

The result is a window containing a list of indicators calculated for the selected area and tractions and, if need be, a list of trains, from which the indicators for each area and traction have been calculated. Fig. 8 shows an example of such a window containing the indicator of the reduced and total number of trains (TTr and RTr columns), total and reduced train km (TTrKm and RTrKm columns) in one region and on one track of the book timetable for passengers for the entire 2010/2011 season of the timetable. The bottom of the window contains a list of trains for the selected line at the top of the window. For each train is given its starting point and destination, path section, which belongs to the area and traction and partial values of the calculated indicators (TrD column represents the number of the days the train runs). The train or the section of its path can be excluded from the calculation, which will automatically recalculate the total values of the indicators. The excluded trains are shown in the Figure with a crossed grey lettering.

The list of indicators, including the list of trains, can be saved to a text file and subsequently loaded into a spreadsheet or word processor for further processing.

VII. EMERGING TRENDS

System KANGO was originally designed for unitary railway represented by Czech Railways. It fulfilled both the function of railway undertaking and infrastructure manager. During the development of this system the function of railway undertaking was taken over by Railway Infrastructure Administration. Modules determined exclusively for railway undertaking Czech Railways were split into new system KASO. Module KANGO-Vlak remained common to both organizations.

Czech Railways have not their own train database and master data, in which the latter could maintain both the data for the infrastructure manager, as well as specific data for their own use. Now all these data are stored in a common database KANGO. Railway operator thus has access to all train data, and at the time of their entering by the railway undertaking.

The current KANGO architecture does not moreover allow connection of information systems of other railway undertakings. Therefore, in 2012, began an analysis of the splitting both systems into two separate systems and the design of a uniform data interface KANGO that would allow other railway undertakings to submit requests for train paths through their information systems.

To ensure the liberalization of the European rail market and the interoperability of infrastructure managers and railway undertakings European Union issued the technical specifications for interoperability (TSI) relating to Telematics Applications for Freight (TAF) [9] and Passenger Transport (TAP) [10].

In accordance with those EU Regulations Railway Infrastructure Administration plans to create Web services KANGO-TSI that will communicate with information systems of railway undertakings through standardized XML messages.

The railway undertaking will be able to send the following

messages:

- path request,
- acceptance of the proposed path,
- refusal of the proposed path,
- path cancellation,
- path modification,

Infrastructure manager will provide the following reports:

- proposal of the path,
- reservation of the path,
- refusal of the path request,

Fig. 9 shows the planned architecture of the systems KANGO and KASO after splitting.

KANGO-Vlak will be divided into two modules:

- KANGO-Tras – will manage path requests of railway undertakings and proposed paths by infrastructure manager. It will communicate with Web services KANGO-TSI.
- KASO-Vlak – will be used to create timetable of the railway undertaking. It will communicate with Web services KANGO-TSI.

International paths will be solved in the target state solely through the PCS, which will communicate with modules KANGO-Tras and KASO-Vlak.

Master data management of the railway undertaking will be realized by KASO-Kmen module.

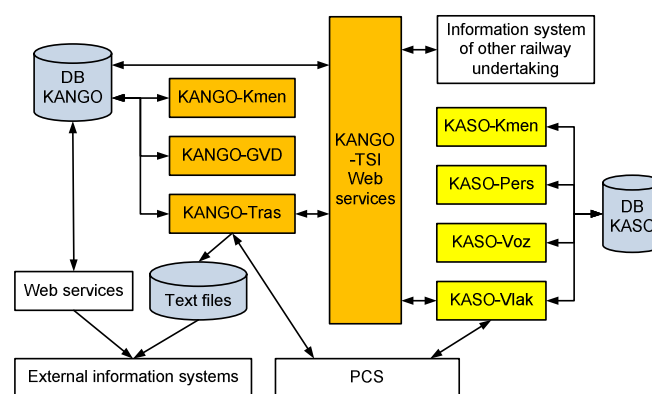


Fig. 9 Divided systems KANGO a KASO.

VIII. CONCLUSION

The application KANGO-Vlak along with other applications of the KANGO and KASO systems were deployed in routine operation at the end of 2010. Their introduction resulted in improving and accelerating the work on the design of the annual timetable.

KANGO-Vlak represents distributed application composed from database server, application server and client program. Data changes made by one client are realized at the other clients within few minutes.

In information system used until 2010 [6] each client had own local database that he operated independently to the other clients. Data exchange was made once 24 hours via export and import of change files through central workstation. Export and import did not perform automatically at the client. User was

the only responsible for execution.

System enables modification of the same record by several clients in the same period of time between to data exchanges. If such a state occurred, system accepted the last updated record. The earlier modification of this record made by other clients did not realized in the database.

New system includes module of the indicators calculation that offers basic indicators for planning and appraisal of the designed timetable. Calculation could be influenced by set of the parameters.

Indicators are calculated for selected trains and or geographical areas. Selection of trains is possible effectuate manually in the trains list or automatically according to defined criterions. The area can be predefined (Czech Republic and its regions) or defined by user.

User area represents arbitrary set of transport points and sections of required type (e.g. stopping point, prohibited section). Type of transport point and section determines including/excluding of the train path in/from the appropriate area. After the calculation is done, selected train paths can be excluded or additionally included, which issues in immediate recalculation of the results.

In the future, division of KANGO and KASO into two separate systems and web services KANGO development are planned that will interact with information systems of railway undertakings using of messages complying with TSI-TAF and TSI-TAP specifications issued by the European Union. Messages allow receiving path request from railway undertakings applications and sending proposed or reserved path by infrastructure manager.

REFERENCES

- [1] H. Bachratý, K. Šotek, "The concept aimed to railway timetable design innovation", Koncepce směřující k inovaci tvorby jízdního řádu v železniční dopravě (in Czech), in *Proc. INFOTRANS 2009*, Pardubice: University of Pardubice, 2009, pp. 117–126, ISBN 978-80-7395-171-9.
- [2] K. Greiner, J. Volek, Information system of railway undertakings' train track requirements, in *Proc. International Conference on Applied Computer Science*, Malta: WSEAS Press, 2010, pp. 254–258, ISSN 1792-4863, ISBN 978-960-474-225-7.
- [3] *Path Coordination System (PCS) – RailNetEurope* [online], 2011 [cit. 2011-08-16]. Available from: <<http://www.rne.eu/index.php/pcs.html>>.
- [4] S. McLean, J. Naftel, K. Williams, *Microsoft .NET Remoting*, Microsoft Press, 2002, ISBN 978-0735617780.
- [5] M. MacDonald, *Microsoft .NET Distributed Applications: Integrating XML Web Services and .NET Remoting*. Microsoft Press, 2003. ISBN 978-0735619333.
- [6] D. F. Garcia, C. Uria, J. Molleda, I. Peteira, "Performance comparison of remote method invocation and web services as communication technologies to build distributed applications", in *Proc. 5th WSEAS International conference on multimedia, internet and video technologies (MIV '05)*, Corfu, Greece, 2005, pp. 17–22. ISBN 960-8457-32-7.
- [7] "Public Passenger Transport Services Act", Zákon o veřejných službách v přepravě cestujících (in Czech), in *Collection of Laws of the Czech Republic*, 2010, Issue 65, No. 194, pp. 2210–2222.
- [8] K. Greiner, "Central train editor of the Czech Railways", Centrální editor vlaků ČD (in Czech), in *Proc. ŽEL 2000*, Žilina: University of Žilina, Slovakia, 2000, pp. 109–114. ISBN 80-7135-054-0.
- [9] G. R. Hrin, L. E. Anghel, A. David, "Integrated solutions for freight multimodal terrestrial transport management", in *Proc. 6th WSEAS International conference on applied computer science (ACS '06)*, Tenerife, Canary Islands, Spain, December, 2006, pp. 126–130. ISSN 1790-5117, ISBN 960-8457-57-2.
- [10] P. Cenek, "Object-oriented model of a transportation system", in *Proc. 12th WSEAS International conference on computers*, Greece, 2008, pp. 1060–1065. ISSN 1790-5109, ISBN 978-960-6766-85-5.
- [11] Commission Regulation (EC) No 62/2006 concerning the technical specification for interoperability relating to the telematic applications for freight subsystem of the trans-European conventional rail system, in *Official Journal of the European Union*, 2006, L 13, pp. 1–72.
- [12] Commission Regulation (EU) No 454/2011 on the technical specification for interoperability relating to the subsystem 'telematics applications for passenger services' of the trans-European rail system, in *Official Journal of the European Union*, 2011, L 123, pp. 11–67.