Procurement and Contracting Strategy ERTMS programme

draft version for consultation

dd. 29 April 2016

This document is translated in English from the original Dutch version. The translation is a courtesy to stakeholders and the market. In the event of debate on interpretations or translations, the original Dutch version will prevail.

Management summary

(TBD, to follow after consultation)

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1. Rationale & Approach

1.1 Review of Preference Decision (PD)

ERTMS (European Rail Traffic Management System) has been developed in Europe since the 1980s as an international train safety system to enhance the interoperability of trains in Europe and, in so doing, promote European competitiveness. ERTMS has gained widespread acceptance both within and outside of Europe as the international standard for train security. In addition to improved safety and interoperability, the replacement of ATB - used since the 1960s - with ERTMS also offers potential benefits in terms of other Long Term Rail Agenda objectives, such as capacity, speed and reliability. These benefits will be mainly achieved by replacing the electromechanical and mechanical relay technology underlying current rail safety systems with ICT. This will allow for a paradigm shift that could not be fully realised through further optimisation of the ATB system.

In February 2012, the Kuiken Parliamentary Research Committee concluded that the situation surrounding train safety on the Dutch railway network had reached a deadlock. According to the Committee's report, effective introduction of ERMTS in the Netherlands would require coordination by the ministry of Infrastructure and the Environment (hereinafter "the ministry"). The Committee also indicated that ERTMS would offer substantial advantages over the now obsolete ATB, while allowing for a paradigm shift.

The Ministry took up the challenge and reached a decision in principle to introduce ERTMS in June 2012. In accordance with the MIRT system for large-scale projects, a Start decision was subsequently taken in February 2013, marking the start of the Exploratory Phase. This project phase served to further assess the purpose of and need for the new system. The Exploratory Phase was concluded in April 2014, following the Government's Preference Decision ('PD', see below) which was subsequently ratified by Parliament in June of the same year. The PD signalled the initiation of the Plan Preparation Phase. This phase will probably culminate in Programme Decision(s) (on infrastructural aspects and on rolling stock), after which the procurement process can be initiated. Contacts with market players and stakeholders will be maintained throughout all phases of the programme. These parties will be regularly informed and consulted on both a formal and informal basis.

The ERTMS Preference Decision of April 2014 can be summed up as follows:

- ERTMS Level 2 will exclusively be implemented in the infrastructure (in order to prevent double maintenance costs and ensure that the system remains comprehensible for train drivers).
- Efforts to install ERTMS in all existing rolling stock will be initiated (by 2022, all trains should be equipped with both ATB and ERTMS).
- All EU obligations for 2020 and 2030 will be met.
- The Schiphol - Amsterdam - Almere - Lelystad Public Transport Corridor (OV-SAAL) will be fitted with ERTMS before 2023 (in view of the need to increase capacity).
- Efforts will be made to build a coherent network of ERTMS lines with a minimum of transitions (in order to ensure that the situation remains comprehensible for train drivers) while taking the need for future replacements into account.

For the aforementioned, a total budget of €2.58 billion will be made available to this end (through 2028, 2015 price level).

The Preference Decision is based on the Alternatives Memorandum (Railmap 3.0) and the associated social cost/benefit analysis (MKBA).

An overarching, comprehensive procurement and contracting strategy will have to be developed during this phase of the programme before the start of the procurement procedure, which may

take around 18 months. This will ensure that the various tenders can be elaborated and presented to the market in a coherent manner. This document describes the programme's development - a process conducted in consultation with stakeholders such as the rolling stock owners and market players[1] and under the supervision and discretion of the interdepartmental working group, the ERTMS governance group, the ERTMS Tender Board and international advisory board - of the procurement and contracting strategy. It should be pointed out that the PCS is not an end in itself: the document provides an overarching framework that will allow us to elaborate tenders for infrastructure and rolling stock into contracting plans and tender dossiers. Programme decision(s) will be submitted to the Parliament in the form of a go/no-go moment conform the MIRT system (long term programme infrastructure, spatial planning and transport).

1.2 From framework letter to Procurement and Contracting Strategy (PCS)

The Parliament was informed about the steps taken thus far to prepare this PCS by means of the so-called framework letter in March of 2015[2]. This letter explained the programme's planned further measures to prepare a comprehensive PCS. Several studies had already been completed at this point. The letter outlined broad strokes on the basis of these studies, offering further information on aspects such as purchasing objectives, the decision as to whether the installation of ERTMS in infrastructure and rolling stock should be separately tendered, and an initial vision on suitable contract forms including or not including private financing.

As the framework letter explained, various key studies were yet to be conducted in order to arrive at a full-fledged PCS. These included a new Market Scan, a PPC update[3], a market consultation[4] and consultations with stakeholders and further studies aimed at assessing past experiences with large-scale ERTMS and railway projects in the Netherlands and abroad. The framework letter also stressed that the process will be iterative in nature: the various studies will not be completed simultaneously, and not all aspects of the PCS will be elaborated at the same time despite their mutual interdependence.

Various key choices as to whether infrastructure and rolling stock should be separately tendered and the need for system integration were then made on the basis of the studies, consultations and meetings with experts. The overall strategy was divided into three components, after which separate strategies were developed for each component. These three strategies were then integrated, so that a single vision on the overall project could be developed on the basis of the individual components. The process can be described on the basis of four funnels (see figure 1). We can identify a single, generic funnel (see the framework letter) subdivided into three sub-funnels that reflect the programme's decision to split up the overall strategy into three components: one for system integration, one for infrastructure and one for rolling stock.

[1] Stakeholders have been regularly informed about the ERTMS programme over the past few years, with a special focus on this PCS in the recent period. Both information sessions and consultation sessions have taken place with market players. The parties will be asked to respond to this PCS over the coming weeks. This may result in further adjustments.
[2] Parliamentary Papers II, session year 2014-2015, 33652 no. 32
[3] Public-Private Comparator, mandatory for all infrastructure projects with a budget in excess of €60 million, used to determine which contract form will potentially yield the best financial results for ERTMS.
[4] The market consultation documents and reports are available at www.ertms-nl.nl.

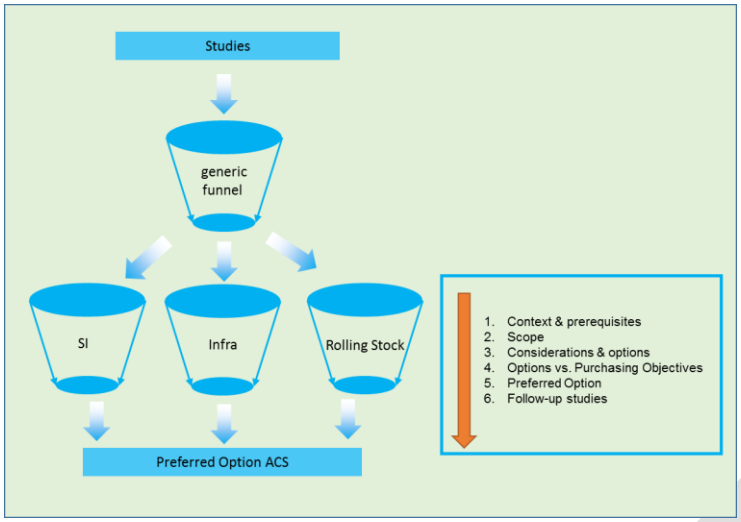


Figure 1 The four funnels

Chapters 3 to 6 describe these funnels and the individual process flows and decisions. Chapter 2 starts by describing the general context for ERTMS, the Dutch railway sector and the ERTMS market.

As noted above in section 1.1, this PCS is not an end in itself: it provides an overarching framework that will allow us to develop tenders for, infrastructure and rolling stock into contracting plans and tender dossiers. Programme decision(s) will be submitted to Parliament in the form of a go/no-go moment conform the MIRT system (long term programme infrastructure, spatial planning and transport). The contract manager (appointed in April) shall, with his team, have to ensure that this strategy is further developed into contracting plans and tender dossiers. The contract manager and his team will be supported by, amongst others, the Tender Board. The contract manager shall take information yielded by recent experiences in relevant sectors in the Netherlands and abroad, and the outcomes of the Fyra and ICT enquiries into consideration. The integrality of programme tenders will be ensured by the appointment of a single contract manager charged with overseeing all procurement procedures, with the overarching system integrator having a monitoring role. Further details, choices and deliberations will be included in the contracting plans and tender dossiers. As such, the present PCS serves to reflect the current state of affairs and points in the desired strategy for the further elaboration of these plans.

2. Context

The preparation of a procurement and contracting strategy for programmes such as ERTMS represents a considerable challenge. Firstly, a large sum of money is involved, namely €2.58 billion[5]. Secondly, it will involve the replacement of a safety system in the existing railway network whereby disruptions to passengers and freight transport operators should be kept to a minimum. Furthermore, the project involves the installation of a single coherent system (comprised of both ICT and other components) in both trains and tracks. These components must also be designed to seamlessly communicate with one another[6]. Finally, the solution must be seamlessly integrated with the current operational railway system[7]. This PCS was developed with due regard for experience gained from the ICT and Fyra enquiries and relevant comparable projects in the Netherlands and abroad. As we have learned from prior experiences with similar projects, such as the Betuwe route and HSL South as well as Paying Differently for Mobility and A15 Maasvlakte-Vaanplein, additional attention will have to be devoted to the procurement and contracting strategy. These points for attention are explained in further detail in the sections below.

2.1 What is ERTMS and what will we be putting out to tender?

An operational ERTMS system consists of various components, which will have to be installed in both rolling stock and trackside facilities (such as the traffic control centre) or infrastructure (in the railway itself). Unlike first-generation ATB (ATB-EG), ERTMS also monitors safety at speeds below 40 km/h. In addition to checking whether the brakes are activated in response to a yellow or red signal, the system also determines whether the train is braking hard enough. Figure 2 shows the various ERTMS components for an ERTMS Level 2 scenario (also see the box on Preference Decision). The various components installed in the rolling stock and infrastructure communicate to one another (in the case of Level 2) through the GSM-R [8] network. Although this network is already being used for verbal communications between drivers and traffic controllers, it will be applied far more intensively under ERTMS in order to allow for the exchange of data between trains and trackside. The constituent components are described below.

The ERTMS system components in the rolling stock are:

- the DMI (Driver Machine Interface), a screen offering the driver information on aspects such as the maximum speed limit and permitted route;
- the EVC (European Vital Computer), the underlying computer system responsible for processing all incoming information and transmitting it to the DMI;
- the odometer, a device located beneath the train that measures the number of wheel rotations to determine the distance travelled;
- the GSM-R module, which receives trackside data and transmits it to the EVC; and
- the STM-ATB[9], which converts the ATB signal in the track into (ERTMS) DMI when the train is driving over ATB track sections.

Key trackside components that will require investment as a part of the ERTMS project include:

- the RBC (Radio Block Centre), which establishes contact with the various trains and transmits Movement Authority to the trains (permission to maintain a specific maximum speed up until a specific location);
- the interlocking (IXL) system, which ensures infrastructural safety by controlling the various track-based elements (switches, crossings, train detection systems) and communicates infrastructure status to the RBC;

[5] This is the amount made available by the Infrastructure Fund for the implementation of ERTMS until 2028.
[6] For an impression: infrastructural aspects include cables and wiring, railway systems (including safety systems for fixed locations, outdoor elements and GSM-R), while rolling stock aspects include the On Board Unit and GSM-R.
[7] For further details, see the last part of section 2.2.
[8] Global System for Mobile Communications for Rail.
[9] Specific Transition Module

- the GSM-R module, which receives data transmitted by the rolling stock and transfers this to the RBC;
- balises (in the track), which serve as beacons, allowing trains to determine their position and speed and check the interlocking;
- cables (in the track), which enable the transfer of information between the various track-based elements, and
- axle counters, which allow for the reduction of block sizes and the increase of track section capacity.

Additional investments will also have to be made in training facilities and a testing laboratory in order to minimise the level of disruption experienced by passengers/freight transport operators during introduction of the new system. This also requires additional facilities, where new baseline versions can be tested (after all, the software used in ICT systems never 'freezes'). Experience with ICT projects shows that good agreements about (partial) responsibilities must be made in advance, especially in chain systems such as ERTMS. By clearly laying down the operational management for both the roll-out and migration strategies in advance by way of good governance, problems during these phases can be prevented. In this regard steps must therefore be taken in advance to lay down what these responsibilities are, in particular with regard to:

- development and testing;
- standard changes and function changes;
- management and monitoring, and
- maintenance[10].

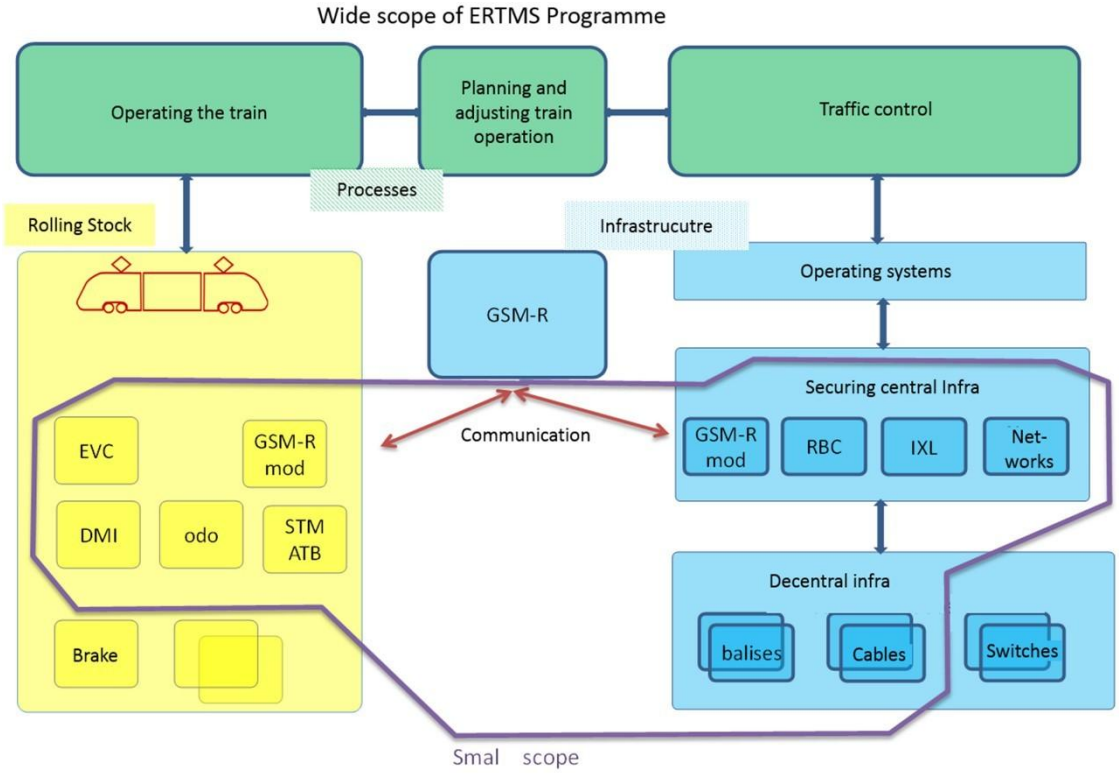


Figure 2 Broad (programme) and narrow (tender) scope of the ERTMS programme

2.2 What the sector/market looks like/general context

As mentioned above, the ERTMS components will have to be installed in and subsequently be compatible with the Dutch railway network's existing systems (trains, railway crossings, switches, etc.). The installation effort must also take account of the current situation in Dutch railway

[10] It should be noted that the ICT component of ERTMS makes the latter more complex to maintain than ATB.

system, factoring in aspects such as the infrastructure manager's maintenance methods and the various train operator timetables. Unlike previous greenfield initiatives such as the Betuwe route and HSL South (new infrastructure), the current project can clearly be categorised as a brownfield situation (existing infrastructure). This section describes the impact of this brownfield situation on the limits of PCS, based on information such as the outcomes of the Market Scan and market consultation.

The Dutch railway sector

ERTMS is set to be installed in existing railway tracks. The Dutch railway industry has a history dating back over 175 years, and has - as is also the case in all European countries - developed its own unique characteristics over the centuries. The entire network is currently managed by a single infrastructure manager, with passenger transport operated by one main rail network operator and multiple regional operators[11]. There is also a limited amount of international passenger transport. The majority of freight is transported by - frequently international - freight transport operators. The Dutch railway network is also used to transport maintenance equipment and made available for historical railway transportation (e.g. steam trains). The marshalling yards are also used by shunting locomotives that currently do not always drive with engaged safety systems.

The Dutch railway network and industry (complex integrated network)

The Dutch railway network has a length of around 3,000 km, of which the majority is dual track (a total length of some 5,000 km, in other words). It is the most intensively used railway network in Europe. The main railway network is a complex, coherent system that is difficult to divide into separate components. For example, NS operates a schedule that is partly dependent on infrastructure. With trains running throughout the country, the various services are highly contingent. In view of the complexity of the main railway network schedule, the ERTMS implementation process should start with the installation of ERTMS on (almost) all rolling stock (see PD). Many regional train and freight transport operators can expect to encounter ERTMS track sections in some capacity - maintenance workshops or docking stations, for example - in the short term. Efforts are currently being made to assess these aspects in detail as a part of the roll-out strategy. ERTMS has already been introduced in some track sections within the Netherlands, including the Betuwe route (such as Kijfhoek), HSL South, the Amsterdam-Utrecht track section and the newly constructed Hanze Line. None of these implementations are (operationally) similar, which can be confusing for drivers and traffic controllers and therefore generates risks. There is also rolling stock, largely in the freight transport segment, that has already been fitted with ERTMS.

Dutch railway market

The Dutch railway market consists of ERTMS and ATB suppliers, engineering consultants and contractors/installation engineers (see below). As compared to the road infrastructure, the number of players with adequate knowledge of the Dutch railways is limited. A lack of knowledge is currently impeding all market players seeking to enter the Dutch market. In order to reach the best tender results for the Dutch, measures for new players will need to implemented to achieve, as far as possible, a level playing field. In addition to eliminating such formal impediments, more informal barriers such as language, cultural aspects and operational agreements will also have to be addressed. Parties and resources such as the ERTMS Academy, Railway Infrastructure Training Programmes (RIO), train operators, maintenance companies, the ERTMS knowledge compendium, private training institutes and the ERTMS knowledge database can play an important role with regard to the aspect of knowledge.

Engineering consultants

Over the course of the Plan Preparation Phase, engineering consultants will mainly be deployed to realise the technical development of the ERTMS transport system. These consultants will then be assigned to further elaborate and test the designs during the Realisation Phase. In the Netherlands, unlike as in some other countries, the engineering consultants relevant to ERTMS are

[11] Regional train operators frequently use track sections secured by new generation ATB (ATB-NG).

independent. In other countries, such activities are often conducted by the infrastructure manager. ProRail applies an accreditation scheme in order to ensure the quality of all engineering services in the area of train safety. The Netherlands has a limited number of engineering consultants accredited for train safety activities. A total of four consultants (of which two are large enough to play a role in consortia) are currently accredited to carry out train safety activities. The number of players accredited to work on rolling stock is even smaller, with a single experienced consultancy firm currently active in the Netherlands. Depending on the selected market approach, this limited number of engineering consultants and their individual capacities could limit the number of possible consortia. The Market Scan recommends efforts to encourage the participation of more foreign engineering firms and suggests avoiding situations where a firm is linked to a single ERTMS supplier. The scan also recommends that activities not covered by the accreditation scheme - such as system integration or project management - be assigned to foreign engineering consultants with ERTMS experience. This will help to ensure that the capacity of accredited engineering consultants is applied where it is needed most, while encouraging challenges from firms with ERTMS experience abroad.

Contractors/Installation engineers

The contractors and installation engineers will be deployed to physically implement the various ERTMS components in the infrastructure and rolling stock. Amongst other activities, this will involve installing cables and wiring in the infrastructure. The contractors authorised to work on the Dutch railways are highly competitive and generate lower returns than their foreign competitors. As a result of several recent experiences with (risk allocation in) DBFM (Design, Build, Finance, Maintain) contracts in areas such as road infrastructure, these parties have become hesitant to take on contracts with a large financial scope. Naturally, contractors are likely to have their own ideas on the most efficient ERTMS construction and installation procedures. This aspect should thus not be left entirely up to the designers (engineering consultants).

Infrastructure maintenance

All railway infrastructure maintenance work in the Netherlands is conducted by maintenance contractors. In order to ensure effective failure recovery, contracts for day-to-day maintenance work are currently based on the concept of a single point of contact for the infrastructure manager in each region. Performance-based maintenance contracts and other day-to-day railway infrastructure maintenance contracts are thus awarded on the basis of a regional classification[12].

Rolling stock maintenance

Every train operator/rolling stock owner can independently itself decide how the maintenance on its rolling stock will take place and has its own maintenance concept or concepts. Many operators (including freight transport operators) generally conduct their own rolling stock maintenance work or contract these activities out to other market players. For instance, NS commissions its Nedtrain subsidiary to carry out maintenance work on its rolling stock. It is of importance to the tendering procedure that ERTMS system maintenance fits into the overall maintenance concept, or is adapted to it, and that necessary workshop refurbishment is taken into account. It will have to be considered whether - and if so, to what extent – maintenance firms that have already been contracted will also be maintaining the ERTMS systems in the rolling stock.

ERTMS suppliers

The ERTMS components to be installed in trains and tracks (RBCs, EVCs, DMIs, balises etc.) will be provided by a limited number of suppliers, also referred to as the ERTMS suppliers. There are roughly eight ERTMS suppliers. These suppliers do not have the same level of experience/expertise. About five of them have experience of the installation of ERTMS Level 2 in existing railway infrastructure (three of them in the Netherlands), while another five suppliers have prior experience installing ERTMS in rolling stock. Where one supplier has more expertise in the area of brownfield solutions, others are more familiar with rolling stock or infrastructure. This market is in a state of transition so the number of ERTMS suppliers may be further reduced as a

[12] PBM: Performance-Based Maintenance

result of mergers or other developments. Two ERTMS suppliers are highly active on the Dutch ATB market. In order to ensure an appealing Dutch market for other suppliers, further investments will have to be made in these parties' knowledge and expertise if explicit and implicit access barriers are to be removed. For example, this applies to the STM-ATB. This system can currently be procured from only two suppliers, as the other parties are not familiar with the exact specifications of ATB (see also section 6.6). There is also a more general risk of vendor lock-in during the Management and Maintenance Phases (including upgrades/updates) once a supplier has been selected. More than in the past, this risk will have to be anticipated when preparing the contracts.

Global demand for ERTMS

The Market Scan shows that global demand for ERTMS products and associated activities (installation, management & maintenance, updates & upgrades) has increased significantly since 2000. Where the emphasis previously centred on new construction projects (greenfield, approximately 75%), we are currently seeing a shift towards replacement projects in existing railway networks (approx. 50% of global market demand). In view of the Netherlands' status as a relatively small player on the global market (approx. 2-4%), careful consideration of a procurement strategy is therefore necessary. To ensure that the tenders are appealing enough to attract bids from ERTMS suppliers, lots will have sufficient financial scope. This with a view to ensure healthy competition between the parties. A large country entering the market could impact the amount of capacity available to the Netherlands, both today and in future. The Netherlands can respond to this by committing long term expertise in advance, stipulating an appealing term of the (maintenance) contracts and carefully selecting the commencement dates for the tenders and contract execution.

Conclusion with regard to market conditions

In view of the aforementioned context, the PCS can create a limited increase in market competitiveness. Furthermore, application of the principle that 'the shop should remain open during the renovation' means that a great deal of work will have to be carried out at night. The ERTMS programme is not intended to achieve fundamental changes in the railway sector. However, market competitiveness can be increased through a limited number of control measures. Inhibiting market conditions can be further avoided by making conscious choices on, for example, contract scopes and the elimination of (implicit) market barriers. The PCS must thus take account of the existing situation, while achieving the best possible quality at the lowest price.

2.3 Lessons learned at home and abroad

Although ERTMS has not yet been rolled out in a brownfield situation in the Netherlands on this scale, greenfield roll-outs (Betuwe route, HSL South, Hanze Line) and nationwide ERTMS roll-outs in other countries (Belgium, Denmark, Great Britain, Sweden, Norway, etc.) have yielded valuable lessons, as have other general infrastructure projects (involving ICT components) such as tunnel systems. The outcomes of the ICT and Government enquiry (Elias Committee) also offer a wealth of valuable lessons in this regard.

ICT enquiry

In 2013, the Elias Committee conducted an investigation into major government projects with an ICT component. This investigation yielded various recommendations and a set of so-called BIT[13] regulations largely relating to project management aspects. One of these BIT regulations concerns the tendering process. It specifies that the tendering strategy must strike an effective balance between the risks borne by the contracting authority and market players and should link payment to the results achieved and accepted by the contracting authority. The clarity and completeness of functional and general requirements must be demonstrably and thoroughly assessed before the contract is definitively awarded. This assessment should make optimal use of pilot projects and/or prototypes in order to ensure the usability and acceptance of the completed system. The proposed tender and key tender documents must be benchmarked against market standards in advance, and the results of this assessment must be incorporated in the definitive tender. Any deviations

[13] ICT Assessment Office (BIT)

from the outcomes of this assessment must be motivated in writing. The contracting procedure should be designed to ensure that all market players involved in the implementation will benefit from the project's timely delivery in accordance with initial agreements. Regular consultations will be scheduled to ensure that the parties involved can evaluate the agreements in a professional and cooperative manner. The first programme progress report discussed the BIT regulations' impact on the programme in detail.

Experiences abroad

Demand for the nationwide roll-out of ERTMS is growing. Different countries are approaching this challenge in very different ways. Denmark has made the most progress so far (national tender, big bang in 2022, but no operational lines at present), Switzerland is gradually transitioning from a dual Level 1 system (interoperability in transit country) to Level 2, while Austria is transitioning to Level 2 on a line-by-line basis (and has managed to eliminate regressions), etc. Market consultations have shown that the Danish tendering model (transparent, incentives, etc.) holds the greatest appeal for market players. Various points for attention have also been identified. For example, many parties emphasise the need for an independent expert system integrator and an integrated approach.

These experiences and expert opinions point to a preference for DBM (Design, Build, Maintain) with incentives (this approach has basically been implemented in all EU countries, on the basis of separate tenders for rolling stock and infrastructure). The scale of the maintenance component the lots is often still debatable. In some cases, all system integration activities have been awarded to a specialised market player (engineering consultants). In others, the infrastructure manager will take on this responsibility either alone or in collaboration with a market player. This role is of major importance, especially with a view to the roll-out (operational system integration) and future system adjustments (upgrades).

Other key areas for attention highlighted in the Private Public Comparator (PPC), the Market Scan and the 2015 market consultation include[14]:

- consult/discuss/be open;
- ensure flexibility in long-term contracts;
- offer the market the possibility to develop ideas (avoid over-specification);
- promote competition (e.g. by providing universal STM-AB and contracting accredited engineering consultants in advance);
- opt for DBM to ensure certainty for suppliers (risks are factored into price by contracting authority);
- ensure effective cooperation between all parties involved (contracting authority and contractor);
- if possible exploit the incipient support for open source technology; and
- apply positive incentives instead of negative ones.

2.4 How do we define success? (purchasing objectives)

The aim is to achieve maximum competition for all sub-systems installed as a part of the ERTMS project. This could impact the configuration of the current railway safety market, as described in section 2.2. In addition to the five overarching objectives (safety, interoperability, capacity, speed and reliability) of the ERTMS project, several purchasing objectives have also been formulated:

A. Optimise the maximum *value for money* for the duration of the entire [15]ERTMS life cycle, resulting in an effective, efficient and coherent transport system.
B. Ensure the *continuity of service provision* for both passengers and freight transport operators during the migration period and Operational Phase (Realisation Phase and Operational Phase).

[14] The market consultation documents and reports are available at www.ertms-nl.nl.
[15] Also referred to as LifeCycleCosts (LCC). The ICT industry applies the alternative term Total Cost of Operation (TCO).

C. Ensure the *integrality, manageability, controllability and reliability* of the ERTMS system for the duration of its life cycle.
D. Ensure that the system is optimally *future-proof* by sustaining competitive forces prior to, during and after the contract period and ensuring that both contracting authorities and contractors acquire and retain relevant knowledge.

This will require fulfilment of the following preconditions:

- management on the basis of the monitoring framework and objectives calculated in the MKBA[16], and
- evidence from the contractors demonstrating that the products provided will offer advantages in terms of the MKBA objectives.

In brief:

"ERTMS will serve to replace and modernise current railway safety systems. The aim will be to maintain current availability levels (continuity of service provision) and facilitate high-frequency railway networks. This will be achieved by applying the expertise of all industry parties."[17]

The purchasing objectives are in fact an important part of the scope of considerations for the score of options for the PCS.

2.5 What are the risks?

Separate risk analysis sessions were held with programme tendering experts as a part of the PCS development process. The main risks identified during these sessions are represented in figure 3, and have been clustered on the basis of the purchasing objectives for the programme in section 2.4.

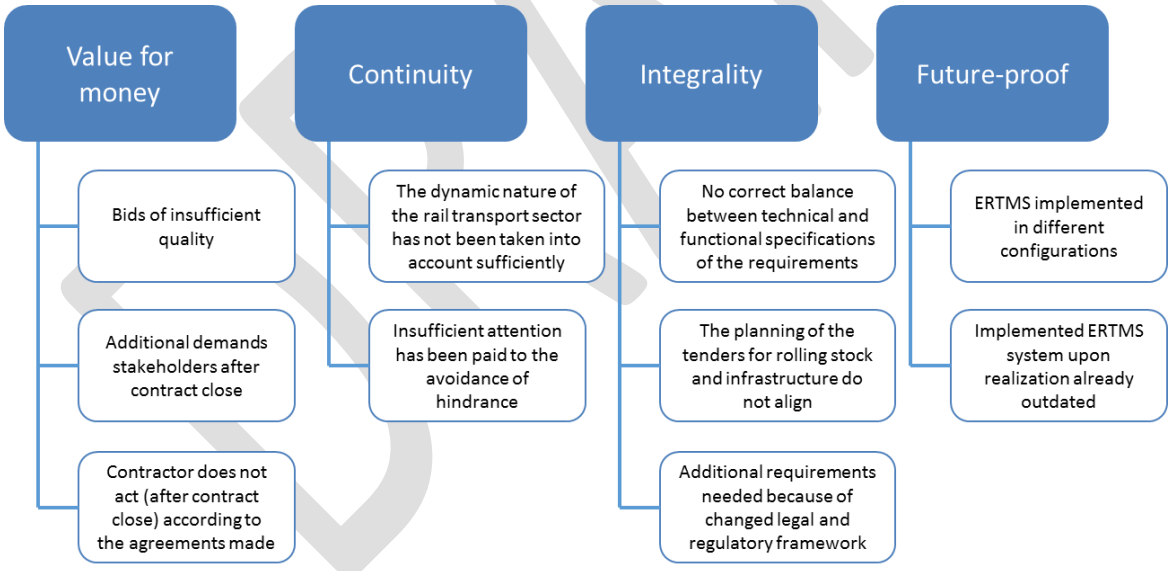


Figure 3 Procurement and contracting risks

The mitigation of risks can partially be achieved by selecting the most appropriate options and measures in this PCS. The contract manager will elaborate risk management procedures in the (various) Programme Decision(s), tender dossiers and contracts prepared as a part of the PCS. In that process, the tasks, responsibilities and powers especially of the contracting authorities and contractors will always have to be clearly defined. This is essential for effective risk management. Those definitions can be laid down in agreements made within the context of governance, or in the preliminary contractual provisions. Aspects such as governance, but also risk management

[16] ERTMS MKBA, 12 March 2014
[17] From ERTMS Procurement and Contracting Strategy framework letter, 31-03-2015

measures for major risks, shall be further developed by means of scenario analysis. The section below explains how this could be approached for both rolling stock and/or infrastructure and/or system integration, offering four specific subrisks as an example:

1. The risk of insufficient coherence and alignment between the various contracts can be contractually mitigated by making sure all contracts specify which activities are to be conducted as a part of the other contracts. This will ensure that the various contractors take this information into account and can be held responsible for coordination. A cooperation agreement - featuring shared key performance indicators (KPIs)[18] - for all contractors would serve to further mitigate this risk. Such 'shared KPIs' are, for example, successfully applied in the ICT industry to ensure cooperation between the various vendors during the Realisation Phase. This concerns shared KPIs to be laid down in a cooperation agreement in advance. That agreement will be entered as a supplement to the 'regular' contracts, i.e. the contract between the contracting authority and the contractor for the ERTMS component or the service to be supplied. It is important for this cooperation agreement to be made known right from the start of the procurement procedure and to be included in the dialogue and presentations, as it will also influence bids (including the bid price). Section 3.5 highlights some of the aspects to be addressed in drafting and providing the cooperation agreement.
2. The risk of a vendor lock-in can be mitigated at contractual level by explicitly highlighting the procedure for contract changes and including exit clauses for the contracting authority. The consequences of vendor lock-in can also be limited by making contractual agreements in advance about how to deal with foreseen and unforeseen changes in the future. Another option is to strive to achieve a relatively uniform roll-out and share sufficient information with the contracting authority to enable it to present that information from the contractor to a third party, if required.
3. The risk of overly complex or unbalanced[19] contracts can be limited by tendering contracts in (sustained) consultation with the market players. This could take the form of a competitive dialogue procedure or competitive negotiated competition proceedings.
4. The risks of insufficient value for money or an insufficiently future-proof ERTMS system can be limited by encouraging interaction between engineering consultants, maintenance companies and ERTMS suppliers. This will challenge market players to develop inventive solutions that are future-proof and offer stable value for money. Achieving this goal will require a prudent approach to specifications; the market must be granted the possibility to be optimally inventive.

Amongst other key conclusions from the risk sessions, it has become clear that every choice and scenario will involve inherent risks, which can all be managed to a greater or lesser extent through control measures. After all, there is no such thing as a risk-free programme on this scale. In the further elaboration of the PCS during all phases of the ERTMS programme, control measures will be taken to mitigate the risks where possible.

2.6 Joint ERTMS programme

The introduction of ERTMS is being prepared in the Plan Preparation Phase in the form of a joint programme conducted by NS, ProRail and the ministry. With effect from 1 April 2016, the organisation has been structured in accordance with the IPM model[20] applied by parties such as Rijkswaterstaat (executive agency of the ministry), also see figure 4. The introduction of this model means that integrated project managers have been appointed to oversee operational processes and technical management, environment management and contract management. The contract manager will be responsible for ensuring that this PCS is fully elaborated into (a)

[18] These are KPIs for individual parties aimed at ensuring a successful joint effort. As regards the pre-delivery phase, these KPIs will largely concern collaboration and the timely delivery of joint products. After delivery, they will mainly concern the availability and reliability of the delivered products.
[19] Contracts in which the contractor bears an excessive amount of risk.
[20] As regards the programme, use of the IPM model will require the appointment of three liaison managers representing the three parent organisations, in order to ensure that these organisations keep pace with the programme plan development process. This is referred to as the IPM+ model.

Programme Decision(s), contracting plans and tender documents in accordance with this document. The operational processes and technical manager will be required to provide input to this end (including the Terms of Reference), while the environment manager will be responsible for aligning stakeholder involvement and decision-making documents. To (further) ensure the interests of NS, ProRail and the ministry are served, liaison managers have been appointed. For regional transport operators, maintenance companies, freight transport operators en historic rail transport liaison managers will also be appointed. Liaison managers are charged with preparing their parent organisations and personnel for the introduction of ERTMS and the coordination thereof with other projects and programmes within their organisations. The modified structure more accurately reflects the high degree of complexity of the assignment. The IPM model essentially means that the managers keep each other alert on the basis of their own expertise. Collaboration between the various managers and workflows will obviously remain a focal point and is one of the programme's key success factors.

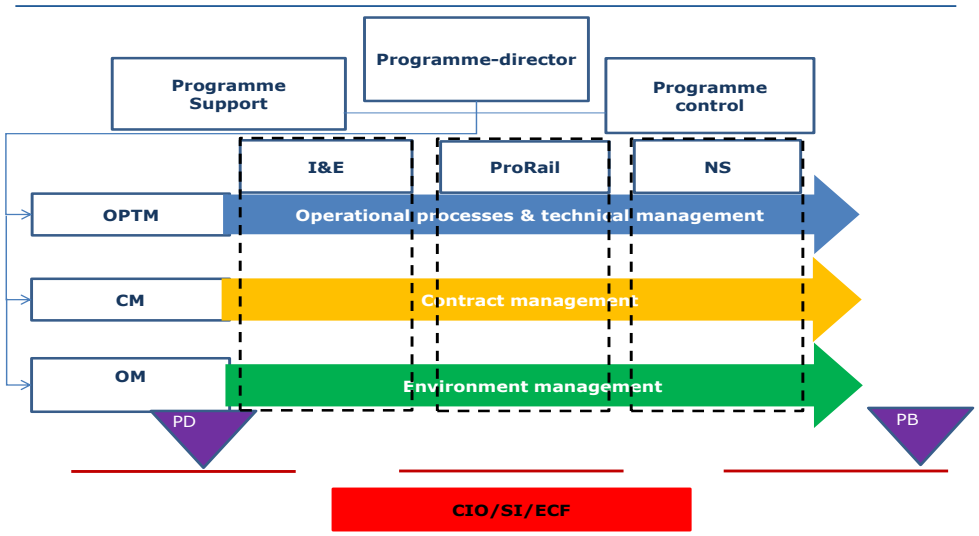


Figure 4 Structure of ERTMS programme with effect from April 2016

3. Generic funnel

This chapter deals, and the next three chapters deal, with each of the four (sub)funnels (generic, system integration, infrastructure and rolling stock) discussed in brief above. This chapter describes the general funnelling as largely described in the framework letter from March 2015, chapter 4 describes the funnel for system integration, chapter 5 the funnel for infrastructure and chapter 6 the funnel for rolling stock.

These chapters are all structured along the same lines, also see figure 5. First, the context described in section 2.2 will be reviewed and further elaborated, followed by an overview of all prerequisites for the relevant funnel. The next section outlines the considerations that form - together with the context and prerequisites - the basis for various tendering options for the relevant component. These options have been benchmarked against the purchasing objectives, resulting in a preferred scenario/option. Finally, the definitive option is chosen based in part on the outcomes of the Market Scan/market consultation and/or PPC. Each funnel description ends with a list of aspects requiring further elaboration/assessment.

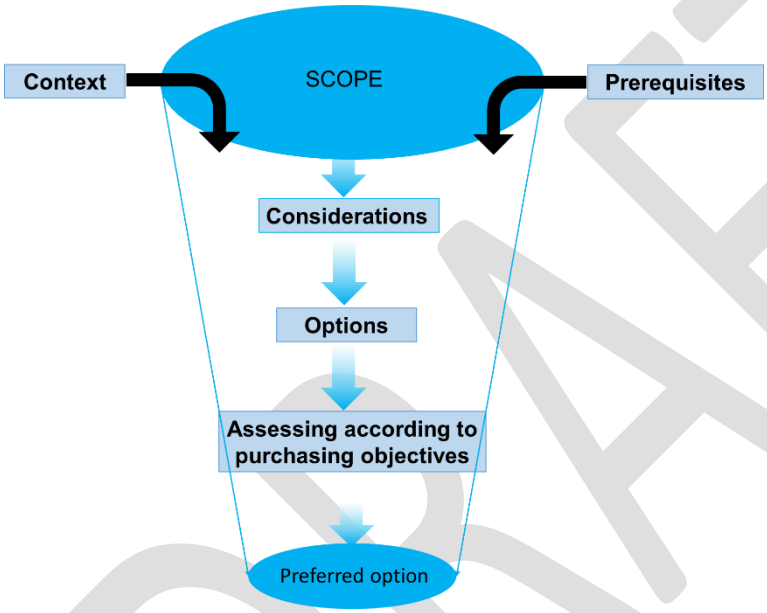


Figure 5 Schematic representation of funnel process

3.1 Context and prerequisites

The desired context for the ERTMS procurement procedure is described extensively in chapter 2. Specific qualities relevant to the choices made in this funnel include the complexity of installation work in a brownfield situation and the high degree of dependence on a limited number of engineering consultants' experience with and knowledge of rolling stock and infrastructure.

The prerequisite for this funnel is the Preference Decision, as elaborated in the OGSM[21]:

We are introducing ERTMS to make the railway system safer, more appealing and future-proof for passengers and freight transport operators. We are doing this with all the rail participants while 'the shop remains open'.

3.2 Detailed definition of scope

Two components of the ERTMS system referred to in section 2.1 deserve additional attention. This concerns the STM-ATB in the rolling stock and necessary improvements to the GSM-R network.

[21] Objectives Goals Strategies Measures, aimed at defining more focused programme objectives.

As described in section 2.2, only two suppliers are currently familiar with ATB and thus capable of developing/supplying the necessary STM-ATB. In order to remove this particular access barrier for the other ERTMS suppliers and ensure that more than two parties are interested in bidding for the Dutch tender, a decision was made to offer the STM-ATB to all ERTMS suppliers by means of management supply (also see section 6.6). As a part of this process, the programme will ensure that all suppliers have access to an STM-ATB supplied by the contracting authority. This will also help reduce the complexity of the procurement procedure.

The ERTMS systems installed in rolling stock and tracks/trackside locations communicate with one another via the GSM-R network. This is an existing network whose management and maintenance has already been contracted out by ProRail. The large-scale introduction of ERTMS in the Netherlands will necessitate limited adjustments to this network in order to ensure effective system performance. These adjustments do not need implemented separately by the ERTMS programme.

The scope of the programme is currently strictly limited to realisation, maintenance and any possible adjustments to ERTMS through 2028. Activities after 2028 do not fall within the scope of the programme. However, they do fall within the scope of the tender. This is due to the fact that the life cycle will continue beyond 2028.

3.3 Considerations & options

One of the first and most important decisions to be taken in this PCS concerns the choice between integrated or separate tenders for ERTMS installation in rolling stock and infrastructure. The framework letter of March 2015 already set out a provisional course in this regard on the basis of the expert judgement. According to the experts, a separate tendering process would be preferable in view of aspects such as reduced controllability, market forces and the risk of a vendor lock-in. The experts also concluded that, for these same reasons, the infrastructure tender would have to be further compartmentalised. In their view, a separate tender would also offer greater flexibility for the sequential roll-out of infrastructure and to incorporate the lessons learned from the initial tender and installation in subsequent procurement procedures.

Broadly speaking, this generic funnel distinguishes between two options:

- option 1: the integrated contracting of both infrastructure and rolling stock in a single contract;
- option 2: the separate contracting of infrastructure and rolling stock in multiple contracts.

3.4 Assessing the options

According to the framework letter, these initial ideas on the tender were supported by the Tender Board and other parties. However, no definitive conclusions could be drawn at the time as further studies were still needed. These studies could potentially impact the strategic direction outlined in the framework letter. Now that all the studies have been completed and the course outlined in the framework letter has been thoroughly assessed, the strategic direction outlined in this document (separate the tenders for rolling stock and infrastructure) has been confirmed. Crucially, this approach will require a continued focus on ensuring the mutual compatibility of infrastructure and rolling stock systems.

The various studies that have been performed outlined two main benefits of an integrated tendering and contracting procedure for rolling stock and infrastructure: improved manageability of the integration between trains and tracks, and the potential for further economies of scale[22]. Apart from these aspects, however, the studies mainly identified disadvantages.

[22] Economies of scale can be achieved because a) the development costs are spread over several units, b) the learning effects of earlier units are included, and c) mass production involves lower fixed costs per unit.

Firstly, the large financial scope of such a tender will inevitably have a negative impact on the manageability of the contract. Furthermore, many market players (with the exception of the ERTMS suppliers) generally do not find such large contracts (in excess of approx. €500-€750 million) appealing due to their mixed experiences with similar 'mega projects'. The coordination involved represents a risk factor in its own right.

As mentioned in section 2.2, the various market players have varying degrees of experience when it comes to the installation of ERTMS in rolling stock and infrastructure (in both brownfield and non-brownfield situations). In the event of an integrated procurement procedure, there is always a risk that a suitable party is contracted for infrastructure work that proves unable to provide the best possible quality in terms of rolling stock or vice versa. This would have a negative impact in terms of value for money.

A single tender for a single integrated large-scale contract means that only one party (consortium) can win. As a result, there will be no way to sustain competitiveness once the procurement procedure has concluded. This will also limit the potential for fall-back options (in the event that the original winner runs into problems) and the ability to offer a further 'bonus' once the procurement procedure has concluded. This also applies to adjustments or new assignments issued after the expiration of this integrated contract (vendor lock-in). The long term of such an integrated contract would make these issues all the more problematic.

As a fourth disadvantage, an integrated tender will make it more difficult to adhere to the basic principle of refurbishing the rolling stock first. In the event of an integrated tender both aspects will have to be put out to tender simultaneously. Since the infrastructure tender requires more preparation time than the tender for rolling stock, this could delay the start of the rolling stock tender.

Integrated tendering of rolling stock and infrastructure means integrated decisions on ownerships and responsibilities resting with the infrastructure manager or train operators, so they both may not be able to fulfil their responsibilities to optimum effect.

3.5 Preferred option

There are a large number of infrastructure and rolling stock interfaces with existing objects that are not set to be replaced by ERTMS (such as switches, ES welds[23], braking systems, etc.). The separation of infrastructure and rolling stock would introduce a new interface in need of active management.

The above factors have prompted a clear preference for the separate tendering of infrastructure and rolling stock. Studies in neighbouring countries have not identified any integrated contracts for rolling stock and infrastructure with a comparable financial scope. Those performing the system integration role can advise on the governance to lay down the operational management for both the roll-out and migration strategies clearly in advance, in particular on the basis of their expertise regarding:

- development and testing;
- standard changes and function changes;
- management and monitoring; and
- maintenance.

This must then be implemented consistently in the contracting for both rolling stock and infrastructure in order to implement updates and upgrades later on.

The separation between rolling stock and infrastructure could also be approached by ensuring that the tender requires all contracted parties to collaborate on the basis of an overarching cooperation agreement. In accordance with common practice in the ICT sector, such an agreement would

[23] Electronic splice welds

feature shared KPIs. Such KPIs focus mainly upon the definitive programme/project objective - an operational and integrated ERTMS system, in this case. The purpose of these KPIs is to mitigate the risks of poor coordination between the contractors for rolling stock and infrastructure. Contractor remuneration should be made partially conditional on the success of the overall programme to ensure that all parties work towards the same goal. This will prevent them from dodging responsibilities and will motivate contractors to help resolve problems they were not responsible for causing. The use of shared KPIs will encourage contractors to intervene even if they are not themselves contractually responsible (when a KPI is in danger of not being achieved due to another contractor's actions or omissions). In addition, contractors will be more inclined to share information and support each other pro-actively.

For example, when preparing and providing a cooperation agreement for the Realisation Phase, the following aspects should be taken into account:

a) *The contractual boundaries of the cooperation agreement*
   If financial incentives are offered when shared KPIs are achieved, contractors will be encouraged to collaborate. However, it should be noted that such collaboration will not be legally enforceable (performance commitment), since contractors can only be made responsible for obligations within their own control.
b) *Level of financial incentives*
   The incentives should be sufficiently lucrative for the contractors to make them collaborate. Another point for attention is how the incentives are to be divided. Not all contractors bear the same risks, and some risks are greater than others.
c) *Type of collaboration*
   Collaboration could be implemented in the form of regular consultation, an obligation to provide information and to issue warnings, and access to information.
d) *Commencement and duration of the cooperation agreement*
   This aspect is particularly relevant in the event of multiple contracts with different time schedules.
e) *The shared KPIs to be formulated*
   Each shared KPI should be worded in such a way that it is clear when it has or has not been achieved. For example, a KPI for an 'operational system' could be deemed to have been achieved only after several successful test runs have been completed. There is also the option of formulating a KPI for each constituent step; for example, a KPI for the Maintenance Phase as well as for Completion.
f) *Fall-back scenarios*
   The cooperation agreement should also provide for situations in which one or more contractors withdraw (i.e., fail to perform their respective duties).

This alone is not enough, however. Experience in other countries shows that system integration must take place. The system integration team must verify not only that the tenders are elaborated integrally, but also that the substantive aspects are effectively aligned and remain so during the Operational Phase. The team responsible for operational system integration must also resolve issues and make decisions during the Realisation Phase in order to help build and maintain an operational transport system. This operational system integration team, which comes under the operational and technical manager in the Plan Preparation Phase, has currently been (partially) defined. In the course of the realisation the task of system integration will change from a preparatory role to a more monitoring and adjusting role and will then consist of advising client(s) about dependencies, specifications, interfaces, tests and cooperation. Needless to add, the operational system integration team must have a proper mandate and sufficient powers. Agreements to that effect will be made concerning governance, for example laid down in a cooperation agreement. Prior experiences with ERTMS in the Netherlands and abroad also show that the appointment and sustained presence of such an operational system integration team is crucial in ensuring and maintaining the integration of rolling stock and infrastructure aspects.

Operational system integration will take place in close consultation with contract management since those powers will have to be laid down in a contract (also see 2.5 and 3.6).

Although the integration team's role will be relatively limited in terms of both FTEs and costs, its appointment will substantially increase the likelihood of success and realisation of joint objectives. In the case of programmes with an ICT component, a well-equipped system integration team in conjunction with contract management will help to ensure more effective management on the basis of five programme objectives (in this case safety, interoperability, capacity, speed and reliability) as compared to situations in which both domains independently work towards their respective goals (in this case simply meeting the specifications for *either* operational rolling stock *or* operational infrastructure). The inclusion of shared KPIs in the various tenders can be useful in this regard (see section 2.5 and the aforementioned in this paragraph). During the procurement procedure it is important to make bidders aware of the contracting authority's objectives. It is crucial for the bidders to familiarise themselves with those objectives and adopt them in the procurement phase. This could be stimulated by incorporating those objectives in the funnelling or award criteria through valuation of, for instance, the extent to which the contractor is in control of the project risks or the contracting authority's risks. It is also important to ensure that, during the tender process, the contracting authority shares its vision of the objectives with bidders (not only by publishing them in the tender documentation, but also by highlighting them in presentations, dialogues etc.).

Operational system integration will also ensure that the completed technical systems are optimally configured for operational use. Finally, it can also contribute to the coordination of infrastructure and rolling stock roll-outs and aspects such as planning and version maintenance (migration). This role will also have to be organised effectively following the roll-out and could potentially evolve into a broader system integration capable of resolving other issues in the railway sector. How the system integrator, infrastructure manager and train operators are to resolve issues in collaboration with the various market players involved will have to be examined and determined during elaboration of the PCS. Relevant aspects in this regard include the following:

- the manner in which parties collaborate in order to achieve an operational system;
- the manner of collaboration during the Realisation Phase (infrastructure);
- the manner in which disruptions are resolved during the Operational Phase. In preparing the disruption resolution protocols, attention will be devoted to collaboration between the parties involved (contracting authorities and contractors) and to the required division of tasks.

These segregated components (SI, infrastructure and rolling stock) will be further elaborated on the basis of the preferred option (the separate tendering of rolling stock and infrastructure and establishment of a well-equipped operational system integration role) in the sub-funnels discussed in the following chapters.

3.6 Options for contracting authority, contract form and tender type

Although this generic funnel does not define the PCS in sufficient detail to allow for definitive choices in terms of contract and tender types or contracting authorities (those choices will be made in the contracting plans to be prepared), generic statements can be made on the basis of conducted studies.

Applicable section of Public Procurement Act 2012, potential contracting authorities and procurement procedures

The framework letter describes the outcomes of various studies. For example, the letter stipulates that the further roll-out of ERTMS in the Netherlands may be tendered on the basis of Section 3 of the Dutch Public Procurement Act 2012, as the relevant tenders concern public service provision in the area of rail transport. This is relevant as tendering on the basis of Section 3 allows for more

flexibility thanks to a greater number of available procurement procedures and the option of applying accreditation schemes. Some potential procedures are not suited to programmes such as ERTMS due to the level of complexity involved, the efforts expected of tenderers during the procurement procedure, the number of components to be procured and the number of parties involved. Definitive decisions as to the number of contracts and desired contract formats are also relevant in this regard. As a result, the number of suitable procurement procedures is currently still limited. Based on an analysis of possible procurement procedures and the preference for separate rolling stock and infrastructure tenders, the following procedures have been designated as suitable:

- competitive procedure with negotiations; and
- competitive dialogue procedure.

A suitable procurement procedure will be selected from the above options in a subsequent section of this document/the elaboration of the PCS.

Under the terms of Section 3 of the Dutch Public Procurement Act 2012, both train operators/rolling stock owners as well as ProRail and the ministry (acting either on behalf of the train operators/ProRail or in the capacity of a contracting agency) may initiate and coordinate the tender procedure or procedures. As regards the tenders for infrastructure, the envisaged interconnections between the contracts and infrastructure ownership would make ProRail the obvious candidate for the role of contracting authority.

Potential contract forms and opportunities for private financing

In a PPC, the most financially advantageous contract form is identified. The initial PPC conducted in 2014 revealed that a DBFM (Design, Build, Finance and Maintain) contract would not yield any added value in comparison with a DBM contract (Design, Build and Maintain). The reason for this is the fact that the major risks inherent to a brownfield situation will inevitably drive up the financing costs. This PPC was updated in the summer of 2015. According to the PPC update, an integrated DBM contract would offer added value compared with separate contracts for Design, Build and Maintain. The primary explanation for the demonstrated added value is the effect of design optimisation and lower transaction costs after awarding the contract. The conclusion of a DBM contract, in a certain sense, equates to pre-financing by the contractors. The costs for which the entire ERTMS programme can be realised are linked to the extent of cost and risk management and changes (of scope).

The PPC defines the following prerequisites for each implementation variant:

- avoiding/managing vendor lock-in;
- ensuring sufficient market competitiveness and a level playing field, both in the short term (current tender) and in the future (ensuring that enough vendors gain experience on the Dutch market);
- ensuring that the contracting authority devotes sufficient attention to the role of integration and the management of interface risks (between ERTMS and other systems, between ERTMS, train, track and the GSM-R communication system and the dynamic risk of changes over time);
- sufficient professional and consistent contracting in terms of both the development and formulation of the necessary products (contract, output specification, payment mechanism) as well as in the attitude and behaviour towards market players; and
- sufficiently documented and accessible current knowledge regarding assets (both infrastructure and rolling stock), for example in an up-to-date asset register.

The various options in the funnels below were defined on the basis of the prerequisites in the PPC, the aforementioned conclusions and recommendations from the Fyra enquiry, the ICT enquiry and experience gained in the Netherlands and abroad.

Contract duration

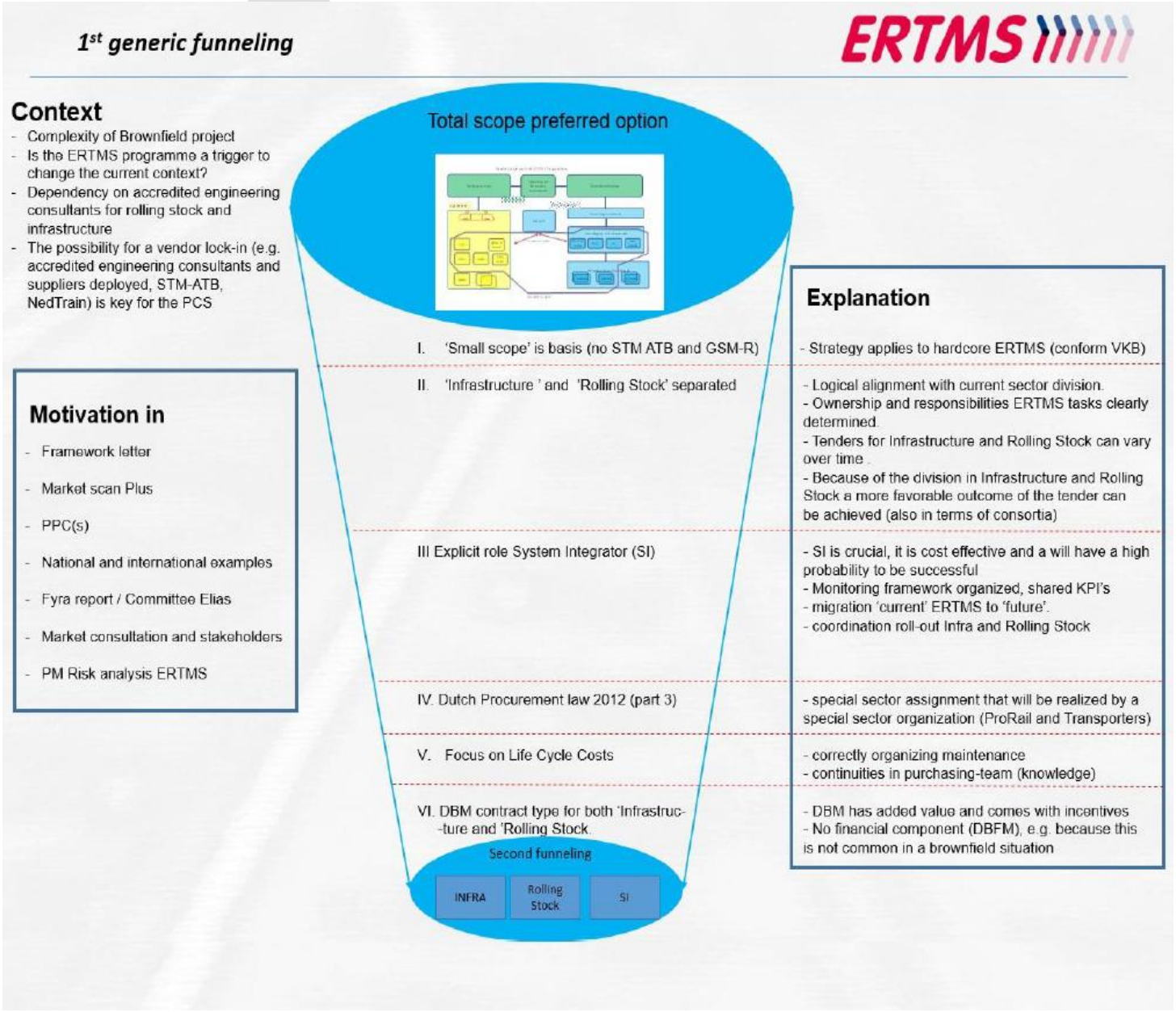
If the selected contract form also includes maintenance, the contracting period for this work must be determined in further detail. This aspect was assessed as a part of the cost estimate. As shown below, the outcomes differ for rolling stock and infrastructure.

As regards rolling stock maintenance, a contractual period of approximately 15 years would seem the most obvious option in view of the expected technical life span of the On Board Unit (OBU) and the STM-ATB. This period would also coincide with the full rolling stock overhaul scheduled halfway through the train life cycle - generally around 15 years - in cases where these ERTMS components are installed in a new train. From a supplier's perspective, such contracts must be long enough to recoup the various transaction, developments and design costs. On the other hand, a very long-term contract would be unappealing to the contracting authority, who will require the flexibility to respond to future developments and avoid vendor lock-ins. The optimal maintenance contract duration would thus appear to be a period of 10-12 years, with one or two opportunities for a 3-5-year extension. This is in addition to the - approximately - 5-year period required for the Design and Build Phases (DB). Crucially, contracting authorities and contractors must be offered clear information on expected and unforeseen changes in advance. The parties can then reach agreements on these aspects which can be recorded - for example - in a price book. This will help to ensure that all the parties involved can sustain a good working relationship for the duration of the contract period.

The situation is somewhat different when it comes to infrastructure. The various ERTMS components have a varying estimated life cycle, such as five to ten years for the software in, for example, the interlockings and RBCs, whereas the physical components such as the balises have a lifespan of up to 25 years and cables can even last as long as 50 years (including the approximately 5-year period required for the Design and Build Phases). A contract duration of 20 to 25 years (with an option for extensions) would thus seem the most logical option. The replacement of components with a shorter lifespan will then take place within the contract period. Unlike rolling stock, infrastructure undergoes many adjustments every year (such as the removal of switches or crossings), thus necessitating adjustments to the relevant ERTMS components. The tender will have to take this aspect into account. This could be approached by allowing third parties to implement changes.

The contract durations mentioned above are supported by experiences abroad, where both rolling stock and infrastructure maintenance tends to be contracted out for periods of 20 years or more. The Danish system offers parties the opportunity to end the cooperation every five years. This enables the parties to reconsider their collaboration on a regular basis. The contracting authority can then terminate the contract if the contractor is no longer delivering satisfactory results or, for example, if maintenance work can be carried out in-house due to changing circumstances. The contract manager should consider incorporating a similar best practice in the Dutch contracting plans as a part of the PCS elaboration process.

Figure 6 Generic funnel diagram



4. Operational system integration funnel

4.1 Context and prerequisites

Now that a decision has been made to tender rolling stock and infrastructure separately, the next step will be to determine the optimal integration strategy. This does not concern independent monitoring by the system integrator as enshrined in the current programme. The current and future responsibilities associated with this role are described in section 4.7.

Both studies and practical experiences gained during the Amsterdam-Utrecht pilot project, for instance, have shown that very few parties in the market are familiar with both rolling stock, infrastructure and the operational processes to be supported by the technical systems. Their number becomes even smaller if the accredited engineering consultants and suppliers deployed during the installation process are required to be independent. However, broad knowledge of the transportation system is a prerequisite to ensure effectively aligned train and track systems and working processes in the overall transportation system. The necessary broad knowledge of the overall railway system is also in short supply in the parent organisations and ERTMS programme.

As regards the Plan Elaboration Phase and programme organisation, responsibility for defining general frameworks for the transport system has been assigned to the transport system work package. However, effective system integration does not stop at defining frameworks for the transport system. Amongst other challenges, an integration strategy and a migration strategy will have to be developed and specifications and interfaces will have to be identified and adopted. More attention is needed for these matters even in the present Plan Elaboration Phase. Other system integration requirements will then also be applied during the Realisation Phase. Amongst other aspects, these will concern configuration management of the specifications and interfaces and in-house or third-party testing and simulations.

This funnel-based method should serve to identify the optimal system integration approach - both prior to and during the tendering process and during realisation - and determine which parties should be tasked with these responsibilities. In view of the parent organisations' and programme's limited amount of knowledge and capacity, additional capacity may have to be sought on the open market.

4.2 Detailed definition of operational system integration

This chapter focuses on operational system integration. As regards ERTMS, the term 'operational system integration' is taken to refer to the integration of train and trackside systems, or the integration of technology, processes and people at transportation system level. However, system integration also takes place at lower hierarchical levels. This includes the integration of multiple ERTMS systems within a train or a specific line[24], and the integration of ERTMS and existing systems in rolling stock or trackside facilities[25]. System integration activities at such lower levels have traditionally been organised by the infrastructure manager/rolling stock owners or market players. This chapter mainly concerns the first two categories (i.e., integration between train and trackside and integration at transportation system level between technology, processes and people).

Experiences abroad and experiences gained during the installation of ERTMS in the Netherlands have both shown that the integrality of the overall transport system tends to be overlooked due to an unintentionally biased focus on either infrastructure or rolling stock. Parties - and thus systems - also tend to disintegrate over time despite initially integrated working and thinking processes. This could be caused by changes in the infrastructure environment and insufficient regard for interfaces with the rolling stock. This means it will be crucial to continually and independently

[24] For example, between a balise or trackside RBC or between the rolling stock-based EVT and DMI.
[25] For example, between the trackside RBC and a switch or between the EVT.

ensure that any decisions taken over the course of the process do not harm the integrality of the overall transport system.

In addition to these efforts to ensure that an integrated approach is being applied at all levels, various system integration tasks will also have to be carried out at higher levels in the programme, during all phases.

In addition to defining a framework for the transport system, this will involve the following activities during the Plan Elaboration Phase:

- acknowledging dependencies, so that all interfaces can be identified and monitored, and identifying/monitoring these interfaces and the associated specifications;
- preparing an integration strategy in order to ensure effective alignment between people, processes, data and technology and safeguard these achievements moving forward;
- preparing frameworks for system requirements in order to clarify performance requirements for the transport system and ensure that these requirements can be translated into to the individual components, and
- preparing requirements for testing and simulations, in order to ensure that the specifications and interfaces are genuinely aligned.

Within the programme it has been found that the above has so far not been implemented to a sufficient degree. Operational system integration for the remainder of the Plan Elaboration Phase should be set up at the earliest possible opportunity. This will have to be elaborated in further detail in a system integration action plan. Additional (potentially external) capacity may have to be brought in to this end, as the programme will not have sufficient knowledge of the overall transportation system and integration processes at this stage. This process is expected to be initiated in the summer of 2016, so that the additional capacity thus acquired can be used to advise on the elaboration of this PCS in (the) Programme Decision(s), contracting plans and tender dossiers. Experiences gained with comparable integration issues in similar projects in the Netherlands and abroad will be crucial in this regard.

These duties will evolve during the Realisation Phase as ERTMS systems are actually procured and installed. Operational system integration will then be charged with the following tasks:

- configuration management of specs/interfaces;
- conducting and monitoring tests and simulations or contracting third parties do to so;
- making decisions at a level transcending individual processes and technologies;
- communicating adjustments to all parties involved during the Realisation Phase, and
- taking go/no-go decisions on the commissioning of systems.

Incidentally, in the Operational Phase – i.e. once ERTMS has been taken into operation – there will still need to be a type of system integration, in order to provide advice on overarching issues: processes and technical systems will continue to evolve over the course of the life cycle, necessitating an effort to balance the interests of train operators and the infrastructure managers. The details of this role will be worked out during the Realisation Phase.

4.3 Considerations & options

The responsibilities of operational system integration are subject to various considerations. The team must be independent of the market players and must prioritise the transport system in all its efforts. As described above, the duties of operational system integration will evolve over the course of the programme.

Based on the aforementioned consideration, three realistic options for the responsibility for operational system integration can be identified:

- option 1: responsibility is assigned to the infrastructure manager;

- option 2: responsibility is assigned to a combination of commissioning parties (such as the current programme), and
- option 3: responsibility is assigned to the market.

The option of assigning responsibility for system integration to one or multiple train operators was considered, but it was rejected as this would make it more difficult to guarantee non-discrimination of other train operators than the three options outlined above.

4.4 Assessing the options

All three options assign final responsibility to a single party, while simultaneously contracting the services of external parties in addition to staff from the parent organisations ProRail, NS and the Ministry of Infrastructure and the Environment because of the limited capacity referred to above or because of the wish to think outside the box and incorporate knowledge from outside the railway sector.

The options have been assessed in terms of the purchasing objectives value for money, continuity of service provision, integrality of controllability, manageability and reliability and future-proofing, and they all have advantages and disadvantages. There is not much to choose between the options for the purchasing objective value for money, i.e. the highest added value. A solution whereby final responsibility is assigned to ProRail (option 1) runs the risk of being overly focused on infrastructure technology rather than on the interests of stakeholders/rolling stock owners and costs (Dutch national interest). The continuity of service provision is best assured in the present division of responsibility, that is option 1 or 2. Option 2 gives the best integrality and manageability because the focus is always on integration under this option. Likewise in terms of future-proofing, operational system integration is best organised as close as possible to the organisations that ultimately have to work with the system. Since this also affects train operators in addition to the infrastructure manager, option 2 scores slightly better in this case than option 1. Option 3 scores less than options 1 and 2 because in the event of the market having final responsibility, neither ProRail nor the train operators nor the ministry would any longer have a clear overview of the overall situation. This could lead to a high level of dependence on external parties, calling for additional governance measures. There is also the question of whether the operational system integration role could then ever be filled by the sector itself again. Options 1 and 2 also score better than option 3 on future-proofing. For future-proofing, safeguarding the knowledge of the connection of the different infrastructure and rolling stock systems to the operational processes at the organisations that will have to work with the transport system during the life cycle is crucial. After all, the transport system will require regular modification and updating throughout the life cycle (even after the market players have been discharged and the programme has been terminated). Examples include European developments, desired functional changes and replacement of system parts at the end of their service life. It is best in this regard if these organisations actively shape the connection independently, but also collectively, during the Implementation Phase.

4.5 Preferred option

In view of the above, a decision was made to select option 2 whereby the parent organisations jointly ensure operational system integration by means of the programme and jointly continue to develop knowledge of the complete system. This choice is supported by both the programme's prior experiences obtained through market consultation and experiences abroad, confirming that an approach that does justice to the overall system design will require centralised management.

As previously noted in 4.2, both the parent organisations and broader industry sector currently lack staff with sufficient knowledge of both rolling stock, infrastructure and the relationship between these two factors in the context of the overall transportation system. Knowledge acquired through the ERTMS programme (assignments) and also through ERTMS Academy and RIO training courses is one of the current strategies to ensure knowledge building for all the players, not only in the ERTMS field, but also with regard to operational system integration. In addition, however, external parties may also have to be contracted to develop the necessary integration skills within

the programme (and subsequently at other organisations) and to think outside the box. This support is also needed in the Plan Elaboration Phase, above all for system integration issues. Engineering consultants that are not accredited in the Netherlands but have gained extensive experience with ERTMS abroad and even experts from other sectors such as the aviation industry may be suited to fulfil this role.

4.6 Follow-up studies of operational system integration

There are three issues requiring further consideration in the follow-up studies of operational system integration:

1. The main question is how operational system integration will be performed by the joint contracting authorities (or the programme) in the Plan Elaboration Phase. This assessment will require further elaboration of the above aspects in the form of an action plan. This plan should clearly indicate the required number of FTEs for operational system integration. The ERTMS programme is expected to recruit the required capacity in the summer of 2016. Knowledge and expertise from the sector and recruitment of staff with an understanding of integralion issues would seem the most logical solution, given the desired specific characteristics of this capacity.
2. An assessment will have to be conducted on the basis of this action plan in order to determine the optimal structure for operational system integration within the programme (in accordance with the preferred option). As regards the Plan Elaboration Phase, it would seem logical to accommodate operational system integration with the operational processes and technical manager (as described in section 2.6.) in the form of a staff position, where the aforementioned duties can be carried out and recommendations drawn up for the operational processes and technical manager on the aspect of integration and results that benefit the national interest. This team can then be supplemented with external integration experts (from other sectors, if necessary) and internal staff with knowledge of the railway sector, in order to strengthen the broad transport system knowledge of internal staff and - eventually - the parent organisations. Needless to add, as pointed out in section 3.5 operational system integration should have a proper mandate and sufficient powers, and this will have to be laid down in agreements on governance and a cooperation agreement.
3. Analysis and optimisation of the entire ERTMS system. This requires analysis of both train and trackside data. In the past this data tended to end up with different parties. Optimisation of timetable models, for example, calls for central chain coordination.

4.7 Independent monitoring system integrator

As previously stated, the role of the independent monitoring system integrator – not to be confused with operational system integration described in the previous sections – is currently performed by an independent external party appointed by the ERTMS Governance Group. In the event of conflicts between the parties (as regards both ERTMS and - potentially - broader technical issues), the independent monitoring system integrator may provide the responsible minister compelling recommendations on the basis of the relevant facts within the scope of his/her mandate. This should serve to ensure that parties are not disproportionally disadvantaged as a result of other parties' decisions. In the short term this role will become increasingly important and will require more and more effort and capacity. It is expected that the purchasing of support by the independent monitoring system integrator can commence in the summer of 2016.

This role of this independent monitoring system integrator will also evolve in the Realisation Phase, and a different structure for this role may be needed in the longer term. In the long term (after completion of the Realisation Phase), an ERTMS organisation could be established along the lines of the ACM[26]. An industry-wide dialogue will have to be initiated in order to shape this new system

[26] The Netherlands Authority for Consumers and Markets (ACM)

integration role after completion of the Realisation Phase. For example, the future system integrator will have to determine how the Dutch railway system can transition from one ERTMS version to the next at the lowest possible cost while minimising disruptions for passengers and freight transport operaters.

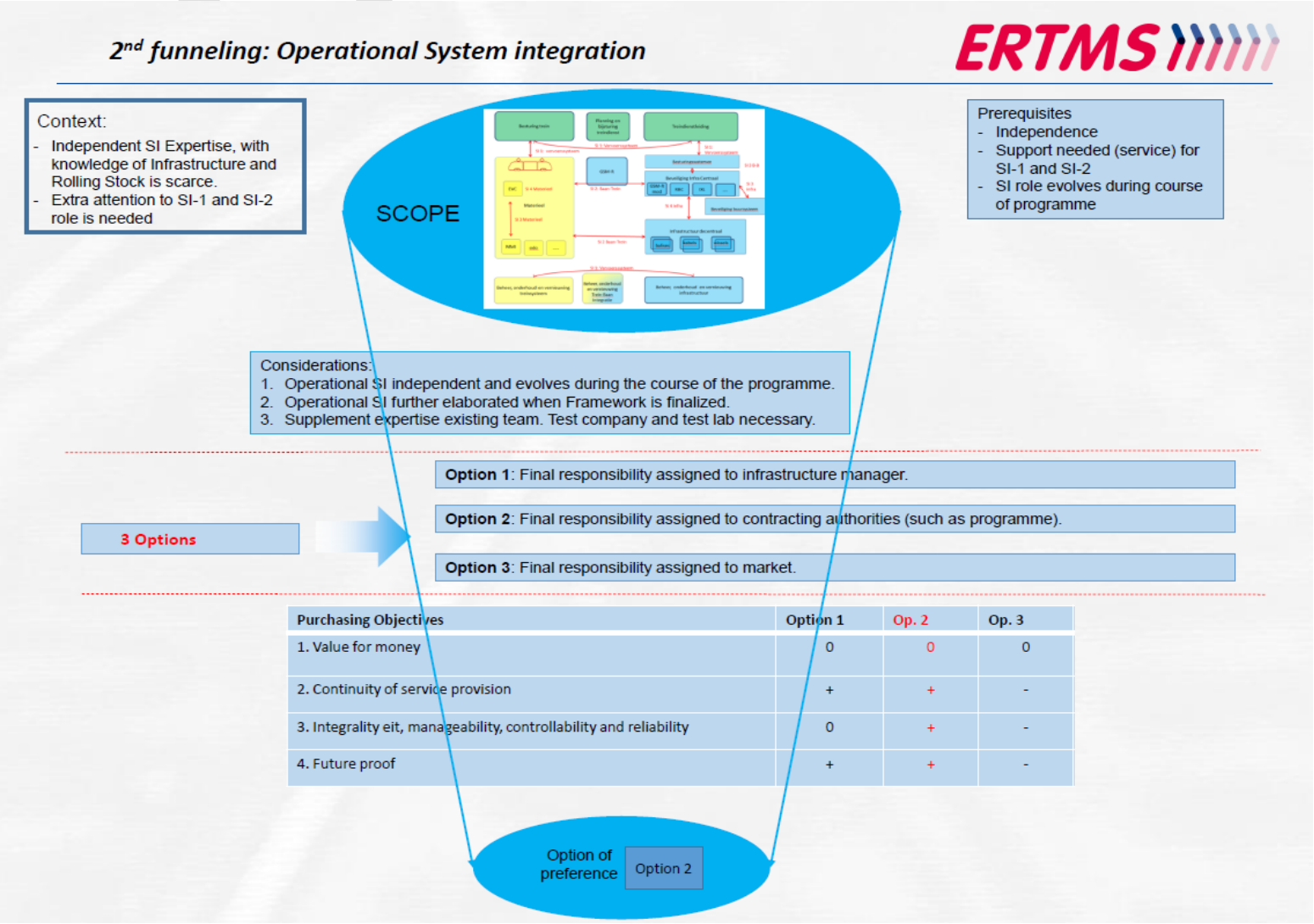


Figure 7 Diagram of overarching operational system integration funnel

5. Infrastructure funnel

5.1 Description of context & prerequisites

Section 2.2 described the current situation in the Dutch railway sector. Key aspects relevant to the tendering of infrastructure include the limited number of engineering consultants accredited to work on train safety systems and their capacity. Furthermore, some ERTMS suppliers are less experienced in terms of infrastructure installation than others, especially in brownfield situations. The market players currently active in the Netherlands are familiar with the Dutch railway network. New parties seeking to enter the market face a knowledge barrier. This barrier should be eliminated where possible by ensuring effective cooperation with engineering consultants and a thorough dialogue with the market. It should also be pointed out that the tender for ERTMS in the Dutch infrastructure system only represents a minor demand on the global ERTMS market. Day-to-day maintenance to the railway infrastructure is currently organised in separate maintenance contracts based on the principle of a single integrated point of contact for rail disruptions in each region.

5.2 Detailed definition of procurement scope

Section 2.1 identifies the ERTMS scope to be purchased for and installed in trackside systems. These include interlockings, RBCs, underground infrastructure (cables) and balises. Determining which (infrastructural) lines are to be refurbished will be an important part of the tender procedure. Although the roll-out strategy (the document will be referred to in due course, expected in the summer) does offer a relatively accurate indication in this regard, the amount of infrastructure to be refurbished will partly depend on the remaining budget after completion of the tender and conclusion of funding agreements for rolling stock as well as the potential for economies of scale in the area of infrastructure. The Programme Decision on infrastructure will define a minimum and maximum scope based on the current business case and roll-out strategy. The scope of the programme is currently strictly limited to realisation, maintenance and any adjustments to ERTMS through 2018. Activities after 2018 do not fall within the scope of the programme. However, they do fall within the scope of the tender, because the life cycle will continue beyond 2028. The upgrades will most likely be conducted in a later stage of the contract period.

5.3 Considerations & options

The options for the infrastructure have been developed in line with two basic principles: only contract that of which there is a clear picture (this for instance prevents the pricing of risks that are difficult to assess) and enter into all the contractual obligations necessary to keep the entire life cycle controllable in one go (this consideration results from the vendor lock-in issue).

In elaborating the options account has been taken of the context in which the implementation of ERTMS takes place, which has been described in section 2.2 (such as: ERTMS is an independent system, it is a brownfield project, it is a long-term programme and the existing market bottlenecks). A suitable approach for the infrastructure has also been considered with a view to future maintenance and management, failure recovery, availability and continuity. In accordance with the Market Scan and the PPC, the basis for contracting is in line with the DBM principle. The question as regards a DBM contract is to what extent services (by engineering consultants), ERTMS components (by suppliers) and geographical roll-out (by contractors) are procured in an integrated contract or separate DBM contracts and to what extent the present maintenance contracts are to be respected. The following main considerations were then made:

- With a view to rapid failure recovery, regular 1st and 2nd line maintenance will be placed with the maintenance contractors in the existing maintenance contracts. Only the knowledge-intensive 3rd and 4th line maintenance on the central ERTMS systems will be placed with the ERTMS suppliers[27];

[27] First and 2nd line maintenance covers relatively straightforward maintenance work that can be performed in situ. Third and 4th line

- The choice for a single supplier would be too restrictive (over-dependency, no competition following contract award, no spread of risk of breach of contract). With a view to ensuring a healthy market after conclusion of the ERTMS programme, more ERTMS should be tendered in competition. Three suppliers would seem too many (on account of high development and management costs and a less attractive volume), so ideally two ERTMS suppliers should be attracted who then work towards each other, for example from the North-South or East-West direction;
- The ERTMS suppliers are global players who focus above all on realising projects. They should be engaged for doing what they are good at: developing and supplying central ERTMS systems. Opting for central ERTMS systems means a vendor lock-in. This vendor lock-in is limited by also allowing third parties to make infrastructure configuration changes.
- The in-depth knowledge and experience of all the (complex) operational processes for infrastructure, regulations and systems is only available at engineering consultants accredited by ProRail. The work can be done in a controlled manner and the continuity of the train service can be better safeguarded by using these accredited engineering consultants in design, planning, realisation, testing, commissioning and maintenance. However, the limited number of engineering consultants accredited for safety should not be a limiting factor in the forming consortium.
- The long duration of the roll-out programme means that the geographical scope will be subject to change because of other projects. This applies before, during and after the realisation of ERTMS. The line followed in the preferred scenario is 'in a single tender where necessary, several tenders where possible, to have a better overview of the scope of the tender'. Among other things this concerns the choice only to contract the actual roll-out/installation along the various corridors as and when necessary, in order to ensure that the pricing is based on the actual scope. The same applies to the contracting of changes in the Operational Phase.

During the preparation of the PCS several variants, in different levels of detail, were generated for the contracting of the infrastructure. Thinking through these variants helped to make a distinction between the main considerations referred to above and other considerations. There are numerous aspects for which variation is conceivable. To give some examples: models based on one ERTMS supplier for the entire scope of the programme gradually dropped out, as did models with more than two ERTMS suppliers. In the case of this latter example there was the possibility of separate tendering processes for each (cluster of) ERTMS corridor(s), with a single contract being used for each geographical cluster for supply, refurbishment, maintenance and if necessary future changes. Variation in the number and the extent of refurbishment contracts is also conceivable, however; for example, a model with one large refurbishment contract, with or without several ERTMS suppliers, was rejected. Analysing the benefits and drawbacks of such models was important to prioritise considerations, which eventually resulted in three PCS options. In this way, at an aggregated level these three options represent the different dominant mindsets of the Preparation Phase that emerged. They all involve progressive segmentation of the infrastructure tender. In all three options, the engineering consultants accredited to work on train safety systems are excluded from the procurement procedure in order to allow for the maximum number of potential combinations, and the present maintenance contracts are respected. This specifically concerns work performed by accredited engineering consultancies during the Design and Realisation Phases. However, this does not mean that market players will not be offered scope to implement design optimisations. Function-based specification, where possible, will create the necessary room for that purpose.

In addition, maintenance referred to as regular 1st and 2nd line maintenance will be accommodated within the existing integrated maintenance contracts. The ERTMS suppliers will initially remain responsible for 3rd and 4th line knowledge-intensive maintenance. All three options, moreover, are

maintenance covers more complex maintenance work that requires specialist knowledge of systems.

subject to the condition that "the shop should remain open", and that any inconvenience to commuters and freight transport operators caused by the EMRTS roll-out should be minimised.

- Option 1[28]: The entire procurement scope (procurement of components, infrastructure design, infrastructure refurbishment, knowledge-intensive maintenance work, training and adjustments during the Operational Phase) is divided over two integrated contracts for two consortia of ERTMS suppliers with contractors. Each of these two contracts covers an entire ERTMS scope for a separate geographical part of the Netherlands.

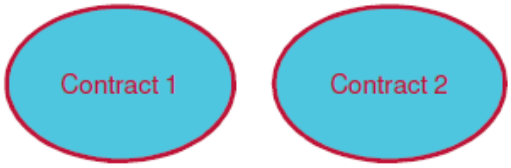


Figure 8 Indicative and simplified representation of option 1

- Option 2: Design, delivery, knowledge-intensive maintenance and adjustments to central ERTMS system components during the Operational Phase will be contracted to ERTMS suppliers by means of two large aggregate contracts, as in option 1. However, the tendering of track section refurbishment will be contracted separately and phased. A total of 7 to 12 contracts are envisaged. All of these contracts will be managed from within the same contracting authority (ProRail).

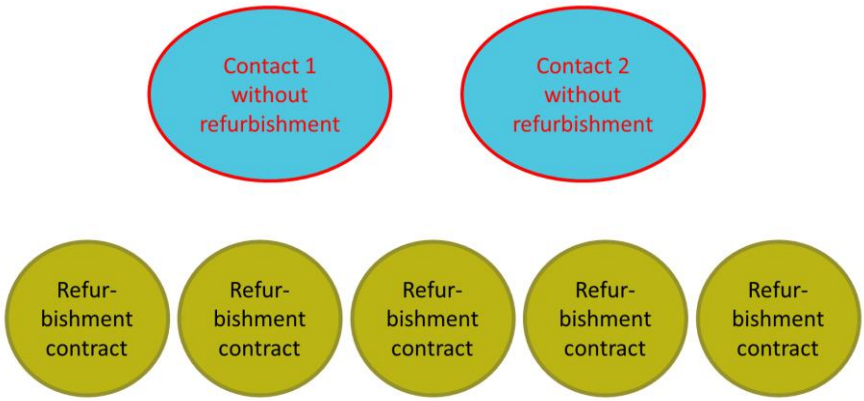


Figure 9 Indicative and simplified representation of option 2

- Option 3: As an elaboration to the second option, any adjustments to the ERTMS system in response to infrastructural modifications during the Operational Phase will be independently contracted as and when necessary under option 3, in addition to refurbishment. Furthermore, aspects such as training will be aligned with existing

[28] This is the preferred scenario from the Market Scan, whereby two consortia each secure a fixed contract with additional work for the better performing consortium. The preferred scenarios from the Market Scan are fairly abstract and, for example, take no account of existing maintenance contracts.

structures such as the ERTMS Academy and RIO[29]. Option 3 thus corresponds to most of the existing structures. Option 3 will involve some 10 to 15 contracts and separate function modification contracts. All of these contracts will be managed from within the same contracting authority (ProRail).

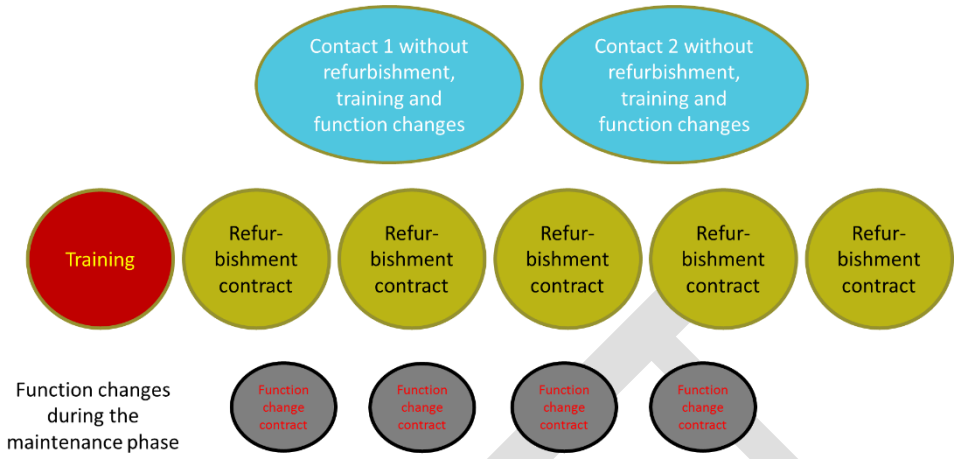


Figure 10 Indicative and simplified representation of option 3

Some matters will require further elaboration under the preferred option. They include:

- the question of whether non-specific ERTMS components (axle counters, cables) must be included in supplier or contractor contracts;
- the question of whether to work with bonuses for good performance in the form of additional track sections for supplier contracts;
- the question of how governance is organised to lay down operational management for both the roll-out and migration strategies clearly in advance. This applies in particular to development and testing, standard changes and function modifications, management and monitoring and maintenance. This is also necessary with a view to implementing subsequent updates and upgrades.

The ideas about this and about the division of risk in this regard will be discussed with the market players in more detail before the Programme Decision and tendering process.

5.4 Assessing the options

The three options have been assessed in terms of the purchasing objectives value for money, continuity of service provision, integrality of controllability, manageability and reliability and future-proofing. All options have advantages and disadvantages.

From option 1 to 3 a movement is made from 2 large integrated long-term contracts to 10 to 15 contracts (with separate contracts for contractors and contacts for function changes with different start dates respectively).

On the basis of the purchasing objective 'value for money' option 1 scores low on competition during and after the end of the programme, vendor lock-in during the service life of the ERTMS system, the distance at which the contracting authority is kept when managing the development process, and risk management. Option 1 also scores low because of the risk of the contractor's demise / bankruptcy. Options 2 and 3 meet these drawbacks, option 3 in particular scoring higher on competition before, during and after the contractual phase, the possibility of price evaluation of the tender and changes in the course of the programme. These points result among other things

[29]Railway infrastructure training programmes in Amersfoort

from the long duration of the programme and the uncertainties regarding the scope and planning of interface projects.

Option 1 with two integrated contracts for two different consortia has advantages regarding the potential for economies of scale, the quantity of contracts to be managed and accountability for the integrated operation of the systems. Options 2 and 3 are similar to each other. The risk of bankruptcy is limited in each contract since the average contract size in both cases is less than with option 1. The possibility of varying the start dates of the different contracts in option 2 (and even more so in option 3) enables all parties to gain a realistic idea of the work based on the actual scope rather than the pre-modelled scope (as in option 1). This gives better opportunities for pricing the scope and risks, and makes it possible to more effectively mitigate the risks of contract renegotiation, abnormally low bid prices and substantial changes. The contracting authority also has the opportunity to respond to developments that come into play during the Realisation Phase, such as lessons learned, changed market conditions or new (interface) projects or infrastructure changes. In this way the contracting authority acquires and retains greater control of the activity of the contractors and has greater room for manoeuvre to make adjustments in the event of disappointing performance.

For the *continuity of service provision* the availability and flexibility in fall-back options in particular are distinctive: these are the greatest under option 3 as flexibility decreases in the case of more integrated contracts with regard, for example, to the moments of contracting, the substantive contractual agreements and the amendment of contracts as a consequence of external changes.

Option 1 scores low on the purchasing objectives *integrality, controllability, manageability and reliability* because there is limited control of the contracted parties' performance and there are limited opportunities to adjust. These disadvantages require extra attention from the contracting authority, and can be managed by good governance.

Despite a decline in integrality in the case of separate contracts, it benefits the controllability, manageability and reliability under options 2 and 3. This refers in particular to the degree of control that the contracting authority acquires and retains over the activities of contractors. The insight, as formulated in the Fyra report, that placing the responsibility for certain risks solely externally does not necessarily reduce the chance of those risks actually occurring comes into play here. In the case of ERTMS these risks exist for instance in the area of the development and the implementation in the brownfield situation. In the event of disappointing performance, the contracting authority's room to adjust is greater in options 2 and 3. This also meets the recommendations in the Fyra report on contract management.

The purchasing objective of *future-proofing* has been given concrete form by sustaining competitive forces inside and outside the programme and also by ensuring that relevant knowledge is acquired and retained. Sustaining competitive forces is limited in the case of two consortia.

In terms of sustaining competitive forces multiple parties are contracted under options 2 and 3. In this way the work is potentially spread more evenly across the market, which meets the objective of sustaining competitive forces. In this way more parties can also use these tendering processes to build up and retain their knowledge of ERTMS. This is also advantageous for the part of the Netherlands not being provided with ERTMS under this programme. Option 2 therefore scores better than option 1, and option 3 in its turn scores better than option 2. On the other hand, under options 2 and 3 some parties may become discouraged after losing a few tenders and may decide not to take part in future procurement procedures. This argument however weighs less heavily than the flexibility that is desirable for contracting. The above benefits apply even more for option 3 than for option 2 because under option 3 there are more contracts and greater flexibility, with the controllability of the construction that is business as usual for the infrastructure manager being able to follow everyday practice and therefore for example possibly being integrated with other infrastructure projects that are going to be carried out towards that time.

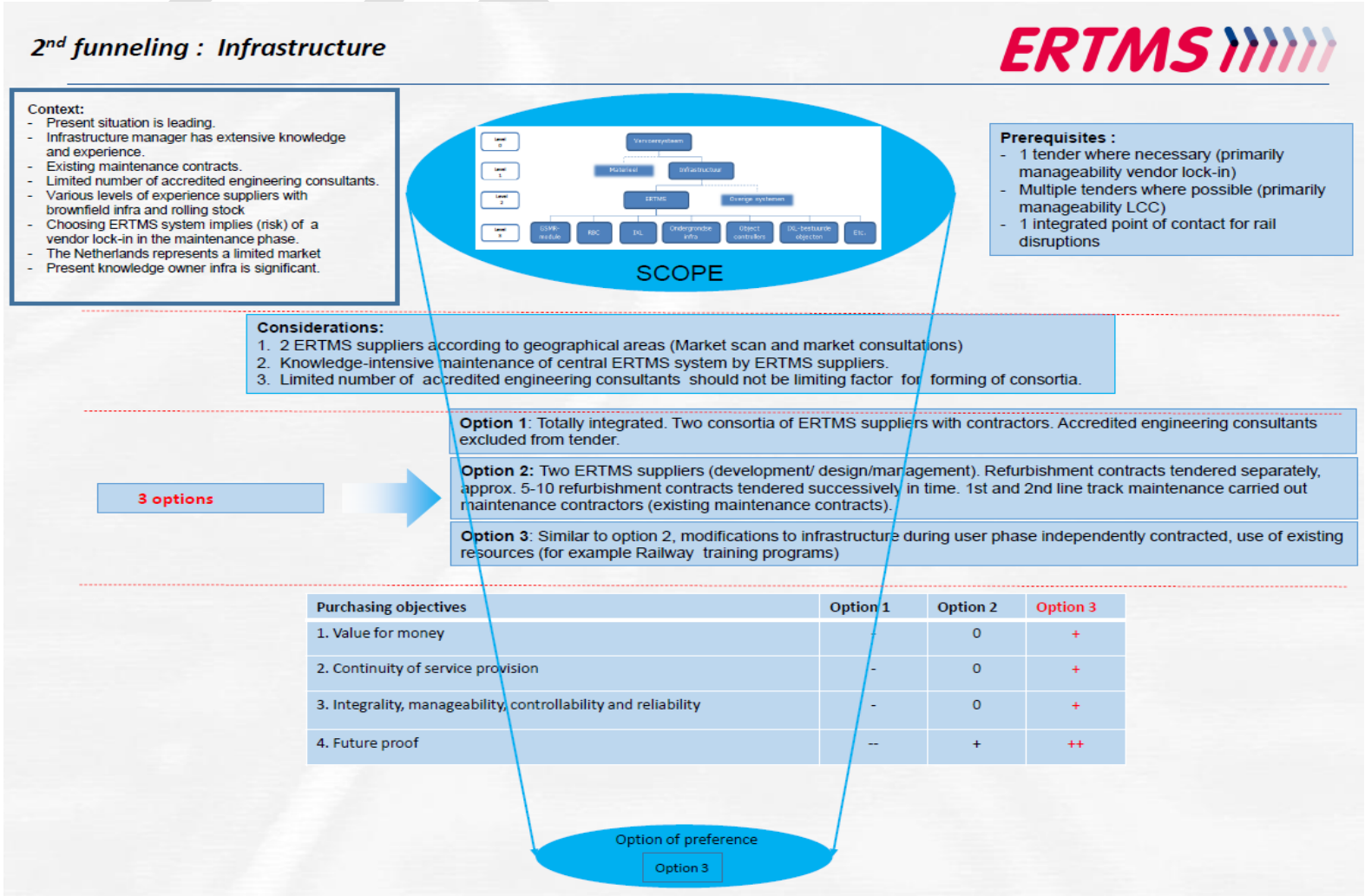
5.5 Preferred option

As stated in the previous section, option 3 scores the best on most criteria compared with options 2 and 1. While it is true that more contracts must be concluded under option 3 and therefore the interfaces between these contracts must be managed, the contracts in themselves are easier for the contracting authority to manage because they are better tailored to the actual work and can therefore be priced better by market players. One possible control measure for the drawback of this option for the contracting authority having to manage integrality is the cooperation agreement with shared KPIs for all the contractors of both infrastructure and rolling stock (see also sections 2.5 and 3.5). As well, attention to governance (including the roll of the operational system integration) is required.

5.6 Follow-up studies

Just as with the other funnels, the contract manager will have to elaborate the preferred option in more detail and for example determine the right contract form for each component. This also depends on the roll-out strategy and the remaining budget following refurbishment of the rolling stock and the associated rolling stock financing agreements.

Figure 8 Infrastructure funnel diagram



6. Rolling stock funnel

6.1 Description of context & prerequisites

Section 2.2 described the current situation in the Dutch railway sector. ERTMS is a train safety system that is interlinked with other on-board systems. This means the existing rolling stock maintenance situation and associated contracts must be taken into account.

As is the case for infrastructure, the number of available engineering consultants accredited to conduct rolling stock is highly limited (in fact, there is just one firm). It should also be pointed out that Dutch demand for ERTMS installations in rolling stock is quite small in comparison with demand on the global market. Furthermore, some ERTMS suppliers are less experienced in terms of rolling stock installation than others, especially in existing rolling stock. The involvement of engineering consultants and other market players is therefore crucial.

When it comes to rolling stock - and, to a lesser extent, infrastructure - knowledge of the train's current configuration and operation is often limited to the manufacturer and, in some cases, the owner or the maintenance contractor. As a result, the various ERTMS suppliers have varying degrees of knowledge, limiting their access to the procurement process. This difference in knowledge level must be eliminated as far as possible before the tendering process, therefore, in order to optimise competition.

Relatively new rolling stock may also frequently be subject to warranty provisions, preventing the owner from commissioning other parties to install ERTMS systems. After all, train manufacturers would no longer be able to guarantee that the train will perform to expectation leading to loss of warranties. Finally, intellectual property rights may have a restrictive effect in this context.

The success of this procurement procedure will be contingent on ensuring that all involved rolling stock owners/train operators support the underlying strategy (also see section 2.2). Effective elaboration of the financing agreements is a prerequisite in this regard. The definitive strategy and division in lots can be devised once funding agreements have been made with all train operators and once it is clear whether these operators will participate in the procurement entity to be established. See section 6.6 for a further explanation on this matter.

6.2 Detailed definition of procurement scope

Section 2.1 lists the components of which the ERTMS system in the rolling stock consists. The scope of the PCS covers the installation of ERTMS in existing rolling stock (‘retrofitting’). Existing rolling stock already equipped with ERTMS falls outside the scope of the tender (though not outside the scope of the programme). If new rolling stock is to be included in the scope of the programme or scope of the tender is yet to be determined. It has been specified that the STM-ATB will, in principle, be made available to all parties in the form of a management supply. The programme scope is currently strictly limited to realisation, maintenance and any changes to ERTMS through 2018. Activities after 2028 fall outside the scope of the programme, but they are within scope for the tender because the life cycle will continue beyond 2028.

In addition to defining the components included in the tender, efforts must be made to determine (in more detail than was done for the Programme Decision) which trains are to be fitted with ERTMS. Section 2.2 lists the various train operators and rolling stock owners currently using the Dutch railway network. Issues to be covered by the funding agreement to be made between the ministry and the rolling stock owners include decisions on whether:

- only rolling stock for which the Netherlands is the first country of approval should be eligible for funding;
- rolling stock scheduled to be permanently taken out of operation should be eligible for funding.

The requirement to tender according to the (European) procurement rules does not exist for all the rolling stock to be refurbished because not all train operators and rolling stock owners can be regarded as contracting authorities as defined in the Dutch Public Procurement Act 2012 (depending in part on funding). The rolling stock can therefore be divided into two groups:

1. the procurement of ERTMS components by means of a European procurement procedure (EU procurement scope); and

2. private procurement (non-EU procurement scope).

In this way, the present PCS offers eligible rolling stock owners the possibility to participate on a voluntary basis in the rolling stock refurbishment tender. A number of funnels have been defined in order to determine which rolling stock can be classified under which group. Discussions with rolling stock owners show that aspects such as the requirement to tender according to the (European) procurement rules, the question as to whether tendering by way of the PCS will be required as a result of financing agreements (subsidies), and the wishes of rolling stock owners (e.g. a preference for centralised procurement, or restrictive factors relating to knowledge ownership and warranty provisions) are very significant. These funnels are represented in the figure below. The major part of the rolling stock is expected to fall under EU mandatory procurement. This is explained in more detail below.

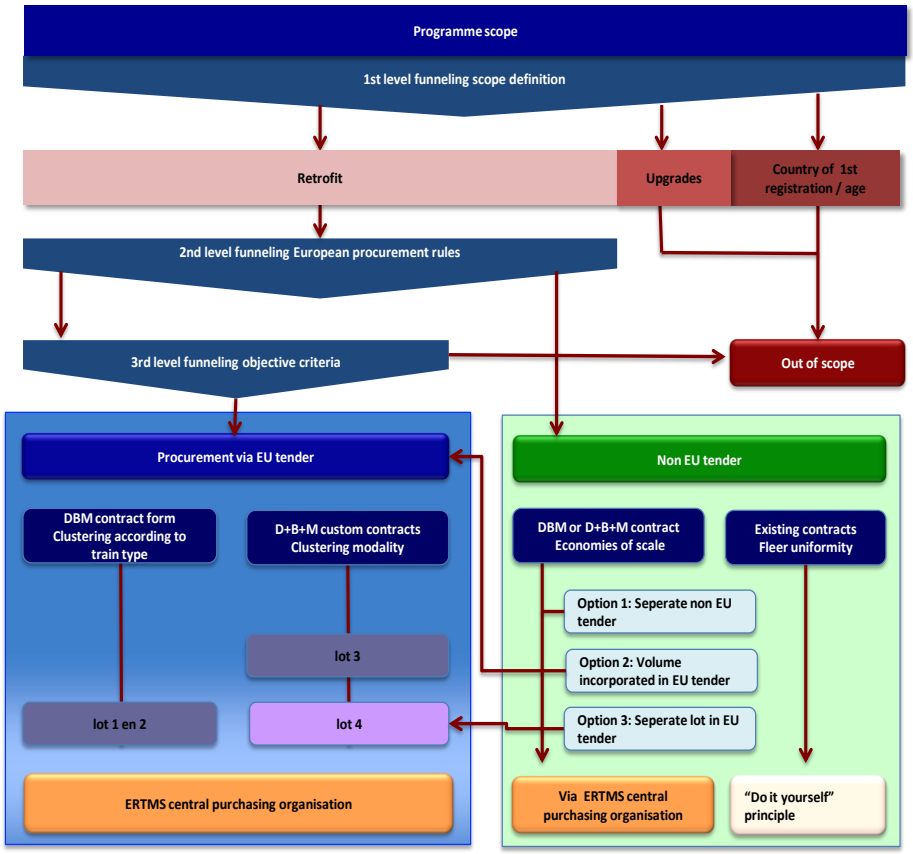


Figure 12 rolling stock scope funnels

First-level funnelling

On the basis of the Preference Decision, all existing rolling stock registered in the Netherlands falls under the scope of the programme. The size depends in part on whether the scope should include rolling stock for which the Netherlands is not the first country of approval; this is yet to be

decided. This also applies to rolling stock that is scheduled to be taken out of operation. In anticipation, this is indicated in figure 12 by 'out of scope'. The same applies to rolling stock that is no longer in use at the time of commissioning of the infrastructure. This is indicated in figure 12 by 'age'.

Second-level funnelling
Second-level funnelling makes a distinction between rolling stock that has to be tendered according to European procurement rules or whether an exception from this obligation might be invoked (for example, in connection with protection of exclusive rights or technical reasons) and rolling stock that is not necessarily subject to mandatory procurement.

Third-level funnelling
Finally, third-level funnelling incorporates other factors that determine whether, and when, certain rolling stock will have to be refurbished. These factors may affect the size of the lots[30]. This will include rolling stock that, depending on the infrastructure roll-out strategy, perhaps has to be refurbished later or not at all or, for example, rolling stock of a regional concessionaire or a maintenance company that in connection with major maintenance, servicing or refuelling has to use infrastructure which, under the roll-out strategy, is to be equipped with ERTMS.

Based on consultations with the rolling stock owners, the programme has concluded that:

- as regards NS rolling stock, the procurement rules apply. NS will thus take part in a tender procedure prepared by the programme. For the two latest train types (SLT, Flirt) it is being examined whether a procurement law ground for exception can be invoked. This may also be necessary due to technical reasons.

- Regional passenger transport operators are subject to mandatory procurement when making purchases with government funds. In the event that the Ministry makes financing agreements with these parties resulting in compensation, they will be required to tender according to the procurement rules. It would be logical for them to participate in a procurement procedure prepared by the programme.

- Freight transport operators, maintenance companies and historical railway transport are primarily exempt from mandatory procurement. However, just as with regional passenger transport operators, financing agreements may subject them to tender according to the procurement rules, in which case they would participate in a procurement procedure prepared by the programme.

Ultimately, the division in lots will depend on the scope of the tender and the funding agreements.

6.3 Considerations & options

The procurement procedure for rolling stock is subject to a number of key considerations. Firstly, it will involve a highly diverse range of rolling stock owners and train operators who all have their own specific wishes and preferences in terms of procurement, contract forms and other aspects. Some parties may wish to contract out all activities, while others may wish to carry out all installation and/or maintenance work in-house. This broad range of wishes and preferences must be taken into account when preparing the rolling stock procurement strategy.

On the other end of the spectrum, contracts for the delivery/refurbishment of fewer than 50 to 70 units do not hold any appeal for contractors. From the point of view of optimal contracting, the ideal number of lots therefore is two to four. Secondly, the Market Scan and market consultation have shown that economies of scale can only be achieved in the rolling stock tender if contractors are allowed to deliver/refurbish more than 200 units. These economies of scale increase proportionally, reaching a maximum at 500 units.

[30] In this context, 'lot' is understood to mean a contract with a contractor, on the basis of which multiple customised contracts can subsequently be concluded.

In accordance with the Market Scan and the PPC, the basis for contracting is the DBM principle. The considerations outlined above yield the following three classification options for the rolling stock:

- Option 1: the rolling stock can be classified on the basis of rolling stock type (e.g. SLT, Flirts, VIRMs, Traxx locomotives, etc.), with one contract per type and with approx. 25 types resulting in some 25 types/lots.

- Option 2: the rolling stock can be classified on the basis of modality[31], as described in figure 13, resulting in four lots, i.e.: passenger transport (approx. 680 units), freight transport (approx. 150 units), rolling stock used for maintenance (approx. 35 units) and historical railway transport (approx. 35 units).

- Option 3[32]: a combination of the aforementioned two options allowing for optimalisations of each partly based on rolling stock types' characteristics in terms of procurement requirements, warranty provisions and knowledge ownership. This provides for an optimal number of lots in which the extent within the lots is more evenly divided.

The contract form can, given the desired customisation, be varied in all three of these options (D and/or B and/or M) in order to meet the wishes of the different rolling stock owners. This is shown in figure 12.

As also indicated in chapters 2, 3 and 5, the operational management for both the roll-out and migration strategies must be clearly laid down in terms of governance in advance. This applies to all the options and particularly to development and testing, standard changes and function changes, management and monitoring and maintenance. This is also necessary with a view to implementing subsequent updates and upgrades.

Ideas about governance and operational control, and about the division of risk in this regard, will be discussed with the market players, in a manner to be decided, before the Programme Decision and tendering process.

6.4 Assessing the options

The options have been assessed in terms of the purchasing objectives value for money, continuity of service provision, integrality of controllability, manageability and reliability and future-proofing.

All three options have advantage and disadvantages. The first option is fairly high-risk because the large number of small lots (for the approx. 25 different types of rolling stock) makes things difficult to control. Nearly every lot is too small and unappealing for a market player to bid on and does not therefore lead to the best value for money (lack of economies of scale). The classification leads to a large number of different contractors for each train operator/rolling stock owner, so that the desired greatest possible uniformity in the rolling stock fleet cannot be obtained (lack of controllability and manageability). Finally, this option will not serve the integrality with the infrastructure because of the variety of new ERTMS products that may appear.

The second option, classification by modality, will lead to a division in four lots. Control, manageability and integrality are better served than under option 1. As a result, this option appears to offer more value for money, due to the potential economies of scale (only four lots). However, this second option will lead to an unequal division of the overall scope, with the smallest lots being unattractive to the market and the size of the contract for the passenger transport modality exceeding the optimum for economies of scale.

The third option is a combination with a classification according to both train type and modality. This might involve clustering of train types and of modalities with the same features. This option

[31] This means transport type.
[32] This option closely resembles the preferred scenario from the Market Scan, the recommendation being that a framework contract be made with three to four parties with contracts for each train type within them.

offers the best opportunities to deal with the disadvantages of options 1 and 2 outlined above. Indeed, option 3 can be regarded as a control measure to mitigate the disadvantages of the other two options. Given that option 3 does not provide for classification entirely on the basis of train type, the drawback of an excessive number of lots can be avoided. It also prevents an imbalanced distribution of rolling stock to be refurbished across the various modalities. A combination of option 1 and option 2, with a division in two to four lots, would make those lots more appealing to contractors since it would enable them to establish the optimum scale for each individual lot (resulting in more economies of scale and better value for money). The limited number of contractors would enhance uniformity (with a view to the procurement objectives of integrality, manageability and controllability).

The continuity of the service provision is best served by a choice for option 3. Given the different characteristics/properties of the modalities and taking account of the variety of train types, the purchasing objectives can best be achieved by combining the two options.

6.5 Preferred option

Based on the above, option 3 - under which division into lots is combined with modality and rolling stock types - would seem to be the preferable choice. Option 3 offers the most feasible combination of market competitiveness (several lots/contracts), economies of scale to be achieved (these lots have sufficient size to increase their appeal to market players) and controllability/manageability/integrality (two to four contracts provide for a manageable span of control for the contracting authorities). The optimum lot size can eventually be achieved depending on the roll-out strategy of the rolling stock owners and train operators.

These three options were submitted to the various rolling stock owners and train operators described in section 2.2. The response has so far been positive. Interviews with rolling stock owners and train operators will be conducted before the summer in order to discuss the matters at hand and gain insight into the relevant tender obligations, warranty provisions and knowledge ownership. The contract manager can then apply this information to further elaborate the preferred Programme Decision on rolling stock into contracts and procurement dossiers.

6.6 Follow-up studies

Various aspects of this preferred scenario still require elaboration. For example, outside this PCS, the ministry and the rolling stock owners/train operators are currently holding negotiations on the extent to which the latter will be compensated for the costs of installing ERTMS in their rolling stock. These agreements and the definitive preferred option will have to be effectively aligned. This effort should also extend to further elaboration of the option. It will be crucial to maintain open lines of communication with these rolling stock owners and train operators in order to maintain sufficient support. The ministry plans to lay down broad policy frameworks in consultation with rolling stock owners and regional authorities that grant concessions before the summer of 2016, and subsequently elaborate these documents on a step-by-step basis.

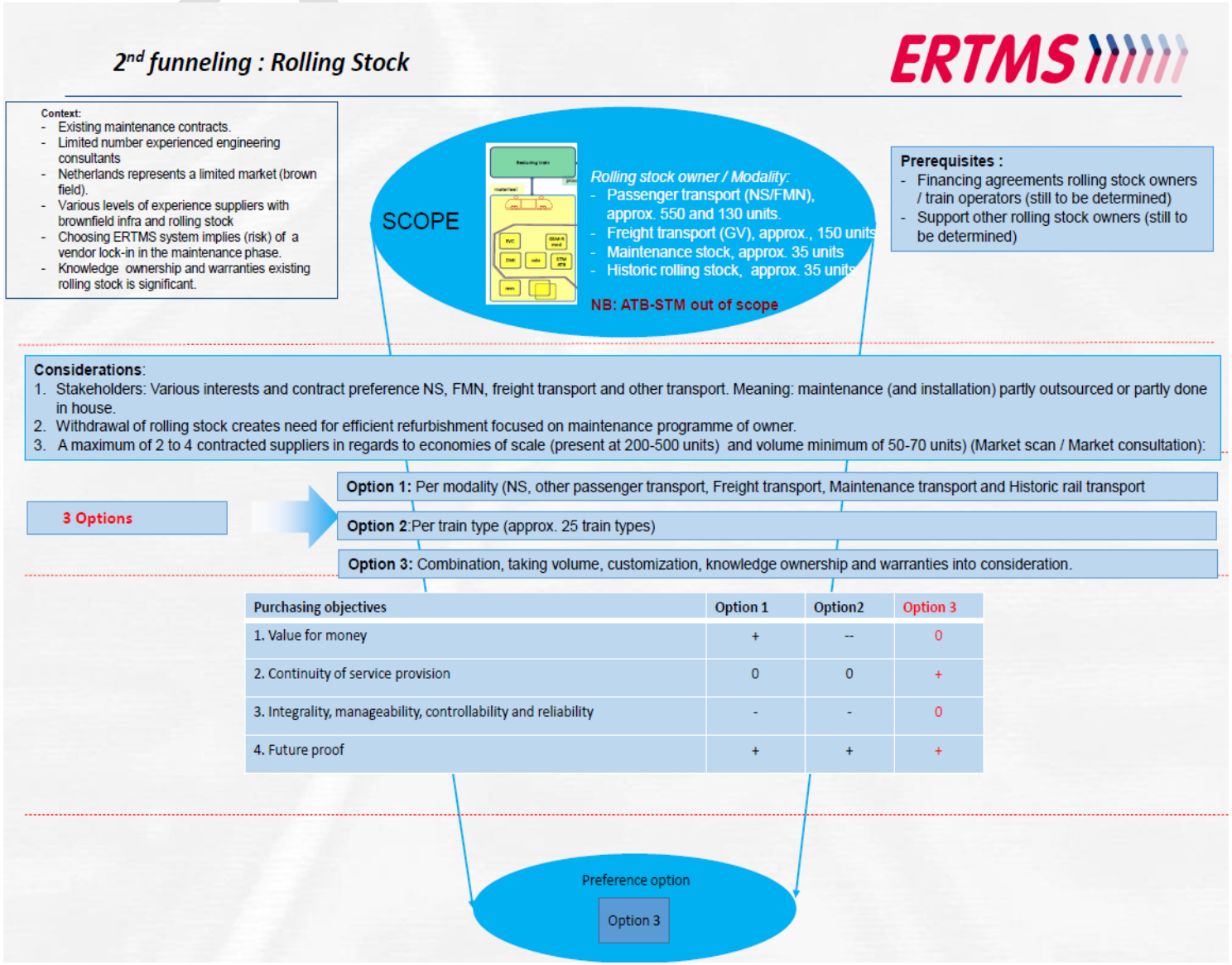
As regards elaboration of the preferred option by the contract manager, both NS and the regional train operators have expressed a preference for DBM contracts. The freight transport operators, maintenance companies and parties engaged in historical railway transportation tend to prefer a separate D+B or DB construction.

In view of the fact that multiple rolling stock owners will be participating in the tender for each plot, centralised coordination of the tender procedure would be desirable. The owners have indicated that they would like to see the ministry/the ERTMS programme fulfil this role. This would involve tendering/procurement through a centralised contracting agency managed by the contract manager, with representatives of the appropriate owners assigned to each individual contracting agency. The programme would then bundle knowledge, prepare standard contracts, etc. rather than taking on overall responsibility, while the rolling stock owners would eventually independently sign their own (sub) contracts. Despite the use of a contracting agency, the rolling stock owners

themselves will serve as the formal contracting authority. Effective management of collaboration between the rolling stock owners will be required, however, in areas such as coordination and planning.

As mentioned, a uniform STM-ATB that is available for all lots will be crucial in ensuring a level playing field for all rolling stock ERTMS suppliers. A total of two suppliers are currently in a position to deliver an STM-ATB for the Dutch market, but engineering consultants and new parties could also enter the market. In this context a study is currently under way into whether an STM product can be supplied by the programme (as a management delivery). To that end, specifications for an STM are being prepared, to be followed by dialogue with market players.

Figure 13 Rolling stock funnel diagram



7. Further elaboration of PCS into concrete Programme Decision(s)

Various aspects will have to be organised in further detail to ensure that the PCS yields effective (a) Programme Decision(s) which can then result in successful tenders.

Governance during the Realisation Phase

(TDB, will be completed following consultation.)

Programme Decision(s)

Following the publication of the PCS we will work towards the Programme Decision(s) for infrastructure and rolling stock. Frameworks laid down in the MIRT regulatory framework among others apply to the Programme Decision(s). The purchasing objectives are designed to achieve Best Value for Money for the procurement. This extends to price, quality and integrality, and will require effective management. The appointed contract manager must ensure that all PCS agreements with regard to SI, infrastructure and rolling stock are adhered to. This can be achieved in two ways:

1. Assigning the contract manager team to benchmark the procurement dossiers;
2. Assigning the programme (contract manager team) to prepare the tender dossiers.

Numerous contracts and selection and awarding criteria will have to be prepared in aid of the infrastructure and rolling stock contracts to be awarded between 2016 and 2018. Standardised tailored contracts will be used where possible within these ERTMS tenders covering multiple tenders for comparable projects, in order to ensure that contracts for rolling stock type (or infrastructure zone) X or Y are optimally predictable for both the contractors and contracting authorities. The planning schedule will be elaborated in further detail over the coming period. The various top-level selection and awarding criteria and the risk allocation will also be determined during this time.

Scope of the rolling stock and infrastructure tender

(TBD, will be completed following consultation.)

Schedule

The programme schedule is currently being reassessed and is expected to be available in the summer. This may have an impact on the scheduling of (the) Programme Decision(s) and therefore on the start of the procurement procedures. The approach following the appearance of the PCS is to hold market consultations about (the) Programme Decision(s) up until the moment of those decisions and then to effect final contracting through a negotiated/dialogue-based procurement procedure.