Digital Transformation in Railway Terminal Management – How it works

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Digitization offers a tremendous opportunity to streamline processes and improve the efficiency and reliability of operations in the rail system.

The reliable transport operation of a railway network depends not in the least on the efficiency and reliability of its nodes such as stations, loading and unloading terminals, shunting and transfer yards and others. The following article presents an example of how digital transformation helps increase and ensure availability, security, and efficiency. The software solution "dRAM - Digital Rail Asset Management", developed by the Austrian software expert Prosoft Süd Consulting GmbH, is a new and innovative approach to the digital transformation of processes in the management of railway junctions in order to achieve the above mentioned goals. The system has its focus on loading terminals and in particular at the sector of connecting lines.

Proper management and efficient operations management is critical to the efficiency and reliability of a railroad site. In the operation of loading / unloading terminals, border crossing points, marshalling yards or the like, the availability of valid and up-to-date information in real time is a central issue. The current status and possibly changing restrictions must be immediately available to all concerned parties in order to keep negative effects as low as possible. The "Digital Transformation" opens up new possibilities of cooperation, coordination and information management to ensure the maximum performance and availability of the respective location.

"Digital Rail Asset Management dRAM" - Digital transformation in the connection railway and railway terminal management

The "dRAM - Digital Rail Asset Management" solution has been developed based on the needs and experiences of employees and experts in the management and operation of branch lines and terminals. The lack of accurate and timely information often results in additional effort, errors,

delays and time-consuming additional work. Tracks closed for maintenance reduce throughput and production and can affect the entire transport chain. Furthermore, appropriate documentation and authorizations must be deposited where the supervisory authority has access to it at any time. Especially in the operation of connecting track systems with few tracks there is a significant effort on the part of the person responsible. Todays, a large number of different players are involved in the railway operations, which must be informed and coordinated accordingly. So, for example, maintenance work must be carefully coordinated with all partners involved. Information about equipment failures and their consequences, such as track unavailability, must be passed on to internal staff and external partners immediately to minimize any negative impact and restore full availability and performance as soon as possible. Today, important information is still often only available in written form, hidden in office cabinets, hard to find and last not least difficult to keep up to date, and available.

Digitization - the first step to improving the situation

Digitization is now the first step towards improving the situation by transforming all relevant information into digital form, making it available centralized use and management and opening new opportunities.

Digitization means *"converting analogue information into digital form"*. The basis for all further activities is to digitize all analogue information about the connecting track or the terminal, then to complete it with existing digital information and to combine all this into a central database.
The first step for the integration into the dRAM is the digitization of the track layouts and the generation of the "Basic Digital Track Model" (BDTM) of the respective connecting railway or rail terminal. In addition to generating the track model using traditional surveying technologies and / or digitizing satellite imagery, dRAM is taking a new approach in the use of high-precision satellite positioning (GNSS) Global Navigation Satellite Systems. These GNSS data are generated by an on-board unit temporarily attached to a local rail vehicle (e.g. shunting locomotive) while the vehicle does its "daily" work. The GNSS on-board unit continuously sends the current geodetic position data to the dRAM server via GSM data services. These data map the track layers in the plane. This approach avoids the „side-effects“ of traditional geodetic surveying as there are production decrease, track closures, safety overhead and more.
Together with data from additional sources, the "basic digital track model" is then created with the corresponding track "objects".

In a final step, for each of these objects (tracks) in the BDTM the system-appropriate designation (identification) is assigned to, as well as possible description and additional properties. The result is named „Site“, provided in the central database and forms the basis for all further digitization. Access is handled via a standard web browser.

Figure 1 shows an example of such a basic digital track model.

Figure 1. example of a basic digital track model (BTDM)

The next step is to enter information about all other facilities that are necessary for management and operation. These are signalling devices, power supply, buildings, loading areas, fences, railroad crossings and more. The data can be imported from a data file or simply positioned directly via the browser in the graphical visualization as shown in Figure 2. This enables the responsible person to integrate "his" connecting track or terminal completely according to his needs and requirements into the digital world and to expand it at any time or adapt it to current conditions. This is shown in figure 2:

Figure 2. adding a “yard asset” (warehouse)

The totality of the entered "assets" now forms the digital representation of the physical railway system and thus the central database for the following "Digital Transformation" - i.e. the application of digital processes and activities onto the digital representation.

In order to maintain the overview of the numerous parts of terminal track or terminal facilities, the assets are mapped into 9 application groups and in each of these groups on one of 9 possible sub layers ("layers"). The groups and their meanings are listed in Table 1:

#	Group	Layers	Description/Content
0	Description	0-9	General Descriptions, Location, Contact, Version Info
1	References	10-19	points of reference / system zero / height References
2	Tracks	20-29	track location, name, length, classification, etc.
3	Switches	30-39	switches, double switches, id, switch control
4	Signals & Sensors:	40-49	main line signals, shunting signals, wheel sensors
5	Infrastructure	50-59	operating buildings, loading points, railway junctions, energy
6	User layers	60-66	User definable assignments
7	Real-time	70-79	Real-time information, system status, vehicle positions
8	Status / conditions	80-89	System conditions, track inclination, maintenance
9	Topology	90-99	general topology, streets, underpasses, buildings, water

Table 1. Layer groups

Complete “Digital Transformation” - the dRAM Eco-system

The complete digital transformation of the railway trunk / terminal management is now based on the digitized information that is centrally available in dRAM, paving the way for true digital collaboration between all concerned players. Workflows and communication are optimized, costs are reduced, errors are minimized / avoided and thus the efficiency and reliability of the connecting track resp. the terminal is secured and increased. Management, update, backup and provision now take place centrally from one point via clearly defined and secure access. Time-consuming searching and comparison of information is eliminated. Each piece of information is available digitally to any interested party at any time in the most appropriate form. All tasks are now performed within the dRAM-ECO system, as shown in Figure 3.

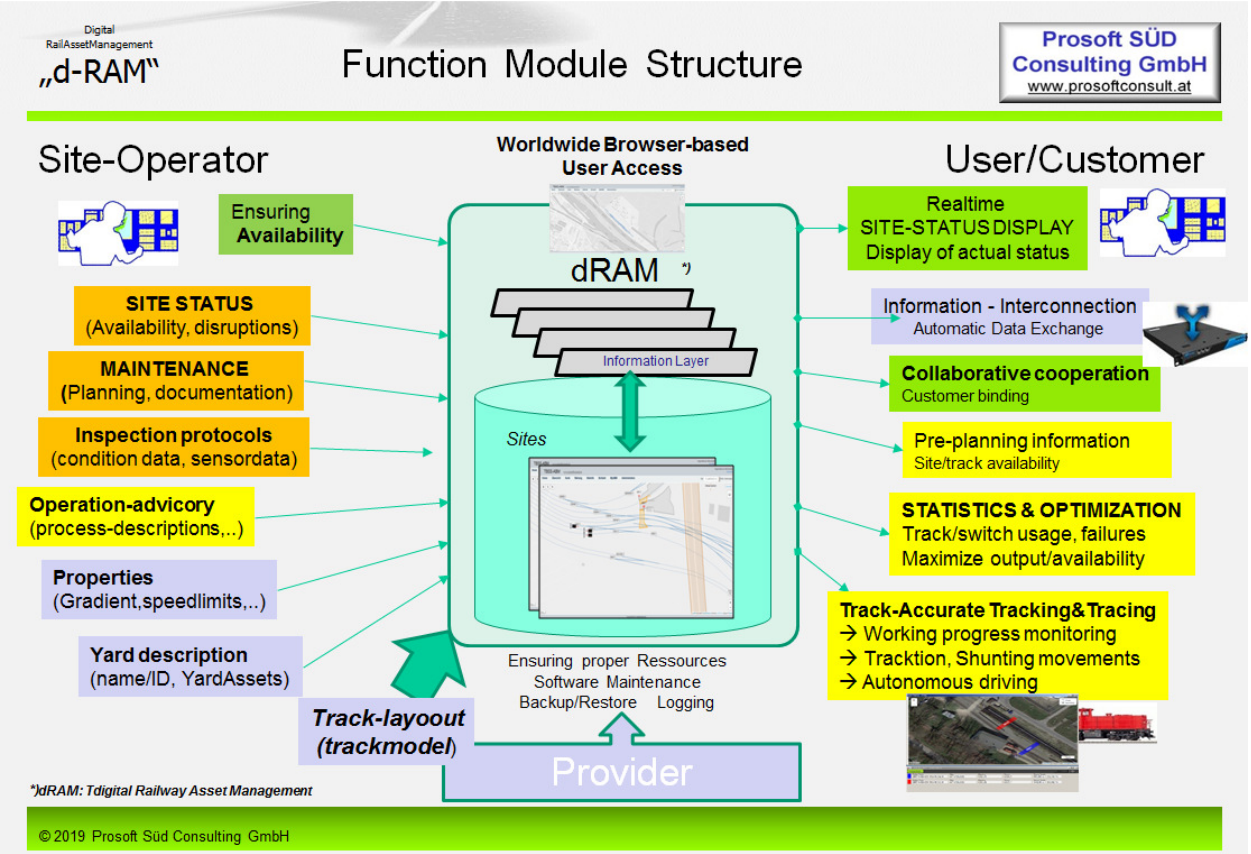

Figure 3. dRAM Ecosystem

Main features and options of dRAM

The software solution was developed to support the active management of a trunk or rail terminal as described above. Various tasks and functions are affected and can significantly be supported in digitized form.

A closer look at some tasks affected:

OPERATIONS: The operations team is responsible for ensuring seamless order fulfilment and maximizing throughput and sales. Current working progress, compliance with timelines / avoiding delays, and the condition such as availability or failure of each asset (tracks, switches, signalling equipment, loading facilities) are managed centrally by dRAM and available in real time. External control systems (signalling, load / dispatching applications, trackside sensors, etc.) can transmit their status directly to dRAM via available electronic data connectors. The results are immediately valid and visible, allowing the site operations to respond to disruptions as quickly as possible.

MAINTENANCE: Maintaining of the track facilities is central to ensuring availability and proper functioning. Maintenance can be assigned to any object in the Digital Site Model (DSM). Planning and monitoring are centralized and visible in tables and on the site's graphical map. Rail partners can be granted selective direct access and thus overview of the (non-availability) of tracks. Pick-up trips can be adopted to the current situation and being performed more efficiently than before. Last but not least, maintenance work for several locations can be summarized in a "maintenance calendar" and maintenance partners can be informed electronically or have insight via the web interface. The approval and confirmation of the work carried out is available immediately after being entered in the system and is immediately available to the employees and partners. This minimizes maintenance and downtime.

REAL-TIME TRACKING & TRACING: The track-specific location of any vehicle equipped with an appropriate GNSS vehicle unit can be accurately and on real-time displayed on the track model in the graphics display and / or transmitted to dispatchers and logistics systems as a "digital location". Such "digital track position" is e.g. "ShuntingLoco1, now at site 1, track 22, 245m from begin of track, at 80% of track useable length" instead of the conventional geodetic location (latitude = 44.1234 °, longitude = 16.5678 °).

TRIP STATUS REPORTS: Initial and regularly updated condition reports such as track condition, track pitch, sutures, etc. are assigned to the track(segments) and are available as documentation and for the maintenance management. Rules relating to track inclination, e.g. Shutdown and security regulations can be checked and updated at any time for being up-to-date. Defects found in the track and their repair are documented accordingly in the dRAM.

LOCATION DOCUMENTATION AND OPERATING INSTRUCTIONS: All documentation, manuals, (regulatory) notes and instructions relevant to the operations are stored centrally in the dRAM and available to employees, partners and the authority supervisors. Documentation can simply be kept up to date, modified and supplied.

COLLABORATIVE COMMUNICATION: Another option of the „Digital Transformation“ implemented is a new way of collaborative communication. This feature helps reducing delays and hassles of distributing and exchanging information in certain policy and / or exception situations. Especially when many different recipients need to be quickly and fully informed. For certain situations and events, message templates and information chains can be defined in advance and, if required, triggered for transmission at the touch of a button

Information access at any time via secure web interface

One of the key benefits of dRAM is its easy and worldwide access via a standard web browser. Access to information is thus possible at any time and de facto from anyone and for any location worldwide. An innovative concept of data security and user access rights ensured that only authorized persons have access to appropriate data.

The web interface is shown in Figure 4:

Figure 4. dRAM Web interface

After logging in properly, the user can select the site to edit, switch to graphical map display, or act on the unlocked main functions and features. The map display already covers a large number

of requirements. Zooming, various (worldwide available) electronic background maps, a search function to find any site element and detailed information through a "Mouse Over ToolTip“ function are just a few of the many features provided. The layer concept mentioned in Table 1 makes it possible to selectively activate or deactivate individual layers and thus limit the presentation to the essentials. At any time, it is also possible to switch between railway that the user is allowed to access.

Figure 5 shows some examples.

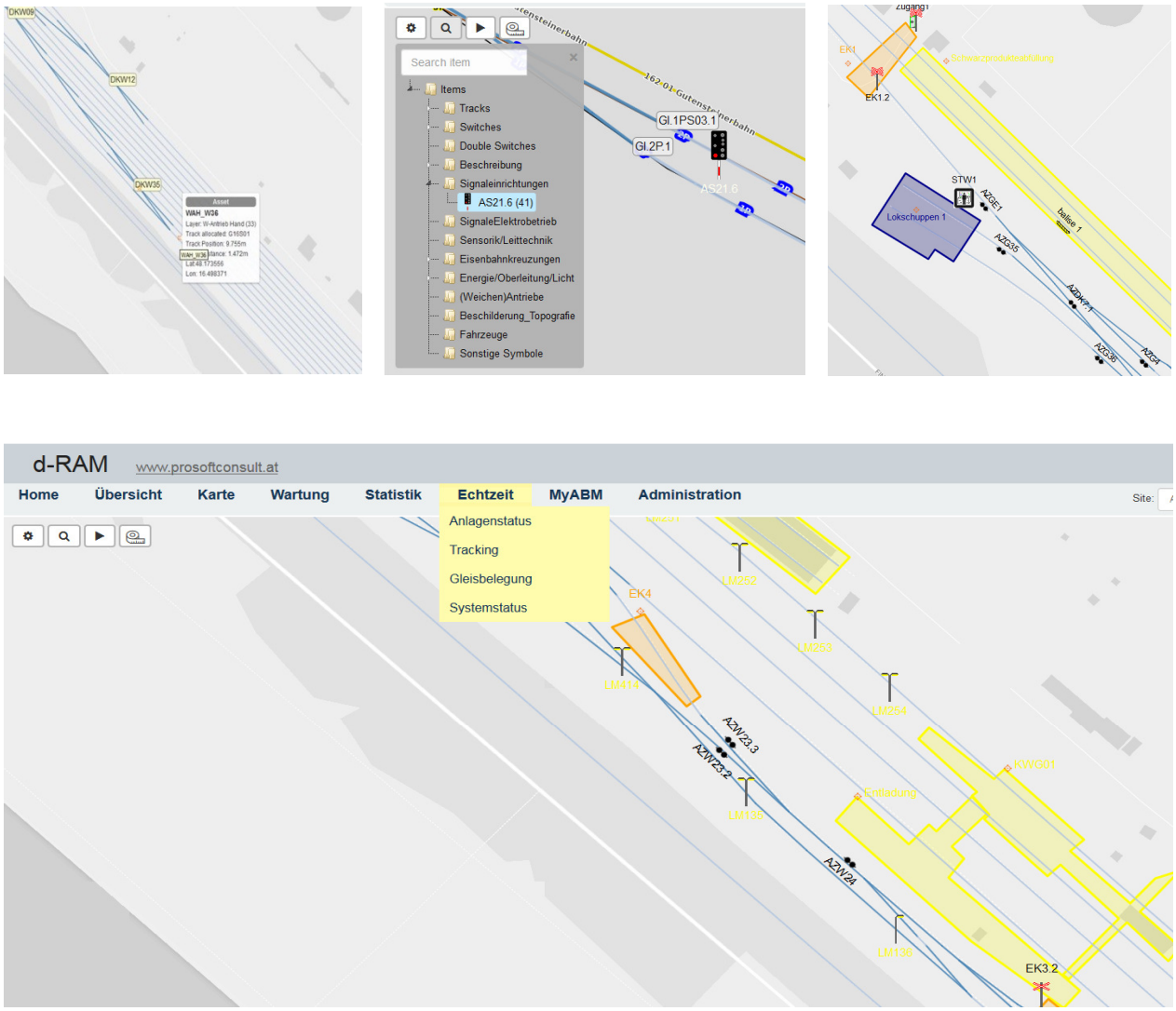

Figure 5. Examples of the graphical interface and representations

Data and access protection

Data and access security is ensured by central and up-to-date security measures as well as a detailed role concept. Each user is assigned a separate "role" for each railway site. This role determines which access rights apply to the corresponding site and whether the user may only act as a reader or as a creator / manipulator. For example, a user with the "Maintenance Manager" role for the corresponding site may plan, modify, commission or cancel maintenance work. In turn, a user with the role of "Maintenance User" can only confirm that the work has been done. As a minimal role, a "user" only has read access to the corresponding site. The data is backed up on the server and all accesses are logged accordingly.

Summary

The "dRAM" connecting track / terminal management application paves the way for a complete „Digital Transformation“ of important processes and workflows in the management and operation of access lanes and railway terminals. The connecting track / terminal is provided in the dRAM in a digital track model with all relevant facilities for operation as a central data model. All the processes and actions necessary for operation are based on this data structure. All relevant information is stored in real time and made available to the affected stakeholders up-to-date and accurately. The access and exchange of information takes place via standard web browsers and, if necessary, by means of automated secure data interfaces. Collaboration among the actors involved in the overall process is maximized to a digital level, minimizing the burden of sharing information and maximizing reliability and efficiency.

The application is highly scalable and flexible, and can be used for both low-track access lanes and highly complex loading / unloading / transfer terminals. No customer software installations are necessary. The application is available immediately after activation of a site on the server. It can be expanded at any time and adapted to growing requirements as well as customized.

The software is server-centric and available both Intranet-based or as external "Software as a Service" (SaaS) and already in use.

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