National Traffic Control Centre, what should it consist of?

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BACKGROUND

There is a general evolution in many railway networks towards a centralisation of traffic control. This evolution began a long time ago and appears to be almost finished in some countries, very well advanced in other ones or even just beginning in others.

Based on a recent survey, this article describes how centralisation was carried out and what are the main benefits observed or expected from this evolution. In addition, it outlines the main lessons learnt from the most advanced countries to give guidance.

An appendix to this article, available on the IRSE Website ***www.irse.org/itc-irse-news***, describes the main existing control centres for railway traffic in the world.

CENTRALISING TRAFFIC CONTROL

Objectives of Traffic Control Centralisation

The main reasons to centralise traffic management and the main expected benefits are:

- reduced operating costs through the reduction of operators;
- reduced number of delayed trains due to better management of incidents;
- improved capacity through better planning and management of train paths;
- improved flexibility in dealing with short notice requirements of additional or amended train paths.

Functionalities of Control Traffic Centres

Initially, organisation of the traffic management was carried out through two or three organisational levels reflecting the following breakdown:

1. in some countries, central traffic control centres.
2. regional operation centres.
3. individual signal boxes.

The centralisation led to reduce the number of levels to one or two.

The common strategy is that the centralised traffic control centres combine the functions of the existing signalling boxes or centres and operations control centres. Manual route setting is eliminated in almost all circumstances, by providing automatic route setting driven by a dynamically updated timetable. The emphasis is on predicting problems in early enough and re-planning to provide a solution, instead of managing the problem as it occurs.

In many countries, staff in the traffic control centres belongs to the main Infrastructure Managers. Presence of staff from different Railway Undertakings is not seen as a problem for confidentiality, but this may need to be considered where data needs to be exchanged between computer systems of Infrastructure Managers and Train Operators.

Moreover, an emergency centre or a crisis room has been installed in each of the traffic control centres. This room is separated spatially from the operating control desks and is equipped for emergencies with components for displaying train movements and with telecommunications systems. The existing emergency concepts were updated as a result to take into account this new organisation.

Usually, the control of the traction supply for overhead and third rail electrification is not located in the Traffic Control Centres.

Traffic Priority Rules

In many countries, passenger traffic still has priority over freight.

In European countries, train operations are managed in accordance with the timetable. Any deviations are agreed between the Infrastructure Manager and the Railway Undertakings in compliance with applicable rules and regulations. The power of real time decision in case of disagreement lies with an Infrastructure network coordinator. The Railway Undertakings may complain to the National Railway Regulation Authority.

CENTRALISATION IMPACTS

Impact on Operating Principles

The main impact of centralisation on operating principles is that every train must be planned and registered in the dynamic timetable. In principle this should include shunting movements.

The second impact is that a lot of operations which usually were dealt with by local operators, officially or not, shall be reassigned to other railway undertakings staff or maintenance staff.

To achieve the targeted staff reductions, every part of the railway can not any longer be continuously supervised by a signaller, even when automatic route setting is provided. This leads to relying on automated systems to alert the operators when some action is required.

Impact on Operation and Operators

The main impact on operation is a better co-ordination in response to major incidents but a loss of local teams geographically structured and organised.

There is an initial worsening impact of local information provision but this may be solved in many cases by improved communications and IT systems giving current position.

Thanks to the high degree of centralisation and automation, more effective and more profitable operations management become possible.

Through structured data management and targeted data evaluation, working processes in the Operations Centre, and in particular the business processes connected directly with them (train and train crew allocation, passenger information, equipment maintenance) are improved.

Impact on Maintenance

Positive Impacts

The concentration of technical systems in one place makes it possible to optimise maintenance.

- the stockholding of certain components can be centralised and the logistics simplified;

- the access to real time information and logs is improved;
- the information of failures due to remote monitoring and availability of information from information infrastructure and trains is improved;
- in respect of the maintenance of infrastructure systems on site, coordination is simplified thanks to the spatial concentration of contact partners and the standardised technical platform of the signalboxes enables maintenance to be performed more efficiently;
- by the same token, the retention by and further development of technical expertise in maintenance staff becomes easier.

Negative Impacts

All the local contacts between maintainers and operators are no longer possible.

The operators of the control centre do not know as well as in the past the installations and the geography.

They generally do not know the maintainers personally and physically.

The contacts are somehow more difficult.

When many work operations are carried out at the same time, all the demands to apply for, or give up possessions are concentrated on a small number of operators. It may cause delays and a waste of time for the maintainer.

Some facilities may have to be added to allow possible simultaneous dialogues between the control centre and the maintainers and to manage the safety of staff on the tracks.

Problems Met (Organisational, Safety, Quality of Service...)

Sometimes it might be hard to get a permit for track work due to limited capacity of dispatchers in Control Traffic Centres. There is a rule how many working groups can be managed by one dispatcher's control at the same time.

A specific issue relates to the supervision of level crossings. Many of the small signalboxes are located at level crossings and in some countries the signaller is responsible for controlling the level crossing barriers and ensuring the crossing is clear of road vehicles before allowing a train to pass. At some larger control centres a significant element of workload is supervision of level crossings for instance via Closed Circuit TeleVision (CCTV).

In the initial situation, an operator worked only in a small area with a very small number of signalboxes. In a Centralised traffic control centre, he controls a larger area with an increased number of signalboxes and installations. He may confuse the identification number of a signalbox or signalling information with another one and give a wrong instruction (track possession). Specific measures must be taken in numbering the signalboxes and/or the signalling information to avoid this kind of mistake.

- Occasional major system failures due to loss of central control systems;
- Need to implement work-arounds to cover initial software problems;
- Social relationship issues with staff required to move to another working location and changing role;
- Staff selection needs to take into account competencies needed for changed roles whereas traditional railway processes favour seniority;
- Need to train staff on new systems require extensive simulation facilities;

DESIGN PROCESS AND TECHNICAL ISSUES

As a rule, the high level functional specifications have been written by the railway network or the Infrastructure Manager.

There are no general rules about the number of manufacturers providing the Traffic Management Systems: ranging from only one manufacturer for the whole network to one manufacturer for each operation or each line without any compatibility.

The usual level of safety is SIL 2 or SIL 0. However, it is SIL 4 in one country.

The centralisation did not impact much on the other components of the control command system such as passengers' information, telecom or radio systems, ERTMS.

The required lifecycle ranges from 10 years to 30 years.

It is recognised that there will be a continuous development of functions and geographical coverage. Generally, some design precautions have been taken to manage easily functional or geographical evolutions.

Almost every supplier has a maintenance support agreement with the Infrastructure Manager which will cover the whole lifecycle for systems in addition to basic maintenance.

This agreement has to be contracted simultaneously with the design contract.

DEPLOYMENT PROCESS

The Target

The target is generally the following:

- Only the main lines (including the High Speed Lines) are controlled and monitored on line by the centralised traffic management system;
- The operational control of signalboxes from the Traffic Control Centres refers principally to lines in the long-distance and conurbation network:
  - o with premium passenger and freight traffic;
  - o with very frequent regular-interval traffic in conurbations;
  - o on major diversionary routes;
  - o on lines with risks of delay propagation throughout the entire network (network effect).

The Process

In all the countries, the deployment was gradual and the complete deployment took more than 10 years.

Two main processes of deployment are identified: In some countries, it was a high level political and strategic decision and the deployment was relatively fast. In some countries, the deployment was more financially driven and took more time.

In some countries, there were two steps:

1. Implement quickly the stock standard, off the shelf Traffic Control Centres (TCS) supplied by the manufacturer.
2. Implement additions and enhancements gradually after initial installation.

In other countries, the goal was to implement the best available solution for each operation and to avoid modifications after the initial commissioning.

In all the countries, the commissioning process was a multi-stage conversion where stations on the old TCS were gradually decommissioned and swung across into the new system. Any issue with the interface between the old and new systems were managed by the railway network.

Social Issues

In all the countries, the required operating staff will be or has been substantially reduced during the course of the project.

Staff reductions were so far organised in a socially acceptable manner, in part due to demographic evolution.

Nevertheless, there were in some countries serious problems in finding suitable staff, particularly in conurbations.

PERFORMANCE

Availability Issues

In all the countries, the availability of the control centre is based on a fully redundant architecture for the control system itself, the power supply and the transmissions up to the interlockings.

Fall back Facilities

There are very various fall back policies in case of a catastrophe: from only local control to fully redundant and geographically separated substitute control centre.

Where there is no fall back, local control of interlocking is provided.

In all the countries, the communication links between the control centres and interlockings are duplicated and diversely routed to minimise the risk of loss of control.

In some countries, each interlocking is provided with an "all signals on" control which will allow staff to stop all trains independently of the Traffic Management software and the primary communication links.

In some countries, the workstations in the new control centres are reconfigurable so that control can be transferred between workstations or between control centres in the event of equipment failure or to share workload.

In other countries, the Operations Centre systems may suffer partial or total failure, a multi-stage fallback level concept takes effect. This encompasses scenarios from short-term through to longer-term failures. Short-term failures are as a rule bridged by automatic systems. This is inherent in the system.

In order to guarantee a high level of availability, it is planned to install the hardware components for a substitute control circuit in each Operations Centre, once for each manufacturer's type (i.e. as a rule twice per Operations Centre) and to keep these operational. Connected sub-centres will be transferred to this substitute control circuit if the associated regular control circuit cannot be used over a longer period of time (e.g. due to disruption to or destruction of components). Above and beyond this, the possibility exists of locally staffing the emergency control desks in the signalboxes. Emergency programmes exist for this purpose and training exercises are carried out regularly. Depending on the size of the signal box and the operational pressure, it is possible that limitations in the efficiency of the system must then be expected.

FINANCE

Financial Business Case

In some countries, the centralisation project was decided on the basis of a real business case. In other countries, the decision was taken for political and strategic reasons.

Costs taken account of in the business case were:

- Development and support cost of new Traffic Management systems;
- Building and equipping the new control centres;
- Cost of re-control of existing relay/electronic interlocking;
- Marginal cost of early renewal of mechanical interlocking.

Benefits taken into account were:

- Reduction in operating costs (staff numbers divided by 2 or 3 – 80% of total benefit);
- Reduction in train delay penalty payments (2% improvement in on-time performance);
- Value of additional trains paths available through better regulation.

Sometimes, the business case does not take into account:

- The cost of the national main IT Network which is deployed independently;
- The regeneration of obsolete installations which would have been replaced even if this CCR project would have not occurred.

Funding Policy

In many countries, the totality or the major part of the budget was supported by the government.

In some countries, the project was financed only by the economies it generates.

PRESENT SITUATION

In some countries, the deployment is complete or near to be complete (Western Australia , New Zealand, Netherlands , North America, England Metro, Germany, Switzerland, …);

In other countries, the centralisation is ongoing at different stages of deployment (France, Great Britain / Network rail, Finland …)

RESULTS

The Operations Centre concept has proven its worth.

In the countries where centralisation has been realised along time ago, long-standing savings have been substantial and continue.

In the countries where the centralisation is still on going, some savings for operational cost have been obtained but target for savings has not yet been fully achieved.

The effects on quality of service are basically assessed as positive. Thanks to centralisation, control and coordination can be carried out on a larger scale and decisions are implemented directly at the connected signalling level. As a result, traffic operations run more smoothly and are more efficient.

There are no known negative consequences for safety.

But …

Maintenance costs are well over what was expected initially.

Savings are less than anticipated, and time for the system to settle down can be long (System includes software, maintenance staff capability, development of operations skills).

Future developments should first and foremost contribute to a substantial reduction in the high level of complexity and to further optimisation of operations management costs. In the course of this, functional adjustments will be implemented. Independently of this, the technical platform must be modernised.

Further synergies can be leveraged if the strategy of signalling operations centralization is continued.

LESSONS LEARNT

For the design stage:

- Time spent identifying requirements is well spent;
- All stakeholders and all the impacts (technical, organisational, operational, human…) of centralisation need to be taken into consideration when setting requirements;
- Interfaces (between parts of the system, to other systems, to neighbouring systems) must be clearly defined and managed;
- Human Factors need to be considered from outset;
- Implementation stages need to be tightly defined and controlled;
- Simulation of functions and testing tools are vital.

For the Operational Phase:

- Fallback facilities are of major importance;
- Time to correct software problems can be extensive, and need for workarounds to keep railway operating whilst upgrade implemented;
- Change management must be strictly controlled;
- Planning of all aspects needs to be thorough (including timetable changes, staff training, customer information, and maintenance preparation);
- Simulation of functions and operator training tools are vital.