RCA

Reference CCS Architecture

An initiative of the ERTMS users group and the EULYNX consortium

Concept: RCA effects overview

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1. Introduction

1.1. Purpose of this document

Applying RCA is not an end in itself but is linked to specific goals. Depending on the specific situation, IMs applying RCA may focus on different goals. In this document, we describe to which goals an RCA-based implementation may contribute, and we will briefly explain the mechanism of the contribution.

Each renewal / rollout project will need its own evaluation of the achievable goals. The explanation of the general goals and mechanisms should help support the specific evaluation.

For the business case (financial evaluation) and the capacity effects, much more detailed documents are available. The detailed documents build on evaluations in specific cases and help extrapolate expected effects for different situations. For the business-case effects, a simple calculator is made available for a first estimate of potential effects.

The benefits of applying RCA extend to stakeholders beyond the IMs, such as customers, RUs and suppliers. We plan to extend this document in the future to add the perspective of these stakeholders.
In the S2R project Linx4Rail, the business case of the standardisation initiatives such as RCA and OCORA will be investigated. This document (and the related documents below) will be used as input for this evaluation.

Terminology

We use the term “RCA effects” to mean all goals that can be pursued with an RCA-based system. We use the term “business case” for the effects that have direct financial impact.

Future work

So far, we have addressed the IM perspective. To complete the picture, effects for the RU need to be taken into account. When new solutions lead to a different distribution of cost / benefits, compensating mechanisms may be needed.

We have not addressed the supplier perspective. There is planned work in the project Linx4Rail to address this.

1.2. Related Documents

The following documents provide more in-depth treatment of the topics shown in the overview.

[1] **Concept: RCA Effects - Capacity** [RCA.Doc.12]

[2] **Concept: RCA Effects – Business case** [RCA.Doc.10]

2. Effects overview (IM perspective)

Concrete (project-related) business cases are the responsibility of individual railways. This document provides a short overview of the "mechanics" of an RCA business case, i.e., how solution elements of the RCA contribute to a valuable business outcome (including financial and non-financial effects).

Many of these solution elements or effects are based on known mechanisms such as moving block, ATO etc. RCA does not pretend to reinvent these mechanisms, but provides a coherent, upgradable architecture to fully use them.

2.1. Business case aspects lead to architectural requirements

The following picture shows the main aspects of the business case of the future railway system from the RCA perspective. They lead to special architectural requirements for the RCA. Lifecycle costs dominate the total cost of ownership of a digitised landscape of applications. Therefore, the architectural requirements get a much higher importance in the tender.

The diagram in Figure 1 shows 5 important goal dimensions: cost, availability, capacity, safety and fast migration. The diagram also shows how the features of the RCA contribute to the goals. Not all IMs will weigh the importance of these goals identically; RCA allows targeting differing priorities.

For readability: red arrows show substantial contributions, grey arrows show 2nd-order contributions.

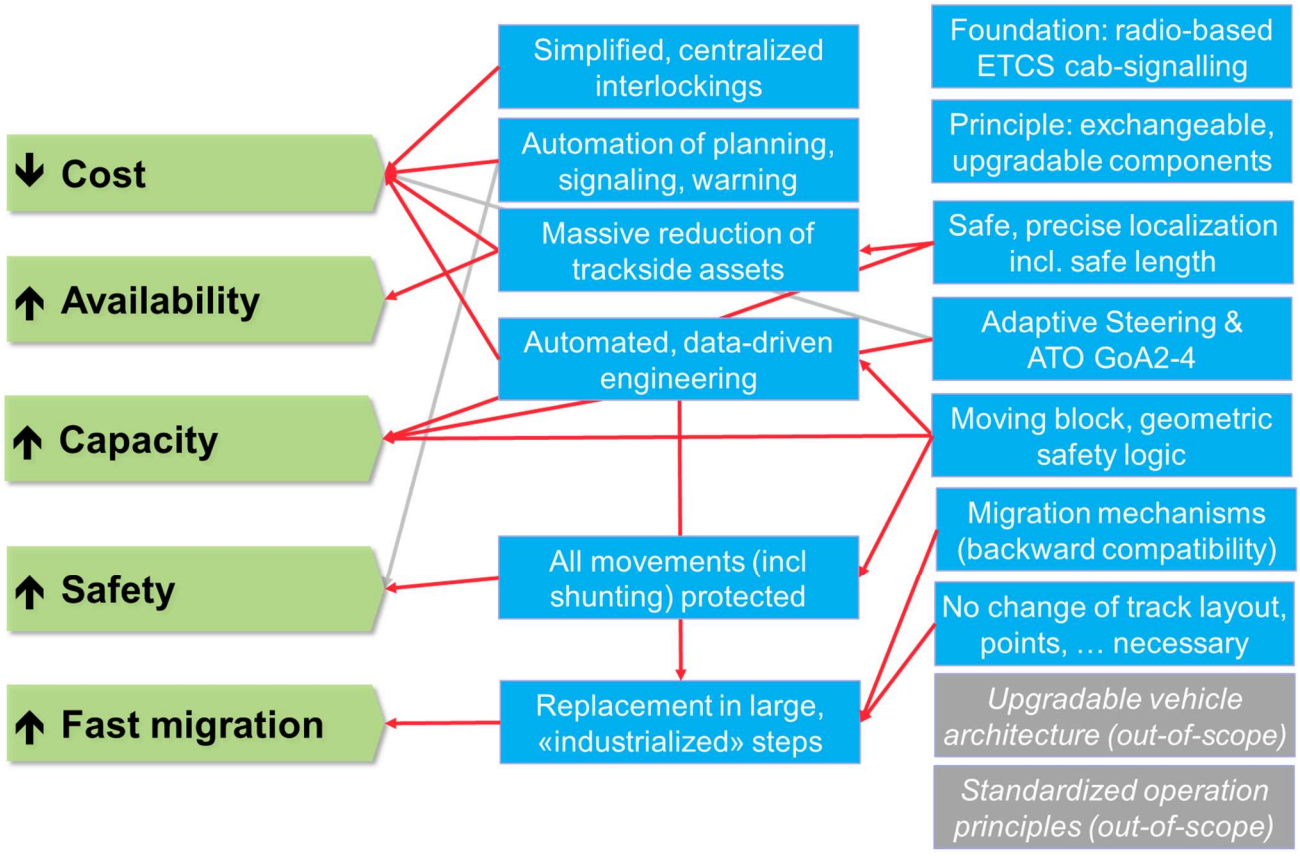

Figure 1: How RCA features drive RCA effects / goals

Important elements of the “business case mechanics” include (non-exhaustive list):

- Cost reduction is driven by:
  - simplification and centralisation (data-centres) of the interlockings;
  - reduction of trackside assets;
  - automated, data-driven engineering;
  - increased automation of tasks such as planning, dispatching or driving (for ATO GoA3 / 4). [Planning (long- and short-term) systems are out of scope for RCA];
- Availability is driven through reduction of trackside assets;
- Capacity is driven by moving block, a higher localisation resolution, geometric safety logic and more precise control of vehicles through ATO;
- Safety (reducing collision risks) is driven through offering full protection for shunting and by including other “objects” such as track workers or heavy machines in the system;
- Fast migration may be an important goal because of obsolescence problems and / or in order to achieve the business case quickly and / or to reduce complex “patchwork” situations. Fast migration is driven by several migration mechanisms in the architecture and by relying on industrial processes (important role of data preparation) for the migration.

Figure 1 is not a complete cause/effect diagram. In particular, potential negative effects (such as potentially reduced availability because of missing trackside train detection in case of a degraded mode) have not been shown for clarity.

2.2. Effect example

A simplified business-case calculator is available on request. Several companies have performed an analysis but have not yet disclosed their results. SBB has made some important aspects of their case public, as shown in Table 1.

RCA Goal category	Example SBB (program smartrail 4.0)
Cost reduction	>400 Mio CHF / year, through ▪ reduction of 65%-70% of trackside assets ▪ increased automation for activities such as engineering, planning, dispatching and warning (some of this functionality is TMS related and out-of-scope for RCA) The underlying network has a length of 3’200 km, 10’700 trains a day, train density of 157 trains/km/day.
Increase capacity	Increase of 15-30% to be used for increased traffic volumes while avoiding / reducing investments in tracks / points.
Increase availability / reliability / operational stability	Increase of punctuality through: • 50% reduction of trackside device failures (through asset reduction) • timetable stabilisation (through increased capacity)
Reduce collisions / Increase safety	Increase safety for shunting and of construction sites through localisation and “full supervision” at all times.
Energy savings / ecological footprint	Savings through avoided braking, which for SBB are included in the cost-reduction case. In other countries this may also be expressed as CO2 reductions.
Speed of rollout	Industrialised rollout: Accelerate commissioning and putting into operation by 50%. Necessary to handle upcoming replacement peaks. Also contributes to cost reduction (see above).
Customer information	Precise customer information based on more accurate information on train position and speed. This is available with an ETCS L2 implementation. Not explicitly part of SBB’s business case.

RCA Goal category	Example SBB (program smartrail 4.0)
Reduces journey times	Acceleration effects are supposed to be low. Fresh buffer times are invested in stability of the network. Not explicitly part of SBB's business case.
On-demand traffic	Made possible by higher automation on all levels. Driven by automated planning / scheduling in the TMS (out of scope for RCA). Not explicitly part of SBB's business case.

Table 1: RCA effects – Concrete example SBB