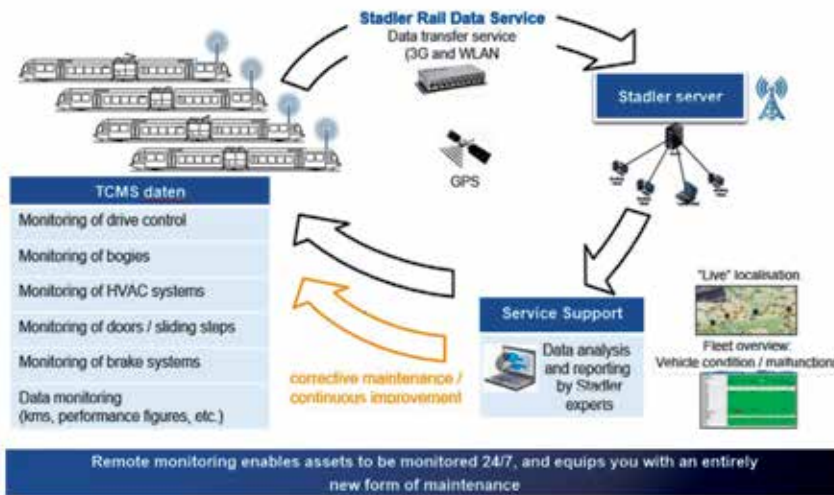
According to the Maintenance system documentation every vehicle at least once in the month goes to the inspection – at the end of the given month inspections' schedule is drawn up for the next month (according to the time or performed exploitation work – depending on needs). Then the Company organizes circulations this way so that handing the trains over to the ser-



Lodz Agglomeration Railway depot

RAIL DATA SERVICE

RDS/TWC: The condition of the fleet at a glance and at all times

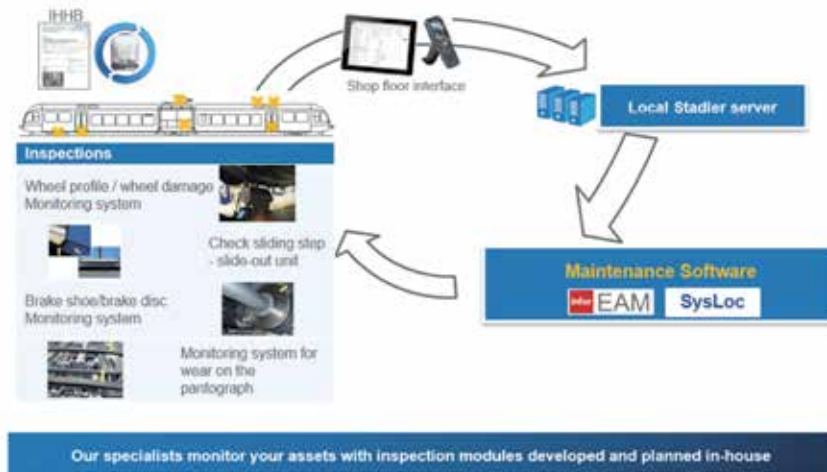


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Fig. 2. Rolling stock remote monitoring process

STADLER RAIL MAINTENANCE SOFTWARE

SRMS: All maintenance processes displayed in a single system



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Fig. 3. Stadler rail maintenance software

vice engineer would be possible. Reporting possible defects is carried out by a Stadler SRMS computer system. Vehicles are entirely equipped with electronic diagnostic systems, enabling service engineer the immediate online control of the technical condition of every train and operations carried out in it. Every defect is automatically detected and classified by the system under the angle of the impact of the further ride. In case that it is serious, the engine driver receives orders to return to the back, where employees of the service company are ready to take the train and a possible spare parts are prepared. The system of the vehicle diagnostics is a basic component of ensuring the highest level of the train's passengers' safety. In some situa-

tions it enables to eliminate the human factor and the engine driver's mistake. The train for example won't go away from the station without prior closing the vehicle's door. The engine driver receives announcement on the vehicle's computer about not closed door. The vehicle's diagnostics includes also such elements, like a state of the main voltage, information about brakes, water level in the container. The service engineer receives this information online in the real time. The carrier receives this information via the service computer, in the form generated report. Łódź Agglomeration Railway has signed an agreement for the delivery of next trains where this access will be online.

In the end of every day a report on units is automatically generated for the carrier, containing information about the level of water in the container, state of the energy meter and the unit course. On this base the unit's arrival for the splashdown or inspection is planned (supervising the course of the rolling stock in order not to exceed a limit between inspections). Thanks to the automatic diagnostics of the vehicle the carrier does not have to call every engine driver to give such an information.

The vehicle administration

Dispatcher of Łódź Agglomeration Railway has systematically and in the real time an access to all information about the vehicle provided by ConSel software of the Aksel company: its position, the current condition (whether is on or off), whether the engine driver is log on which an engine driver that is and what time he has logged on, train route with the commercial number, whether the train is going on time or whether is late, along with information, how much delay amounts, or speed of vehicle. He also knows, how many passengers are now in the vehicle (each of vehicles is equipped in automatic counters of passengers). The system shows also the map based on OpenSourceMap licence.

It enables for efficient and effective current managing the rolling stock and keeping the high level of safety of organized transports.

System of managing the onboard personnel

Every engine driver has his RFID card, on which base it is possible to identify the engine driver and issue the automatic permission to drive the vehicle. The engine driver puts the card in the computer and logs automatically into the computer system (without the need of manual supplementing information about himself). He is choosing the train route at once – on a computer he sees the closest Łódź Agglomeration Railway trains and he chooses one of them. The engine driver does not write the train number by hand, but after choosing the route he automatically receives the timetable (so now it isn't necessary in the paper version). In the timetable its position is shown on a computer. He receives the information about the departure time and possible delay. In the moment, when the engine driver is logging

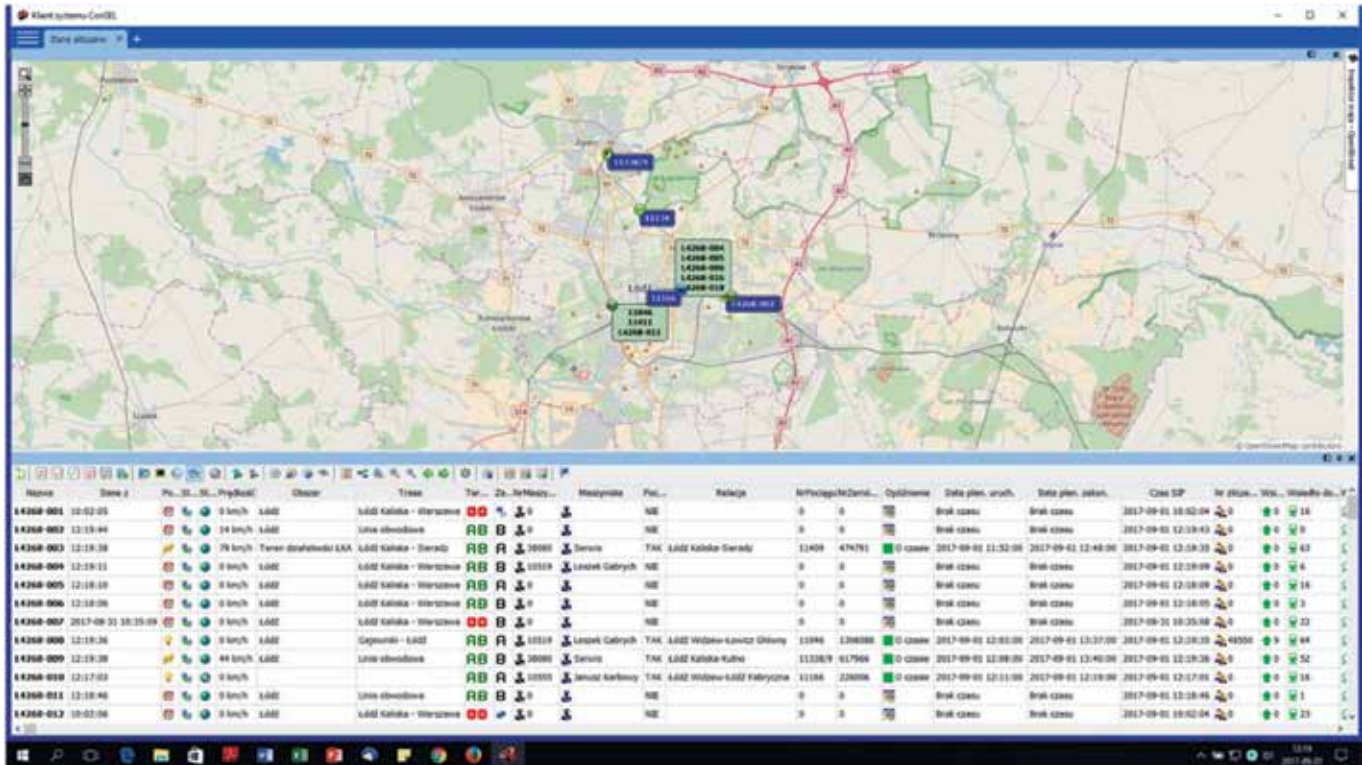


Fig. 4. Dispatcher monitoring system – general view

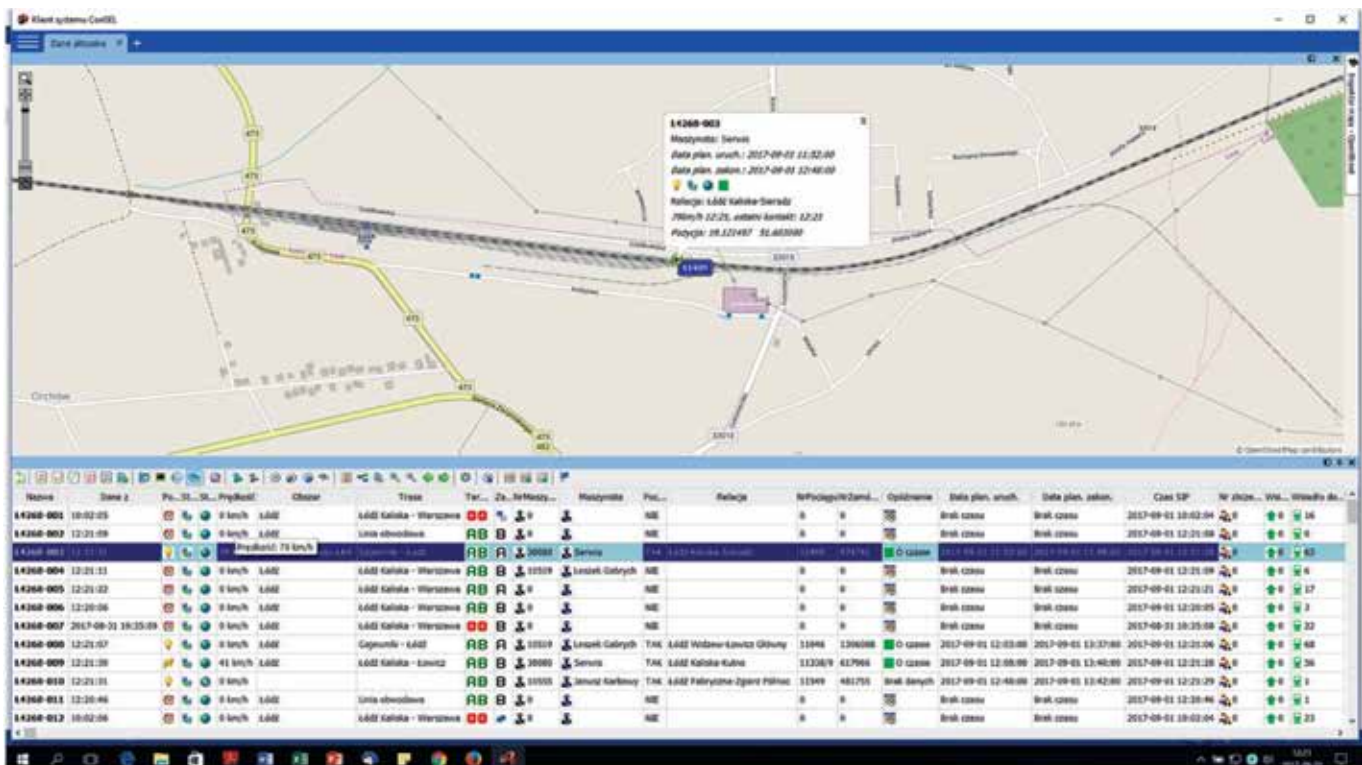


Fig. 5. Dispatcher monitoring system – chosen vehicle

on with his card and is choosing the train number – passenger information system is automatically on-vocal and visual information. This log-on is visible in the Consel system at the dispatcher.

Łódź Agglomeration Railway additionally uses the DPK software system – Integrated Management System of DPK Railways © traction and conductor's squads employees in the process of

managing working time of traction and conductor's teams. The system is characterized by a possibility of fully multi-station work and with centralized architecture with applying the remote access by the application server. In case of Łódź Agglomeration Railway it is used for the service of the following areas of transit activity:

- ♦ register of traction teams,

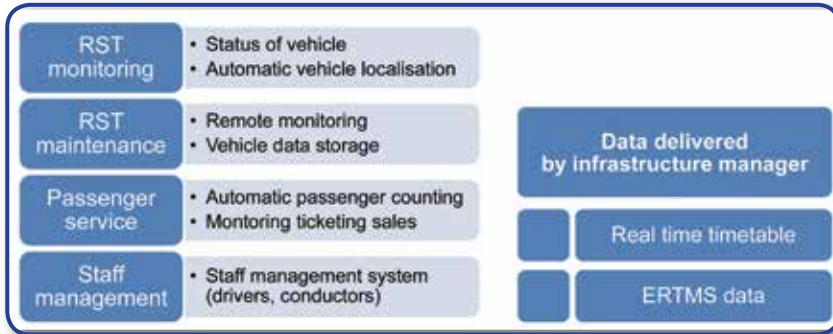


Fig. 6. Integrated Management System in ŁKA Rail

- ◆ structure of working changes,
- ◆ creating work schedules,
- ◆ verification and counting employees' working time.

The work of engine drivers and conductor's teams is monitored with the help of the mobile application installed on their tablets. Electronic work records are installed there – it is planned to abandon their paper version.

Analytical systems based on IT technologies

Łódź Agglomeration Railway uses the analytical systems based on the rolling stock management systems and sale system of wide scale. Thanks to ConSEL program a current inspection of filling in vehicles and forming the layout offer depending on needs are possible. Also taking the quick respond in case of the need for exaggerated filling the vehicle is possible (increasing the balance sheet). Such use of technology possible to equipping every vehicle with meters is crucial and gives significant decrease of costs of performing measurements of passengers' number in vehicles is possible at any time (contrary to traditional, outsourced measurements), is much more precise and independent from the mistake of the person performing measurements. It also lets for tracking current trends and hesitations in number of transported passengers what is impossible in case of the traditional method of performing measurements. This system enables analysis of filling in all vehicles, on specific lines, segments of the line, in specific commercial trains, as well as at specific stations and stops – along with information about the number of passengers getting on and off the train. This sys-



Sight impaired person entering Lodz Agglomeration Railway FLIRT

tem supplements analytical data from the sale system. The CERTUS software enables to obtain data from the sale system – in the division into any segments – details about the number and the kind (relation and possible discount of sold tickets, delivery channels). This system enables to make analyses both about commercial, and financial character, as well as optimization of trade offer.

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Authors:

MSc Eng. **Andrzej Wasilewski** – Łódzka Kolej Aglomeracyjna
MSc Eng. **Janusz Malinowski** – Łódzka Kolej Aglomeracyjna



LKA train at the Radogószcz station