



Request for Consultation

**Nederland's Spoorwegen (NS)
(Dutch Railways)**

ZitplaatsZoeker
(ZZ)



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1 Introduction

This document describes the approach for the market consultation for the ZitplaatsZoeker project, executed by NS (Nederlandse Spoorwegen – Dutch Railway Company).

1.1 Structure of this RfC

The purpose of this market consultation, including the consultation objectives, is presented in Chapter 2 of this RfC document.

The practical information and procedure, such as timelines, contact information, and confidentiality agreements, of this RfC are explained in Chapter 3.

Appendix A represents the main domains this RfC is investigating. Furthermore, an overview with questions per domain is presented, for which the participants are requested to provide an input for.

Appendix B is provided to enable you to provide your answers and the requested information. You are kindly requested to use the provided template for providing your input. This approach will enable NS to evaluate your response in a structured and orderly manner.

1.2 NS company description

For participating in the Market Consultation, it is important, that you take cognizance of NS and the activities performed by NS. For the background of NS and its business units, please consult www.ns.nl.



1.3 Glossary

Item	Explanation
Accuracy	A measure of how close the predicted/measured value is to the real value (exactness).
API	Application Programming Interface.
CiCo	Ticket check-in check-out of passengers.
Compartment	Room in a coach separated by doors. Maximum compartment dimensions are limited to a coach.
DDZ	Intercity rolling stock series: DubbelDekker Zone.
HVAC	Heating Ventilation Air Conditioning
FLIRT	Local train rolling stock series: Flinker Lichter Innovativer Regional Triebzug.
ICM	Intercity rolling stock series: InterCity Materieel.
ICR	Intercity rolling stock series: InterCity Rijtuig.
NS-app	Journey planner app for mobile devices.
OBIS	On board IT Services. Dedicated IT system in NS rolling stock for passenger and staff services (e.g. travel information, passenger content, Wi-Fi, CCTV monitoring and diagnose information etc.).
Occupancy	Number of passengers in a train.
Passage sensor	A counting sensor that detects and counts passengers, while passing by the sensor. Detecting and counting is done in both directions (left to right and right to left).
Resolution	A measure for the size of the space in the train to which the measurement/prediction is contained (detail), for example information per compartment, per carriage or per rolling stock.
Rolling stock composition	A composition of one or more rolling stock units.
Rolling stock series	A physical group of rolling stock units of the same make and model.
Rolling stock unit	The smallest physical rolling stock identity that can be used for passenger service.
SGM	Local train rolling stock series: StadsGewestelijk Materieel.
SLT	Local train rolling stock series: Sprinter Light Train.
Snapshot sensor	A snapshot sensor scans the environment, detects and calculate the amount of passengers in a compartment. Can also be a measured physical quantity with a (linear) relationship with number of passengers
Spread	The distribution of passengers over the train.
Train trip series	A series of train trips on a specific route at a specific pattern. For example route Den Bosch – Arnhem with a 30 minute pattern.
VIRM	Intercity rolling stock series: Verlengd InterRegio Materieel.
ZitplaatsZoeker	Research and development program within NS with the goal to make passenger occupancy and spreading information nationwide available for travelers.
ZitplaatsZoeker Application	Manner of presentation of the occupation and spread in a specific train to the customers of NS.
ZitplaatsZoeker engine	Software algorithm for calculating passenger occupation and spread in a specific train.



2 Request for Consultation

2.1 Purpose of Consultation

2.1.1 Introduction

In 2018 NS started the Research and Development program ZitplaatsZoeker with the goal to make realtime passenger occupancy and spreading information nationwide available for travelers. The occupancy and spreading information are based on predictions which are calculated with models in the big data domain. Three data streams are identified to feed the ZitplaatsZoeker engine, from here on referred to as Stream 1, Stream 2 and Stream 3:

1. Sensors and data feeds that are already available within NS and used by the ZitplaatsZoeker engine (e.g. weight scale in the infrastructure and historical passenger counting data);
2. Sensors or data feeds that are owned by NS, but not (yet) used as input for the ZitplaatsZoeker engine at this moment (e.g. CO₂ sensor data from the HVAC system, Wi-Fi usage data from the public train portal);
3. New (unknown) sensors not (yet) present and available for NS, which can give additional valuable information (with sufficient resolution and accuracy) for nationwide coverage of the ZitplaatsZoeker application.

2.1.2 Purpose of this RfC

It is expected that Stream 1 and 2 do not cover all the needs to achieve the program goals. This market consultation is executed (in preparation of an European Tender) to gain information about:

1. Which technologies are available in the market to support Stream 3 and what is the maturity of these technologies.
2. Which technologies of Stream 3 need further development for operating in a rail specific environment.
3. General information and insights of the market and the parties that are active in this market or similar industries.

This RfC is not limited to the rail industry, suppliers of other markets are explicitly encouraged to participate in this RfC.

2.2 Present Situation

In the current situation the ZitplaatsZoeker engine uses historical data (Stream 1). In the near future this will be enriched by data from Stream 2. The enrichment will increase the accuracy of the occupancy and spreading prediction. At this moment the prediction information is shared* with the passenger when the following conditions are met:

1. The train trip is executed according the planned time schedule (no major delays).
2. The train trip is executed with the planned rolling stock series and rolling stock composition.

*Under the assumption that the passengers flow at stations are in line with the prognosis based on historical data.

The NS-app is the first publication channel for the ZitplaatsZoeker. From April 10, 2018 the information is shown for the routes and rolling stock in Figure 1. To put this in context, it is recommended to find the ZitplaatsZoeker in the NS-app on one of the trajectories shown in Figure 1. It can be found by selecting a trip, and then push the tile between the starting station and the exit station. Occupancy per train and spreading information over the train is given at three levels (green, yellow and orange) per coach.

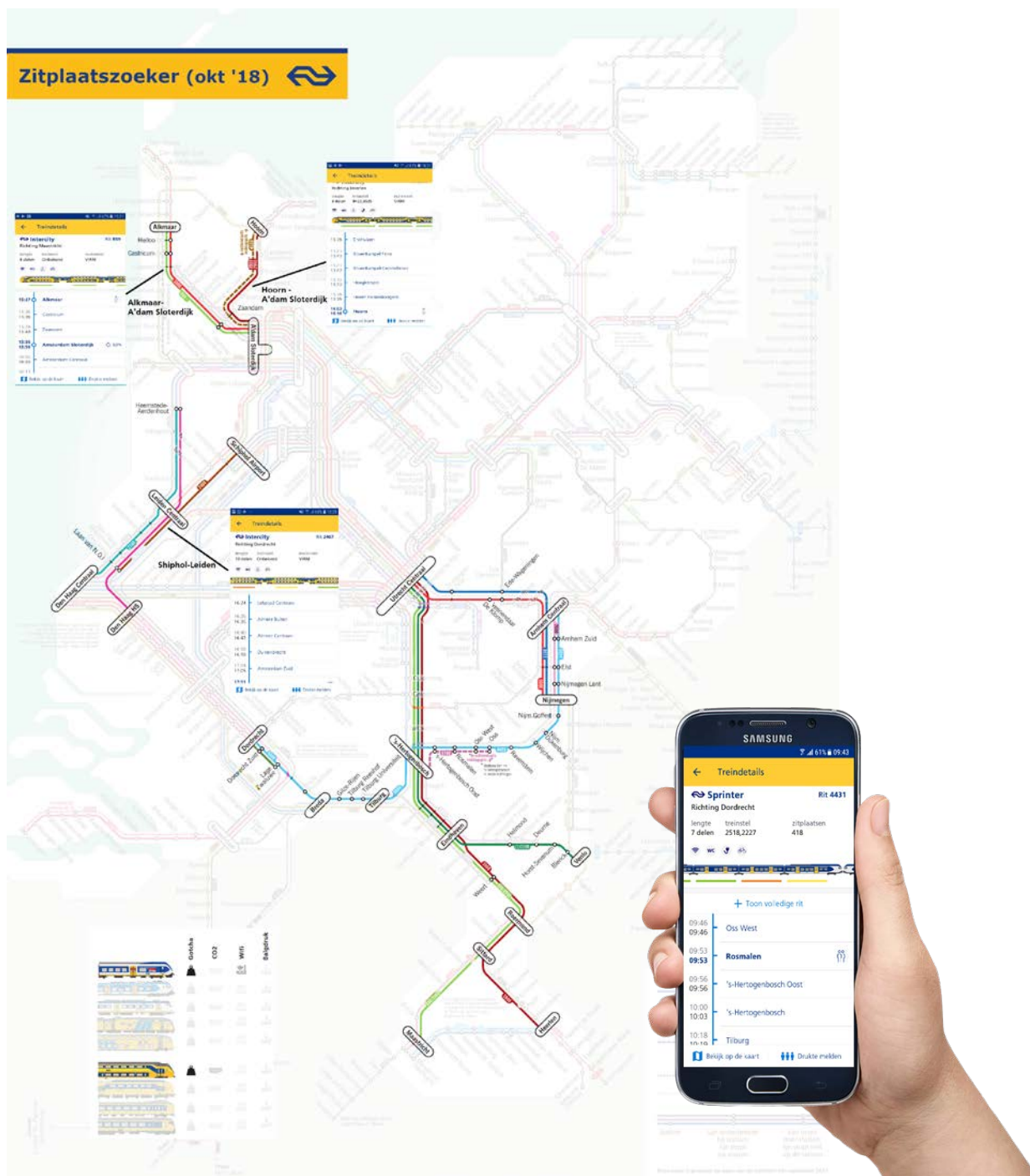


Figure 1 - Coverage ZitplaatsZoeker application

The video following this link gives an explanation of the ZitplaatsZoeker and how it works.

Link to video: <https://youtu.be/4kPfwIzAiRo> - English subtitles can be activated on Youtube

2.2.1 ZitplaatsZoeker engine model

The engine model of ZitplaatsZoeker predicts the occupancy and spreading per individual train and this information is combined in a color indication per coach. This color visualizes the expected availability of seats in the train at departure. Figure 2 shows the schematic of the engine model.

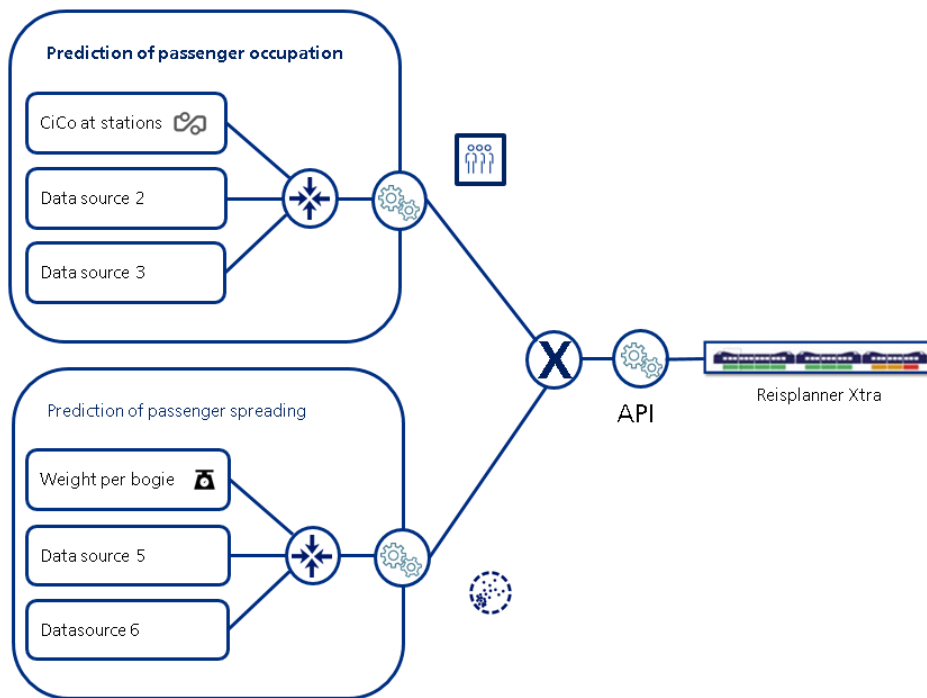


Figure 2 - Schematic of the ZitplaatsZoeker engine

The implemented and planned data sources (resp. Stream 1 and Stream 2) to feed the ZitplaatsZoeker engine are given in Table 1.

Data source	Data status	Occupancy	Spreading	Project phase
Check-in check-out data from every train station	Historical	X		Implemented
Weight data from 50 infrastructure sensors	Historical		X	Implemented
Wi-Fi usage data from the public train portal	Actual	X	X	Research
CO ₂ sensor data from the train air conditioning	Actual		X	Research
Check-in check-out data from every train station	Actual	X		Research
Operational rolling stock	Actual	X	X	Planned
Events	Actual	X	X	Research

Table 1 - Data from Stream 1 and Stream 2

2.2.2 Rolling stock fleet of NS

NS has a rolling stock fleet that consist of Intercity and local trains. The majority of the fleet is equipped with an OBIS IT system that enables real-time exchange of sensor data with the wayside. For this part of the fleet it is possible to install extra sensor hardware to enrich the ZitplaatsZoeker engine. For the rolling stock without OBIS IT system, the ZitplaatsZoeker engine cannot use sensor data from the train.

The fleet consist of various rolling stock series: Single decker with individual compartments, single decker without compartment separation and double decker with compartment separation.

In Figure 3 some examples of rolling stock types are given. For this RfC all rolling stock types of the NS fleet are in scope.



FLIRT single decker



ICM single decker



VIRM Double decker



No compartment separation



Compartment separation
with sliding door



Compartment separation with
glass tilting doors

Figure 3- Various rolling stock types of NS

2.3 Desired Situation

NS has the ambition to implement the ZitplaatsZoeker for all the rolling stock types and train tracks. The ZitplaatsZoeker application shall be everywhere and always available with a correct prediction of occupancy per compartment. This means that the ZitplaatsZoeker will also handle disturbed situations (trip delays, deviation in rolling stock type planning and deviation in passenger flow at stations).

Accuracy and precision is foreseen in 4 up to 6 levels for occupancy and the spread information will be available on compartment level, whereby the double-decker should distinguish both floors individual, see Figure 4. The prediction of occupation and spread should be updated after departure of the station and before arrival of the next station. This means that in practice that at least one calculation for occupancy and spread between two stops is executed. In this way the passengers at the arriving station can be informed, so the passenger can decide which train to take and were to embark in the chosen train.

Spreading



Occupation



Figure 4 – Ambition visualisation occupation and spreading information

2.3.1 Amount of sensors per compartment

Implementing new sensors in rolling stock can have a significant impact on project costs and non-operational hours during installation. With a classic door sensor a single deck coach can have up to 9 sensors and a double deck coach up to 12 sensors, see Figure 5. Snapshot sensors are not bound to count when people enter through a door. Innovative sensor solutions can reduce implementation costs and duration significant.

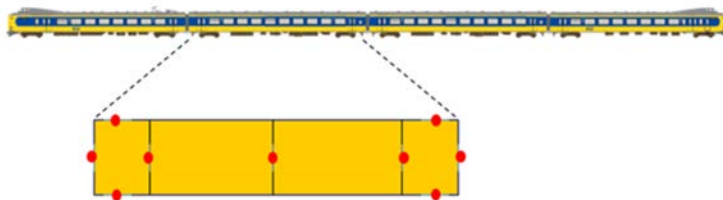


Figure 5 - Visualization of door bound sensor placement

2.3.2 IT resources in a rolling stock environment

The location of the sensors is important as well. The IT infrastructure of rolling stock has limited resources, as well for power supply as data connectivity. In general can be stated that every coach has only power and data connections available on the balconies. For sensors that need to be mounted in compartments of the coach, extra cables (power and data) are needed.

Engineering and Installation costs will be a crucial subject during the tender process for the selection of the sensor solution.

Wireless data transmission and self-supplying energy solution can have a positive effect on the engineering and installation costs. However, in all situations the sensor solution should be reliable and robust.

2.3.3 Innovative solutions

In the traditional way of thinking the sensor is expected to be placed in the rolling stock. However the solution is not limit to the rolling stock scope and this offers the possibility to gain data sources outside the rolling stock itself. For example:

- Occupation by GSM network tracking (between two stations, between two cities)
- Occupation and or spreading by a passage sensor through the compartment windows
- Passenger flow measurement on the platforms, with the assumption that the passengers stays in the coach where they embarks.

2.3.4 Product development

NS does not limit this RfC to so called off-the-shelf sensors. NS is also interested in solutions that are in earlier stages of development: idea, research or prototype phase.



2.4 The Deliverable

NS aims to get additional sensor solutions to enrich the data engine of ZitplaatsZoeker to increase the accuracy of the prediction. The enrichment is needed to get a nationwide coverage of the ZitplaatsZoeker with the same accuracy in occupation and spread. At any time, every rolling stock type and track. These sensor solutions are categorized as Stream 3.

Note that since your product will be part of a larger solution it does not necessarily need to contribute to both spread and occupancy, it can be only spread or only occupancy as well. On top of that, being part of a larger solution means the solution does not need to have a 100% accuracy.

2.5 Project Goals

Below the project goals are listed in priority

1. The low retrofit effort.
2. The low purchase costs.
3. Low nonoperational hours of rolling stock during installation.
4. An optimum match with the specified accuracy and reliability of the solution.
5. Smooth introduction for the customer.



3 Administrative Conditions

Below you will find the applicable administration conditions for this RfC to ensure a seamless and efficient procedure.

3.1 Schedule of the Consultation

The schedule of the market consultation is as follows:

Date	Deliverable
Wednesday 31-10-2018	The RfC document is issued by NS
Wednesday 14-11-2018 @12:00 hours	Deadline for submitting your questions on the RfC document
Wednesday 21-11-2018 @12:00 hours	Deadline for NS to reply to the questions and communicate any additional information or revision
Wednesday 28-11-2018 @12:00 hours	Deadline for submitting your input in writing

3.2 Standard Language of the RfC

All communication and documentation, by both NS and the consulting parties, will be in English. NS holds the right to change the language of this RfC to Dutch in case the responses are from Dutch companies only.

3.3 Information Exchange

All communication regarding this RfC should be directed to the assigned contact person of NS for this project. NS prefers communication by e-mail. Please send your queries and input to:

NS Procurement

Att. of: Mr. E. P. Guldenaar
E-mail: Erik.Guldenaar@ns.nl
Telephone: +31 6 49 38 91 62

Please make sure to start the subject-field of your e-mails with the reference:

"RfC ZZ – [name of your company]"

3.4 Cost Reimbursement

NS will not reimburse any direct and/or indirect expenses incurred in responding to this market consultation to the participating parties. This consultation should be done free of any charge. NS will not pay any allowance for time spent on this RfC. NS will not have any commitment to the participants of this RfC, nor can a participant derive any rights from entering this RfC.

3.5 Reservations

The market consultation does not bind NS in any way to place a contract. In case NS decides to acquire any technology or services, NS will proceed according to the applicable Public Procurement Law. Any decisions for investments are subject to Board of Approval of NS. Your response will be considered as non-binding, however it must be realistic.

3.6 Confidentiality

NS explicitly requests you to treat this market consultation as **confidential**.



NS will treat the information received confidentially. However, NS reserves the right to make use of the provided information and consultation in the near future, in which a European Tender process can be executed to obtain the sensors.

3.7 Format of the Consultation

NS has chosen for a consultation in open form. This means that all interested parties can provide the required input.

3.8 Your Response

NS desires your consultation and input regarding the questions formulated in Appendix A. Please make sure to use the template in Appendixes B attached to this document to provide us with the required input and the answers to the questions in Appendix A.



Appendix A – RfC Questions

A. General Company Information

NS is interested in how the market is organized and on which industries the market focuses. To get an objective view, NS asks questions about company details and project references. We want to develop an objective view without bias, despite that the questions could seem suggestive.

Company detail

Contact information and an impression of the kind of businesses in the market .

A	Questions
1.	Company Name
2.	Contact person (name and contact details)
3.	Address of the representative
4.	Headquarters address
5.	Website
6.	Company's overall business scope and strategy
7.	Number of employees in total
8.	NS intends to demand an option under which third parties will produce the solution under license and a NDA. Would such a contract term be a showstopper for participating in the tender?
9.	Which industry/industries are you mainly focused on?

References

NS wants to know what kind about experiences in crowd prediction are currently available in the market and at what maturity levels these solutions are in their product life cycle. Please provide an overview of related and relevant projects undertaken by your company in the recent past. Please include the following aspects in an orderly fashion.

A	Questions
1.	Do you have experience with European Tenders?
2.	Can you describe a reference in which you developed a solution in iterations e.g. concept, proof of concept, prototype, production ready product?
3.	Do you have experience in complex data-analysis and modelling? If so, what do these experience(s) entail and why are they relevant in the context of this RfC?
4.	Do you have experience with developing technology whilst competing with other candidates in a tender?
5.	What experience do you have with crowd prediction solutions?
6.	With which industry/industries do you have significant experience(s) in the field of development of sensory technology? What type of experience(s) are these?

B. Key Questions

NS invites you to share your vision or thoughts on the most important criteria for the EA.

B	Questions
	Context: Within this project the following criteria are identified by which the suggested solutions are valued. These criteria are not quantified yet: • Retrofit effort; • Purchase costs; • Nonoperational hours of rolling stock during installation; • Accuracy and Precision; • Reliability and maintainability; • Resolution.



1.	Do you recognize other criteria that may be important to value the proposed solutions by?
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C. Your solution

NS wants to know about your proposed solution.

C	Questions
1.	Which technologies do you propose to add value to the existing system design of NS?
2.	Will this solution add value to the measurement/prediction of occupancy, spread or both?
3.	Where will this solution be placed, in the infrastructure, rolling stock or other?
4.	What is the range (minimum and maximum) of accuracy possible with this technology?
5.	What resolution can be expected?
6.	What type of rolling stock will the solution apply to single decker with compartment, single decker without compartment, double decker with compartment?
7.	What type of solution do you propose: hardware or software or a combination?
8.	Does your solution include a service NS has to hire (external data source)?
9.	Do you have an estimate of the list price of your solution?

D. Timelines

1.	What phase of maturity is the proposed solution in? Idea, concept design, prototype, ready for production, or operational in different environment.
2.	What phases do you identify in this process?
3.	What effort (activities) is necessary to develop the proposed solution until it is ready for production? In case you identify your product as ready for production, are you able to explain why it would work in the environment for this specific application?
4.	What is timespan do you need to develop your solution towards a final design ready for production?
5.	What level of support would you need from NS to make your solution ready for production?
6.	What is the leadtime between ordering and delivery of 100 pieces the solution?
7.	What is the leadtime between ordering and delivery of 1.000 pieces of your solution?
8.	What is the leadtime between ordering and delivery of 10.000 pieces of your solution?
9.	What are factors that limit the production capacity should NS place an order for one or multiple rolling stock types?



E. Interest

This section is meant to find out if your company is interested on participating on a possible NS ZitplaatsZoeker tender procedure.

D	Questions
1.	Would you be interested in participating in the European Tender, in case NS chooses to start a European Tender?
2.	What condition do you, as a company, impose on the European Tender in order to participate?



Appendix B – Response Sheets

Below please answer all RfC questions as mentioned in appendix A. It is highly appreciated not only to answer with Yes/No but also provide the rationale behind and your opinion and alternatives where applicable.

A. General Information

Company Detail

A	Answer
1. Company Name	
2. Contact person (name and contact details)	
3. Address of the representative	
4. Headquarters address	
5. Website	
6. Company's overall business scope and strategy	
7. Number of employees	
8. Production under license and NDA	
9. Focus on following industries	

References

1. Experience with European Tenders	
2. Development in iterations	
3. Experience with complex data analysis and modelling	
4. Development while competing	
5. Crowd prediction solution	



6. Field of development	
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B. Key Questions

B	Answer
1. Criteria for solution	

C. Your Solution

C	Answer
1. Which technologies	
2. Occupancy, Spread or Both	A) Occupancy B) Spread C) Both
3. Infrastructure, rolling stock or other	A) Infrastructure B) Rollingstock C) Other:
4. Placement solution	A) Rolling stock B) Infrastructure C) Other:
5. Range of accuracy	
6. Resolution	
7. Single decker, double decker or both	A) Single decker with compartment B) Single decker without compartment C) Double decker with compartment D) All
8. Service hire	
9. List price	

D. Timelines

D	Answer
1. Phase of maturity	A) Idea B) Concept design C) Prototype D) Ready for production E) Operational in different environments



2. Phases	
3. Effort	
4. Timespan	
5. Level of support	
6. Leadtime 100 pieces	
7. Leadtime 1.000 pieces	
8. Leadtime 10.000 pieces	
9. Limiting factors production	

E. Interest

E	Answer
1. Interested in participating in possible Tender	
2. Conditions imposed by you	