

Study

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[Association of German transport Companies]
Vereinigung der Privatgüterwagen-Interessenten
[Union of Private Freight Wagon Companies]
DB Schenker Rail GmbH
DB Netz AG
AAE Ahaus-Alstätter Eisenbahn Cargo AG
European Rail Freight Association
UIC International Union of Railways

Study to Determine the Transaction Costs of Different Incentive Models for Retrofitting the Freight Wagon Fleet with Composite Brake Blocks

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Final Report

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Summary

The noise of rail traffic has received increasing attention from railways, industry, politics, associations and the people affected. While in the past most investment was put into noise protection measures on infrastructure and buildings (e.g. noise protection walls), new studies show that investment in noise protection on rolling stock is more efficient from a cost-benefit point of view. The main cause of rail freight traffic noise is cast iron brake blocks which roughen up the wheels. This leads to unevenness in the treads of the wheelsets and as a result to increased noise when running. With new types of composite brake blocks there are technical solutions available which can produce a significant reduction in the noise level of the wagon fleet.

At present different promotional programmes and incentive models are being discussed on the European and national state levels which aim to provide for a modern and comprehensive retrofitting of the complete wagon fleet. The range of models standing in the public domain extends from direct support for retrofitting programmes through bonus models that depend on the distance wagons run to noise differentiated track access charge systems.

This study was commissioned by the Verband Deutscher Verkehrsunternehmen e.V. (VDV), [Association of German Transport Companies] the Vereinigung der Privatgüterwagen-Interessenten (VPI Hamburg), [Union of Private Freight Wagon Companies], Ahaus-Alstätter Eisenbahn Cargo AG (AAE), DB Netz AG, DB Schenker Rail GmbH, the European Rail Freight Association (ERFA) and the International Union of Railways (UIC). The aim was to investigate the incentive models in the public domain and to determine the transaction costs which would be produced if they were introduced and applied.

The following four models to support the retrofitting of freight wagons were investigated:

- **Model 1:** Mileage and noise dependent Bonus scheme on the basis of GCU and NVR¹ (below referred to as 'ND Bonus Model');
- **Model 2:** Noise differentiated track access charge scheme discriminating charges by time of the day and by route on the basis of IT operating systems (below referred to as 'NDTAC-IT Model');
- **Model 3:** Noise differentiated track access charge scheme discriminating charges by time of the day and by route on the basis of RFID-technology (below referred to as 'NDTAC-RFID Model'); and

¹ GCU is the General Contract for the Use of Freight Wagons and contains the regulations for freight wagon provision between wagon keepers and RUs. NVR stands for the National Vehicle Register, in which every wagon must be entered. There is a an NVR in every EU State and in Switzerland.

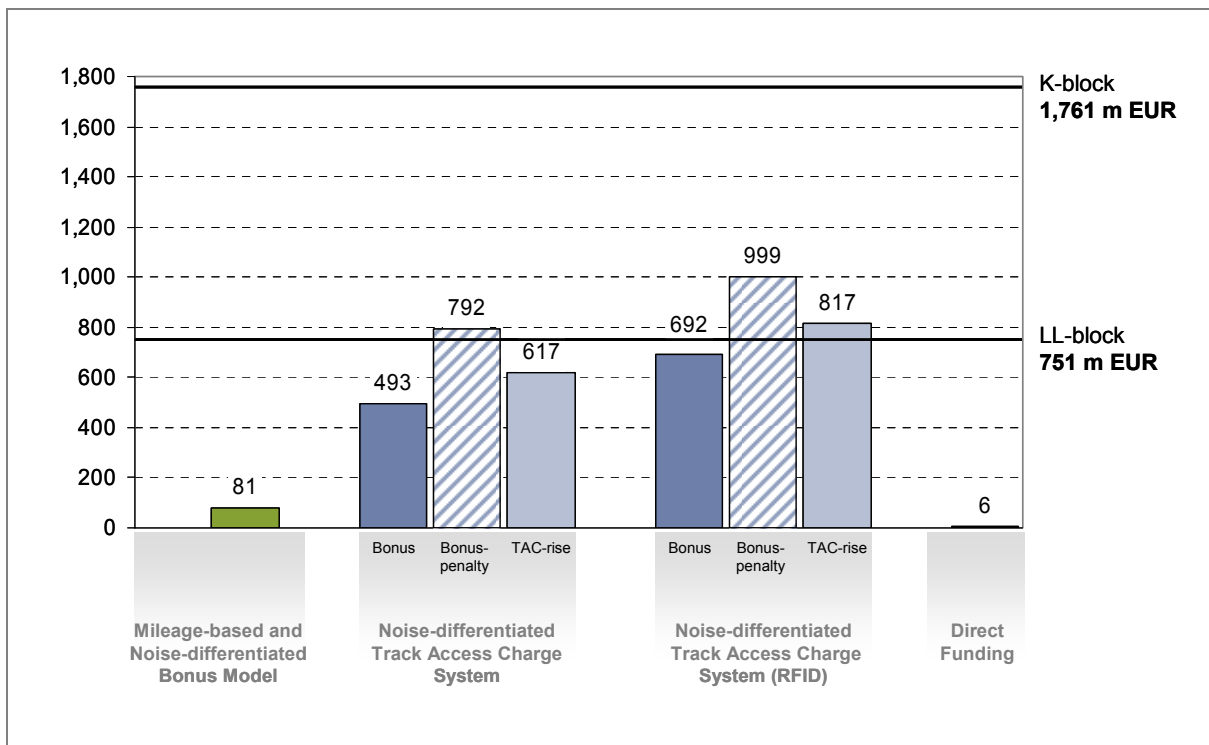
- **Model 4:** Direct Funding

It was assumed for all models that the duration of the programme would be eight years. The choice of the four models was specified by the customers and was based on the incentive models discussed by Working Group 3 of the 'Quiet Rhine' project. In so far as these models had not been defined in detail in the public discussion presentation, their form was largely laid down by the customer. The development of additional (as well as the optimising of the considered) incentive models was not part of this study.

The following methodology was used to quantify the transaction costs in the incentive models: The first step was to do a market analysis based on interviews with people who were involved in the market. The aim of this analysis was to determine the existing procedures (especially IT) and the administrative cost associated with them. The second step was to determine the additional processes and relationships between the players if the incentive models were introduced. Then on the basis of a cost model developed by the experts the costs of these additional transaction processes were calculated. These were determined with the help of a quantity structure developed in the market analysis and bearing in mind the benchmark values from reference sectors. The cost module differentiated between one-off costs to set up the necessary IT infrastructure for the calculation system, annual fixed operating costs and variable process costs which depend on the weighting of certain quantity drivers – such as the number of daily train journeys or number of wagons entitled to bonus. For this a consistent reimbursement of the bonuses (or in some cases penalties) was assumed throughout all the player levels. Then a simplified qualitative assessment of the individual incentive models was carried out.

The diagram shows the transaction costs of the four cost models (including the sub-variants investigated for the noise related track access charge systems) compared with one another as well as in relation to the retrofitting costs produced (plus the operating costs produced in the programme period) for the wagon fleet to be converted:

Cumulative Transaction Costs in Germany for the four Incentive Models Investigated for 8 years in the comparison (in EUR millions)



Source: KCW on the basis of the cost calculation and data from the client of the study

The results determined in this study indicate that the bonus model which depends on the mileage is the most suitable to achieve noise reduction as a result of quick retrofitting of freight wagons to silent brake blocks, since its transaction costs of about EUR 81 million distributed over the eight years investigated, are comparatively small and it appears that the introduction and carrying out of the work can be done without any serious problems.

The noise differentiated track access charge systems, both with and without RFID, are in contrast, more expensive and depending on the refinancing – by sector or public funds – accompanied by different negative market effects. In addition the convertibility appears problematic, since in particular the aim of the traffic control in view of the market structure is hardly possible. In the most favourable variant as a pure bonus model and without RFID recording of the trains the complete transaction cost is calculated at about EUR 493 million. A noise differentiated track access charging system with RFID recording of trains by means of RFID portals on the line and RFID chips on the freight wagons would bring with it almost a EUR one billion price tag just in transaction costs for the bonus-penalty variant.

The smallest transaction costs are anticipated for the direct support method in which due to the missing reference to the direct mileage the effectiveness of the money spent is assessed to be lower than with a mileage bonus model.

In addition to the detailed investigation for the German market, an estimate was made for certain selected European Countries using simplified analogous decisions. The work was based on similar standard model arrangements in the different countries. This showed that by applying the noise differentiated track access charging models (without RFID) to the selected European States (including Germany), depending on the variant chosen (bonus, bonus-penalty, increased track access charges), the total cost in the complete programme time would be about EUR 2.3 to 4.7 billion. In the noise differentiated track access charging models with RFID recording the sum expected over the period of the programme was about EUR 3.3 to 5.8 billion. In the mileage and noise differentiated bonus model on the other hand for the 17 countries considered there were likely transaction costs of between EUR 400 and 500 million in eight years.

1 Introduction

For a number of years the noise of rail traffic has become an increasingly important issue for railways, industry, politics, associations and the people affected. In particular the latter find it ever harder to accept the increasing noise of rail traffic. Important factors for the increasing awareness of the problem of rail noise are the increasing amount of freight traffic on the European trunk routes and the greater sensitivity of the people who live near the line.²

In the past most effort was invested in passive noise protection measures on infrastructure and buildings (noise protection walls on the line, noise protection windows, etc.). However, more recent studies have revealed that investment in active noise prevention on rolling stock delivers a higher benefit-cost ratio than investment in passive noise protection does.³ The main cause of noise from rail freight traffic is cast iron brakes, with which the majority of the wagon fleet is fitted. These roughen up the wheel leading to unevenness of the wheel treads and results in increased noise generation when running. With new types of composite brake shoes there are technical solutions available which can produce a significant reduction in the noise level of the wagon fleet. On one side there is the composite block (K-block), which is relatively expensive in view of the total cost of retrofitting, but has been already approved by safety regulators. On the other side there is the more economical LL-block which is still undergoing an approval process.⁴

Since 2006 – in accordance with the regulations of the TSI Noise – the introduction of noise reducing brake systems is obligatory for new freight wagons.⁵ For wagons with conventional cast iron brake blocks the change to composite blocks is technically possible. However there are high costs for the players who have to finance the wagon retrofitting. Furthermore there are additional costs due to higher operating costs of the composite brake blocks.⁶

² Anderson, Ögren, 2007: Noise charges in railway infrastructure – A pricing schedule based on the marginal cost principle; Transport Policy 14 (2007) pp. 204-213. Regarding the technical cause of the noise: Prof. Dr.-Ing. Markus Hecht: Technical noise reduction – limits and possibilities. Paper read to the technical conference 'Rail Traffic and Noise Protection' of the Ministry for Infrastructure and Agriculture of the Federal State of Brandenburg on 16.11.2009 in Berlin.

³ PWC (2007): Impact Assessment study on rail noise abatement measures addressing the existing fleets.

⁴ A cost overview in: Hübner, Peter: Noise depend path charges – incentive or emotive word in: Eisenbahn-Revue 12/2010, pp 616-620.

⁵ Directive 2006/66/EC Decision of the Commission of 23 December 2005 on the Technical Specification for Interoperability (TSI) for the partial system vehicles – noise of conventional transEuropean rail systems.

⁶ This arises in comparison to cast iron blocks particularly due to the higher wear and tear on the wheel and the resulting cost of reprofiling.

These costs would, in the opinion of the railway representatives (especially wagon keepers and railway undertakings [RUs]) endanger their market position, in particular in price sensitive market sectors, because of the high price elasticity of the rail freight market. Therefore the players have been reluctant to organise a blanket retrofitting of the current fleet. It is thus necessary to give the players some incentive for their expenditure and avoid the transfer of traffic from rail to road. Anyhow the total costs of a retrofitting of the European freight wagon fleet lie in the billion-euro area.⁷

At present different support programmes and incentive regimes are being discussed on the European and national state levels which aim to provide for a modern and comprehensive retrofitting of the complete wagon fleet. Based on their experience with the programme applied in Switzerland most sector players favour a direct grant for the retrofitting paid by the respective member states. On the other hand, the European Commission thinks that a noise differentiated track access charge is the most suitable model as was clear from the 'Recast to the first railway packet of the European Union (EU)', published in autumn 2010. In this document the possibility of noise differentiated track access charge was expressly mentioned. Representatives of the railway industry in Germany proposed an alternative concept at the beginning of 2010: A mileage related bonus for converted freight wagons paid directly to the wagon keepers.

To investigate the different approaches there were and are a series of national and international studies and initiatives.⁸ In the previously available studies the transaction costs, which can arise due to the incentive models, were not or only approximately considered. However, for a financial evaluation and assessment of the incentive models discussed the determination of the transaction costs that fall on the market participants is necessary. These are also important for the economic efficiency as well as the actual incentive effect each of the individual models has.

In order to assess selected incentive models for the retrofitting of freight wagons regarding their transaction costs the Verband Deutscher Verkehrsunternehmen e.V. (VDV), [Association of German Transport Companies] the Vereinigung der Privatgüterwagen-Interessenten (VPI Hamburg),

7 To show different cost scenarios: KCW, SDG and TU Berlin (2009): Analyses of preconditions for the implementation and harmonisation of noise-differentiated track access charges commissioned by the European Commission.

8 Some examples will be given here: KCW, SDG, TU Berlin (2009): Analyses of preconditions for the implementation and harmonisation of noise-differentiated track access charges. NEA (2010): Study noise on the railway corridor Rotterdam-Genoa. PWC (2007): Impact Assessment study on rail noise abatement measures addressing the existing fleets. VDV (2010): Minderung der Lärmemissionen des Schienengüterverkehrs [Reduction of the noise emissions of rail freight traffic]. EU-Commission (2010): Proposal for a Directive of the European Parliament and of the Council to produce a standard European Railway Area (new version) (KOM (2010) 475 final) UIC (2009): Status report and background information on noise-related track access charges.

[Union of Private Goods Wagon Companies] the Ahaus-Alstätter Eisenbahn Cargo AG (AAE), the DB Netz AG, the DB Schenker Rail GmbH (DB SR), the European Rail Freight Association (ERFA) and the International Union of Railways (UIC) (below referred as 'the customer') have commissioned this study. The aim of this study is to quantify the transaction costs associated with the introduction of various incentive models for the retrofitting of the freight wagon fleet with composite brake blocks as well as further noise reduction incentives (time- and route specific traffic control).

This study only carries out an assessment for the German market. An estimate for several selected European Countries will be made using by analogous conclusions.

2 Methodology and Approach

2.1 Organisation of the Study

The incentive models to be investigated are defined in Chapter 3. Basically, they are existing models which have been put forward for public discussion by different players. The choice of the four models considered (with in some cases several variants) was made by the client of the study to illustrate the important incentive models discussed in Working Group 3 of the 'Silent Rhine' project.⁹ In so far as these models had not already been defined in detail as part of the public discussion, their form was largely laid down by the client. The development of additional (as well as the optimising of the considered) incentive models was not part of this study.

The purpose of the study was thus the determination and the inclusion of all arising transaction costs with consistent passing on of the financial incentives for the use of noise reduced freight wagons to all involved player levels up to the envisaged receivers and addressees of the incentive effect – the market player responsible for the actual investment in the retrofitting (wagon keeper and wagon owner respectively) or the market players responsible for making the wagons available.

The following four models to encourage the retrofitting of the freight wagon fleet were studied:

- **Model 1:** Mileage and noise dependent Bonus scheme on the basis of GCU and NVR¹⁰ (below referred to as 'ND Bonus Model');
- **Model 2:** Noise differentiated track access charge scheme discriminating charges by time of the day and by route on the basis of IT operating systems (below referred to as 'NDTAC-IT Model');
- **Model 3:** Noise differentiated track access charge scheme discriminating charges by time of the day and by route on the basis of RFID-technology (below referred to as 'NDTAC-RFID Model'); and
- **Model 4:** Direct Funding.

Afterwards an overview of the German rail freight market is given in Chapter 2.2.2 in order to identify important factors and parameters which are of

⁹ The 'Silent Rhine Project' is a pilot project funded by the Federal Ministry of Transport, Building and Urban Affairs.

¹⁰ GCU is the General Contract for the Use of Freight Wagons and contains the regulations for freight wagon provision between wagon keepers and RUs. NVR stands for the National Vehicle Register, in which every wagon must be entered. There is a an NVR in every EU State and in Switzerland.

significance to the transaction costs of the incentive models. To this belong, for example, the description of the market situation as well as a division of the players into size classes. These size classes serve as important building blocks for the cost determination, which is later done in Chapter 6.

Chapter 4 gives a short explanation of the processes in rail freight traffic. Starting from this actual situation, Chapter 5 shows in detail what process adjustments are necessary for each individual incentive model. In addition to this on one side there are completely new processes and technical preconditions (IT), and on the other side also existing or, if necessary, modified processes can be used.

These new requirements and processes should then be described by means of a cost model for the incentive models in as detailed a way as possible for the individual players levels (Chapter 6). In this connection quantity frames and sizes are used, in order to achieve the desired degree of detail in the cost determination.

Chapter 7 sketches out what an introduction of the models in other European countries would mean. This is done by analogous conclusions starting from the results for Germany.

In the concluding Chapter 8 an estimate is made of the incentive effect of the individual models, which arises from the assessment just by means of the transaction costs.

2.2 Methodology

2.2.1 Interviews

The basis for the actual description and the assumptions for adjusting IT processes and organisational structures were obtained in 11 interviews held with market players. The aim of these interviews was to verify ideas and definitions regarding the processes and administrative costs and, if necessary, to falsify or to add to them. At the same time due to the band width of the estimates made by the branch representatives the assumptions made in the end did not always agree completely with those of the interview partners.

Between 3 September and 3 December 2010 interviews were held with the following market players¹¹:

¹¹ The undertakings were questioned about the named characteristics of the players, that is to say other business sectors (in particular with integrated railway companies) were not considered.

- Railway Infrastructure Managers (IMs) or operators of the track
 - DB Netz AG
 - Häfen und Güterverkehr Köln AG (HGK)
 - Eisenbahn und Verkehrsbetriebe Elbe-Weser GmbH (EVB)

- Railway Undertakings
 - DB Schenker Rail GmbH
 - TX Logistik AG
 - Havelländische Eisenbahn AG (HVLE)
 - Mittelweserbahn GmbH (MWB)

- Wagon keepers
 - Transwaggon GmbH
 - Ahaus Alstätter Eisenbahn Cargo AG
 - VTG AG
 - Ermewa GmbH

If it was necessary for the investigation, additional industry experts were invited to discuss individual questions, and people outside the sector from other disciplines of large IT based accounting and clearing systems. In addition there were coordination meetings with the multi-client consortium. In this way basic assumptions were verified and steps in the investigation explained.

2.2.2 Cost Model

To determine the transaction costs an analytical cost model was developed in which all basic assumptions and quantity structures were put in that could be derived from personal assessment, interviews, discussions and available sources.

In general the cost derivations were divided into immediate monetary and indirect monetary positions. The immediate monetary costs consist of one-off implementation costs (e.g. for hardware, software) as well as the annual fixed costs for the operation (e.g. maintenance and support). The indirect monetary costs consist of process dependent expenditure. This was first estimated by time and then on the assumption of an hourly rate converted to a monetary value.

2.2.3 Definitions

2.2.3.1 Transaction Costs

This investigation assesses transaction costs for various incentive models. As transaction costs, all costs are listed below which arise from the introduction and operation of the respective incentive model. Retrofitting costs, as well as the associated operating costs of the quiet braking systems, are not transaction costs. Transaction costs include in the main:

- One-off costs of the implementation of the incentive system;
- Maintenance costs for the systems necessary to operate the incentive system;
- Process costs which result from the carrying out of the incentive model.

2.2.3.2 Naming the Freight Wagons

For the brake characteristics of the wagons the simplified terms 'loud' and 'quiet' are frequently used. 'Quiet' wagons are fitted with brake blocks generally classed as noise reducing (e.g. composite blocks) or have a TSI noise approval certificate. 'Loud' freight wagons are correspondingly freight wagons which do not have a TSI Noise certificate and use cast iron brake blocks. The retrofitting incentive is based on the change from cast iron to composite materials.

2.2.4 Central Players

The incentive models to reduce noise defined in the investigation should always work on the wagon keeper as an incentive to do the retrofitting. Two models (see Chapter 3) also aim to incentivise the use of the wagons. In this case the player is in the focus which is responsible for the deployment of the wagons. In order to show clearly the position of the two players in rail freight traffic both will now be briefly described.

Wagon Keepers

The essential player in every retrofitting incentive model – regardless of its concrete form – is the wagon keeper. This is the stakeholder the incentive for the retrofitting must reach. For this investigation it is assumed that the wagon keeper (who is generally the wagon owner¹²) is responsible for the retrofitting of a wagon and carries the financial risk for the retrofitting of the

¹² The wagon keeper is the legal entity or natural person entered in the national vehicle register. This is the entity or person responsible, among other things, for registration of the wagon in the NVR. The wagon keeper does not necessarily have to be the owner of the wagon – in the sense of the legal definition 'owner'.

wagon. At the same time it is assumed for simplification that the wagon keeper is the wagon owner.¹³ A distinction between these two stakeholders is not relevant for the methodology of this investigation.

With regard to the wagon keeper the present study distinguishes between the following stakeholders:

- Railway undertakings as wagon keepers;
- Customers (below also called consignors) as wagon keepers;
 - Intermediate players or downstream players as wagon keepers (Intermediate players are players interposed between RUs and consignors, such as railway forwarding agents or additionally integrated RUs); and
- Wagon rental and leasing companies as wagon keepers (below referred to as wagon lessor).

A detailed listing of the players is given in Chapter 4.2.

Person Responsible for Making Arrangements

While the wagon keeper does not necessarily have any influence on the actual use of his wagons, the person who is responsible for allocating wagons, for the preparation of the train at the right time, its departure time, possible intermediate stops and arrival time, as well as the choice of route does. An incentive which applies to the actual wagon use must therefore not be addressed to the wagon keeper but to the person responsible for making the arrangements. In practice these can be different players:

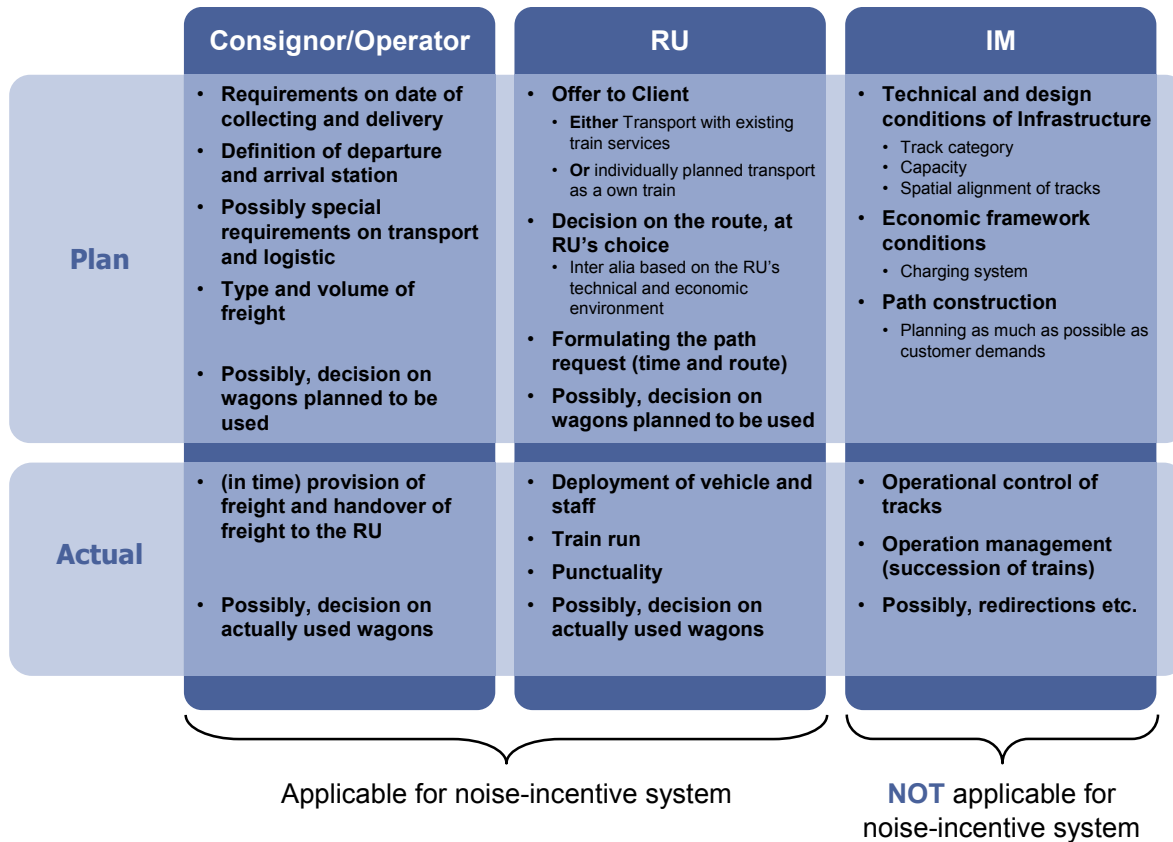
- **Railway Undertaking (RU):** As the player who forwards the wagons, a considerable part of the arranging decisions lies with the RU. This includes the placing of the wagons in certain trains, and applies, in particular for the route of their journey (route specific arrangements), but also the departure and arrival time (time specific arrangements) are to a large extent controlled by the RU. The RU has a lot of influence on this as it is actually operating the trains (influence on punctuality) and hence determines the extent to which the actual train running time corresponds with the scheduled running time. If the consignor does not provide wagons, the RU decides the choice of the vehicles used.
- **Consignor (RU customers):** The freight customer looks after the provision of the goods (if necessary including the wagons) so that a consignment can be despatched. In addition to the setting of the time of the

¹³ In individual cases this structure can be more complex, that is to say lessors lease wagons, which they do not own. In addition the lessor can hand over the holder ownership to the RU if there is a long term lease contract.

transport the consignor also has a big say in the time of day that trains run. Consequently the consignor is responsible for a large part of the transport and the arrangements. The consignor has influence, by his provision and handover of the loaded freight wagon to the RU, on the extent to which the actual train journey is in accordance with the planned journey.

- **Operator:** Like the consignor an operator (or railway forwarding agent) can also be responsible for the provision of the goods to be transported and the time related transport requirements. He also has to be considered in the incentive system.
- **Railway Infrastructure Manager (IM):** The Infrastructure Manager imposes by the configuration of his network (equipment, capacity and availability of alternative routes) important technical framework conditions. His access charge system sets the economic basis for the train paths required by the RU. The IM translates the requirements of the RUs regarding arrival and departure time as well as the route of its train into actual train paths. In the actual train operation the IM controls train movements through his operating control centres and movements inspectors, (and arranges, for example, route diversions when necessary). The NDTACs investigated here take no notice of these and are designed and defined as incentive systems, which do not provide any inclusion of the Infrastructure Manager in the incentive model.

Figure 1: Overview of the Players Responsible for the Allocation of Wagons and Carrying out the Transport



Source: Own chart

3 Description of the Incentive Models

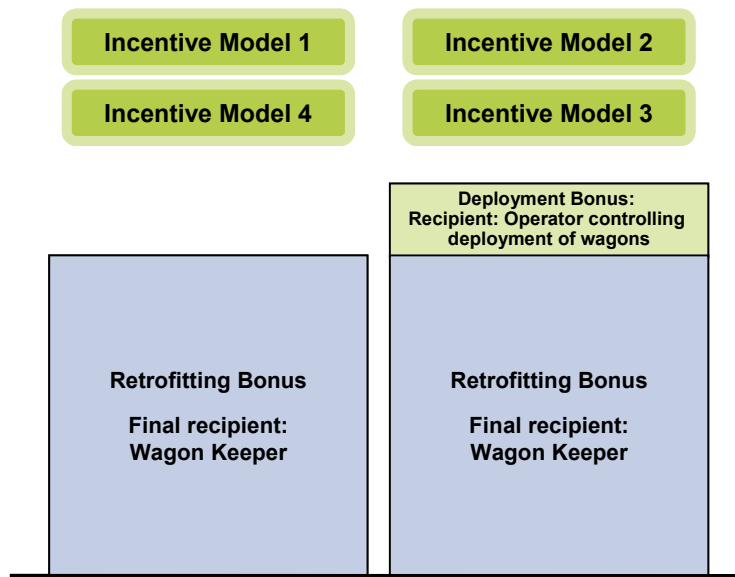
In the following section the four incentive models to be investigated in the study will first be described with regard to their control objectives and their principle method of operation as well as their consequent relationships with the players concerned. All four are defined in their basic form as bonus models to promote retrofitting of freight wagons. In two of the incentive models studied a non-mandatory bonus is considered for further route and time related traffic control. With both models there is, in addition, a sub-variant in which a penalty is levied for loud wagons. Uniformly for each model there is a retrofitting based incentive payment per axle-kilometre. This mileage based bonus payment remains constant over the duration of the programme period. The level of the bonus payment to incentivise the retrofitting depends on the total expenditure incurred by the holder in converting and operating quiet vehicles. These costs were not separately determined in this study, but available figures from the 'Quiet Rhine' project were used.

The procedural chart of the incentive models as well as the consideration of the costs arising are given in Chapter 5 and Chapter 6.

Basically it should be noted that model one (mileage and noise dependent bonus model on the basis of GCU and NVR) and four (direct funding) are directed just at the retrofitting of freight wagons to composite brake blocks and offer no further incentive objective. The models two and three are likewise primarily directed at the retrofitting of the freight wagons, but were, however, in the model design investigated here additionally extended by the formation of the time- and route specific traffic control effect. By this means the introduction of quiet or loud wagons is positively or negatively encouraged, especially at certain times of the day as well as on specially noise sensitive sections of line.

While the retrofitting places the wagon keeper in the central position is it the behaviour control (below also designated 'deployment incentive') of the players concerned, which controls the deployment of freight wagons in practice, that is to say the RUs, operator or consignor.

Figure 2:
Types of Bonuses in
the Incentive Models
Investigated



Source: Own chart

3.1 Mileage and Noise Dependent Bonus Scheme on the Basis of GCU and NVR

The object of the noise and mileage dependent bonus system put forward at the beginning of 2010 by a wide group of players (VDV, VPI Hamburg, DB SR, DB Netz) into the public discussion based on the GCU and NVR is as described in the Chapter introduction. It is just the incentivising of a fast retrofitting of loud freight wagons to wagons with quiet brake blocks. For this purpose the wagon keepers will receive a bonus dependent on the number of axles on their wagons and the annual mileage in Germany provided that they are converted to quiet brake blocks. The financing of the bonus would come from public authority budgets and would be paid directly to the wagon keeper – bypassing the relationship RU – IM, which is the most relevant with regard to access charge payments, or other possible stages of invoicing between stakeholders.

On application from the wagon keeper the bonus would be directly paid by a public Bonus Office (that could be located at the Eisenbahn-Bundesamt [EBA] (Federal Railway Authority¹⁴) annually depending on the 'quiet' axle-kilometres run by converted wagons. The bonus relevant information and payment flows would basically take place between the wagon keeper and the

¹⁴ In principle it would be possible to set this up at the Federal network Agency or an office at BMVBS. Since however the EBA already manages the NVR it would be more efficient in practice to set up the Bonus Office here.

Bonus Office. For this, the wagon keeper would report the annual mileage of wagons that are entitled to the bonus to the Bonus Office and receive the bonus from it.

The model uses the existing contractual relationships and information obligations of the GCU which is applied throughout Europe, the result of which is that the RUs that carry out the work can report to the holders of the allocated wagons the annual mileage in their respective business¹⁵, as well as the legally standardised entries in the national wagon register – here in particular the classification of wagons regarding their brake block equipment, as well as the date of the retrofitting in order to ensure the information exchange on the annual mileage by the freight wagons. Further players who can be connected between the RUs which carry out the work, and wagon keepers (as, for example, consignors or forwarders, who themselves lease wagons from holders and hand these over to the respective RU for forwarding) must be included in the process only in exceptional cases. In particular, if the RU does not pass on the mileage data to the wagon keeper.

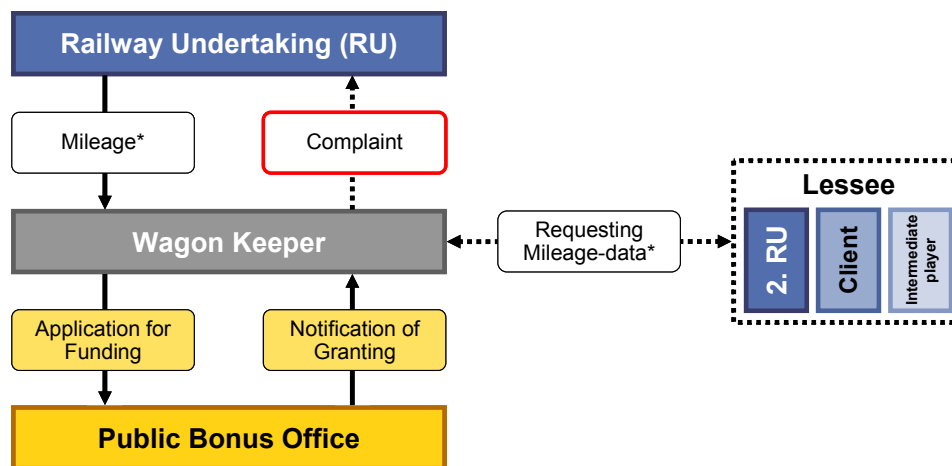


Figure 3:
Incentive Model 1: ND
Bonus Model on the
Basis of AVV / NVR

* not applicable if wagon keeper = RU

— necessary process
 possible process (dependent on frequency)

Source: Own chart

The incentive model is basically designed as a temporary model for a period of eight years. However, the bonus period of a wagon can be ended earlier if the maximum amount of payable bonus is reached before the end of the eight years. When the programme is finished there is, in general, no further

¹⁵ Controversial among the representatives of the organisations is whether the mileage report is an obligation of the wagon keeper or an obligation of the RU. For the general functioning of this system this is only a side issue.

bonus for any wagon. As a result the fast retrofitting of freight wagons should be encouraged, especially wagons which run a high annual mileage.

To reinforce the incentive effect, if necessary, economic or regulatory instruments can be implemented with transition periods after the programme running time (flat rate licensing charges or mileage related penalties for cast iron block vehicles in service, prohibition rules, etc.). Because of this the re-retrofitting of brakes with cast iron brake blocks should be excluded. Moreover retrofitting should be encouraged for those wagons, where cumulative bonuses paid during the programme life do not completely cover the additional cost for composite brake blocks. The combination of positive (bonus) and negative (penalty, prohibition) incentives would force retrofitting even for these wagons.

The principal characteristics of the system are summarised in Table 1.

Table 1: System Characteristics ND Bonus

System element	System characteristics
Objective	Incentive for retrofitting wagons
General description	Mileage-dependant bonus; wagon keeper applies for bonus at a national bonus office
Relation to current TAC	Use of elements for determination of annual mileage
Requested modification in legislation and administration	None
Programme duration	Maximum 8 years or reaching a wagon-specific bonus ceiling
System after 8 years	Ban of cast iron brakes; registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs
Options of funding	Public funding; optional: partial funding through rail industry possible
Applicability	All freight wagons (German and foreign) operating fully or in part on the German rail network
Stakeholders	RU – wagon keeper – public bonus office
Accounting system / detection system	Application system
Transfer of boni	Not necessary
Differentiation by time	No
Differentiation by route	No

Source: Own chart

3.2 Noise Differentiated Track Access Charge System (NDTAC)

The NDTAC for quiet/loud freight wagons chosen for investigation in this study has, besides the fast retrofitting of freight wagons, also the control of traffic as an objective. It is thus intended to control traffic both from a route and time point of view so that the noise suffered by the people who live close to the line is reduced. The basic idea of this is that noise related track access charge should be applied permanently and the technology to achieve it left open.¹⁶

The incentive in the form of a bonus or bonus penalty in these models, is first calculated between IM and RU, since the incentive amount is given as part of or, in addition to, the calculated access charge – therefore also the definition of the 'noise differentiated' access charge. NDTAC can be considered as a bonus model but also as a bonus-penalty model. In this investigation three variants are considered:

- Pure bonus system (Incentive Model 2.1) for quiet freight wagons (NDTAC-bonus).
- Bonus-penalty system in which bonuses are paid for quiet wagons and penalties charged for loud freight wagons, calculated on a wagon-specific base (per wagon) (Incentive Model 2.2) (NDTAC- bonus-penalty).
- Bonus-penalty system, in which the bonuses are calculated on a wagon specific base, the penalties are only levied indirectly and not for each wagon, but in the form of a general increase of access charges for freight trains (Incentive Model 2.3) (NADTC-TAC-rise).

While the public sector pays for the bonuses in the NDTAC- bonus model, this is significantly changed in the NDTAC- bonus-penalty model and NDTAC-TAC-rise model. In both cases the financing of the bonuses is now paid for by the rail sector.

In addition to the 'retrofitting bonus' which as in all other incentive models is a fixed amount per axle kilometre and is paid to the wagon keeper's address, there is, in addition, in all three sub-variants a 'deployment bonus' (or in model 2.2 and 3.2 a penalty) (see also Figure 2). This incentive (bonus for quiet wagons, penalty for loud wagons) is then paid at different levels in case a freight wagon is used at certain times of the day (less sensitive to noise) and/or on certain routes (less sensitive to noise). However this incentive is not aimed at the wagon keeper (who in general cannot influence the allocation of his wagons), but should be paid to the players who organise the

¹⁶ However for better comparison of the incentive systems the time frame considered is also fixed at eight years for the NDTAC. Likewise in the current investigation the incentive is only set on the basis of the brake characteristics of a wagon.

transport (these are the RUs, consignors and operators). The RUs must undertake the distribution of the share of the bonus to the wagon keepers as well as the players responsible for the arrangements. For this purpose intermediate players are included, if necessary (see the market description in Chapter 4). The principles (bonus level, differential bonuses for certain times of the day or on certain sections of line) should be stated in the IMs rail network statement and the list of payments for all path users clearly shown.

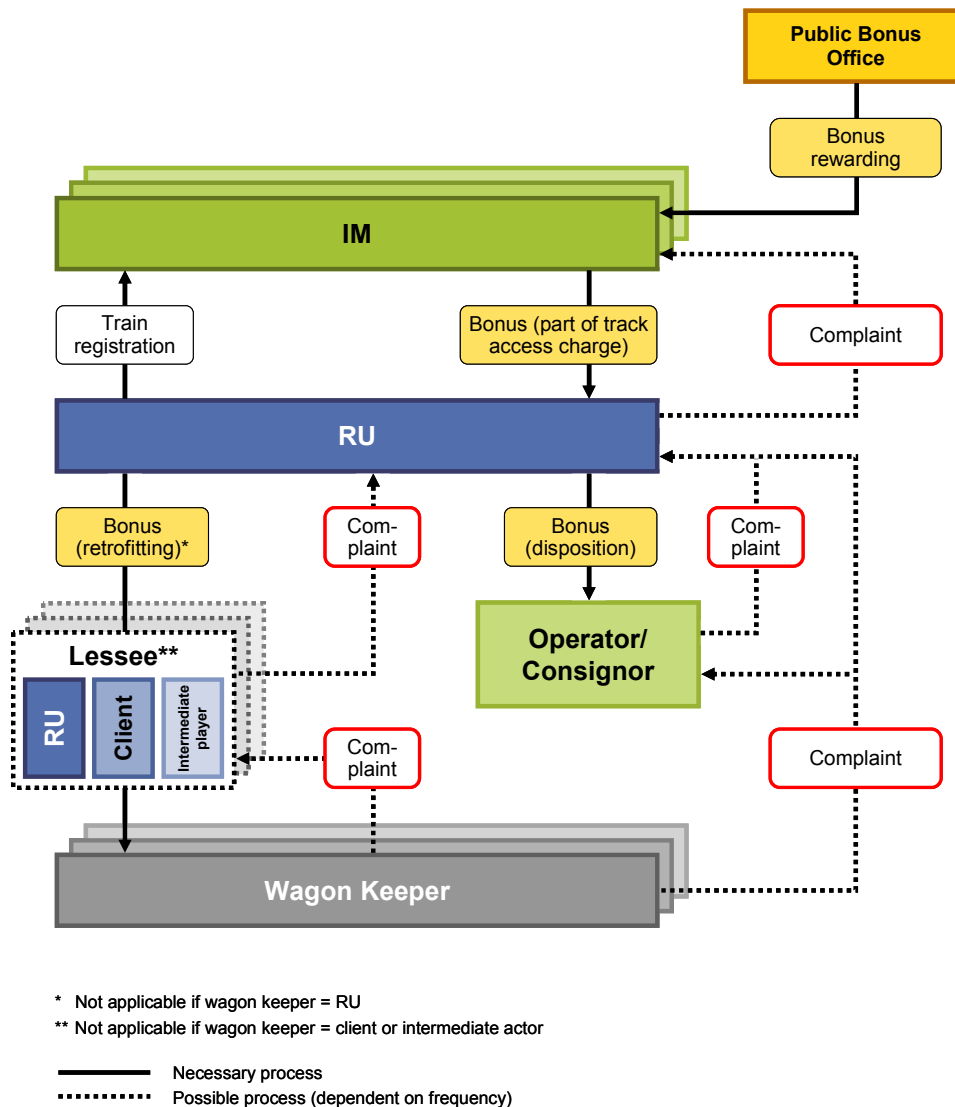
The wagon specific calculation of bonuses and penalties, regardless of whether for retrofitting or arranging for wagons to be used, is first done by means of the invoicing stage IM – RU. Included are all rail lines in Germany on which there is freight traffic. Unlike incentive model 1 all quiet wagons are included, that is to say also wagons that are already fitted with 'quiet' brake equipment.

The distribution or transfer of the bonuses and penalties should be done according to the model conditions specified here so that:

- the retrofitting bonus per wagon is determined by the RU by means of the invoicing process with the IM, as well as from the data of the internal production system of the RU, and then transferred to the wagon keeper (in case the RU is not the wagon keeper). Since there isn't a direct relation between RU and wagon keeper in every case, intermediate players (e.g. other RUs, operators and consignors) should, if necessary, be included as 'transit players'.
- the deployment bonus of the RU in the cases in which it does not itself control the dispatching arrangements, is transferred to an operator or consignor.

Figure 4 shows the Incentive Model 2 in the form of a pure bonus system (below also called Incentive Model 2.1). It shows in a simplified way the complexity of an NDTAC which results from the possible inclusion of different Infrastructure Managers and wagon keepers (or intermediate players) per train journey:

Figure 4:
Incentive Model 2.1:
NDTAC-IT TAC-rise
(Schematic Diagram)



Source: Own chart

The practical implementation of NDTAC systems is done, in general, on the basis of existing player relationships (e.g. IM – RU, RU – consignor – wagon keeper). It requires, however, expenditure to implement it because of the processes to be adjusted as well as the basic and necessary information and data exchange between the players. A suitable IT system needs to be installed on all the player levels or the existing systems need to be adjusted in order to ensure a smooth exchange between the players, as well as the correct allocation of information and data to the various players.

The adjustment and further development concerns, in particular, the relation IM and RU since previously a train based calculation is done on the basis of the paths ordered. If time related and route related differentiation are now added an adjustment of the recording, processing and invoicing is necessary

on the basis of the trains actually run. This is in addition to the data transmitted from the RUs regarding the respective trains, in order to guarantee the axle related part of the bonus. Legally a change of the IM's network statement may be necessary.

Table 2 shows the system characteristics of the NDTAC investigated in the base variant as a pure bonus model (Model 2.1), in which a public authority pays the bonus payments to the Infrastructure Manager.

Table 2: System Characteristics NDTAC-IT Bonus

System element	System characteristics
Objective	Incentive for retrofitting wagons; wagon deployment incentive
General description	Settlement of Bonuses through Track Access Charge Clearance
Relation to current TAC	Recording and clearance system of IM is used as a basis for clearance of bonus with RU
Requested modification in legislation and administration	Amendment of network statement
Programme duration	8 years; could be prolonged
System after 8 years	Possible prolongation; ban of cast iron brakes; registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs; incentive for a different deployment of wagons
Options of funding	Indirect public sector funding through bonus office and IM
Applicability	Infrastructure manager
Stakeholders	Bonus office – IM – RU – consignor / operator – wagon keeper – (wagon owner)
Accounting system / recording system	IT-System of IM and relevant IT-Interfaces (need to be amended)
Transfer of boni	Forwarding of bonus from RU to wagon keeper or party responsible for deployment of wagons; differentiated by market structure models
Differentiation by time	Yes
Differentiation by route	Yes

Source: Own chart

The NDTAC is considered in two further variants, firstly as a bonus-penalty system and secondly as a bonus system with an increased general track access charge level for all freight trains.

A bonus-penalty system means that a bonus will be paid for quiet wagons and a penalty imposed for loud wagons. Thus, unlike the models in which only a wagon specific bonus is applied, all wagons (quiet and loud) are included. The aim is that the bonuses for retrofitting and allocation are refinanced by the penalties for using loud freight wagons. This difference is especially important for the passing on of the financial incentives, since now the recording of all wagons together with the incentive calculation, as well as the possible queries, are necessary.

In the Incentive Model 2.2 (NDTAC-bonus-penalty) there is additional expenditure for network operators, who on the basis of traffic and retrofitting forecasts must determine the level of the penalties for non-converted 'loud' wagons. The Federal Network Agency (BNetzA) should be included since it is a question of compensation which needs to be regulated.

The following Table 3 summarises the characteristics of the bonus-penalty system:

Table 3: System Characteristics NDTAC-IT Bonus-penalty

System element	System characteristics
Objective	Incentive for retrofitting wagons; wagon deployment incentive
General description	Settlement of bonuses and penalties through track access charge clearance
Relation to current TAC	Recording and clearance system of IM is used as a basis for clearance of bonus with RU
Requested modification in legislation and administration	Amendment of network statement and EIBV where applicable, Involvement of Federal Network Agency
Bonus period	8 years; could be prolonged
System after 8 years	Possible prolongation, ban of cast iron brakes, registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs; incentive for a different deployment of wagons
Options of funding	Penalties for loud wagons / deployment penalties
Applicability	Infrastructure manager
Stakeholders	IM – RU – consignor / operator – wagon keeper – (wagon owner)
Accounting system / detection system	IT-System of IM and relevant IT-Interfaces (need to be amended)
Transfer of boni	Forwarding of bonus from RU to wagon keeper or party responsible for deployment of wagons; differentiated by market structure models
Differentiation by time	Yes
Differentiation by route	Yes

Source. Own chart

In the Incentive Model 2.3 investigated the bonuses paid are refinanced by raising the track access charge for all freight trains, so in this case there is no public financing. In addition the client's model definition specifies that the RU should pass on the increase in the track access charge to the first wagon keeper or wagon provider level by apportioning the general increase to the individual wagons in order avoid disadvantage the RU.

This means that the RU must reapportion the track access charge delta for all those wagons in a train where it is not the wagon keeper. These can be wagon keepers, e.g. lessors or consignors, or operators and consignors, who

are not themselves wagon keepers, but obtain wagons from a third party and then supply them to the RU.

In case of a general increase of track access charges the Infrastructure Manager has in coordination with the Federal Network Agency will have to review the IM's forecast.

Table 4 presents the characteristics of the Incentive Model 2.3 in an overview:

Table 4: System Characteristics NDTAC-IT TAC-rise

System element	System characteristics
Objective	Incentive for retrofitting wagons; wagon deployment incentive
General description	Settlement of bonuses through track access charge clearance; Increase of general track access charge
Relation to current TAC	Recording and clearance system of IM is used as a basis for clearance of bonus with RU
Requested modification in legislation and administration	Amendment of network statement and EIBV where applicable, Involvement of Federal Network Agency
Bonus period	8 years; could be prolonged
System after 8 years	Possible prolongation, ban of cast iron brakes; registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs; incentive for a different deployment of wagons
Options of funding	Increase of general track access charge level
Applicability	Infrastructure manager
Stakeholders	IM – RU – consignor / operator – wagon keeper – (wagon owner)
Accounting system / detection system	IT-System of IM and relevant IT-Interfaces (need to be amended)
Transfer of boni	Forwarding of bonus from RU to wagon keeper or party responsible for deployment of wagons; differentiated by market structure models; forwarding of access charge increase to downstream player
Differentiation by time	Yes
Differentiation by route	Yes

Source: Own chart

In Incentive Model 2.3, as well, there are costs for the network operator in determining the track access charge increase using forecasts of wagon retrofitting and general traffic development. The regulatory body must finally agree, in the same way as in Incentive Model 2.2, to this process and finally to the increase in track access charge.

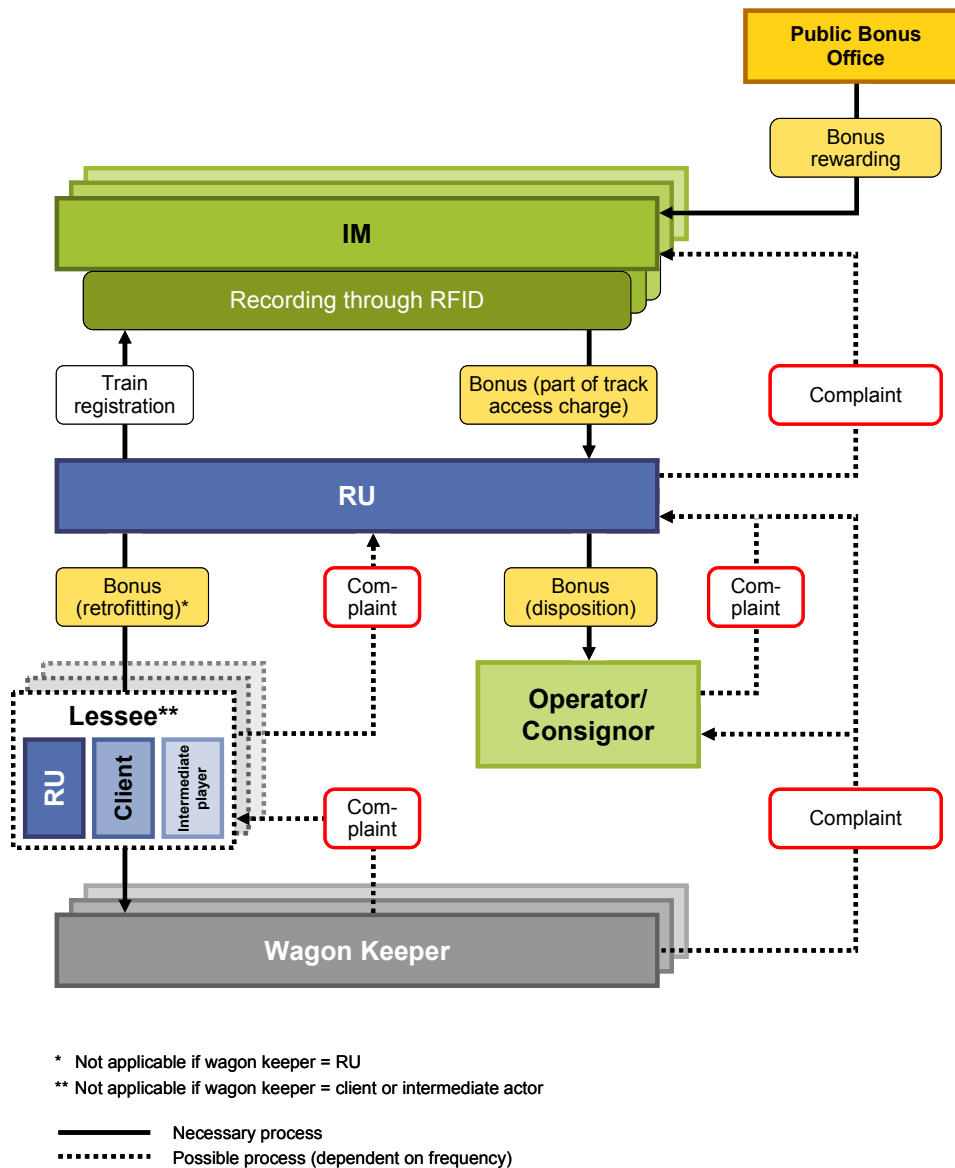
For the implementation of the NDTAC or its safe legal basis, in some cases, the Eisenbahninfrastruktur-Benutzungsverordnung (EIBV) (railway infrastructure conditions of access and use regulation) needs to be amended. In Article 21(2) of the regulation the costs for the user of the environmental based charges are determined, provided that the total proceeds for the network operator remains unchanged. Paragraph 5 gives the possibility of the balancing out 'over suitable time scales', that is to say if the scheme is to be self-financed by the sector (bonus-penalty, track access charge rising) the network operator must not necessarily get back the cost exactly year for year. The question of what is a suitable time scale is still in dispute until clarified by legislation or the Federal Network Agency.

3.3 Noise Differentiated Track Access Charge System on the Basis of RFID

The RFID based noise related track access charge system corresponds in essence to the Incentive Model 2 NDTAC- IT and is investigated in three different variants (Incentive Model 3.1: Pure bonus system, Incentive Model 3.2: Bonus-penalty system, Incentive Model 3.3: Bonus system with general increase of the track access charges). The main difference between NDTAC- IT and NDTAC- RFID is the recording of trains, or the wagons running in these trains, by means of RFID portals along the track. In order to allow RFID identification the freight wagons eligible to receive the bonus (also foreign wagons) need to be equipped with RFID-chips. In model 3.1 and 3.3 it is sufficient to fit the quiet wagons with RFID chips, however in model 3.2 all freight wagons need to be fitted so that penalties can be charged for the loud wagons. Because of the automated RFID-recording it is not necessary in principle to transmit the information between IM and RU but the corresponding IT infrastructure is not, nevertheless, completely indispensable, since if there were a failure of the RFID recording a manual transmission of the data would have to be done in the same way as for the NDTAC-IT.

Apart from this all incentive models with RFID recording correspond to the models described in Chapter 3.2. This means that the bonus transmission from the RU to the downstream players runs identically (see Chapter 3.2 for details).

Figure 5:
Incentive Model 3.1:
NTDAC-RFID Bonus
(Schematic Diagram)



Source: Own chart

As it is similar to the noise differentiated track access charge system without RFID recording, only an overview of Incentive Model 3.1 (pure bonus model) is given below. For the Incentive Models 3.2 and 3.3 reference is made to Table 3 and Table 4.

Table 5: System Characteristics NDTAC-RFID TAC-rise

System element	System characteristics
Objective	Incentive for retrofitting wagons; wagon deployment incentive
General description	Settlement of bonuses through track access charge clearance on the basis of RFID-recording
Relation to current TAC	Clearance system of IM is used as a basis for clearance of bonus with RU
Requested modification in legislation and administration	Amendment of network statement
Bonus period	8 years; could be prolonged
System after 8 years	Possible prolongation, ban of cast iron brakes; registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs; incentive for a different deployment of wagons
Options of funding	Indirect public sector funding through bonus office and IM
Applicability	Infrastructure manager
Stakeholders	Bonus office – IM – RU – consignor / operator – wagon keeper – (wagon owner)
Accounting system / detection system	Recording of wagons through RFID-portals
Transfer of boni	Forwarding of bonus from RU to wagon keeper or party responsible for deployment of wagons; differentiated by market structure models
Differentiation by time	Yes
Differentiation by route	Yes

Source: Own chart

3.4 Direct Funding

With the direct support system the wagon keeper receives a grant from a public sector entity to retrofit his wagons with composite brake blocks. This applies to all German wagons, but it can also be extended to foreign wagons if the design conforms with the support criteria and they run a defined minimum distance in Germany. The correct use of these funds has to be justified to the grant giver. Consequently only the wagon keepers and the public sector entity which is granting the bonus – the ‘public Bonus Office’ (most likely the EBA) participate in this model. Direct support is considered by many representatives of the railway sectors as the most suitable model for

the fast retrofitting of freight wagons with K (composite) or LL (long life) brake blocks. In Switzerland, it was possible to convert the freight wagon fleet quickly with this method.

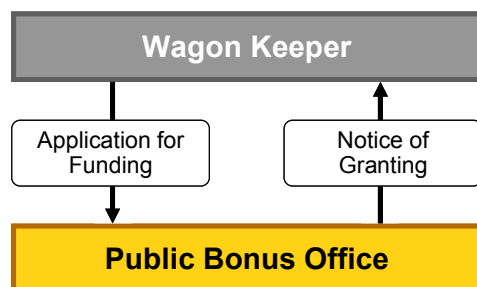
Table 6: System Characteristics Direct Funding

System element	System characteristics
Objective	Incentive for retrofitting wagons
General description	Bonus paid directly for 'quiet' wagons
Relation to current TAC	None
Requested modification in legislation and administration	None
Bonus period	8 years
System after 8 years	Ban of cast iron brakes, registration fee etc.
Level of bonus	Compensation for costs of retrofitting and additional operational costs
Options of funding	Public Sector
Applicability	All German or foreign wagons entitled to receive funds
Stakeholders	Wagon keeper - public bonus office
Accounting system / detection system	Application system
Transfer of boni	Not necessary
Differentiation by time	No
Differentiation by route	No

Source: Own chart

The processes involved are limited in essence to the administrative cost which falls on the wagon keeper for putting in the application and on the public Bonus Office for processing the applications. In order to properly qualify for the grant this model must be made accessible in the same way to all wagon keepers in the interoperable European market. A legal assessment of the model is not however part of this study.

Figure 6: Incentive Model 4: Direct Funding (Schematic Diagram)



Source: Own chart

4 Overview of the German Rail Freight Market

4.1 General

The German rail freight market has many different players related in different ways and is exposed to strong intermodal competition in other areas. This competitive situation, produced by changed requirements for transport (e.g. increasing consumer goods, just in time production), but also the international liberalising of road freight traffic keeps the margins in Germany low. Only with few freight sectors (e.g. bulk goods except for waterways) are the railways exposed to small intermodal competitive pressure.

With the step by step opening up of the European railway network intramodal competition has increased considerably in importance. Accordingly the variety of the rail freight market has increased. Besides DB Schenker Rail and private and/or regional railways in the meantime foreign national railways have also become active, directly or through subsidiaries, in the German market. Some of the players in the process pursue clearly different business models. The market share of the non-State railways on the German network is today about 25% (both with respect to the traffic carried and the trains run), on some important lines it is higher.

A further important feature is the growing volume of international traffic. Especially in Germany with its central position on important European freight corridors (e.g. Rotterdam – Genoa) this share is steadily increasing.

Below, first of all an overview of the most important players in the rail freight market will be given and a description of the current processes. These are just directed at the operating requirements of railway traffic as well as economic necessities, not at incentive effects for noise reduction on freight wagons. The various business models for this will also be briefly described.

4.2 Overview of the Players in the Rail Freight Market

The following groups of players are involved in the rail freight market.

- Railway Infrastructure Managers
- Railway undertakings
- Wagon leasing companies
- Operators and forwarding agents
- Consignors (loaders, transport customers)

It is possible to differentiate between these groups of players. For this investigation this is, in particular, necessary for the first three groups, in order to avoid subsequent levelling of the costs due to non-consideration of the differences between the players. The allocation is done only from methodical points of view in order to be able to arrange comparable undertakings in one sub group.

Starting from the basic allocation in the cost model the same assumptions are made for each player of a cluster which are used in further calculations.

In this connection they are repeating processes within a certain period (e.g. number of invoices issued, number of train journeys). Many players can have a double identity, e.g. RU and at the same time wagon lessor.

4.2.1 Railway Infrastructure Managers

For the consideration of the IM it is necessary to distinguish from the railway legal point of view between track operators (BdS) and service organisations (e.g. harbours). In German railway law an environmental differentiation of the user compensation is only provided for operators of the track (21(2) EIBV). Below therefore it is always operators of the track who are meant even when talking about Railway Infrastructure Managers.

The IMs to be considered are divided into four different clusters for this study. In principle all the track operators in Germany on which freight traffic is carried are included.¹⁷ The division is done by the criterion of network characteristics, that is to say, is the infrastructure an independent network or only a feeder to a larger network Traffic capacity on the network or network length is not important, with the exception of cluster 4. Not included are IMs on whose tracks there is no rail freight traffic (e.g. museum railways) or which are not usable by standard gauge vehicles. Finally there remain a total of 141 undertakings which are arranged as relevant to the investigation and are divided into the four clusters.

Cluster 1: DB Netz AG

DB Netz which is by far the largest German IM forms a cluster by itself. The undertaking is responsible for almost 90% of all rail tracks in Germany. With about 4,600 freight trains daily the vast majority of the freight traffic in Germany flows on the lines of DB Netz. Almost all the rail traffic in Germany runs on the network of DB Netz AG at least somewhere. About 170 undertakings involved in the rail freight traffic run on their network.

¹⁷ Since first of all only a cost estimate is being prepared for Germany, foreign railway infrastructures were not considered. As part of an analagous consideration estimates for other countries were prepared in other countries.

Cluster 2: 'Surface' IMs

A series of railway infrastructures have several accesses to the main network or can to a limited extent be considered as independent networks, as for example that of the EVB or the OHE in Lower Saxony. In most cases the networks of the 'Surface' IMs are the starting point or the destination of traffic, but depending on the geographical situation through traffic is also possible. Unlike cluster 2 because of the character of the network a great deal of internal traffic is possible. But also here there are only a few trains each day.

Cluster 3: 'Last Mile' IMs

In the rail freight market many trains run on the infrastructure of DB Netz AG and on other networks, often on the so-called last mile, that is to say the traffic has a destination or starting point on a non-State network. In cluster 2 the undertakings which only have access with one line to the main network are grouped together.

The users of these infrastructures are in general limited to only a few undertakings, frequently local and regional RUs, which are partly connected with the infrastructure undertakings or were once.

Cluster 4: Small IMs

In addition there are throughout Germany a number of small networks and lines whose freight traffic revenue is marginal. Often only a few regular trains run or there is irregular traffic (e.g. wood trains). The number of users is thus very small.

It can be concluded for clusters two to four that the operation of the infrastructure is done in many areas on a simple level. DB Netz AG is alone, because of the size of its network and the large number of trains runs, in being dependent on a high level of automation and technology. However the undertakings of clusters two and three are increasingly introducing IT systems in order to simplify their processes, and have already adjusted their production systems in the past years. In view of the minimal number of trains these trends are unlikely to spread to the small IMs (cluster 4).

It is unclear to what extent the number of the lines used by rail freight traffic will change in the future. Besides the occasional efforts to reactivate closed lines, in a number of places there are calls for regional sponsorship to take-over lines of DB Netz AG lines. The number of Infrastructure operators could perhaps increase slightly, even though presumably the majority of them will fall into cluster 4.

4.2.2 Railway Undertakings

The group of RUs is relevant to the investigation for several reasons. As the undertakings that carry out freight transport they are in the end the people responsible for the noise, but at the same time because they are in direct business relationships with the IMs, wagon lessors, operators or consignors they are in a central position. However, many RUs are also wagon keepers (but the proportion of wagons in use that they hold themselves varies widely from RU to RU).

RUs are classified below depending on the size of the undertaking. The definition of size depends on the number of journeys per month carried out by the RU. A distinction is made between four different class sizes.

The basis of the investigation is the assumption of DB Netz AG that some 170 different RUs in the rail freight business run on their lines. The division of the undertakings into the individual clusters (with the exception of cluster 1) was not based on any market survey but was done on the basis of available secondary data in agreement with the customers.

Cluster 1: DB Schenker Rail

As with the IMs the Federal undertaking, DB SR is by far the biggest player and so forms a large class on its own. With an average of about 3,500 trains every calendar day, DB SR runs about three quarters of the freight traffic on the German railway system.¹⁸ Most DB SR trains run on German territory generally in domestic traffic on the lines of DB Netz AG, some of the DB SR-trains also run on the lines of other IMs in Germany. Schenker has about 97,000 freight wagons and is the largest wagon keeper in Germany.

Only DB SR offers a nationwide system for single wagon traffic. The hallmark for this transport system that can be used by a large number of freight customers is the DB SR market orientated planned train connections between the marshalling yards of the major business centres which provide connections with regional and feeder services to meet customer requirements.

A further feature of the DB traffic is the so-called cooperative traffic in which wagons or complete trains are handed over by a cooperating-railway (e.g. a foreign national railway) to DB SR which then moves the traffic in Germany (and vice versa).

¹⁸ By using the number of train journeys it is possible for the transport volume to be reliably estimated. Thus in 2008 about 79% of the transport volume was carried by DB Schenker. (Source: Competition report 2008/2009). The share has fallen slightly in the past years.

Cluster 2: Large RUs

Even in the rail freight business there has been an increase in competition since the middle of the 1990s because, compared to the German railways other RUs were more active, or often also new on the market. Some of these RUs are private; some are publicly owned or are foreign owned (national) railways. A small group of about ten undertakings has obtained in comparison to other competing railways a sustained market share. The RUs of this cluster have established themselves in the market by means of their flexible business models or by concentrating on certain segments of the market. They have been helped by the fact that they are wagon keepers to a much lesser extent than DB SR and when required lease wagons. German subsidiary companies of foreign RUs also run some of their trains with these wagons. In spite of the large number of leasing companies, most of the leasing is done by only a few lessors who often have long business relations that run for many years. In some cases these undertakings run cooperative traffic, however not to the same extent as DB SR.

Cluster 3: Medium Sized RUs

Besides the larger competitive railways there are a lot of smaller railways, in the main set up by regional or local players. These players have expanded in some cases, however the majority of their train movements still occur in the region (e.g. feeder services for long distance traffic on DB SR or other RUs), or the undertakings run inter-regional traffic for long-standing customer. Among these are undertakings that only operate in niche markets.

Cluster 4: Small RUs

The numerically biggest group of RUs consists of undertakings which only carry very little traffic. Often it is (irregular) traffic such as service trains, seasonal traffic or feeder services in which only one customer is served in the initial or final part of a long distance consignment.

Just as in the case of the Infrastructure Managers the degree of automation with the railway undertakings varies enormously. While DB SR must maintain a powerful IT system because of the quantity of traffic they carry the standard of IT in cluster 4 undertakings is low. In the medium sized classes the trend to increasing automation is unmistakable.

Fifteen years after the railway reform, the rail freight market in Germany is thus still 'in flux'. Finally it has been possible to see an increasing market concentration due to takeovers and amalgamations. How far this concentration process may still go, cannot be estimated. It is, however, probable that the total number of RUs active in Germany today will decline in future. In addition it is unclear how the ratio of owned wagons to leased wagons will

change in the coming years. For DB SR it is expected that the number of owned wagons will decline. On the other hand some competing railways have decided to buy their own wagons.

4.2.3 Lessors

In Germany there is a long tradition of private wagon lessors operating in the market. The changed market situation in rail freight has, in addition, had a positive effect on the development of leasing and renting companies in the last few years. The increasing competition between the railway undertakings has promoted the expansion of the leasing market, in which today over a hundred companies are active. In principle these companies are active right across Europe. Often they do indeed know on which services their wagon fleet operate, but certainly not the details of where their freight wagons actually run. This applies in particular when the lessee is not an RU but, for example, a consignor who hands these wagons to an RU for transport.

It is important to note that this group of players consists exclusively of undertakings which lease their own wagons or wagons held by them. Other wagon holding players as, for example, consignors, foreign RUs or operators which make their own wagons available to the so-called 'operating RU' for the transport, are not recorded in this group of players as 'lessors', since they make the wagon available, in general, free of charge or on another basis (e.g. as part of a special agreement).

Cluster 1: Large Lessors

The largest group as far as the number of wagons is concerned comprises only five undertakings, some of which hold several tens of thousands wagons. These large lessors consequently cover a considerable part of the leasing market. Due to their size their customer spectrum which adds up to several hundred customers (RUs, operators, railway forwarding agents, and consignors) is especially wide. Wagons can be leased for short periods (if necessary even for single journeys) or long term, that is to say from a few months to several years. In individual cases in long term leases the wagon ownership is ceded to the lessee. Likewise it often occurs that the lessee is responsible for contractually agreed maintenance work (e.g. changing worn brake blocks).¹⁹

Cluster 2: Medium Sized Lessors

Beside the large undertakings there are a lot of medium sized lessors with an average of some 1,300 wagons who clearly take second place behind the lessors of cluster one in wagon and customer numbers. Apart from this the

¹⁹ These facts were not considered further in the investigation, since it is only a question here of a proportional bonus retention and not the complete replacement of the bonus forwarding to the wagon keeper.

business models are very similar to those of the undertakings in the other clusters. This concerns the type of customers as well as the contract arrangements.

Cluster 3: Small Lessors

The largest group (in terms of companies belonging to the respective cluster) is cluster three which contains a large number of small undertakings. Often they are the lessors of special wagons or regional undertakings. Since these undertakings have a small number of wagons (about 50) their client group is correspondingly smaller.

With wagon lessors the degree of automation is likewise dependent on their size. Smaller niche workers are not yet highly automated.

4.2.4 Further Important Players in the Rail Freight Market

Besides IMs, RUs and wagon lessors a lot of other players play an important role in the rail freight market. These will be briefly described, even if they are not included in a cluster, since this is not necessary for this investigation.²⁰ Frequently these players have the function of a wagon keeper or they provide wagons as lease customers to other players. In addition in many cases the dispatching responsibility lies on a level below the RU.

'Second RU'

RUs can act not only as the RU that carries out the transport operation (therefore the RU which applies for the path and runs the trains) but also as the upstream player for another RU that carries out the transport operation. Thus, it can happen that an RU which has the freight contract with the actual customer transfers the carrying out of the transport to another RU which acts as subcontractor. On the other hand it is possible that a foreign RU with an international cooperation indeed organises the transport with regard to customer care and wagon provision, but hands over this train at the frontier station to another RU that operates in Germany. The RU that carries out the transport has little influence in such circumstances on the configuration of the train and no immediate business relationship with the holders of the wagons that run in the train. For the RU that carries out the transport, in general, there is a payment as part of a complete agreement with the contractual RU (e.g. kilometre tariff or flat rate tariff agreements).

²⁰ Their importance for the incentive model takes second place behind the IMs, RUs and wagon keepers, which is why they are not included in the clustering. Also the number of players shown in the Chapter 6.2 is an assumed figure adapted to the practice in order to simplify the cost calculation. The number of players thus plays a subordinate role since -as will be explained – the number of train journeys and the number of wagons involved in the incentive are the important parameters which drive the quantities.

With the provision of rolling stock and the complete organisation of transport as part of their customer relations these RUs have behind the RU that carries out the work a certain dispatch responsibility and consequently in some cases need to be included in the bonus system. The same is true for the retrofitting bonus which they either retain (provided they are the wagon keeper) or must pass forward to other downstream players (if they have obtained the wagons from other players).

Consignors

Apart from empty journeys and movements within a station or other necessary operating journeys transports have a consignor as departure point. In general the consignor authorises an RU or an operator/forwarder to carry out the transport or the organisation of the transport and does not get involved with the operating questions. In some cases consignors are themselves wagon keepers. Then they provide some wagons to the appointed transporteur and are also entitled to the retrofitting bonus for wagons. If the consignors obtain the wagons themselves only from other players they remain included in the system of a NDTAC, because they then must act as the bonus distributor between RUs and the wagon keepers.

With respect to the deployment bonus it is assumed that consignors are responsible in a large part of the traffic for its control, therefore this group of players is considered in the later examination of the deployment bonus.

Operators and Railway Forwarding Agents

These undertakings organise transport, but do not necessarily do it themselves. A lot of undertakings operate as forwarders in the general transport market; others have specially focussed on rail.

The logistics organisation commissioned by the consignor begins with the choice of RU to carry out the transport, the provision of the wagons (if the consignor does not provide them himself) and can also include the combination of different consignors in separate trains. In addition the operators have a role as the people responsible for making arrangements which entitles them to the receipt of the deployment bonus. At the same time the operators also have, in general, their own wagon fleets and can therefore be entitled to the retrofitting bonuses. And finally they are located in the chain of players between the RU and consignor, that is to say even when they themselves are not entitled to a bonus the operators must act as go-betweens in the incentive models.

4.2.5 Public Authorities

In addition to the market players there are two important players on the side of the public authorities. Firstly there is the EBA which is responsible for the

approval of freight wagons and the management of the national vehicle register. All freight wagons approved to run in Germany including certain features are listed in the German NVR, e.g. wagon keeper and brake block type. Foreign wagons, which are not registered in the German NVR, are recorded in other countries, at present, however, not yet with the feature descriptions as in Germany. In the models defined here the newly set up Bonus Office is located at EBA and is responsible for the payment of the bonus as well as the sample checking of the sums paid.

The other is the BNetzA, (Bundesnetzagentur) [Federal Network Agency] which is responsible for discrimination-free access to the network and for checking the payments for path use. Provided that noise related components affect the track access charge system the BNetzA should be involved.

In addition, for the rest of the study the provider of funds should be included as a new player. This is the State office (of the Federation) which has to arrange the distribution and ensure the proper use of any Federal subsidies.

4.3 Overview of the Market Structure Models in Rail Freight Traffic

The diversity of the players described in the previous section is mirrored in the business models in the rail freight business. Some of these are more complex than others and offer, in particular for the NDTAC in the form described in Chapter 3 a clue for the complexity of the bonus distribution. To explain this, ten market structure models that occur in practice will be briefly described below in order to examine the degree of bonus transfer.

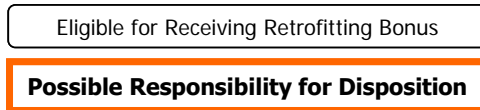
The market structure models are illustrated below in a one-dimensional way, whereby in practice for each player level under certain conditions different players can appear (see also the multi-dimensional chart in Figure 4). In addition for the investigation firstly the player who has to take the investment decision for the individual wagons (wagon keeper) is relevant, and secondly the player who is responsible for the marshalling of the train and therefore the wagons. If intermediate players, consignors and lessors are directly involved in the wagon provision, this increases the complexity. Simply said the following principle is valid: The simpler the market structure model, the simpler the bonus calculation. Thus, it is basically possible that within a train only one of the market structure models described occurs (e.g. block train traffic with wagons of the same holder) but there may be a mixture of several market structure models in one train (e.g. individual wagon traffic, block trains of different wagon groups). This means that the further calculation of the bonuses (or penalties) for a train can assume different complexities. If a train passes the frontier between Infrastructure Managers, this raises the complexity still further by involving several IMs. In the following description

these potentially mixed forms are not described since here only a brief market overview can be given.

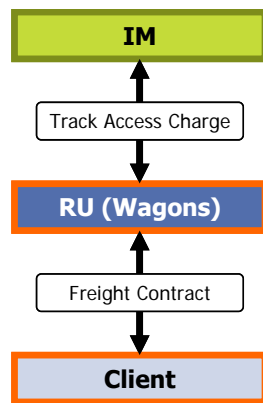
The illustrations shall show, beside the structural complexity, which players must receive the retrofitting bonus and which, if necessary, can receive a deployment bonus. Since the latter, unlike the retrofitting bonus, cannot be so clearly allocated, different players are correspondingly indicated below. It should be mentioned that there is always only one player who is responsible for the allocation of vehicles to a train.

Figure 7: Market Structure Models in Rail Freight Traffic

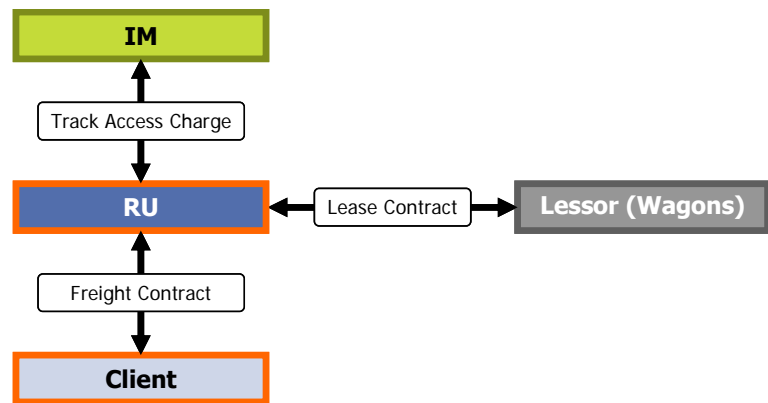
Key:



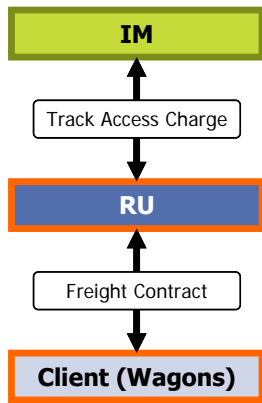
**Market Structure Model 1:
RU Operates Trains with Own
Wagons**



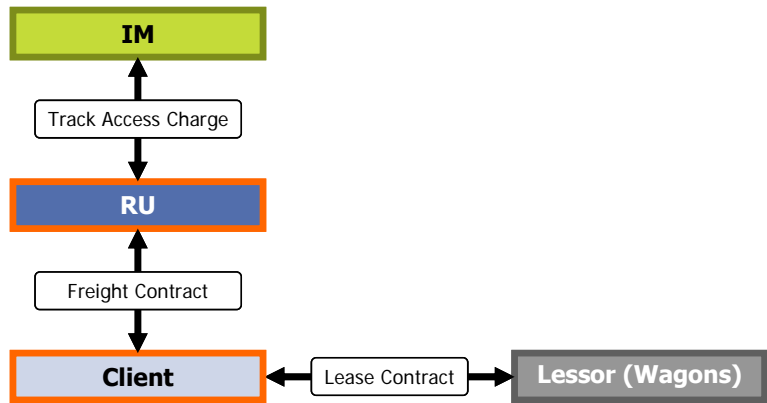
**Market Structure Model 2:
RU Leases Wagons**



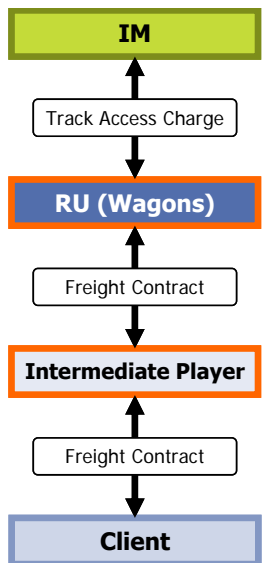
**Market Structure Model 3:
Client Provides Own Wagons**



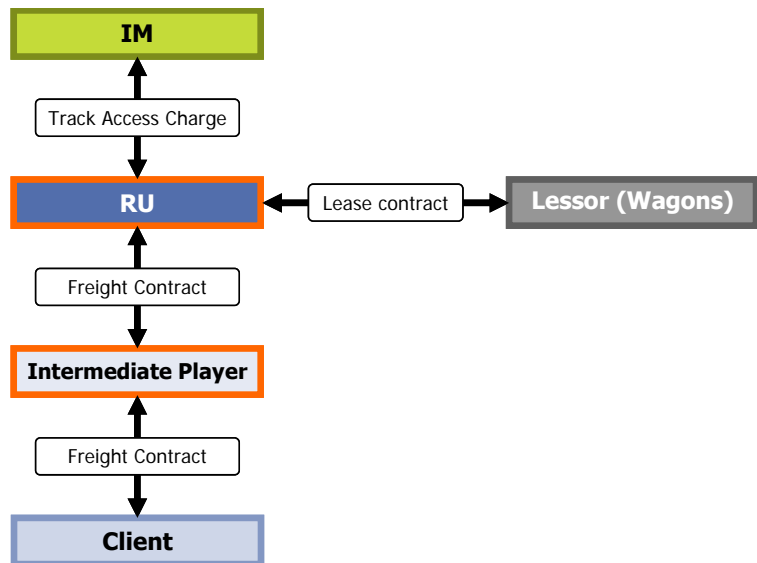
**Market Structure Model 4:
Client Provides Leased Wagons**



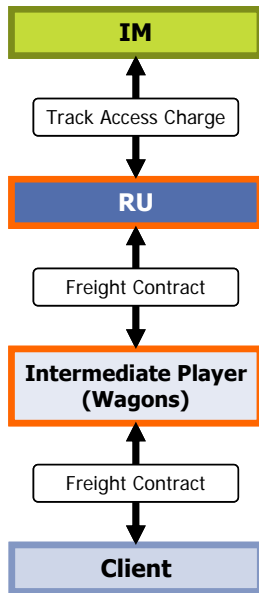
**Market Structure Model 5:
RU Operates Trains with Own
Wagons, Intermediate Player is
Involved**



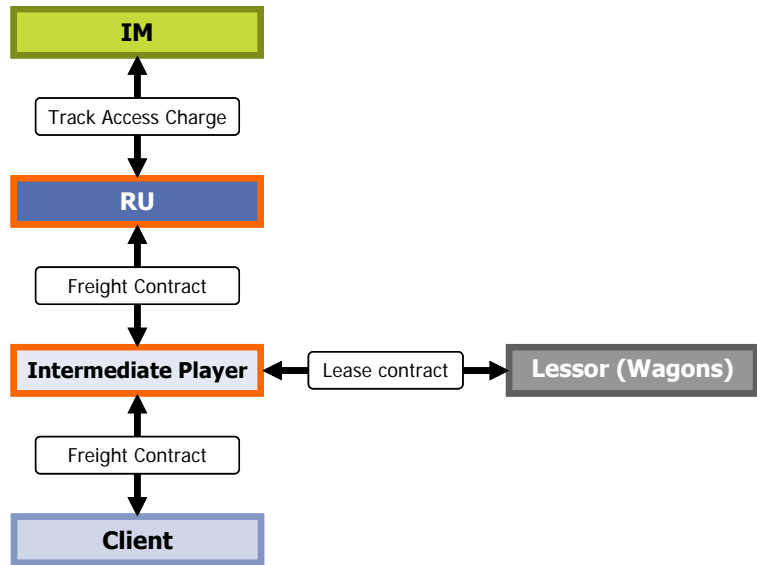
**Market Structure Model 6:
RU Leases Wagons,
Intermediate Player is
Involved**



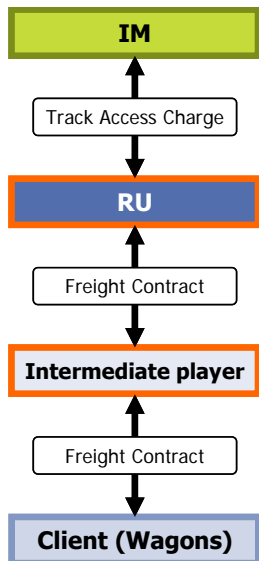
**Market Structure Model 7:
Intermediate Player Provides
Own Wagons**



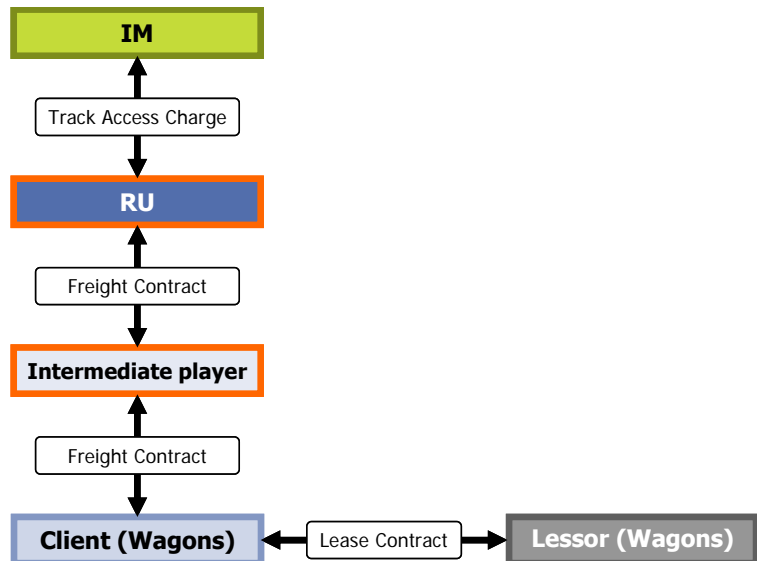
**Market Structure Model 8:
Intermediate Player Provides
Leased Wagons**



**Market Structure Model 9:
Client Provides Owns Wagons,
Intermediate Player is Involved**



**Market Structure Model 10:
Client Provides Leased Wagons,
Intermediate Player is Involved**



Source: Own chart

4.4 Relevant Business Processes in Rail Freight Transport for Incentive Models

In order to adapt the incentive models to freight wagon retrofitting – depending on the model involved – adjustments to the previous processes and structures are necessary to a varying extent. In this Chapter processes in rail freight traffic will be briefly described, which are relevant to at least one of the incentive models investigated. This will serve as a basis for the processes described in Chapter 5 of the individual incentive models. The description will be done by means of the direct player relationships, beginning with the interaction between IMs and RUs.

4.4.1 Processes between the Infrastructure Managers and the Railway Undertakings

If an RU/person entitled to access intends to move traffic on the railway network of an Infrastructure Manager he must first of all apply for paths. There is a difference between applying for paths in the network timetable which have to be applied for long before a timetable period by a fixed date and application for paths for occasional traffic the application for which is outside the time of the network timetable and can take place up to a few hours before the actual transport takes place. The Infrastructure Manager then constructs the timetable on the basis of the applications from different RUs, to obtain the best possible use of the infrastructure. When doing this the Infrastructure Manager endeavours to meet the wishes of the RUs as far as possible. As path applications for occasional traffic are made just a short time in advance they are supplied exclusively from the residual capacity.

Unlike other countries, for example Austria, it is not essential in Germany that before or after a journey is carried out a list of wagons is sent from the RU to the infrastructure Manager. The Infrastructure Manager, therefore, has no knowledge of how many wagons are in a train today. However the RU train driver has a list of the wagons. This is necessary, for example, to determine the brake force.

During the train journey the train is permanently monitored in the control office of the Infrastructure Manager, in order to take operating decisions if there are deviations from the plan and temporary restricted use of the line infrastructure to enable the railway operation to continue. In addition DB Netz AG, which is the biggest Infrastructure Manager, offers the possibility of renting an allocation work place in the network control centre or in the operating control centre or to get information in real time on what is happening to their trains by means of the allocation system LeiDis-NK.

After the train journey is completed the RU is charged for the use of the path. On DB Netz this is done, in general, but monthly, smaller Infrastructure Managers have in some cases different invoicing cycles, often depending on

customers' wishes. The invoices show the contractually agreed route (set-path) any track access charge adjustments as part of the reduced payments are shown with the following invoice on a special calculation sheet.

4.4.2 Processes between Consignor and Railway Undertakings

From the RU's point of view the most important relation is with the transport customers. Moving their goods is, in the end, the business of the RU. For this intermediate players (e.g. railway forwarding agents) can be interposed. This leads to the result that the RU does not itself have direct contact with the customer and does not negotiate commercial and service conditions of the transport with him. This is done instead by the intermediate player, so that then between him and the RU there are business processes, e.g. over the basic conditions and conditions of transport. With cooperative traffic this is for the most part simplified, since here the framework is basically marked out, and so complicated negotiations of individual traffic are largely minimised.

In any case the RU must define the service in agreement with the customer or the intermediate player and calculate the price for the transport. This is done based on the cost factors, such as capital, staff and energy and considering the market situation. Regarding the wagons the capital and maintenance costs of own wagons or the leasing costs of foreign wagons are included. In addition there is the charge for using the path as well as the charges for using the service equipment (e.g. for using harbour railways). While the use of the infrastructure results in the same costs for all RUs, the other types of cost in some cases are very different. In addition there are risk surcharges as well as specific company profit surcharges, which are likewise not standard.

With respect to the allocation both of the route and of the time slots the room for manoeuvre by the players is reduced. The actual route can to a large extent be specified in advance by the RU, however it is already restricted at the time of the path application by the building and economic frame conditions of the available infrastructure and the payment for use. The RU advises the IM the details of the desired route and times required (depending on the customer's requirements and the system necessities, e.g. connections for single wagon or international traffic). The IM constructs the paths depending on the available capacity and the technical criteria for the path suitability. For the consignor the route for the transport is not generally a critical matter, for him it is the transport of his goods from source to destination within certain time requirements that is important. In addition RUs seldom invoice the actual track access charge to their customers, thus route changes do not result in price changes. On the other hand the start and the arrival times are relevant. The provision of the goods to be transported at the right time

depends to a large extent on the upstream production processes of the consignor.

Individual planning and preparation of the train path is not done for every consignment of single wagon traffic, there is a pre-designed system of train journeys that connect with one another, into which the individual wagon consignments can be put. In this respect there is only a very limited provision for single wagon consignments, e.g. if certain freight yards are connected together with various trains. Certainly the pre-designed basic framework of the trains for single wagon traffic is set up not only to meet the operating requirements of the RU but also the requirements of the important customers who regularly use this train system.

The difficulty of planning occasional paths for freight traffic should be noted²¹. These paths can only be planned at short notice by the RU and consignor under certain conditions, for there are paths designed on the basis of the residual capacity between the regular paths by the IM.

The invoicing for the transport is, in general, depending on the customers wish, that is to say monthly bills are just as common as separate invoices for each transport (especially when a customer commissions only a few movements in a month). In any case it is guaranteed that the individual movements are separately shown even in summarised invoices.

4.4.3 Relationship between Wagon Lessors and Lessees

If wagons are leased, there are corresponding processes between lessee and lessor. This involves the wagon provision and the production of invoices by the lessor as well as the payment of the leasing charge by the lessee. Freight wagons can under certain conditions be leased for several years, and in this case a monthly invoice is issued. Lease contracts also lay down who is responsible for which maintenance jobs. In most cases this is done by the lessor himself, but in some cases the RU or other lessees (generally maintenance carried out close to the operating place) can carry out part of this work themselves, especially when the lessee has his own workshop.

In accordance with the AVV, every RU which enters into this contract is obliged to forward mileage data the wagon keeper so every lessee can obtain the mileage of his wagons. The implementation of this contract runs with the big players in the market with few problems (e.g. with DB SR against payment), for smaller RUs this is not entirely satisfactory at present according to information from the market participants. As the rules in the regulations on 'Entity in charge of maintenance' (ECM) become stricter, many players consequently consider that the mileage advice from small RUs will much

²¹ Occasional paths are paths outside the regular paths planned in the annual timetable.

improve. Implementation discussions have already been held between the associations of wagon keepers and RUs in Germany (VPI, VDV and Netzwerk Privatbahnen) [Network Private Railways].

4.4.4 Relationship between Infrastructure Managers and Federal Agencies

The relations between Federal Agencies and Infrastructure Managers must not be neglected. While the EBA (Federal Railway Agency) functions as a supervisory and approval body for the domestic IMs, the majority of which are owned by the Federation, the Federal Network Agency (BNetzA) is responsible for monitoring the discrimination-free access to the railway infrastructure. They are especially involved with the production of the network timetable, the decisions on the allocation of train paths, the access to the service facilities as well as the conditions of use, the payment rules and the level of charges. The BNetzA is responsible not only for access to the federally owned RUs but also for access to paths on the non-federally owned IMs. This arises from the one sided regulation in the railway sector (Article 14b AEG as well as Article 1 EIBV).

For each new timetable period the payment principles in the form of the rail network conditions of use and the list of current fees are updated. Before they are published they are submitted to the BNetzA for examination. The BNetzA can, if they consider they are not in accordance with the railway legal regulations, refuse to accept the changes or demand corresponding compensatory mechanisms.

The legal basis of its dealing is in the first place the Allgemeine Eisenbahn-Gesetz (AEG) [General Railway Law] which is supplemented by the regulations of the EIBV. In the EIBV, for example, it is laid down that the track access charges can include environmental payment components ('bonuses/penalties'). These may not, however, lead to a change of the path proceedings and according to EIBV should be equalised within 'a suitable period of time'.

5 Changes in Business Processes and Stakeholder Business Relationships through Implementation of the Incentive Models

This Chapter describes the business processes (below referred to as 'processes') that occur when introducing the incentive models. Thus, firstly the model definitions described in the partial processes are analysed in Chapter 3. Secondly, these partial processes form an important basis for the cost model in which they are linked with other modules of the cost model (e.g. volume drivers, cost sets).

Necessary one-off expenditure (e.g. setting up IT systems, data storage as well as general management expenditure (bookings, inspection activities, etc.) are described in the following Chapter 6.2 The latter is considered as a fixed and process independent expense.

The variable processes describe the carrying out of the incentive models in the way they evolve according to the definition of the customer. The players are assumed to behave in accordance with the regulations, that is to say none of the players are expected to make deliberate errors (e.g. false accounting).

5.1 Mileage and Noise Dependent Bonus Model on the Basis of GCU and NVR

This model can be divided into three main phases in each of which another player (shown in brackets below) plays a central role:

- Preparation of the application (RU);
- Application (wagon keeper); and
- Preparation of the bonus applications (public Bonus Office).

In addition there is a final cross-check by the federal authority which is actually providing the funds.

5.1.1 Preparation of the Application

Once every year the wagon keeper can make an application for bonuses for his retrofitted wagons. In order to do this he must first determine the mileage these wagons have run on the German railway network.

If the wagon keeper is at the same time the RU which runs the wagon, this is an internal process in which only internal costs but no transaction costs arise. The latter occurs in cases in which the wagon keeper is not identical with the

RU which also occurs in such cases where wagons held by one RU is operated by a different RU.

The RU determines the mileage for their own or foreign wagons by means of comparison with its internal production systems (read out of the wagon movements from the wagon lists). This process is done automatically with the help of an internal interface. Reading errors cannot, however, be avoided and are hence taken into consideration with one percent of all train runs (or wagon lists respectively). The necessity of a manual data recording by an RU member of staff is considered. For the RU cluster 4 manual recording is generally used since in view of the small number of cases the setting up of a higher IT standard is not realistic.

After the investigation carried out by the RU the data from the RU is sent to the wagon keeper via an interface.²² It is accepted that this works for the vast majority of the wagons (90%) without problems. For the other 10% the wagon keeper must ask the RU, because the mileage-data is completely or partly missing for these wagons. The latter is, for example, possible if the wagon was used by different RUs some of which have reported correctly and others incorrectly. Since the wagon keeper does not always know which RU is using his wagons, in a few other cases intermediate players (e.g. operators, consignors) need to be asked as well.²³ They give the wagon keeper the name of the relevant RUs so that they can be asked.

In a next step the wagon keeper enters the data for the individual wagons in his internal wagon data base.

Finally – and because the mileage data is equivalent to a potential payment for the wagon keeper, i.e. the bonus – a query in form of an additional explanation of the mileage to the RU should be sent. In this connection the transaction costs falls on the wagon keeper which over all players is uniform per wagon. With regard to the query a rate of 5% of the wagons of the wagon keeper is accepted for which the wagon keeper places an inquiry on the RU. The expenditure caused by this falls uniformly on all wagon keepers and is correspondingly mirrored by the RUs.

5.1.2 Application

On the basis of the consolidated data the wagon keeper places the application with the Bonus Office. For this a form has to be filled in along with a list prepared of all the quiet wagons for which a bonus is requested. The wagon number and the mileage should be given as well as the RU which within the

²² In this connection see Chapter 3.1 and 4.4.3.

²³ An alternative would be to ask all the RUs that are involved in this matter. In discussions, this option was, however, thought to be unsuitable in the practice.

bonus period has used the wagon in its trains. The application is assessed at a flat rate and uniformly for all the 575 wagon keepers.

5.1.3 Processing of Bonus Applications

After the bonus applications have been received it is the responsibility of the public Bonus Office (EBA) to process them. First the applications are formally processed (checked to see that they are generally in order and have the required information, etc.). The cost of this is the same for all applications. In a next step the wagon data is entered in a database by the Bonus Office.

After formal checking and entering the data there is a check based on the internal bonus database and by means of comparison with the NVR.²⁴

The comparison with the NVR is done automatically for all wagons and in principle produces no costs. Nevertheless even here reading errors are assumed, which leads to one percentage of all wagons being manually checked by a member of staff. The general cost for the comparison depends on which vehicle register the wagon is listed. For half of the foreign wagons an increased checking or clarification cost is taken into account.²⁵

In connection with this a check is made to see whether a wagon still qualifies for bonus or its maximum support has already been exhausted. The process runs automatically similarly to the NVR comparison with the exception that all wagons, regardless of whether they are registered in Germany or another country are left with uniform expenditure. The enquiry is carried out within the database of the Bonus Office without including external systems.

Since the use of public funds places particular requirements on their application, in addition a spot check is made by the public Bonus Office on the RU cited in the bonus application. The sample size is fixed at one percent of the wagons applied for.²⁶ It is therefore necessary for the RUs to retain the mileage data for a sufficiently long time.

After the conclusion of all the planned checks the authorities determine the bonus for each particular wagon. This is done automatically. For a small percentage (1%) of the wagons, as in all automatic processes in all incentive models, if an error is found then it has to be resolved manually. This means here that a member of the Bonus Office staff does the bonus calculation

²⁴ If the checking shows implausible information the application is rejected. The rejection is neither considered in respect to the frequency nor in regard to the costs produced.

²⁵ While the entries in the German and some other vehicle registers are regularly updated the time for this varies considerably from country to country. A remedy for this would be a clearer instruction from the EU regarding the updating of NVRs.

²⁶ Not considered either are the consequences if errors are found in the sample. In practice this can lead to the rejection of the application for the wagon, in order to make all players take more care. This needs to be specified in the grant directive.

manually. When the calculation has been done the authority produces the bonus decisions and transfers the bonuses to the wagon keepers.

5.1.4 Verifying of Total Bonus Payments by the Federal Authority

Finally the public Bonus Office must demonstrate to the federal authority which is actually providing the funds (the Federal Government), by means of an annual audit, that it has properly distributed the grants. For this purpose the grant decisions of the fund provider are checked. This has been considered applying a flat rate charge.

5.2 Noise Differentiated Track Access Charge System

The processes for the three variants of Incentive Model 2 are described below. This is done in detail for the Incentive Model 2.1 (pure bonus system). For the Incentive Models 2.2 (bonus-penalty) and 2.3 (bonus with increased track access charges) only the differences to 2.1 are described.

The NDTAC can be divided into phases; these should be considered rather as interaction between players. For the pure bonus system the following important clearing level are defined on the basis of the model data put forward by the customer.

- Clearing level IM – RU;
- Clearing level RU – wagon keeper; and
- Clearing level RU – wagon allocation supervisor.

Finally the provider of funds is included who reimburses the IM for the bonuses paid out.

5.2.1 Clearing Level IM – RU

Bonus Payment Based on Track Access Charge Calculation

The NDTAC basically calculates by the existing processes the path booking and monthly access charge. For the inclusion of the noise components in the path payment the RU must advise the IM before it executes the calculation of the train bonuses and the data of each train journey, which are necessary in order to make the bonus calculation. Unlike the path use the noise aspect cannot be calculated on expected values, but shall be done on the actual configuration and carrying out of the respective train journey.

Before the delivery of the data to the IM the RU compiles this data, by reading out the necessary information from its internal production systems (wagon lists, wagon data bank). This is done, apart from an error rate of one percent (manual processing by staff), as an automated process through internal interfaces. For RUs of cluster four all trains are recorded manually.²⁷

The data is supplied to the IM monthly and is deposited with a stepped flat rate expenditure for the RU clusters (reducing from cluster one to four)²⁸. The required data should be specified by the Infrastructure Manager, but may be like the model from DB Netz who would ask for the following data²⁹:

- Customer number;
- Train number and day run;
- Originating regional area; and
- Number of quiet wagons (axles) and total number of axles in the train.

From the data delivered by the RU as well as the information available in the IM from the control centres (actual data of the train journey) the IM can make the bonus calculation for the individual trains.³⁰ The calculation takes into consideration:

- Retrofitting bonus for quiet wagons; and
- If necessary deployment bonuses for the use of quiet wagons on certain noise sensitive sections of the line as well as noise sensitive times of the day.

The determination is done automatically, it is however accepted that an additional calculation for each train results in a final check cost for the calculation processor at the RU. The train dependent expense is estimated uniformly for the first three large classes (IMs). It is somewhat higher for cluster four due to the lower level of automation.

²⁷ Reference is made here to the factors described in Chapter 6.2 for the use of different infrastructures as well as for the changed train composition during the use of an infrastructure.

²⁸ Monthly delivery is sufficient, since the bonus calculation of the IM is only done on a monthly basis. The bonus is calculated in the following month, consequently the RU can send all the trains of a month to the IM.

²⁹ Source: DB Netz AG

³⁰ The following applies: Basically the trains are settled as previously in the target condition (that is to say as planned), while the bonuses are calculated in the actual. The only exceptions are trains in which the IM is responsible for the plan-actual deviation. In this case the bonuses are calculated as planned (in the target condition). The IM gets these bonuses back at the end of the year from a public authority, since it is not directly included in the incentive system, that is to say no behaviour control of the IM is intended.

In addition, a test stage is carried out with the help of which the data passed from the RU is verified. For this purpose the network operator requests the wagon list for one percent of the trains on his network from the RU and compares this with the RU data supplied by the RU as part of the bonus application. This comparison is always done manually. On the RU there is only a search expenditure on this level to provide the wagon lists.

Finally the bonus calculation is attached to the regular path calculation as a separate sheet, but only an aggregated train bonus is given. The breakdown of this is the job of the next level of the RU.

Query as Part of the Bonus Calculation of the IM

For bookkeeping reasons a calculation check is essential in order to eliminate possible errors by the people who do the calculations or if necessary to determine them. If these are found a query follows the calculation check.

The RU bonus calculation check is done with the help of the IM calculation as well as the plan data and internally available data and information (e.g. wagon lists). The time period of a check depends on whether there was a deviation between plan and actual and who was responsible for this.³¹ The basis for the check is therefore the individual train.

On the basis of the DB Netz AG data made available it was assumed for the investigation that only half of all trains run without plan-actual deviation. For the other 50% of all trains, therefore, there are time and/or route differences from the planned condition of the planned time or route. For these trains there are potential modifications for the bonus calculation. Moreover a plan-actual deviation in the IM responsibility works like a plan-target journey, that is to say in this case the bonus is calculated in the plan condition. This is accepted for 50% of the trains in question (that is to say 25% of the total trains). For the other 25% of all train journeys a plan-actual deviation is based in the responsibility area of the RU.³²

³¹ Delays due to disruptions in the DB Netz AG area are permanently recorded by a management system and causes of delay assigned (=reason for delay code). The causes of delay can be arranged in four clusters/responsibility areas – track operators, railway undertakings, external effects, and secondary causes. The responsibility area is consequently clearly specified by the coding. If delay codes are incorrect they can be queried by means of a recoding application. This allocation was done by DB Netz in the past for unpunctuality using the actual data in form of a coding which indicates the party responsible for the delay. On the level IM – RU it is only these two players that are involved, that is to say responsibilities of upstream players are allocated to the RU.

³² Basis of the considerations are assessments of punctuality and causes of delays from the incentive system and the reduction of payment. Partly the assessments refer exclusively to the normal train paths. For this investigation it was assumed that all trains even those in occasional traffic are uniformly assessed. In addition it should be pointed out that external effects in the form of oil films or weather also belong to the responsibility of the Infrastructure Manager.

There are therefore three parts for the checking and query. The cost of the checking is rising – from a relatively small time required with trains without plan-actual deviation, through trains with plan-actual deviation, in which the IM allocates the responsibility itself, to the highest expense for trains, in which there is a plan-actual deviation and the IM has allocated the responsibility to the RU.³³ In the last case the checking also includes the internal clarification, of whether the responsibility allocated by the Infrastructure Manager to the RU was justified (e.g. interrogation of the operating staff/train driver). Consequently, in principle, all trains are checked, however with a different level of expenditure.³⁴

The different steps in the check then lead to queries of different frequency and expensiveness.

For the checking level without plan-actual deviation as well as with deviation, but responsibility allocation for the IM, a query rate of one percent for all trains checked on this level is assumed. This means that for this one percent of the train based bonus calculations that contain questions or calculation errors from the RU point of view, which have to be resolved with the IM, and if the RU query is correct must lead to a calculation correction by the IM. The cost of this falls both on the RU and on the IM and is accepted for the individual case with a standard time requirement on both players' levels. Differences between individual players-class sizes are not assumed, since queries can hardly be automated. In total the time required for the simple query is estimated to be small since it is a question of easy to explain points (e.g. incorrect bonus calculation), which is why no expensive check or settlement process is assumed.

For trains for which there is a plan-actual deviation and the RU was allocated the responsibility, a significantly higher checking cost is however assumed. The reason for this is that unlike the upstream test level (no plan-actual deviation or plan-actual deviation that is the responsibility of the IM) no bonus or only a changed bonus is paid. A different calculation sum than expected needs to be checked in detail and has to be verified just for tax reasons. In addition, in many cases the RU is obliged to pass on the deployment bonus in accordance with the model definition. Since in accordance with the given model specifications the upstream players also check the deploy-

³³ In general it is difficult to limit the additional calculation cost, since even today as part of the path invoicing a train based calculation check is done and now there are additional attributes. That is why the additional checking cost is limited to the pure checking of the bonus relevant aspects. The formal correctness of the complete calculation is not considered as an expense as part of the NDTAC.

³⁴ It should be pointed out that in practice it should be assumed that the comparison of the responsibility allocation by RUs with many daily train journeys (RU cluster 1 and 2) would better be done daily and not monthly. In the model this was nevertheless considered to be a monthly process since the expenditure accumulates from case to case, that is to say the time periodicity is not cost relevant. The check can, for example, be carried out for the use of the DB infrastructure by means of the software LeiDis-NK.

ment bonus in more detail if there is a deviation from the plan, the RU accurately checks the trains in question with the IM to begin with, in order avoid more expenditure later on the explanation level to the upstream players.

With respect to the derivation of the query rate it is assumed and fixed as cost, that the RU already determines in an internal check whether the responsibility key of the IM was correct. Since as described at the beginning no incorrect classification of the delay coding is supposed, already a considerable proportion of the trains in question are internally cleared. In addition it is true for all the checked trains that not only the responsibility allocation but also the bonus calculation was properly done by the IM. Finally for 20% of the trains on this checking level a query from the RU to the IM is assumed because in spite of internal clarification, errors or unclear facts remain. The query cost for each individual case (train) is identical for the IM and RU (and divided among all clusters).

The cases explained in the frame of the query are finally invoiced in the following bonus statement as a new calculation or credit note. It is accepted that as a result of the query the responsibility may be changed and that now 45% of the plan-actual deviations are due to the RU and 55% to the IM.³⁵

The different checking levels are illustrated in Figure 8 below:

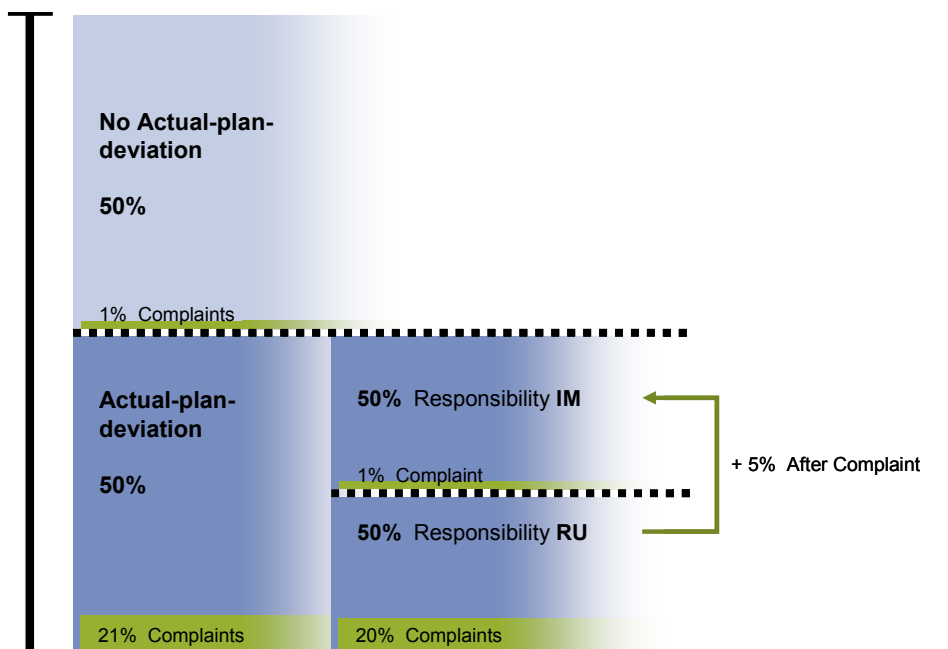


Figure 8:
Control Levels of a
Bonus Enquiry be-
tween IM and RU

Source: Own chart based on data provided by DB Netz and assumption of KCW

³⁵ From the interviews it became clear that changes to the responsibility allocation in favour of the RU occurred comparatively frequently when the check was done by the RU. Actual figures are not known, so a conservative 5% displacement was assumed.

5.2.2 Clearing Level RU – Wagon Keeper

Passing on the Retrofitting Bonus to the Wagon Keeper

After the bonus calculation between IM and RU is completed, the next step is the passing on of the bonuses (for retrofitting and disposition) to the upstream players. This is also done monthly and is separately identified for the individual wagons.

First on the RU level the wagon bonuses for the wagons used in the trains that ran in the month must be broken down (decomposition). For this by means of the RU bonus calculation and the wagon lists the data is put into the internal database by the RU. From this database the wagon keeper or at least the player who has made the wagon available to the RU that is to say it finds an address allocation for which there is no doubt for the bonuses to be distributed.³⁶ The IT is so programmed that it can carry out the division of the retrofitting bonuses as well as the deployment bonuses which in view of the fixed bonus amount for the retrofitting can be done relatively easily. The process of the decomposition is automated and, therefore, does not result in any special expenditure. However if there are reading errors (1% of the trains in question from which the data is read) they must be entered by hand by a member of staff of the RU which leads to a considerable train based cost (clusters one to three). In cluster four any classification is done manually. Because of the small number of cases it is not necessary to install a more powerful IT system.

The classification of the bonuses is the starting point for the distribution to the upstream players. Thus with regard to the retrofitting bonuses those wagons should be excluded in which the RU itself is a wagon keeper and therefore no passing on occurs. Next the passing on depends on what is the relationship of the RU to the wagon keeper. If it has obtained the wagon directly from the wagon keeper, then the bonus goes directly to it and there are costs for the RU for the compilation of data and for the wagon keeper for the inputting of the data. If additional intermediate players are drawn in the bonus is first transferred to them and from them sent onto the wagon keepers (or corresponding to Market Structure Model 10 first to a further intermediate player, see Figure 7). As a result there are also costs on the level of the intermediate players for inputting and transmitting the bonus benefits.

The cost of passing on occur on every level dependent on the players considered, that is to say depending on the number of players among whom the retrofitting bonus must be shared based on a flat rate compilation and transfer cost, which in addition for all large classes is uniform per individual

³⁶ From the discussions with the branch experts it was concluded that the information regarding the wagon keepers was available at the RU. Thus in principle it would be possible to pass on the retrofitting bonuses directly, by-passing the intermediate players, but this was excluded by the customer in the model definition.

player. This also means that data on a player can be transferred in the form of a bill (credit note) in which the data for the individual wagons are comprehensibly listed (automatic read out from databases).

Queries from Wagon Keepers for the Retrofitting Bonus

After receipt of the bonus calculations, the wagon keeper checks whether all calculations are correct and raise queries if necessary.³⁷ In the check, the cost of which is uniformly estimated for each wagon and wagon keeper which is not an RU, there is a plausibility check and an arithmetic check. The basis for the plausibility check is an estimate by the wagon keeper carried out on the basis of the available data (e.g. details of the mileage in the bonus calculation, mileage calculation according to AVV), that the bonuses received are comprehensible.

For 5% of the wagons it is assumed that there are unclear points for the wagon keeper, which needs to be resolved with the RU which is named in the bonus calculation, even if there is no contractual relationship between the RU and wagon keeper.³⁸ The cost of the query is calculated uniformly for all wagon keepers per wagon, without differentiation according to size class or level of player. In addition a factor is put in to allow for the fact that a wagon can be used by different RUs during the year (see Chapter 6.2.2). The cost of the query falls equally on the wagon keepers and RUs.

If the queries with the RU cannot be resolved the wagon keeper must involve an intermediate player in the resolution, since it is only here that an error can have occurred in the further bonus calculation.

5.2.3 Clearing level RU – Wagon Deployment Supervisor

Passing on the Deployment Bonus to the Relevant Player

Besides the retrofitting bonus there is in the NDTAC also a deployment bonus for the use of quiet wagons at certain times of the day and on certain sections of the line. This bonus should incentivise any player, who can affect the use of the wagon. The deployment bonus is granted for quiet wagons (axles) and is finally accumulated (thus de facto as train bonus) to distribute to the

³⁷ This is based on a monthly consideration, also if for some wagon keepers, especially if they only have a few wagons in their fleet, bigger checking cycles would be possible.

³⁸ It is assumed in this connection that the intermediate players appear as pure data agents and the information is passed on without any changes. Therefore no query level wagon keeper – intermediate player has been put into the system. For big players shorter checking intervals, more frequently than once per year should also be considered, so that once a year the work load for checking is not so high that it cannot be processed or only be processed with difficulty with the available resources.

player, who is mainly responsible for the deployment.³⁹ In some cases the passing on is not done, when the RU itself controls the deployment (e.g. single wagon traffic). Then the RU can retain the bonuses. This is assumed for 20% of the train journeys, the other 80% are, therefore, to be further distributed to the consignors (52% of all train journeys) as well as intermediate players (operators, 2nd RUs, 28% of all train journeys). The deployment bonuses to be passed forward are as specified in the distribution of the market structure models (see Figure 9) distributed to these.

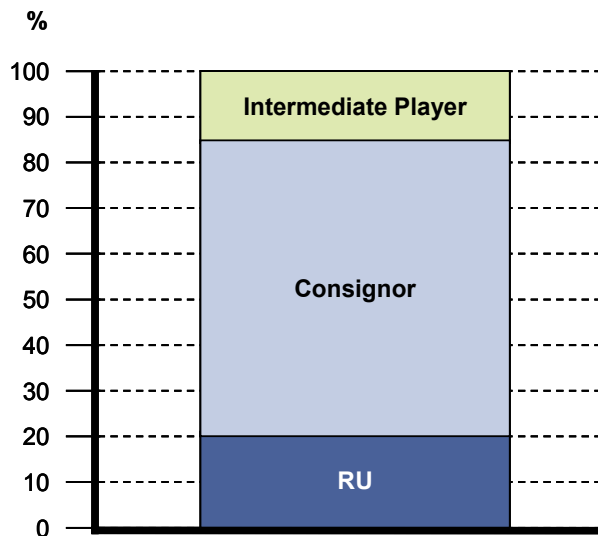


Figure 9:
Distribution of Train Journeys with Regard to Responsibility for Deployment (%)

Source: Own chart

In addition it should be noted that in the case of a plan-actual deviation the RU only transmits the bonus if the upstream player is not responsible for the plan-actual deviation.⁴⁰ Not only in cases without plan-actual deviation does the bonus transmission take place without difficulty, but also when there is indeed a plan-actual deviation, the responsibility for which is to be attributed to the IM since in this case it is nevertheless paid out. Finally the RU also passes on a deployment bonus to the bonus entitled player if the plan-actual deviation is within the responsibility of the RU. In the remaining cases (assume: 25% of the train journeys of the third check level between IM and RU [minus the trains, in which the RU keeps back the deployment bonus] that is to say 2% of the total trains [see Figure 14]), there is for the upstream player

³⁹ It is assumed here in order to simplify the process that only one player is responsible for the deployment of the wagons. This also applies for traffic in which the provision is done by several players (wagon load traffic), for example, the incorrect behaviour of another player leads to delays of a player.

⁴⁰ The possibility that a wagon keeper is responsible for the plan-actual deviation has not been considered. In this case the RU must carry the costs itself. An incentivising of the wagon keeper is not the objective of the deployment bonus.

a plan-actual deviation of the deployment bonus since the upstream player was responsible for this deviation.

For the RU there is a charge for making the data available and transmitting the bonuses and for the receiver for entering the data.

Query from the Incentivised Player for the Deployment Bonus

Corresponding to the retrofitting bonus there is a check for the deployment bonus for all train journeys as well as for some train journeys an associated query. The basis of the bonus is indeed the single wagon; the basic check starts with the train since the player entitled to a bonus receives all the deployment bonuses of a train. Similar to the check described in Chapter 5.2.1 on different detail levels; this also applies to deployment bonus. If there is no deviation of the actual to the plan the check takes place on a simple level. This applies as well for the check of the cases in which there is indeed a plan-actual deviation, this however lies within the responsibility of the IM or RU and is recognised by them. More expensive is the check in the cases in which the deviation of the actual calculated deployment bonuses is allocated to the bonus entitled player and the difference from this has to be carried.

The distribution of the checking levels is done on the starting basis of 80% of the total train journeys for which there is a deployment bonus to pass on (of which 65% to the consignor and 35% to the intermediate player). Of this though the cases are largely indisputable, as there was no plan-actual deviation and correspondingly a rate of queries was assessed at only one percent of the trains in question. This also applies for trains in which there was a plan-actual deviation, these were however answered either by the IM or the RU without doubt and accordingly the previously agreed deployment bonus was passed forward.

Only in the cases in which because of supposed errors on the part of the player entitled to the bonus there was a plan-actual deviation, is an expensive query process with higher checking costs assumed (among other things also internal checking of whether the responsibility allocation of the RU was correct).

Analogous to the consideration of the query process between the IM and RU the number of queries is reduced here by the trains in which the upstream player determines by internal enquiry that the RU allocated classification is correct. Then the queries on this level are dropped which otherwise would be considerably more expensive than in the query process with to a large degree simple clarification cases.

In the same way as Figure 8 the illustration below shows the further calculation of the deployment bonus as well as the subsequent check and query probability. For the majority of the train journeys there is a check on a simple

test level since either there is no plan-actual deviation or if there is the deviation lies within the responsibility of the IM and RU.

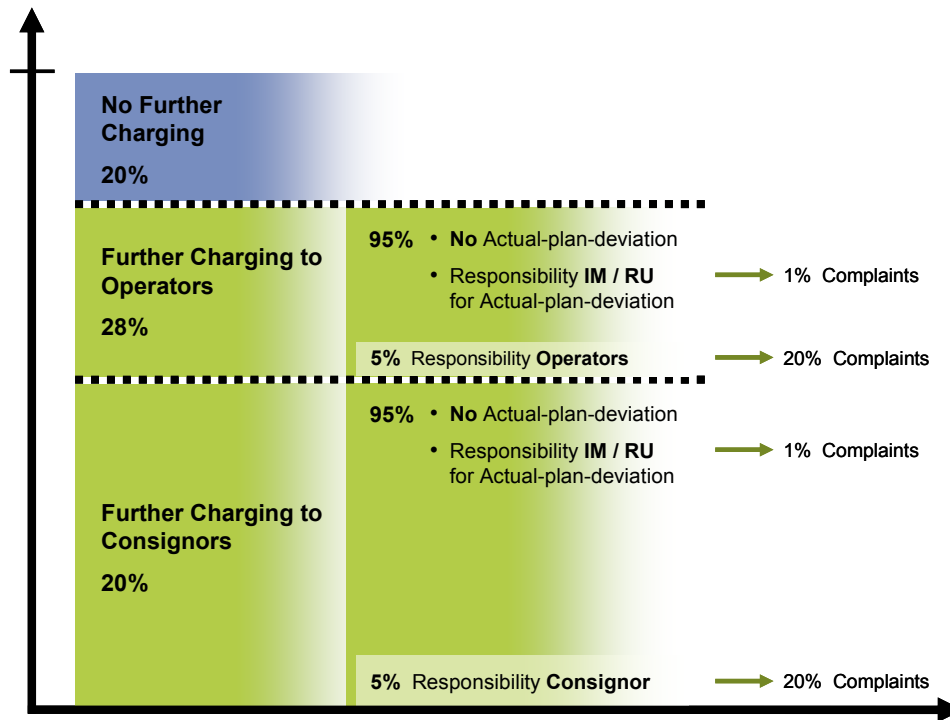


Figure 10:
Distribution of Train Journeys with Regard to Reimbursement (%)

Source: Own chart

5.2.4 Reimbursement of the Bonuses for the IM

In accordance with the model definition (see Chapter 3.2) the Incentive Model 2.1 is designed as a pure bonus model. At the end of the year the Infrastructure Manager can therefore report the bonuses paid out by the Federal Authority (the Federal Government). This is necessary as part of a special funds application. The applications are checked in connection with the money provider which is considered in the cost model with a flat rate time entry for the authorities. In addition spot checks are necessary, so that the Federal Government can confirm that the payments made by the Infrastructure Managers are in order. For this there is a search cost for the IM in order to make the bonus calculation for one percent of its trains internally. Thus, there is a checking cost for the organisation that makes the payment which was set equally for all train journeys. Next a funds decision is made out and the bonuses paid to the respective IM.

5.2.5 Differing Processes in Incentive Model 2.2

Changed Assumptions for Existing Processes

The processes in the Incentive Model 2.2 in which not only are the bonuses paid for quiet wagons, but penalties are imposed for loud wagons, are almost identical with those described in the previous section in Incentive Model 2.1. A more important detailed technical difference described in Chapter 6.2 is the significantly increased number of cases due to the inclusion of all wagons in the NDTAC.

- Due to the greater complexity in the penalty case, firstly there is already a surcharge included in the IT costs (see Chapter 6.2). Secondly the checking cost per train is increased in comparison to the pure bonus model. Since the bonus calculation or bonus passing on is done automatically both on the IM and on the RU level, an increased number of payment queries should not be expected. Therefore the query rate itself remains unchanged.

However, the error rate in the decomposition at the RU is increased from one to two percent, since the complexity of the allocation of bonuses and penalties per train increases. Thus a higher rate of allocation errors is assumed.

However, the rate of queries regarding the retrofitting bonuses or penalties (as negative equivalent of the retrofitting bonuses) by the wagon keeper remains unchanged. For the individual wagon there is no recognisably higher error rate and therefore increased checking requirement.

In addition, there is no change for the case dependent costs, e.g. time taken per case checked or per query.

Discontinued and New Processes

Since the bonus-penalty system is self financing, there is no reimbursement of the bonuses by the money provider.

New consideration is the cost for determining the correct penalty levels.⁴¹ These are specified by the IM, which requires a cost forecast by the network operator. In addition it is next necessary to develop as a one-off cost a procedure for the development of traffic as well as the retrofitting to quiet brake blocks as a basis for predicting the penalty calculation. This procedure needs to be agreed and, if necessary, modified by the network operators and

⁴¹ The level of the retrofitting bonus remains unchanged, since this is coupled with the emerging costs for the wagon keeper. Even the deployment bonus can correspond to those of the incentive model 2.1. Assuming that or from the annual total, the penalties per wagon need to be determined. Whether the penalty level between individual Infrastructure Managers can be different or whether assuming a comprehensive survey of all network operators uniform penalty levels apply must remain open.

the Federal Network Agency as the regulatory body for the network compensation.

Next it is incumbent on the network operators to regularly ascertain the necessary data for the forecast and enter it into the internal systems. In this connection it is also assumed that the Infrastructure Manager must not only talk regularly with the Federal Network Agency, but also ask the RUs and wagon keepers directly about their experiences and developments. This can, for example, be done in the form of working meetings or questionnaires and leads correspondingly to cost for the people questioned.⁴² This means basically a cost of the Infrastructure Manager in each year, independent of the frequency in which a new penalty calculation must be made.⁴³ It should be noted in addition that the estimates need a multi-year advance due to the advance period for the SNB [Rail Network Conditions of Use].

5.2.6 Differing Processes in Incentive Model 2.3

Changed Assumptions for Existing Processes

With regard to existing processes there are no changes in Incentive Model 2.3 in comparison to Incentive Model 2.1 either in the number of cases or in the rate of queries.

Discontinued and New Processes

As with Incentive Model 2.2 there is no reimbursement of the bonuses paid out from public funds and consequently from all processes arising in this connection.

However the Infrastructure Managers are requested to develop suitable procedures for the annual fixing of the track access charges. For this, in the same way as for Incentive Model 2.2, development trends regarding rail freight traffic as well as the retrofitting rates need to be understood in order to calculate from them the level of the annual bonuses which are then to be applied to the track access charges. The split on the track access charges is seen as simpler than the wagon specific penalties and is thus estimated to involve less expenditure (for the process description see Chapter 5.2.5).

Completely new and only in Incentive Model 2.3 is the passing-on of the increased track access charges to the first wagon providing player (see model definition in Chapter 3.2). This is done first by means of splitting the in-

⁴² Nevertheless it should be noted that participation in such questionnaires is not compulsory for the market participants. Though it may be in their own interest that the penalties are accurately calculated and that they therefore invest time in this.

⁴³ If a NDTAC with bonus-penalty is introduced, this aspect in particular should be thoroughly checked in advance, since the EIBV is not clear in this respect and only speaks of a 'reasonable time' for the refinancing (Section 21(5) EIBV).

creased track access charges on all wagon axles independent of whether they are classified as loud or quiet. For foreign wagons, that is to say wagons that are not held by the RU itself, in connection with passing-on of this 'penalty' that is to say the invoice is sent to the player who provided the wagon. This can be in the case of a lease a wagon lessor or also the customer (consignor) or intermediate player (2nd RU, operator), which provided the wagon. The latter does not necessarily have to be the wagon keeper.⁴⁴

From the cost point of view, this means that for the RU a more complex infrastructure is necessary for the breakdown of the bonuses and increased track access charge, which in particular results in higher IT costs (corresponding to Incentive Model 2.2). In addition, in a similar way to Incentive Model 2.2, the error rate with regard to the breakdown is increased from one to two percent.

5.3 Noise Differentiated Track Access Charge System (RFID)

The NDTAC-RFID corresponds in many parts to the process description for the Incentive Model 2. This applies in particular from the RUs process steps to the upstream players. Also the exchange relationships of the network operators to public offices (payment office, Federal Network Agency) remains unaffected.

A decisive difference is the wagon recording by means of RFID-chips on the wagon, which means that the RU does not need to transmit data to the IM. This process step is thus not required. An exception is formed by an assumed failure rate of the RFID chips which results in a faulty or failing to appear recording for a train. In this case the IM asks the RU for the data specially, and then a member of staff must call this data up from the system manually and send it to the IM. The cost for the RU for this transmission increases as a result in individual cases, but reduces absolutely considerably because of the lower number of cases.

With regard to the RFID recording there are costs for the RU or the train driver before the start of the train for the programming of a describable RFID-chip located in the locomotive. The train driver must input certain data to be defined (at least train number, date, number of wagons). As a result the train can be correctly classified in the IT of the IM when recording and in addition reading errors can easily be identified.⁴⁵ Then the regular process of the bonus calculation can be continued.

⁴⁴ A possible passing on to intermediate players upstream wagon keeper is not considered.

⁴⁵ Adjacent aspects in the recording remain unconsidered, e.g. if foreign quiet wagons are not fitted with RFID. Moreover all conditions of use of the IM can be so arranged that the bo-

The processes in the further use of the data between the RU players – upstream players remain however identical to the NDTAC without RFID.

5.4 Direct Funding

Direct Funding is not divided into sub-processes because of the few processes involved. The wagon keeper must merely compile a list of wagons for retrofitting and send it to the public Bonus Office (EBA) with a support application. It is considered in the model that the wagon keeper can apply each year, that is to say he does not immediately have to apply for all his wagons in the first year.

At the bonus authority the applications are all formally checked and after a comparison with the NVR (to see that it is actually for wagons that have not yet been converted or TSI noise conforming wagons) processed.⁴⁶ Then the bonus is granted. In the addition the bonus authority checks by means of the NVR comparison whether the retrofitting was carried out and then put into the vehicle register.

In addition the bonus authority does a spot check (1% of the wagons) to see that the mileage declared in the bonus application matches with the actual mileage of the wagon. Bonuses have to be refunded in case these values do not match.⁴⁷

nus is only paid out if the corresponding wagons are fitted with RFID. A similar situation is produced to the conditions of use of the DB Energie GmbH, which likewise only then gives a credit on energy put back if the vehicle has a calibrated energy meter (TEMA box).

⁴⁶ Also in this case it should be remembered that questions on foreign NVRs in individual cases (50% of the foreign wagons) are more expensive.

⁴⁷ The cost of repayment of the grants is not considered in the investigation.

6 Transaction Costs of the Examined Incentive Models

6.1 Approach and Functionality of the Transaction Cost Model

6.1.1 Methodology of Determining Costs

The developed model for the calculation of the transaction costs follows the logic of an analytical standard cost model. The costs are set up on a quantity structure and calculated bearing in mind the interviews carried out and the benchmark values from reference branches. In a next step these are 'standardised', which means independent of undertakings and their productivity within a cluster of undertakings the same process costs are assumed for similar processes.

The complete process of cost calculation is carried out in five phases: In the first phase the additional business processes necessary for all models are investigated and are identified. In the second phase partial processes were worked out, standardised and assigned to the respective players. The results of both phases were shown in Chapter 5 and serve as the basis of the cost model. In the third phase the cost parameters necessary for the calculation of the transaction costs, as well as the quantity drivers, were determined and put into the cost model. Next the transaction costs arising were calculated with the help of the model and a sensitivity test carried out for all cost parameters.

Phase	Content
Phase I	Identify necessary business processes to implement the various incentive models
Phase II	Development of standard processes (including sub processes) and standard interfaces
Phase III	Determination of the cost parameters and quantity drivers (quantity structure); setting up the basic assumptions
Phase IV	Calculation of the transaction costs
Phase V	Sensitivity analysis

Table 7:
Development Phases
of the Analytical Cost
Model

Source: Own chart

The construction of the cost model is schematically shown in Figure 11. The main components are on one hand the estimated costs as well as the model parameters. Basically the costs are dependent on the type of costs combined with one or more model parameters in order to get to the total costs. The components of the model are described in detail in Chapter 6.2.

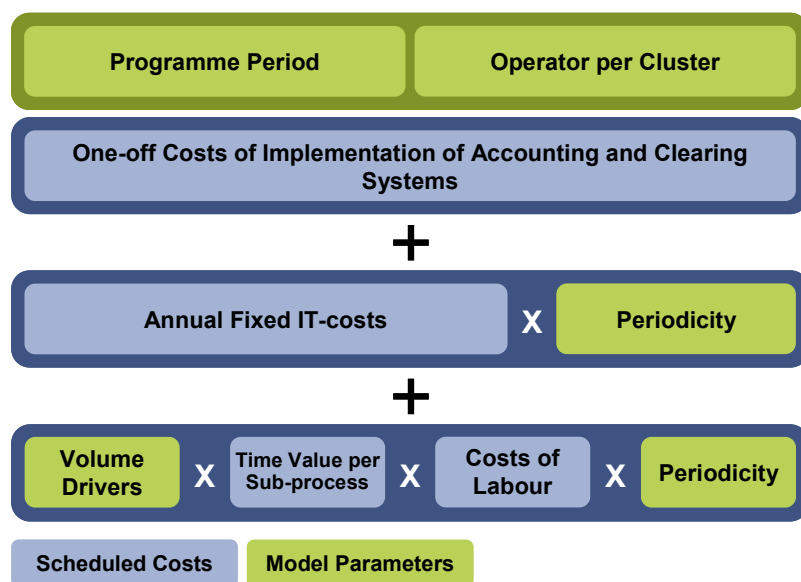


Figure 11:
Components of the analytical cost model

Source: Own chart

6.1.2 Procedure

Phases I to III are carried out in parallel in order to guarantee the plausibility of the processing and to verify the recognition progress. In order to put the results on a broad and justifiable base they were backed up by various expertise and sources.

Expertise of the Authors

KCW brings in particular its railway expertise and know-how from other cost investigations. The GFA B.I.S. GmbH is involved in many IT-projects both at home and abroad and provides a lot of assistance for assessing the cost of IT structures.

Finally it was possible to use the available scientific know-how from the Hochschule für Wirtschaft und Technik [University of Applied Sciences] in Berlin for the process evaluation and cost modelling.

Expert Interviews

By means of the interviews mentioned in Chapter 2.2.1 a clear view of the business processes of the players and aspects of the operating practices is obtained. This enabled questions, for example, regarding the accounting for the actual railway operation to be resolved. Likewise potential processes in the implementation of incentive models that were relevant in practice could be discussed. A standardised questionnaire was developed for the interviews, which served as a discussion agenda (semi-standardised interview). It became obvious in the first discussions that the structures and processes in the various undertakings of a player level were largely identical in spite of different software standards or degree of detail of the individual processes. The most important reason for the differences is the size of the undertakings considered. The wide agreement results in the main from specified procedures in operating practice which gives the undertakings little room for manoeuvre. In the further part of the study the interviews were conducted as a more informal discussion (non-standardised interview) in order to be able to discuss questions of detail, which arose during the investigation.

Summarising, the following conclusions can be drawn from the discussions:

- The operating practice in the various undertakings (IMs, RUs, wagon lessors) is similar within each group of players and differs basically due to the different sizes of the undertakings. This is why the beginning of formation of large clusters has proved to be expedient.
- There is a clearly recognisable trend towards more standardisation and -automation. Processes that are immediately relevant for the calculation are indeed standardised, however because of new requirements some of them need to be extensively adapted.
- In smaller undertakings even in the future there is not likely to be a high level of standardisation. Nevertheless due to the small numbers the necessary processes could be carried out by means of manual data capture.
- Regardless of the size of the undertakings new requirements and processes cannot be depicted with the available capacities. This applies both for the IT and for the staff.

Client Meetings

The model definition was the main subject discussed with the clients in a series of coordination meetings. This was done for all models by the client on the basis of the approaches in the political discussion. Also the process definition was done in close agreement with the client, and included some information obtained in the interviews. In addition the agreements supplied valuable information on quantitative data, such as for example, the number of train journeys or number of wagons. As a result the model parameters could be worked out and verified.

Additional External Expertise

Besides the discussions with the customers and interviews with branch players, external experts were also used for special individual questions. This was done in particular for questions that were outside the sector but considered to be relevant to the subject, when this expertise was not available internally in sufficient depth. These detailed questions occurred, in particular, during the processing of the NDTAC-RFID. In the course of this it became clear that in the past years an enormous effort had been put into developing RFID. Many of the technical problems that until recently were still open have now been largely solved or their solution is very likely by the supposed time of starting of the incentive model. This applies in particular to failure probability rates or reading errors.⁴⁸ Reading errors due to fouling of the RFID chips or weather related recording problems have in the meantime been largely resolved. For the speeds of up to a maximum of 120 km/h which are normal in rail freight traffic, the experts in this field agreed that over 99% of the figures would be correctly recorded.⁴⁹

Beside the questions regarding RFID, at the request of the customers, experts from other large scale road user charge projects were consulted. In addition experts were questioned who were and are involved in various positions for toll road projects (in particular HGV toll systems in Germany). However the knowledge gained here was too little on the entry level in order to have a useful result for the questions dealt with in this study. The unanimous opinion of the people questioned was that it was not possible to compare road user charge systems with similar based systems on rail NDTAC, due firstly to the general differences between road and rail. Thus on rail several wagons in a train must be recorded, while on the road only one vehicle needs to be included. Secondly there are differences in the recording procedure (delivery of the train composition from the RU or RFID portal on one hand, GPS location or 'charging bridges' on the other hand).

6.2 Components of the Cost Model

In the following section the components of the cost model – the model parameters and estimated costs – are explained in detail for the Incentive

⁴⁸ Nevertheless some problems have still not been resolved by previous development work, thus for example the erroneous recording of trains, which run past the RFID line portal at the same time and in the same direction as the train being recorded. Therefore on double track lines two sets of RFID portal equipment are essential.

⁴⁹ The type of transponder is important (there are "surface" transponders or "bar" transponders, the latter can be set up vertically or horizontally) as well as their signal strength. The results get worse as the speed increases, but due to their position in the network, a low to medium speed is suitable for the majority of the transponders.

Models 1-3.⁵⁰ The model parameters basically assume the character of factors on the estimated costs. This can have the effect of a one-off surcharge or a combination of different parameters and consequently has a big effect on the total transaction costs of the individual incentive models.

6.2.1 Estimated Costs

The cost model differentiates between three different types of cost:

- One-off costs to set up the incentive model;
- Annual fixed costs of the operation; and
- Variable costs of the part processes and estimated cost of labour.

One-off Costs to Set Up the Incentive Model

The one-off costs to set up the calculation systems only occur at the start of the programme period. They are made up for the most part of the setting up of the necessary IT interfaces, the modification of existing calculation systems as well as, if need be, the staff costs in connection with additional agreement between IMs and regulatory authorities. There are also additional hardware costs due to higher quantities of data as well as for data storage.

With regard to the IT costs, the costs which would be charged if an external IT service provider was involved are estimated. In addition first the requirements of the respective IT system were determined in order to assess the expected costs. In this connection the size of the respective players, as well as their integration in the respective system, was considered. That led finally to considerable cost variation for the individual cost components. It was decided for the time being not to show the band width in the individual cost determination. This led in the aggregation of the costs to a player specific spread of the complete one-off costs, which considerably reduces the reliability of the cost calculation.⁵¹

The one-off cost determination differs in two cases from the general procedure. For DB Netz the undertaking prepared its own cost estimates. For players in cluster 4 (IMs, RUs and lessors) a small IT supported solution was accepted. Because of the small number of cases no cost intensive IT systems are expected to be installed. That means, for example, that simplified databases have been set up internally and without the support of a service

⁵⁰ The cost evaluation for the direct support model is done separately. Because of its very different character in comparison to the other incentive models a common consideration is not appropriate.

⁵¹ Nevertheless it should be mentioned that the one-off costs just for IT can vary considerably depending on the choice of service providers. The costs estimated here are realistic figures based on experience.

provider. In this case the time required for these activities is estimated and put in with the standard estimated cost tariff. At the same time however it was considered when looking at the variable processes, that these clearly generate correspondingly higher manual costs since the level of automation is very low.

Adaptation of the Wagon Database (All Incentive Models)

For all wagon keepers it can be assumed from the interviews that today an internal wagon database is available in which the undertakings own wagons are listed. RUs list, in addition, the foreign wagons which the RU has already transported. These wagon databases however need to be adapted for the various models, which in the simple case imposes costs of one man-day (players without external support), in the complex case however it may lie in the six figure region if large players have to adapt their databases (consideration of new input fields, suitability for interfaces etc.).

Adaptation of the Internal Production Systems for the Data Exchange between IMs and RUs (Incentive Models 2 and 3)

In the case of NDTAC the data exchange between IM and RU would clearly be more complex than it is today. Therefore, both groups of players must adapt their IT systems so that the data exchange can be done without problems. Even here the complexity is the important driver, which is why for the variants with bonus and penalty a cost factor of 1.25 in comparison to the pure bonus models has been put in (exception: for the cluster 1 (RUs , IMs) the surcharge factor is increased to 1.5 since this IT system is basically assessed as more difficult to adjust).

The range of costs is the highest in this area. With the two clusters 4 (RUs and IMs) it was not assumed that a structure would be set up for these, which means that the manual calculation cost is significantly increased. Conversely for each of the largest clusters a one-off cost in the seven figure area is estimated. In clusters 2 and 3 the costs lie in the six or five figure area.

Setting up Interfaces for Internal and External Data Exchange (all Incentive Models)

For all incentive models there are exchange processes by means of which wagon data can be exchanged between the players. For this purpose firstly interfaces need to be installed at the players involved. Secondly for the players who make the data available, the preconditions must be obtained for the data to be prepared so that it is correctly addressed. This is most complicated for the NDTAC model where the so called breakdown of the bonuses must occur on the RU level, that is to say the costs are highest in the NDTAC

(because the quantity of processing in the bonus-penalty models is higher than in the pure bonus models).

Costs for additional Hardware (all Incentive Models)

The introduction of the incentive models leads to an increase in the quantity of data which arises both internally at the players and in the exchange between the players. In addition the data must be stored for a suitable time. Here as well there is basically a higher requirement with the NDTAC compared to the ND-Bonus model.

Further One-off Costs

For some incentive models there are additional costs for some players:

- **Setting up the Bonus Office:** Since in the ND-Bonus model the Bonus Office plays a central role, there is a comparatively higher one-off cost here to set up the authority. This includes besides the necessary IT also the preparation of the application forms and a one-off management cost, in order to set up the procedure within the authority. This expenditure is in the lower six figure range.
- **Federal Network Agency:** In the models with a bonus-penalty as well as those with an increase in the track access charges the Federal Network Agency as the responsible authority must be included in the discussions to agree the procedure. For this purpose in our estimation there is a one-off five figure sum necessary which includes just the staff costs.
- **Procedure to determine the level of penalties as well as the increase in track access charges:** In the Laps each IM has to develop a procedure, and agree it with the Federal Network Agency, to calculate the penalty level and the increase in track access charges. This incurs expenditure for a calculation model as well as staff costs (agreement of the procedures, etc.) which is estimated to be a six figure sum.

Estimated Costs for the RFID Recording of Wagons

A special feature regarding the one-off costs both in the type and in the extent is shown by the NDTAC-RFID, since here there are considerable one-off costs due to the setting up of the RFID portals as well as the fitting of vehicles. These costs will be described below in detail.

Since in the RFID supported NDTAC the wagon recording in general cannot be done as a report by the RU to the IM but from a line side recording by means of RFID portals, which first have to be installed. In the calculation of the number of necessary RFID portals it was assumed that the infrastructure of all IMs would be fitted. On the basis of an educated assessment of the German network it appears that 40% of the stations/signal boxes need to be

fitted with RFID portals. RFID portals would not be installed on the main lines but connected to existing railway premises. Only in this way can accessibility to the installation for maintenance be ensured. In addition the network produced from the RFID recording portals should be based on the present division of the network into train recording sections. Stations/signal boxes are identified as suitable places (thus stations/signal boxes today reflect the routes in clear detail, and the RUs are able to ask the operating centres for the location of their trains). This does not mean that RFID portals have to be installed on each station. On sections on which neither a junction relevant for freight traffic nor a freight station exists, two measuring points are sufficient; the stations at the start and end of the section. In addition it must be remembered that on two track sections two portals are installed (one for the track in each direction) in order that parallel running past the portals is possible. With respect to the proportion of single track and double track sections of line data is available from the Statistischen Bundesamtes which shows that there is an approximately equal amount of single and double track sections in the whole of the German network.⁵² Hence, the German railway network requires about 9200 portals to implement this system.

This line equipping is associated with a Geo Information System (GIS)-software in order to ensure complete network coverage. In fact, the software connects the recordings made at the portals and can consequently chart the train movements between the portals in real time. Thus the different bonuses and penalties based on time of day and route can be applied.

The estimated costs per unit were determined in interviews with representatives of the sector. These costs were all assigned to the biggest IM (cluster 1), since it was assumed that finally one standard operator would take over the RFID recording.⁵³ If the RFID system is operated by one player, all the others will need an interface to record their section of the network.

In addition there is the cost of fitting the rolling stock. In all three NDTAC-RFID models all the wagons entitled to a bonus need to be fitted with two RFID transponders (that is one transponder on each side of the wagon). With Incentive Models 3.2 and 3.3 all freight wagons need to be fitted since in that case the loud wagons also need to be recorded.⁵⁴ In addition the locomotive

⁵² Source: Statistisches Bundesamt [Federal Statistical Office] (2008): Railway traffic. Rail traffic operating data.

⁵³ This operator can basically be an independent third party. At the same time it is assumed that the other Infrastructure Managers must pay corresponding charges to the portal operator. If this is not so the costs must be broken down on the individual IMs.

⁵⁴ It is assumed that all the bonus or penalty relevant wagons will be fitted. If quiet wagons are not fitted they will not receive any bonus. With penalty systems the difference between the number of recorded wagons and the input number of wagons in the train on the RFID chip on the locomotive can be used to calculate the maximum penalty per wagon-km for these wagons.

has to be fitted with a programmable RFID chip, on which the train driver can enter core data before the start of the train journey.⁵⁵

Annual Fixed Costs of the Operation

The second cost category is the annual fixed costs of the operation of the IT equipment. This is made up of maintenance and support costs for the newly purchased interfaces, databases and the modified production systems of the individual players. The costs for the first two categories have been deposited directly in the model for each position (part process). No indexing of these costs takes place. For the derivation standard values from the IT world were again used. This means that for maintenance and support an annual surcharge of 20% is added to the one-off cost. In addition there is a further 20% for licence charges which in clusters 2 and 3 is likewise considered an annual surcharge. This clause is not required for cluster 1 since licence charges for internal IT developments in general cannot be applied. On the other hand in clusters 4 (IMs, RUs) the annual supplement for the internally produced cost is estimated at 55%.

In addition for each incentive model a charge is made for general management costs. This includes activities such as checking work, book keeping activities or general organisational work (e.g. mailing of messages), which it is difficult to allocate to a definite heading or for instance coincides in the case of entries with current processes and therefore a separate process examination would not be appropriate. Since this is a question of staff costs a time value is initially assumed which is assessed in connection with the tariff for salary costs.

The forecasting of development costs accruing in the NDTAC system and the continuing exchange with the Federal Network Agency are likewise included in this cost area. It was assumed that the costs always fall in the specified level and not, as is normal with variable costs, depend on the particular case. Therefore it was decided against a grouping in the variable costs.

Also with reference to the forecast annual operating costs the NDTAC – RFID is a special case. Maintenance of the RFID portals chip exchange must be done by staff and thus is added by default as a supplement on the installation costs for maintenance and repair based on the one-off costs.⁵⁶

Variable Costs of Part Processes and Estimated Cost of Labour

The third category includes the variable costs which are dependent on the individual processes explained in Chapter 5. In this category first of all time

⁵⁵ By this means it is possible to read out from the portal recording of the train not only the wagons but also train data from the locomotive chip. With this data, the Infrastructure Manager can file records of wagons and train data (train number, etc.) without uncertainty.

⁵⁶ Reference values from other branches of industry were used for this.

values were determined which accrue per process. The estimated time values are reference values which were obtained in particular from benchmarks of comparable firms in other branches of industry, or they were in some cases the result of expert interviews or they came from internal reference values that could be transferred to the investigation. Each process was then allocated one or more 'quantity drivers' and multiplied with the values put into the quantity structure. Behind this action was the assumption that there is a linear relationship between costs and quantity drivers.

The calculated total time spent on the variable costs as well as in individual cases also the one-off – and annual fixed costs were multiplied with the estimated labour cost (or 'tariff') which were specified to be the gross wage costs plus common and special cost supplement. This was estimated based on figures from the State Statistical Office at 70 Eurocents per person minute. In order to apply a methodology inline with the requirements of a standardised cost model it was consciously decided not to differentiate between wage groups or the general wage level in different firms.⁵⁷

The cost model works with real money values (2010 price basis) without considering inflation. No net present values (discounting of the expected values) was set up.

6.2.2 Model Parameters

As model parameters, the components of the cost model can be defined which can also be designated to simplify matters as multipliers or quantity drivers of the estimated costs. They have an important effect on the total costs of the individual systems. These model elements are composed of:

- The lifetime of the programme;
- Periodicities;
- The number of market players per cluster; and
- Further quantity drivers.

Programme Lifetime

The lifetime of all the models investigated was assumed to be eight years. This lifetime was chosen to ensure comparability between the models investigated and is based on the maximum legally permitted period between major examinations of freight wagons. This follows from the assumptions made in earlier studies as well as the political requirements of doing the retrofitting as

⁵⁷ Net labour costs are taken from the Federal Statistical Office (work costs increase 2008). The surcharge for materials and overheads was fixed using experience values from other branches of industry at 40% of the estimated net labour costs.

quickly as possible.⁵⁸ The cost model is therefore based on the period from 2013 to 2020. The start date reflects in our opinion the minimum time that would be required for the administrative implementation (e.g. preliminary times for rail freight traffic, setting up and implementing of IT infrastructure, as well as the necessary steps proposed in this study to set up organisations and implementing additional business processes).

It must however be mentioned that, in particular, the NDTAC model has been designed to run over a longer period than eight years, thus the operating fixed and variable costs of these models can accrue over a much longer period than the eight years assumed in the cost model, if for example, the route and time differentiation of the track access charge is also continued after the completion of the retrofitting.

Periodicities

The periodicities reflect the time related frequency of processes and function therefore as important drivers for the transaction costs. The periodicities considered in the cost model are:

- one-off: all one-off costs accrue only at the start of the period considered;
- annually: All the processes belong here which only occur once in a year:
 - All process which are classified as fixed costs,
 - The general management expenditure which accrues in all incentive models,
 - All processes within the ND-Bonus model since the application and processing of the retrofitting bonus is done annually in accordance with the definition.
- monthly: In the NDTAC model, monthly periodicities are applied.

The Number of Market Players per Cluster

The clusters of undertakings mentioned in Chapter 4.2 as well as the number of undertakings allocated to each of the clusters are of elementary significance for the cost model: First they serve to group together similar undertakings or sizes of undertakings, in order to enable conclusions to be drawn on the necessary expenditure on all cost levels due to their characteristics (e.g. degree of technical standardisation, number of train journeys, etc.). The clusters are cost multipliers, in order to project cluster specific reference

⁵⁸ KCW, SDG, TU Berlin (2009): 'Analyses of preconditions for the implementation and harmonisation of noise-differentiated track access charges'. Likewise: Draft regulation of the Federal Council: Draft of a Regulation to modify the EIBV. BR-Drs. 553/10

values on the total costs. Table 8 summarises the assumed number of players per cluster.⁵⁹

Stakeholder	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Federal Authority	1	—	—	—
Public Bonus Office	1	—	—	—
Infrastructure Manager	1	10	50	80
Railway Undertaking	1	10	50	109
Lessor	5	10	150	—
Operator	75	—	—	—
2nd RU	15	—	—	—
Client	300	—	—	—

Table 8:
Market Players per
Cluster in the Refer-
ence Year 2010

Source: Own chart on the basis of the agreement of customer and KCW

Further Quantity Drivers

To determine the complete variable costs of the various incentive models, the cost model uses further quantity drivers beside those already named (players, periodicities). In order to examine the costs per cluster of players, process specific time values were formed in the cost category "variable costs" and then allocated to a quantity driver and multiplied with it. The other quantity drivers are:

- Number of freight wagons relevant to the investigation;
- Number of train journeys per calendar day;
- Number of invoicing sequences per year;
- Selection quota;
- Special factors.

Number of Freight Wagons Relevant to the Investigation

Incentive models with accurate details of wagons require firstly a clear determination of the wagons, for which the bonuses (or if necessary penalties) are paid. For this the fleet to be included was determined in conjunction with the customers and it was then listed for the individual players. Included

⁵⁹ The number of customers does not reflect the actual number of customers in practice but was chosen as an estimated figure for the cost model. It includes firstly about 150 customers who are wagon keepers and was doubled in order to include customers who provide wagons. It should be mentioned that this is only relevant for the projecting of some items. This is irrelevant for example when determining the expenditure from the number of trains (e.g. complaint regarding arrangement bonus).

are all freight wagons in Germany as well as foreign wagons, which because of the distance they run in Germany, can be relevant to the incentive. The next step is to divide the complete fleet into already retrofitted (or quiet) freight wagons, wagons that it is planned to convert and wagons which are not designated to be converted, but nevertheless run in traffic. This division is necessary, since the individual incentive models include different wagon fleets.

- NDTAC model and direct funding: All wagons to be converted which were put into service before the TSI Noise came into force.
- NDTAC-Bonus with and without RFID: All quiet wagons, that is to say those wagons with TSI Noise approval.
- NDTAC Bonus-Penalty: NDTAC- TAC-rise with and without RFID: All quiet and loud wagons.

The composition of the wagon fleet shown in Table 9 was obtained from discussions with the client of the study:

Table 9: Assumptions on the Configuration of the Wagon Fleet in the Reference Year 2010

Wagon Keeper	Total	Thereof Retrofitted	Designated for Retrofitting	Not Designated for Retrofitting
DB Schenker Rail	97,000	7,000	75,000	15,000
RU Cluster 2	1,050	100	750	200
RU Cluster 3	2,250	500	1,250	500
RU Cluster 4	981	109	763	109
Lessor Cluster 1	90,000	5,000	67,500	17,500
Lessor Cluster 2	13,250	750	10,000	2,500
Lessor Cluster 3	7,800	300	5,250	2,250
Operator/Carrier (Wagon Keeper)	21,900	1,875	15,000	5,025
2nd RU (Wagon Keeper)	43,500	7,000	6,500	30,000
Client (Wagon Keeper)	10,050	300	7,500	2,250
Total	287,781	22,934	189,513	75,334

Source: Own chart on the basis of data supplied by the client of the study

In order to determine the number of bonus relevant wagons over the duration of the programme, assumptions must be made about the retrofitting

rates over the duration of the programme. For this a uniform retrofitting rate of 12.5% per year was assumed for all ⁶⁰incentive models.

Furthermore a constant number of wagons is assumed, that is to say the rate of purchase of new wagons is equal to the number taken out of service. Firstly possibly an increase in productivity should be considered, that is to say the wagons would be more efficiently utilised. Since at the same time the volume of transport is forecast to increase, it cannot therefore be concluded that the total number of wagons will be reduced. It is also assumed that for the duration of the programme all the wagons to be scrapped will come from the category of wagons that are not designated to be converted.⁶¹

Since the costs used in the cost model were based on the reference year 2013, the number of new quiet wagons purchased each year from 2013 is assumed to be 1 800. A retrofitting rate until 2013 was not assumed for reasons of uncertainty.⁶²

In Figure 12 the development of the wagon fleet configuration for the duration of the programme is shown: The chart differentiates between:

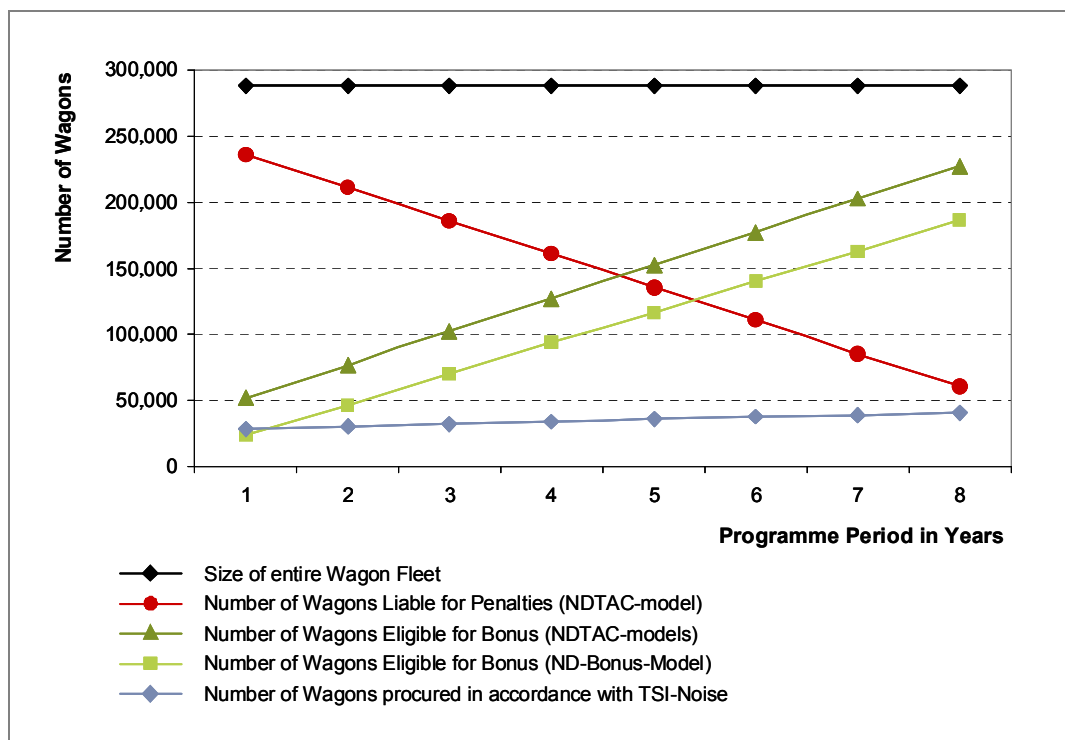
- the quantity drivers relevant for the NDTAC model 'Number of wagons in the GCU model eligible for bonus' (these are all converted, but not newly purchased wagons): 23 314 wagons in 2013 rising linearly to 189 513 wagons in 2020.
- the relevant quantity driver for the NDTAC bonus with and without RFID 'number of wagons eligible for bonus in NDTAC' (these are all converted and newly purchased wagons): 51 714 wagons in 2013 rising linearly to 227 513 wagons in 2020.
- the additional quantity drivers relevant for the other NDTAC 'Number of wagons liable for penalties': 236 067 wagons in 2013 falling linearly to 60 268 wagons in 2020.

⁶⁰ It should be mentioned that this value was chosen just for reasons of simplicity. The real retrofitting rates are very much dependent on the actual incentive effect of the models as well as flanking measures, e.g. on whether the legislator puts a prohibition on cast iron blocks after the end of the programme or how much retrofitting is available in the work-shops for retrofittings. The estimated 12.5% per annum cannot therefore be interpreted as an indicator for the expected incentive effect.

⁶¹ It should once again be mentioned that there are a certain number of wagons for which retrofitting would not be sensible from an economic point of view, e.g. wagons which will reach the end of their life within the duration of the programme as well as special vehicles (e.g. works vehicles).

⁶² This uncertainty comes from information supplied by market participants essentially from the uncertainty of authorisation problems, the question of the estimated arising costs for the composition blocks and also from the uncertainty of whether an incentive model is to be introduced and if so which one. The already planned retrofittings as part of the 'Quiet Rhine' pilot project are not considered.

Figure 12: Development of Wagon Fleet Size Relevant for Bonuses/Penalties over Programme Period



Source: Own chart

Number of Trains per Day

A further quantity driver of the cost model, especially for the NDTAC, is the number of trains running on the entire network. In 2010 on a weekday with average traffic 4 509 freight trains ran on all the lines in Germany.⁶³ In order to show the future increase in freight traffic, the growth forecasts of the BMVBS were used.⁶⁴ These forecast that between 2010 and 2025 there will be an increase in rail freight traffic of 22%. In addition in this investigation it was assumed that the number of daily train runs would increase in the same way as the freight traffic. In order to determine the expected values for the duration of the programme the values of 2010 with the help of the actual freight traffic revenue for the years 2007-2010 were readjusted to the value of 2007 and then projected in the same way as the increased path assumed

⁶³ This was obtained from data available from DB Netz as well as assumptions of the number of trains developed in agreement with the customer for other Infrastructure Managers. Starting from the numbers of the DB Netz in addition the distribution per RU cluster was carried out. The figures shown in Table 10 refer to the train journeys from the RU perspective, that is to say there is no double recording when using different IM networks.

⁶⁴ BVU / ITP 2007: Forecast of the all German traffic integration 2025.

in the BMVBS forecast.⁶⁵ Consequently the number of trains considered at the start of the programme period 2013 is about 14.3% higher than the numbers in 2010. The table below shows this.

Table 10: Development of the Number of train Journeys throughout the Duration of the Programme

Year	Rail Freight Volume (m tonnes) Forecast BMVBS*	Actual Rail Freight Volume (m tonnes)	Train Runs per Day
2007(readjusted)	337.5	361.1	4,501
2008	342.7	371.3	—
2009	347.9	310.0	—
2010	353.1	361.8	4,509
2013	368.6	—	5,152
2014	373.8	—	5,225
2015	379.0	—	5,297
2016	384.2	—	5,370
2017	389.4	—	5,442
2018	394.5	—	5,514
2019	399.7	—	5,587
2020	404.9	—	5,659

Source: Own figures on the basis of the data of the Federal Statistical Office and client of the study.

Number of Calculation Events per Year

With respect to the number of calculation events the essential driver is the invoicing periodicity. While for the NDTAC model and the direct funding a continuous annual bonus examination is assumed and therefore the invoicing and transfer of data and information are done once a year, in the NDTAC (with and without RFID) in general a monthly examination of the events is considered (see also the diagram in Chapter 5).

In addition the number of players involved is a not insignificant factor, although clearly less important than the number of wagons or as in NDTAC (with and without RFID) the number of train journeys (respective wagon movements). Since these parameters also occur in the individual calculations, the scope of the individual calculations varies greatly between the players in a group (e.g. RUs). Thus in the RU cluster 1 calculation procedure 105 000

⁶⁵ Source: Federal Statistical Office press announcement of 29.11.2010. In this connection it should be noted that in spite of the serious effects of the economic and financial crisis the freight traffic revenue of the railways in 2010 was 361.8 million tonnes (provisional estimates of the Federal Statistical Office November 2010). This was over the trend forecast of the BMVBS for 2010 (353.1 million tonnes).

train journeys need to be considered but in cluster 4 there are only 30 train journeys. All 575 accepted wagon keepers, as well as the public authorities are involved in the incentive models one and four. In the NDTAC (with and without RFID) further players are involved, who do not hold or provide any wagons. Thus corresponding to the transfer of bonuses consignors are involved, who do not provide their own wagons. The number can vary from month to month. As monthly average the number of 1 000 players was assumed as the maximum number for the RU cluster 1 to which data should be transferred. These must not necessarily be the same players every month.

Selection Quota

Individual sub-processes call for queries – or also spot check rates, since the process arises not in every case, but just in a certain sub-set. In addition there are reading errors of the IT, which results in manual processing by staff.

Query rates follow in every case on checking processes and serve to resolve the facts. Therefore expenditure for queries always falls on two player levels, first on the player who has complained and in addition on the player who was complained against.

A spot check is an additional level of check and enables the checking player to check a fact. A spot check is always addressed as a query to another player and produces a corresponding search expenditure, which, however, is smaller than, for instance, the costs involved in a query. For players who draw the sample there is, besides the inquiry, also the actual checking cost.

Lastly there are reading errors. These result in the necessary manual re-recording of a process because of an IT error and can be a cause for complaint.

It should be mentioned again here that apart from some exceptions, many standard values were chosen for all incentive models. The novelty of the system basically makes assumptions difficult. Deviations from these assumptions between the incentive models involved a further uncertainty in them. Therefore it was decided not to show development curves but to form an average using values based on experience, which can then be used in the same way for all periods.

Special Factors

Furthermore, occasional special factors are considered as surcharge factors on the respective process dependent expenditure. With only one exception, all these factors occur in the NDTAC.

- Use of different infrastructures for each train journey: In view of the large number of Infrastructure Managers it is likely that a train of an RU runs on

the tracks of different network operators during its journey. Therefore a report of the train composition should be sent to all the IMs involved for each train journey. Accordingly these exchange processes are given a cluster specific surcharge factor which is divided among the various RU clusters as follows:

Table 11: Special Factors for the Use of the Infrastructures of Different Network Operators

RU-Cluster	Supplement Factor
1	1.15
2	1.25
3	1.50
4	1.50

Source: Own chart

- Surcharge factor for train changing within a train number: There is the possibility that a train only runs on one IMs network, but the train composition changes, e.g. additional wagons are added at an intermediate station. If the train number does not change, provision of one set of train data to the IM would not be appropriate since there is no suitable basis for the correct bonus calculation. Therefore the supply of all actual train compositions is necessary. In practice this can be done with the so-called 'sub-train numbers'.⁶⁶ In order to put this in the cost model an additional surcharge factor of 1.35 divided equally among all clusters is raised for the assessment of the data supply process of the RU to the IM.⁶⁷
- Queries of the wagon keepers: On receipt of the process description of the Laps, the wagon keeper checks the bonus figures for correctness and plausibility and, if necessary, sends queries to the RU if he finds discrepancies or anything that is not clear. Since a wagon can be used by different RUs during the year, it is possible that queries are therefore submitted by more than one RU. On the other hand it should be assumed that it is not necessary to explain all bonus calculations but only some isolated ones. Thus the factor 2 was decided for the wagon keeper, on the assumption that for each queried single wagon a complaint is made to two different RUs. This factor is also assumed for the query of the reported mileage in the ND-Bonus model.

⁶⁶ This multi-supply is not necessary if the train composition change occurs at the boundary between two Infrastructure Managers, since then, in any case, two reports must be sent to the two IMs. Also the repeated information reporting does not occur if a new train number is given to the changed train composition.

⁶⁷ The distribution is made on the assumption that 70% of the trains run on the network without change of train composition, 25% have one change and 5% have two changes.

6.2.3 Assumptions for the Retrofitting Costs

The inclusion of the retrofitting costs is itself not important for the determination of the transaction costs. Moreover one aim of the study is to show the transaction costs in relation to the retrofitting costs produced. From this a standard basis for all the incentive models is possible.⁶⁸

Included in the model are both the one-off retrofitting costs as well as the mileage dependent costs of new composite brake blocks. In addition it is assumed that the level of bonus is based on the retrofitting costs, that is to say neither an over- nor an under-compensation occurs. As the basis for the retrofitting costs as well as the running costs dependent on the mileage, currently available data from research projects and studies in which these costs were investigated were first checked. While the band width of the one-off costs of retrofitting was similarly assessed in the studies, there are, in some cases, considerable differences in respect of the estimation of the mileage costs.⁶⁹ The band width of these differences reflects the lack of figures from operating experience, especially in relation to the LL blocks. In this study reference is made to the figures put forward in the 'Silent Rhine' pilot project by Working Group 3.⁷⁰ These values are given in the table below.

Table 12: Costs for the Retrofitting with Composite Brake Blocks

Cost Pool	LL-Block (4 axes)	K-Block (4 axes)
Retrofitting Costs (Material, Retrofitting, Opportunity Costs etc.)	1,250 - 2,030 € (16 brake blocks)	5,650 - 6,850 € (16 brake blocks)
	1,500 - 2,280 € (32 brake blocks)	6,250 - 7,450 € (32 brake blocks)
Increased Operating Costs p.a. (Mileage: 30.000 km)	500 - 600 €	600 - 770 €

Source: Own chart on the basis of data from the Working Group 3 of the pilot project 'Silent Rhine'

⁶⁸ Nevertheless as has already been mentioned here, the ratio of retrofitting costs to transaction costs can indeed be shown in a similar way for all incentive models, but in view of the different arrangement of the incentive models this can be distorting. Thus for instance for NDTAC – as opposed to the ND-Bonus model – firstly a bonus is also paid for TSI Noise wagons and secondly further money distributed to the players for a deployment bonus. In this case the ratio of distributed bonuses to transaction costs is more meaningful, but cannot be shown in this investigation because of the uncertainty e.g. over the level of the deployment bonuses.

⁶⁹ Hübner, Peter: Noise depend track access charges – incentive or emotive words? Eisenbahn-Revue 12/2010, pp 616-620.

⁷⁰ Source: Appendix IV: Proposal of the sector for a noise and kilometre dependent wagon bonus system from the 'Silent Rhine' pilot project, Working Group 3 (wagon tracking, track access charge arrangement). The cost assumptions are based on experience values from representatives of the railway sector.

6.3 Results

The results obtained in the cost model for all the incentive models are shown in the following Chapter. First the results for the models are shown and then supplemented by short classifications. This is necessary in order to clear up supposed implausibility and to avoid false interpretations.

Regarding the chart, the results of the cost models are finally provided with a band width, in order to be able to show any deviations. This is sensible, especially for the processes or IT structures which in their design involve new fields for the players since their costs can hardly be obtained accurately. As is mentioned in Chapter 6.1 it was consciously decided not to proceed with the formation of the scatter bands for the individual values, in order not to generate too great a difference in the end results. The chosen scatter bands are therefore estimated on the final results of the three cost blocks, one-off costs, annual fixed costs of the operation and variable process costs. These were based on differentiated values:

- One-off costs: In particular, wide scatter bands are normal with the estimates of IT costs (sometimes up to 40% above and below). In order not to dilute the results of the cost model too much, in this investigation a scatter band of only ten percent above and below was estimated.
- Annual fixed costs of the operation: For these costs a flat rate of 10% was assumed as the scatter band. This is methodically not quite correct, since in this cost block general management costs are also included. As far as the scatter band formation is concerned this can, however, be neglected, since here no significant distortions are to be expected.
- Variable process costs: For this cost block the scatter range was assumed to be five percent lower than with the other cost blocks, since with manual calculations a lower range can be assumed.

Regarding the chart of the results the individual clusters of players were summarised, that is to say the chart is done for the following groups of players:⁷¹

- IM (contains all four IM clusters),
- RU (contains all four RU clusters),
- Lessors (contains all three lessor clusters)
- Intermediate players (contains operators and '2nd RUs'), referred to below as: 'Other market players',

⁷¹ It should be emphasised that this is only valid for the result chart. The calculation of the transaction costs is done as specified in the classification of the players explained in the previous steps.

- Consignors,
- Public authorities (contains public Bonus Office, payment provider and BNetzA).

Not included in the costs shown are the bonuses and penalties involved in the respective incentive models.

Finally the results of the individual incentive models are placed side by side for comparison.

6.3.1 Results for the ND Bonus Model

In the ND-Bonus model during the eight year period of the programme transaction costs of about EUR 81 million were estimated that is to say on average a good EUR ten million annually. The results separated for cost blocks and groups of players are shown in the following Table 13 **Error! Reference source not found.** The transaction costs calculated show on the basis of the defined finite nature of the system after eight years the total transaction costs of the incentive model, that is to say there are no subsequent costs after eight years.⁷²

Table 13: Transaction Costs Calculated for the ND Bonus Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
RU	2.2	5.9	16.1	24.1
Lessor	1.7	5.6	11.2	18.5
Other Market Players	3.0	9.6	16.4	29.0
Consignor	1.1	3.1	0.8	5.0
Public Authorities	0.2	0.5	4.3	5.0
Total	8.1	24.6	48.7	81.5

Source: Own chart

Costs per Player

IMs

There are no transaction costs on the IM level.

⁷² Exceptions here, as in all other incentive models, would be amended rules (e.g. approval charges for wagons with cast iron blocks). This expenditure is, however, nothing like that for the incentive model defined here.

RUs

The highest transaction costs in this group fall, as is expected, on DB SR. As these are in the mid single digit million range for eight years they are relatively small. For the other players there are annual costs in the five figure range.

Lessors

An incentive model whose costs are basically dependent on wagons leads unsurprisingly to relatively high costs for the wagon lessors. For the first large class the total transaction costs are likely to be in the lower single figure million range, the other groups are clearly lower with values in the low six or five figure area over eight years.

Other Market Players

The other market players, which consist of operators and '2nd RUs' have on the basis of their comparatively high fleets of bonus eligible wagons seemingly high transaction costs. Since large foreign State railways also belong to this group the total results lie in the comprehensible area.

Consignors

Because of the high number of players, consignors have comparatively low transaction costs. The reason for this is the low number of wagons eligible for bonus.

Public Authorities

Because of its central role as Bonus Office comparatively high costs fall on the EBA which are essentially wagon dependent process costs.

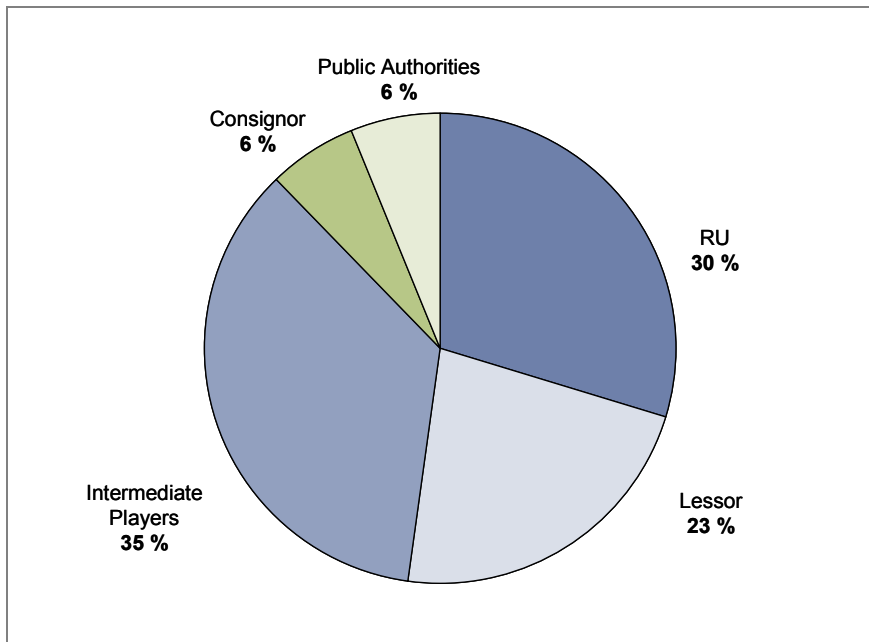


Figure 13:
ND Bonus Model:
Distribution of Transaction Costs among Players

Source: Own chart, with rounded figures

Cost Distribution

The distribution shown in Figure 14 indicates that more than half the total transaction costs in the ND-Bonus model are variable process costs. This compares with the comparatively smaller one-off cost (11% of the calculated transaction costs), which can be explained by the comparatively simple requirements of the IT adjustments. The main driver of the variable costs is the number of wagons.

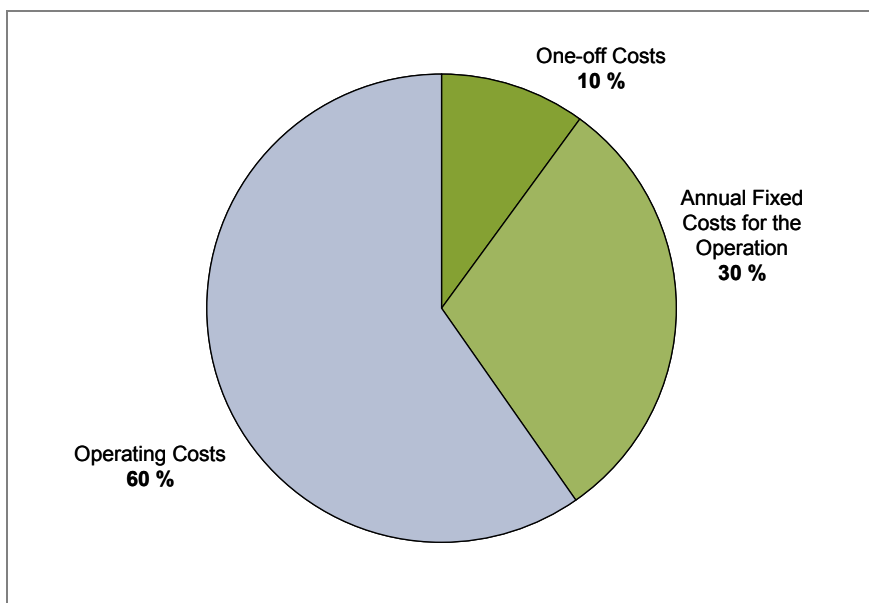


Figure 14:
ND Bonus Model:
Distribution of Transaction Costs among Cost Categories

Source: Own chart, with rounded figures

Band Widths

The concluding Table 14 shows the results on the basis of the scatter ranges. The transaction costs for the ND-Bonus model are, therefore, between almost EUR 76 million at the lower end of the results scale and about EUR 87 million as the maximum cumulative transaction costs for eight years.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
RU	22.5	24.1	25.7
Lessor	17.2	18.5	19.7
Other Market Players	26.9	29.0	31.0
Consignor	4.5	5.0	5.4
Public Authorities	4.7	5.0	5.3
Total	75.8	81.5	87.2

Table 14:
ND Bonus Model: Band Width of Transaction Costs (in million EUR)

Source: Own chart

6.3.2 Results for the NDTAC-IT Models

The costs for the three NDTAC models are shown in this section. Because of the important differences regarding method and quantity drivers the chart is done separately for each of the three variants. In spite of the potential long life of NDTAC it should be pointed out that the calculated costs were only calculated for eight years. If the system is used for a longer time the cumulative transaction costs obviously continue to increase.

NDTAC-IT Bonus

In the NDTAC as a pure bonus system the total transaction costs are about EUR 493 million. These are made up as follows:

Table 15: Transaction Costs Calculated for the NDTAC-IT Bonus Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	9.7	23.6	30.8	64.1
RU	12.6	30.7	202.0	245.4
Lessor	1.4	4.6	22.0	28.0
Other Market Players	2.7	7.2	69.1	79.0
Consignor	1.8	5.5	69.0	76.3
Public Authorities	0.0	0.0	0.5	0.5
Total	28.3	71.6	393.4	493.3

Source: Own chart

Costs per Player

IMs

If the Infrastructure Managers are still let out of the ND-Bonus model this suggests that the NDTAC has an enormous effect on transaction costs. The quantity driver train journey has a significant weight in this model which is reflected in the cost loading for the IM. The Federal undertaking DB Netz AG has to carry the highest costs by a long way.

RUs

The main charge in the system, which is half of all costs, falls on the RUs which are connected both with regard to the settlement with the IMs and with regard to the settlement with the upstream players. In view of the high market share DB SR is the highest loaded with a three figure million sum. For smaller RUs above all there is a relatively high case dependent expenditure which is due to the smaller IT standards in comparison to the other RU clusters.

Lessors

Lessors are lightly loaded relatively considered, since in this model the wagon purchase is rather in the background. Absolutely considered for example, the large lessors have to pay total transaction costs in the middle millions range.

Other Market Players

Other players have to carry high shares of the cost due to their role, firstly as wagon keepers or wagon providers as well as operators, and secondly as supervisors responsible for the allocation of vehicles. The big effect that checking and answering queries has is shown here.

Consignors

The same can be said about consignors, whose high costs are above all due to the settling or checking and querying of the deployment bonus.

Public Authorities

In comparison with the ND-Bonus model, in the NDTAC (bonus) the public authorities are less involved, since they have no central role and, in addition, a considerable smaller number of cases (train basis) are sent to them.

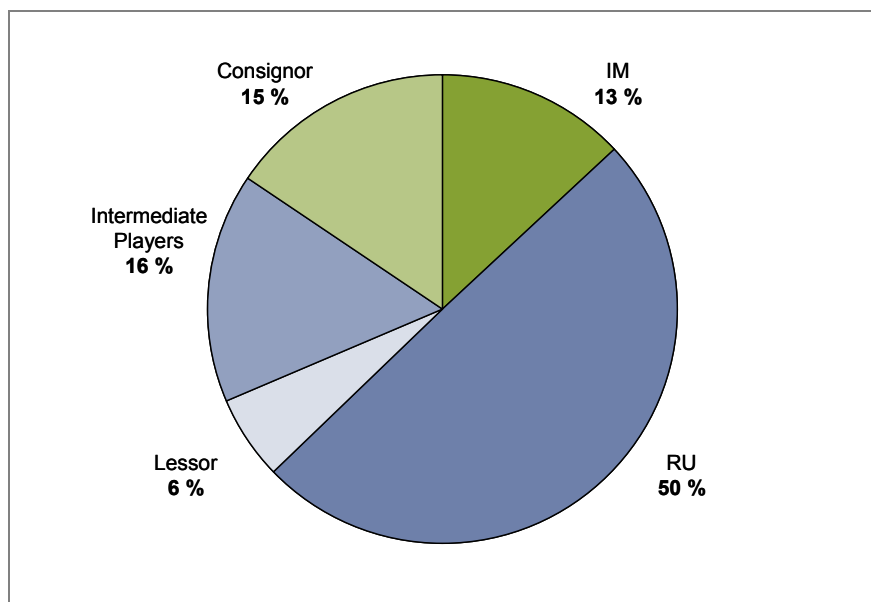


Figure 15:
NDTAC-IT Bonus
Model: Distribution of
Transaction Costs
among Players

Source: Own chart, with rounded figures

Cost Distribution

The percentage of the process costs in the NDTAC in the pure bonus variant is very high at 80%. This shows the driver function of train journey and wagon, which increases the case by case expenditure. Thus, just the cost of the consistent transfer, as well as the checking and querying of the deployment bonus, is assessed at about EUR 150 million in eight years. In total it can be concluded that here as well as in all NDTAC variants the parameter train journeys is the determining factor.

The percentage of the one-off costs is only about six percent, so a total of more than EUR 28 million complete transaction costs have to be divided among all players, and consequently in spite of the small cost share lie far above the comparative value of the ND-Bonus model.

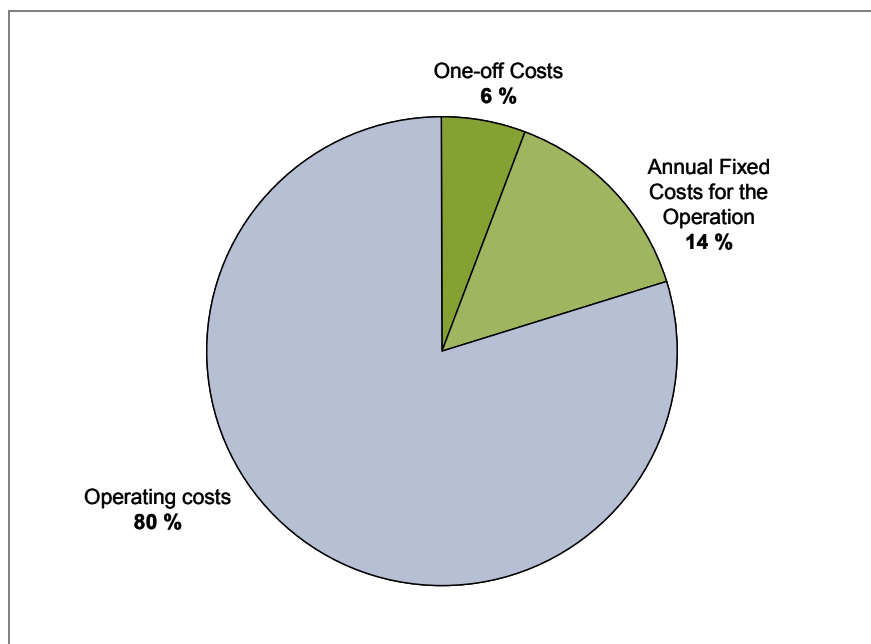


Figure 16:
NDTAC-IT Bonus
Model: Distribution of
Transaction Costs
among Cost Categories

Source: Own chart, with rounded figures

Band Widths

Regarding the band widths within which the costs can vary, the scale ranges from almost EUR 464 million minimum cost up to total transaction costs of over half a billion euro (about EUR 523 million) as shown in the following table.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	59.2	64.1	69.0
RU	230.9	245.4	259.8
Lessor	26.3	28.0	29.7
Other Market Players	74.6	79.0	83.4
Consignor	72.1	76.3	80.5
Public Authorities	0.4	0.5	0.5
Total	463.6	493.3	522.9

Table 16:
NDTAC-IT Bonus
Model: Band Width of
Transaction Costs (in
million EUR)

Source: Own chart

NDTAC-IT Bonus-penalty

This noise differentiated track access charge causes the highest transaction costs of all the NDTACs. About EUR 792 million are estimated here in eight years. That is to say on average close on EUR 100 million per year.

Table 17: Transaction Costs Calculated for the NDTAC-IT Bonus-penalty Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	13.9	32.8	35.2	81.8
RU	15.8	36.5	304.2	356.5
Lessor	1.8	5.0	106.6	113.3
Other Market Players	3.4	9.6	106.1	119.1
Consignor	2.3	6.6	112.4	121.3
Public Authorities	0.0	0.0	0.0	0.0
Total	37.1	90.5	664.5	792.1

Source: Own chart

Costs per Player

IMs

The costs increase for the IMs by a good quarter in comparison with the NDTAC (bonus), mainly due to the higher value IT structure (one-off costs and equivalent annual fixed operating costs). In addition there is forecast expenditure for the preliminary invoicing of the penalty levels.

RUs

The highest costs, as in the NDTAC (bonus), must be paid by the RUs. Their costs increase again to over a hundred million euro, based on the complete time span considered. There are higher costs in all cost areas. While in the penalty variant the parameter train journeys remains unchanged the parameter wagons changes significantly.

Lessors

The transaction costs of lessors increase significantly with the recording of a penalty since this increases the number of cases.

Other Market Players

This applies also to the other market players in which, for example, '2nd RUs' have a large wagon fleet.

Consignors

Finally consignors also have to pay higher costs. This also follows the increased number of cases.

Public Authorities

As the model is self financing the public authorities are only involved through the BNetzA as regulator which leads to comparatively small costs on this level.

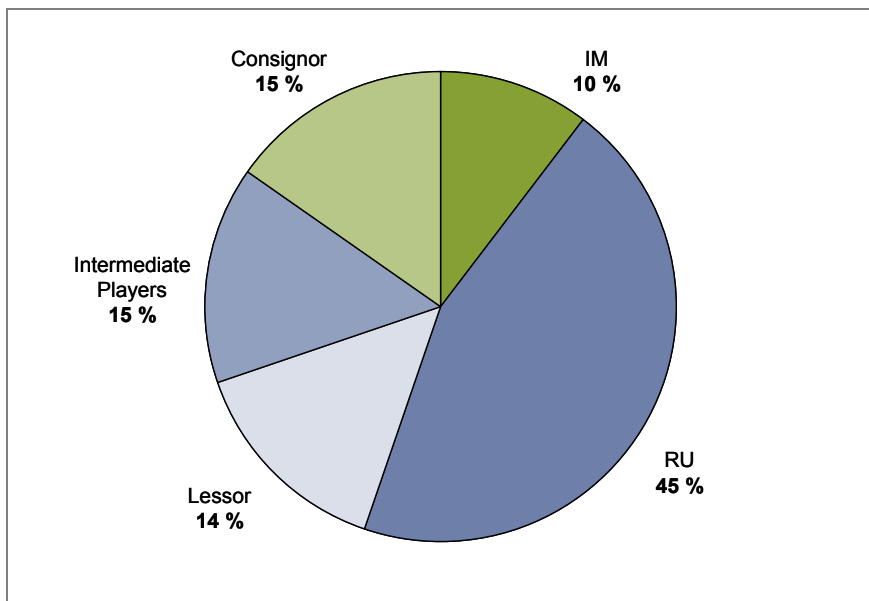


Figure 17:
NDTAC-IT Bonus-
penalty Model: Distri-
bution of Transaction
Costs among Players

Source: Own chart, with rounded figures

Cost Distribution

In spite of higher one-off and fixed operating costs, in the NDTAC bonus-penalty model the percentage of the process costs increases slightly to about 84%. More wagons automatically mean more processes and consequently individual case costs. Within the process costs the effect of the quantity driver wagons increases in comparison to the quantity driver train, which in comparison to the pure bonus model is constant. In spite of the higher significance of the wagon as quantity driver, the train journey remains the dominant quantity in the process costs. Included in this is the exchange process between IMs and RUs as well as between RUs and the staff responsible for deployment.

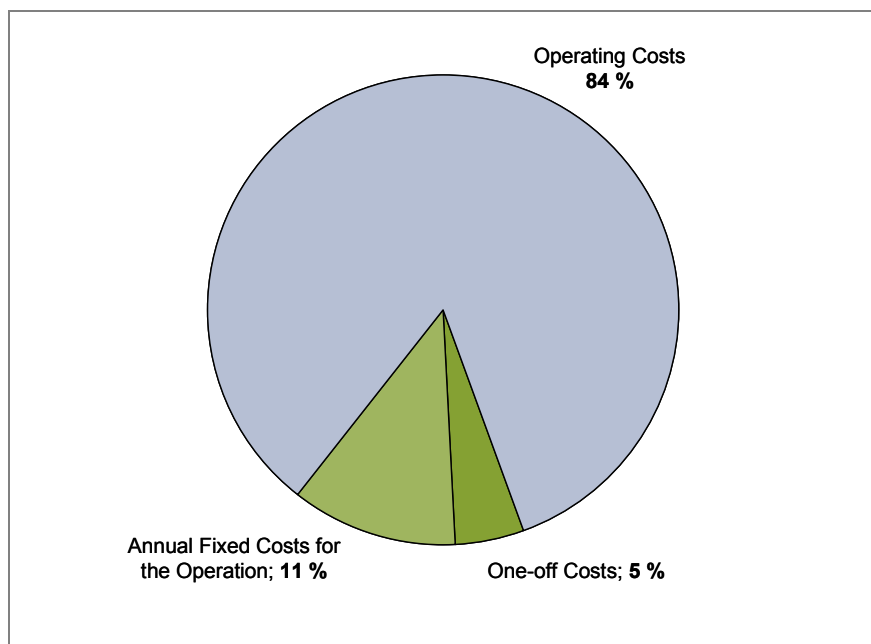


Figure 18:
NDTAC-IT Bonus-penalty Model: Distribution of the Transaction Costs among Cost Categories

Source: Own chart, with rounded figures

Band Widths

Looking at the minimum and maximum costs for the transaction expenditure for eight years, the range within which the transaction costs of the incentive model can lie increases to about EUR 92 million (between EUR 746 and 838 million).

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	75.4	81.8	88.3
RU	336.1	356.5	376.9
Lessor	107.3	113.3	119.3
Other Market Players	112.5	119.1	125.7
Consignor	114.8	121.3	127.8
Public Authorities	0.0	0.0	0.0
Total	746.1	792.1	838.1

Table 18:
NDTAC-IT Bonus-penalty Model: Band Width of Transaction Costs (in million EUR)

Source: Own chart

NDTAC-IT TAC-rise

If instead of the public authorities providing the funding, the retrofitting cost was financed by increasing the track access charges, the calculated transaction costs would increase to over EUR 600 million. The costs consequently lie higher than for the NDTAC (bonus) model due to an additional further settlement level for the higher track access charges.

Table 19: Transaction Costs for the NDTAC-IT TAC-rise Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	10.7	24.9	32.7	68.2
RU	14.2	33.4	229.7	277.2
Lessor	1.6	4.6	86.4	92.6
Other Market Players	2.9	7.9	87.0	97.7
Consignor	2.0	5.8	73.7	81.5
Public Authorities	0.0	0.0	0.0	0.0
Total	31.4	76.5	509.4	617.3

Source: Own chart

Costs per Player

The distribution of the costs among the players changes only slightly as Figure 19 below shows. The biggest increase is the cost on the level of the RU, since here additional breakdown costs occur for the further invoicing of the track access charges.

For the other players, in general, the statements for the NDTAC (bonus) apply, so the public authorities are less loaded, since here they are only involved as the regulator (BNetzA).

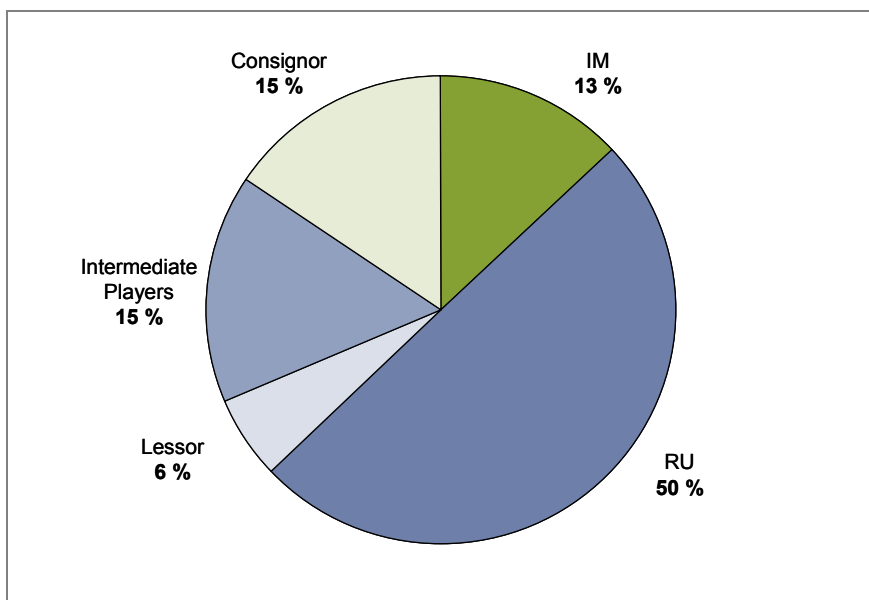


Figure 19: NDTAC-IT TAC-rise Model: Distribution of Transaction Costs among Players

Source: Own chart, with rounded figures

Cost Distribution

The distribution of the entire transaction costs on the cost blocks, one-off costs, fixed costs of the operation and process costs is almost identical with the NDTAC (bonus). The costs are by and large higher but are basically not divided differently since beside an increase in processes there was also a rather more expensive IT system.

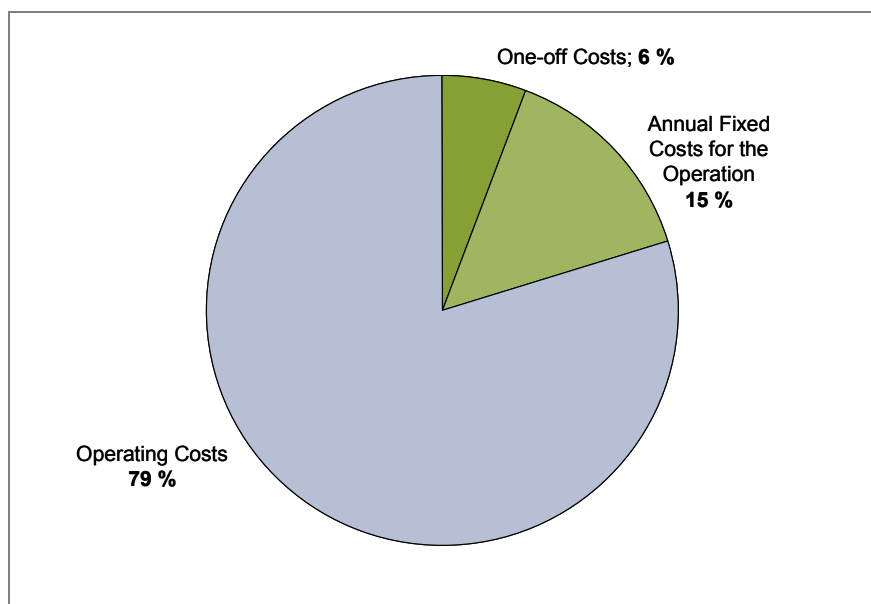


Figure 20:
NDTAC-IT TAC-rise
Model: Distribution of
Costs among Cost
Categories

Source: Own chart, with rounded figures

Band Widths

The width of the range for the NDTAC (increased track access charges) is shown in Table 20.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	63.0	68.2	73.4
RU	261.0	277.2	293.4
Lessor	87.7	92.6	97.6
Other Market Players	92.3	97.7	103.2
Consignor	77.0	81.5	85.9
Public Authorities	0.0	0.0	0.0
Total	581.0	617.3	653.6

Table 20:
NDTAC-IT TAC-rise
Model: Band Width of
Transaction Costs (in
million EUR)

Source: Own chart

6.3.3 Results for the NDTAC-RFID Models

Similarly to the results of the NDTAC without RFID, the results for the NDTAC with RFID are separately identified. Here also it should be noted that the transaction costs have only been considered for eight years. If the incentive model is continued over the period of the programme investigated there are further costs (annual fixed operating costs, process costs).

NDTAC-RFID Bonus

In the first model of the RFID incentive models there are significantly increased costs when compared with the NDTAC without RFID. These are almost exclusively charged to the IMs and for the RUs the costs even fall slightly, since the exchange processes between IM and RU decrease in frequency. However this slight "cost saving" on the RU level cannot by a long way equal the additional cost on IM level.

Table 21: Transaction Costs of the NDTAC-RFID Bonus Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	113.7	147.6	30.8	292.1
RU	8.2	17.2	186.9	212.3
Lessor	2.2	5.7	22.0	29.9
Other Market Players	6.9	7.3	66.3	80.4
Consignor	1.9	5.5	68.9	76.3
Public Authorities	0.0	0.0	0.5	0.5
Total	132.9	183.2	375.5	691.6

Source: Own chart

Costs per Player

IMs

The lion's share of the transaction costs fall unsurprisingly on portal operators for the RFID recording which here were allocated to the IM cluster 1.

RUs

The complete loading for RUs is somewhat smaller than in the model without RFID recording. This can be explained by the extensive omission of the exchange with the IM. If this cost arises due to the breakdown of the RFID recording, the cost is basically manual, that is to say the IT is rather less expensive. Here wagons and locomotives must be fitted with chips, the costs for this are comparatively small because of the relatively low individual costs.

Upstream Players

Summarising, it can be concluded for the upstream players that their costs in comparison to the NDTAC without RFID do not change much, since the additional settlement process from the RU to lessors, consignors, etc. is done in a similar way to the NDTAC without RFID recording. In addition there is the fitting of the wagons with RFID chips.

The Public Authorities

The public authorities are involved in a similar way to the NDTAC (bonus) as the reimburer of the bonuses paid for the IM and consequently have comparatively low costs.

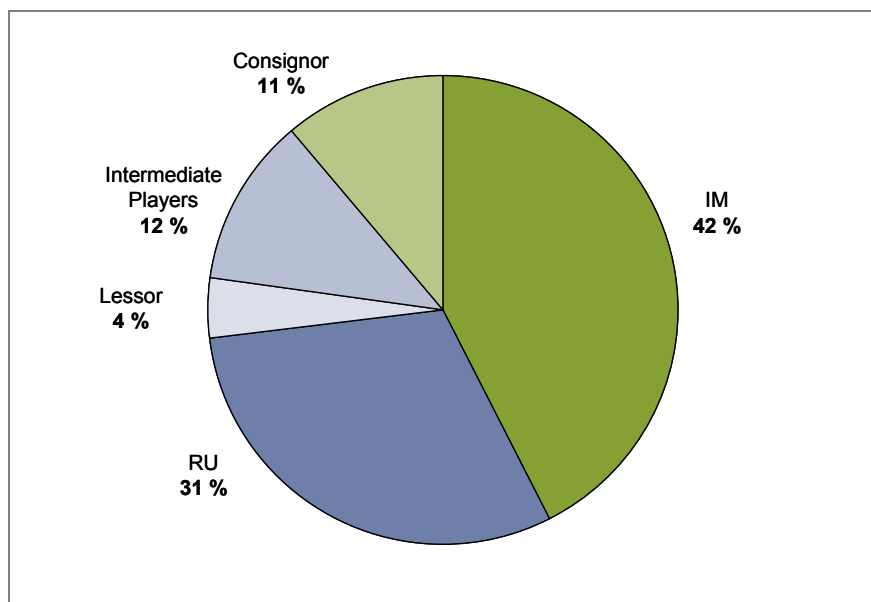


Figure 21:
NDTAC-RFID Bonus
Model: Distribution of
Transaction Costs
among Players

Source: Own chart, with rounded figures

Cost Distribution

The setting up costs of the infrastructure with recording portals as well as – to a clearly lesser extent – the vehicles, affects the allocation of the type of costs significantly. The share of the one-off costs is three times as much as in the NDTAC (bonus) without RFID recording, though it should be pointed out that the reason for this lies mainly in the absolute cost increase of the model. The process costs fall in comparison to the corresponding model without RFID recording by almost EUR 20 million divided between the market players over eight years.

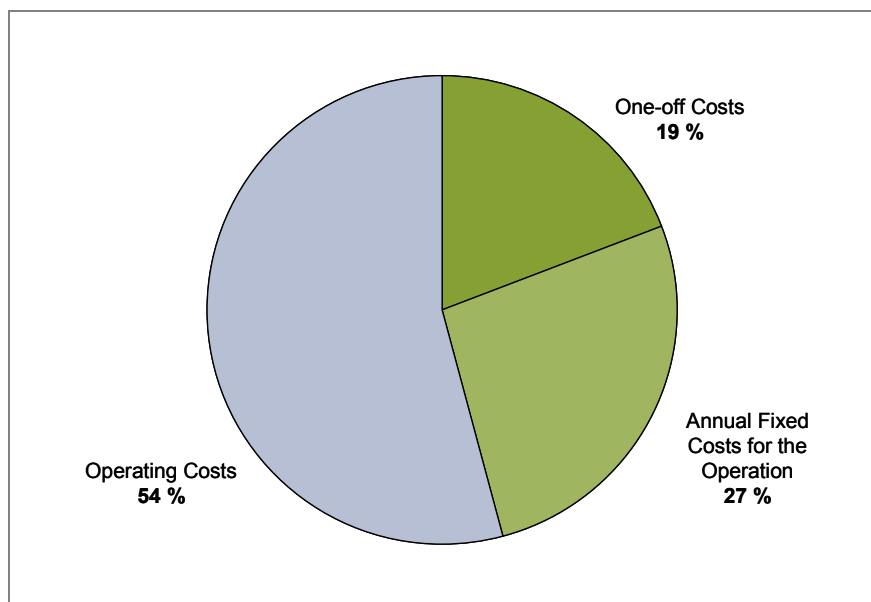


Figure 22:
NDTAC-RFID Bonus
Model: Transaction
Costs per Cost Cate-
gory

Source: Own chart, with rounded figures

Band Width

The range of calculated costs goes from EUR 641 million to almost EUR 750 million as the complete transaction costs in eight years. By considering the respective minimum and maximum values of the Incentive Models 2.1 and 3.1 the pure bonus NDTAC can therefore be almost EUR 280 million more expensive in the total time considered.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	264.5	292.1	319.8
RU	200.4	212.3	224.2
Lessor	28.0	29.9	31.8
Other Market Players	75.7	80.4	85.2
Consignor	72.1	76.3	80.5
Public Authorities	0.4	0.5	0.5
Total	641.2	691.6	742.0

Table 22:
NDTAC-RFID Bonus
Model: Band Width of
Transaction Costs (in
million EUR)

Source: Own chart

NDTAC- RFID Bonus-penalty

The costs of the NDTAC (RFID [bonus]) are, as is expected, far exceeded by the bonus-penalty variant. With almost EUR one billion cumulative transaction costs over eight years this is the most expensive of all the incentive models investigated. Beside the parameters, wagons and train journeys it is, just like in the RFID models in total, the equipment of the line as well as the associated fixed operating costs which are the important cost drivers.

Table 23: Transaction Costs for the NDTAC-RFID Bonus-penalty Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	115.0	150.1	35.2	300.3
RU	13.6	30.5	289.1	333.3
Lessor	4.0	10.1	106.6	120.7
Other Market Players	9.0	12.1	101.7	122.8
Consignor	2.5	7.1	111.7	121.3
Public Authorities	0.0	0.0	0.0	0.0
Total	144.2	210.0	644.4	998.5

Source: Own chart

Costs per Player

Compared with the NDTAC (RFID [bonus]) the relative share of the costs for the IMs falls. In absolute figures the costs of the IMs nevertheless rise slightly because of the more complex IT systems.

For the other market players basically the drivers in the NDTAC (bonus-penalty) that are already effective are decisive for the cost development.

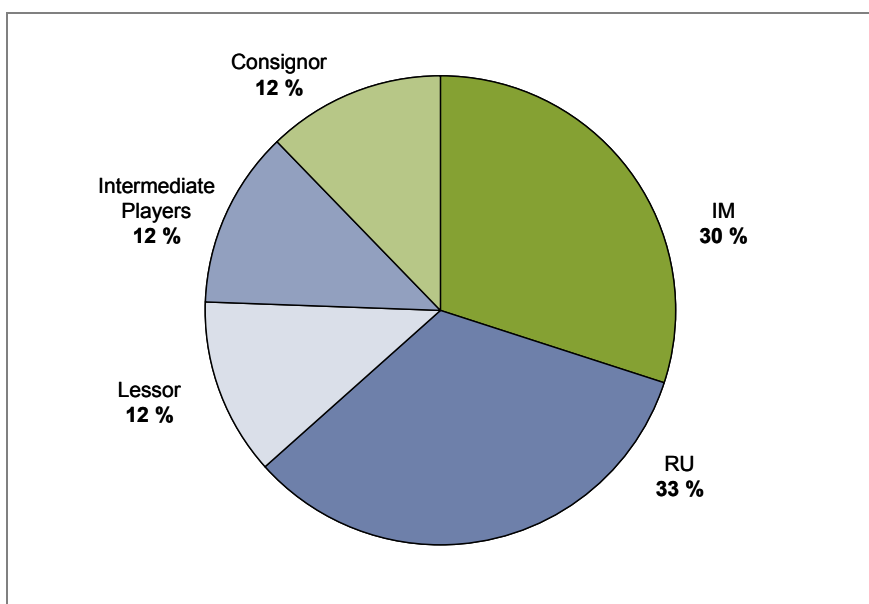


Figure 23: NDTAC-RFID Bonus-penalty Model: Distribution of Costs among Players

Source: Own chart, with rounded figures

Cost Distribution

Likewise the higher costs on the RU level and those for the upstream players ensure that the share of the process costs rises while the one-off costs fall. It

should also be mentioned that in all cost blocks the total cost is higher than in the NDTAC (RFID [bonus]).

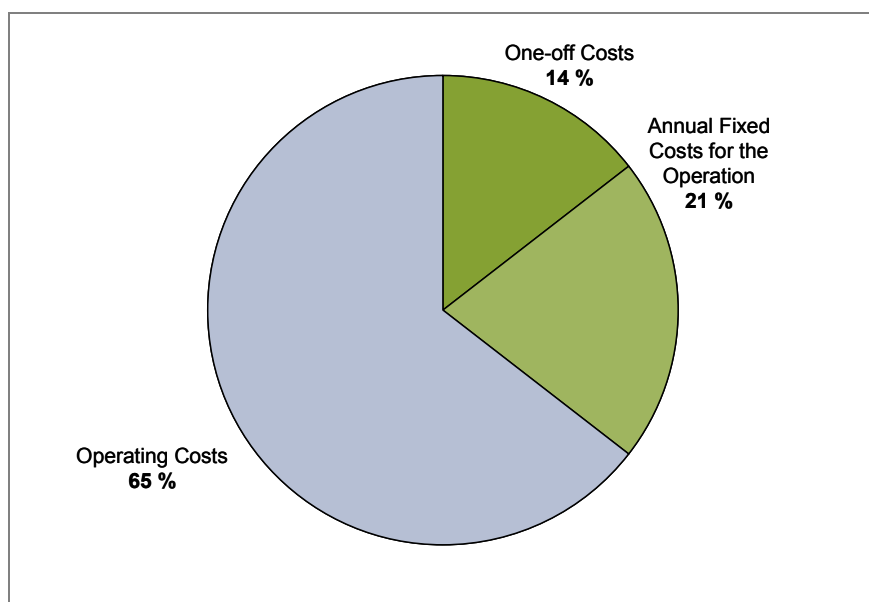


Figure 24:
NDTAC-RFID Bonus-penalty Model: Transaction Costs per Cost Category

Source: Own chart, with rounded figures

Band Width

If the billion mark on basis of the cost model was slightly undershot, on the assumption of potential cost increases it is expected that this limit will be clearly exceeded when the band width is formed. This would mean in the maximum case more than EUR 130 million annual transaction costs in this incentive model.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	272.1	300.3	328.6
RU	314.4	333.3	352.1
Lessor	114.0	120.7	127.5
Other Market Players	115.6	122.8	130.0
Consignor	114.8	121.3	127.9
Public Authorities	0.0	0.0	0.0
Total	930.9	998.5	1,066.1

Table 24:
NDTAC-RFID Bonus-penalty Model: Band Width of Transaction Costs (in million EUR)

Source: Own chart

NDTAC-RFID TAC-rise

In the NDTAC- RFID with increased track access charges after evaluation of the results of the cost model there are almost EUR 817 transaction costs over

the period of eight years. These are distributed on the players groups and cost blocks as follows:

Table 25: Transaction Costs of the NDTAC-RFID TAC-rise Model (in million EUR)

	One-off Costs	Annual Fixed Costs for the Operation	Process Costs	Total Costs in 8 Years
IM	114.7	148.9	32.7	296.2
RU	10.3	21.3	214.6	246.2
Lessor	2.3	5.7	86.4	94.4
Other Market Players	7.0	7.2	84.2	98.4
Consignor	2.0	5.8	73.6	81.4
Public Authorities	0.0	0.0	0.0	0.0
Total	136.4	188.9	491.5	816.8

Source: Own chart

Costs per Player

The share of the costs for the IMs is more than with the NDTAC (RFID [bonus-penalty]) and corresponds essentially with the NDTAC (RFID [bonus]). Here as well there is only a small increase in the total transaction costs which corresponds to the NDTAC (increased track access charges) even though to a higher total level.

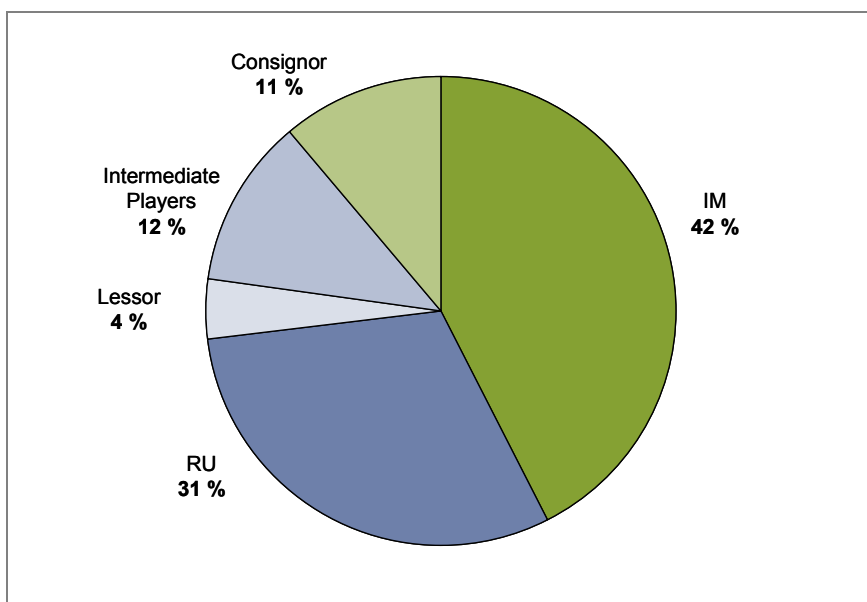


Figure 25: NDTAC-RFID TAC-rise Model: Distribution of Transaction Costs among Players

Source: Own chart, with rounded figures

Cost Distribution

And finally the division according to the type of costs is again similar to the NDTAC-RFID Bonus.

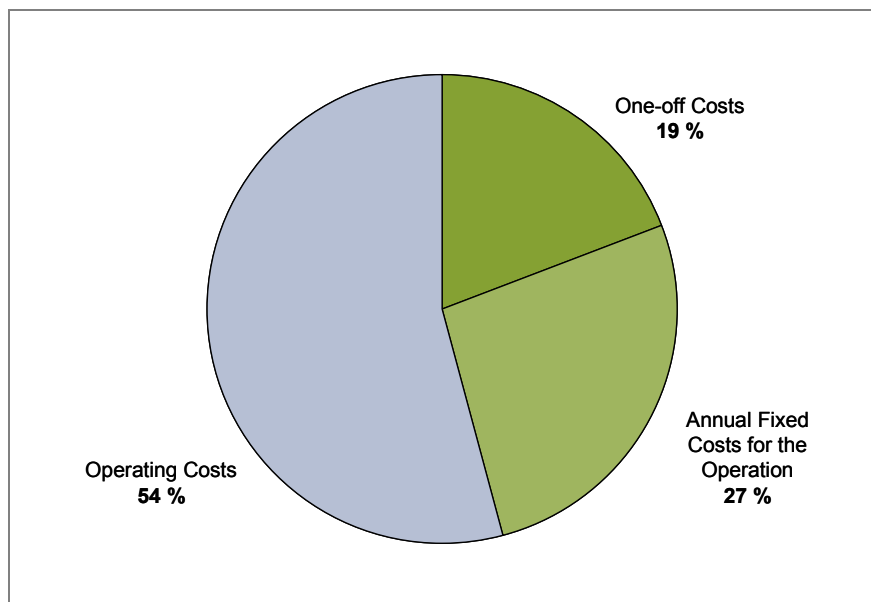


Figure 26:
NDTAC-RFID TAC-rise
Model: Transaction
Costs per Cost Category

Source: Own chart, with rounded figures

Band Widths

Consideration of the scatter shows that in this model there is a spread of about EUR 114 million within which there can be variations in the total transaction costs. The IMs make up the biggest block as they do in the other two RFID models, and here, in particular, the possible cost variations lie in the setting up of the line side recording portals.

	Total Costs in 8 Years		
	Lower Range	Cost Model	Upper Range
IM	268.3	296.2	324.2
RU	232.3	246.2	260.1
Lessor	89.3	94.4	99.5
Other Market Players	92.8	98.4	104.1
Consignor	76.9	81.4	85.8
Public Authorities	0.0	0.0	0.0
Total	759.7	816.8	873.9

Table 26:
NDTAC-RFID TAC-rise
Model: Band Width of
Transaction Costs

Source: Own chart

6.3.4 Results for Direct Funding

The results for the direct support were not divided into cost blocks because of the missing IT system. It can be assumed that almost exclusively variable quantity driver dependent processes occur, which, however, could be supported with existing IT structures. It can clearly be seen that the costs of the direct support are much less than the costs of the other models. In view of the simplicity of the system there is no need to consider the scatter and its effects can be neglected because deviations in eight years will at most be in the low six figures. Also these complete transaction costs are finite as in the ND-Bonus model since the system would probably be closed at the end of the programme period.

Table 27: Overview of the Transaction Costs of Direct Funding

	Total Cost in 8 Years
RU	1.8
Lessor	2.0
Other Market Players	0.7
Consignor	0.3
Public authorities	1.2
Total	5.9

Source: Own chart

The diagram below shows the distribution of the costs on the individual groups of players. It is not surprising that in view of the fact that the high driver function is the number of wagons the RU and lessor groups of players have to carry a high share of the cost since they hold the majority of the fleet. Also the public authorities must carry a high proportion of costs because of the testing of all wagons. Consignors, however, are only lightly loaded because of the low number of wagons that they hold. By considering an assumed number of 300 consignors with their own wagons this figure becomes more meaningful.

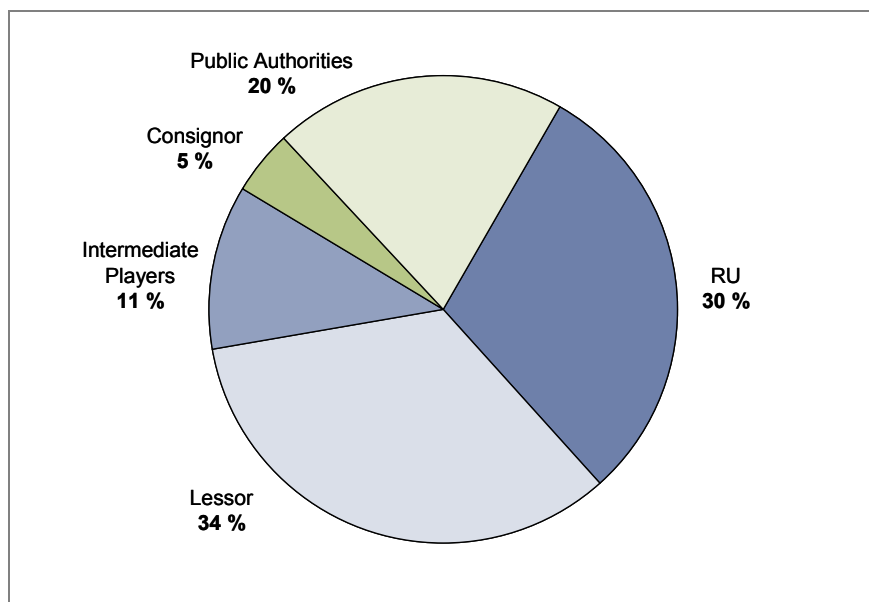


Figure 27:
Direct Funding:
Distribution of the
Transaction Costs
among Players

Source: Own chart, with rounded figures

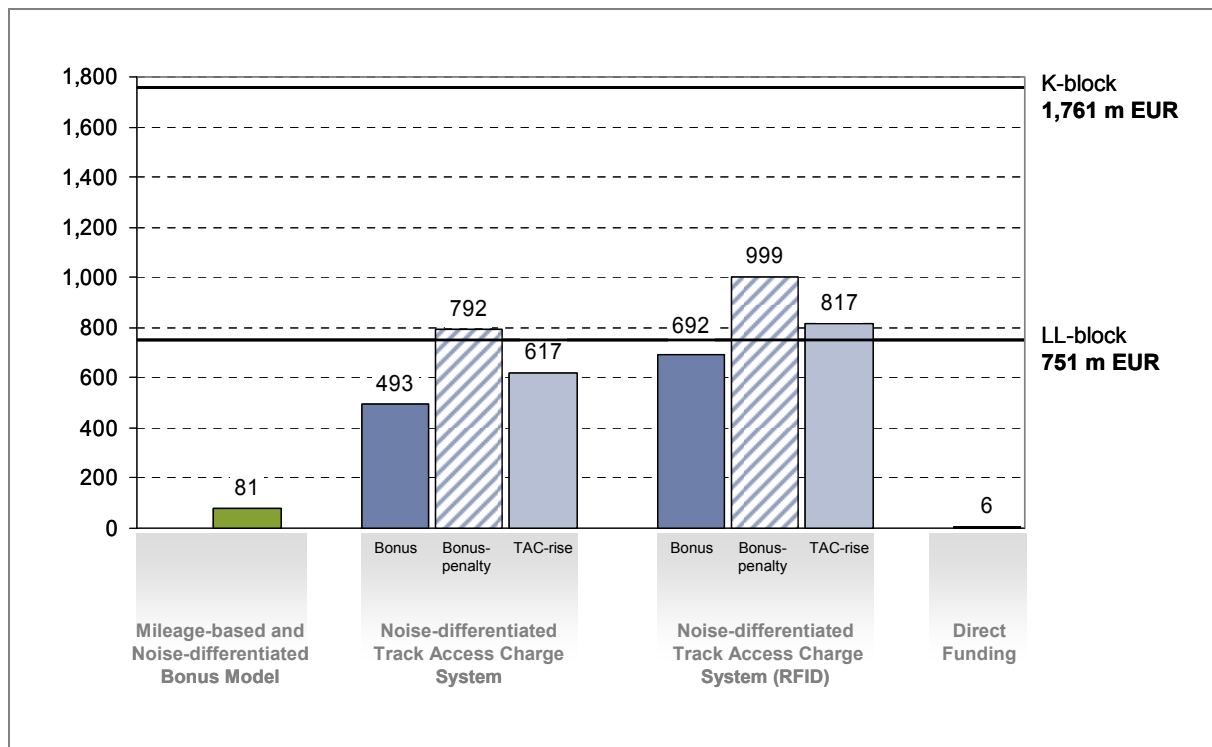
6.3.5 Model Comparison

The final diagram shows the four cost models (including the sub variants investigated) compared to one another. In addition their relationship to the retrofitting costs produced and additional operating costs, which arise from converting the wagons planned, are shown.⁷³

The significant differences between the individual models are made clear. However, it should be pointed out that the difference in costs can also be explained by the different aims of the incentive models.

⁷³ It should be pointed out that the chart for the bonus model and the direct support also shows the situation for the paid out bonuses or requirements on the wagon keepers. For all NDTACs there are additional bonuses for TSI Noise-wagon as well as the bonuses for the traffic control, that is to say here the ratio of transaction costs to retrofitting bonuses is worse than the ratio transaction costs – bonuses paid out. In addition it should be mentioned that the retrofitting costs from the pilot project 'Quiet Rhine' only allow for the retrofitting costs of four axle wagons, that is to say a differentiation of the fleet into two and four axle wagons is not included in the depiction of the total retrofitting costs.

Figure 28: Comparison of Cumulative Transaction Costs for the Four Incentive Models for 8 Years (in million EUR)



Source: Own chart on the basis of the cost calculation by KCW and data from client

7 Estimation of Transaction Costs when Implementing the Incentive Models in other European Countries

The main objective of this study was to determine the transaction costs of various incentive models that might be introduced to support the retrofitting of the freight wagon fleet that runs on the German rail network. The results of this are shown in the Chapter 6.3. In this Chapter the transaction costs of the various incentive models investigated are projected for other European countries. This cannot be done in such a detailed manner as the results calculated for Germany. The results can only be validated by means of a cost modelling exercise with same degree of detail as for Germany. For this, however, a suitably comprehensive market investigation would be necessary in all the countries considered. Therefore to simplify the analysis an approximate estimate of the transaction costs in other European countries was made on the basis of analogous conclusions, which in the investigator's opinion shows a trend of the transaction costs, which would be calculated in a more detailed investigation for these countries.

The investigation includes selected EU member States and Switzerland⁷⁴:

- Belgium;
- Bulgaria;
- Denmark;
- France;
- Italy;
- Luxemburg;
- Holland;
- Austria;
- Poland;
- Rumania;
- Sweden;

⁷⁴ There is no railway system on Malta and Cyprus. Great Britain and Ireland were excluded because of their island character. The Baltic States were also not considered. The traffic here is almost exclusively traffic to and from Russia. It is not likely that the EU would be willing to support the retrofitting of Russian freight wagons. In addition Finland, Portugal and Spain are excluded because of their broad gauge. Greece can also be excluded because of the negligible amount of traffic.

- Switzerland;
- Slovakia;
- Slovenia;
- Czech Republic; and
- Hungary.

7.1 Parameters of Comparison

The calculation of the transaction costs on the basis of an approximation requires first the identification of the important quantity drivers of the transaction costs calculated for Germany. Included in the projection are:

- Number of market players in the respective railway markets;
- Number of daily train journeys; and
- Number of freight wagons relevant to the investigation.

Other potential cost factors, which in the end only slightly affected the outcome were not included (e.g. the costs of the public authorities). Also the validity of the applied factors and quotas in the other countries were not checked, that is to say a higher or lower weighting was not considered. An indexing was likewise not part of the investigation, that is to say the assumptions on which the values are based are the cumulative transaction costs for Germany.

Number of Market Players

The market players are the relevant quantity for the determination of the one-off costs and the annual fixed costs derived from this. The determination of the players relevant to the investigation was based on the data provided by the customers of this study. Division into clusters was largely avoided since this is not necessary for an approximation. An exception was the IMs and RUs since here in general a national incumbent, similar to DR Netz AG or the DR SR in Germany was assumed. The end results were not identified for specific players. The players were merely taken as a basis for the determination of the one-off and fixed operating transaction costs.

With regard to the players level considered in the same way as in Germany a distinction was made between:

- **IMs:** The large number of active network operators who are active in Germany is far more than the number abroad. Here there is generally one large network operator and at present few small ones.

- **RUs:** The number of active RUs in Germany is also extremely high. Therefore in many countries the number of nationally active RUs is increasing – especially for those with a high proportion of international traffic.
- **Lessors:** Theoretically every lessor can operate in every European country. Moreover it can be assumed for simplicity, that the maximum number of 165 lessors is not reached in any other European country, but there is a grading depending on the size of the railway market.
- **Other market players** (intermediate players): Just like lessors, for operators the number of players is graded. The number of the so-called '2nd RUs' has, however, remained at 15.
- **Consignors:** The number of consignors who provide wagons varies from country to country. Their number was determined on the basis of an estimate depending on the size of the railway market.

Number of Daily Train Run

The train run are a significant cost magnitude for the mileage dependent incentive models, essentially the NDTAC (with and without RFID recording). This magnitude cannot be based, as in Germany, on figures of the biggest network operator as well as a plausibility check for other networks. Instead of this starting from the transport carried in Germany (in millions of tonnes) the values for the other countries are based on similar conclusions. Starting point is the rail transport traffic in the countries investigated, which is set in comparison to the values in Germany.⁷⁵

Number of Freight Wagons Considered for Retrofitting

Besides the train journeys the number of freight wagons is the second most important quantity driver for the transaction costs process. The derivation of the transaction costs in other European countries considers only the bonus relevant wagons, as well as in the case of the penalty models also the penalty relevant wagons. A further subdivision of the bonus relevant wagons as for Germany has not been done.

Relevant to the investigation are, just as for Germany, firstly wagons registered to run on their home lines and those registered abroad but allowed to run at home. This means that the totalling of wagons in all countries pro-

⁷⁵ Source: Eurostat (2011): Rail traffic – Goods carried by mode of transport. The transport volume in tonnes is more meaningful and less liable to erroneous conclusions than the often quoted traffic flow given in tonne kilometres, since there is a risk that in the interaction between transport quantity and transport distance erroneous conclusions can be drawn. The solitary reference to the transport quantity is not problematic since the assumption of equal transport quantity per train is indeed not conclusive, but in general appears plausible.

duces significantly more freight wagons than are permitted to run in Europe.⁷⁶

7.2 Methodology for Calculating the Transaction Costs

The approximate calculation of the transaction costs for the other European countries was carried out with the help of the quantity drivers described in Chapter 7.1. However it is necessary to note that this investigation is based on the fact that an essentially standard system would be introduced in all European countries.⁷⁷ All the figures calculated in this Chapter are based, therefore, on the results of the cost model for the implementation and carrying out of the incentive models in Germany.

The cost calculation was first done separately per country by cost blocks (one-off costs, fixed operating costs, variable process costs). Then a band width per cost block was implemented, in order to minimise the uncertainty of the cost calculation, which is inevitably produced from the simplified cost estimates. Next the results of the respective cost blocks were summed and a common band width per country and incentive model identified.⁷⁸ The chosen band width is ten percent up and down on the end result per country. The chosen range is consequently somewhat rougher and also broader than in the investigation for Germany, but can be justified with the simplified investigation for other countries.

One-off Costs

The one-off costs were calculated first of all player specific, corresponding to the players cited. For this the values of the respective player classes in Germany were transferred or determined on the basis of the clustering in Germany on the basis of a chosen mean. These considerations were carried out for all incentive models that depend on mileage, as here in every case one-off costs are produced. Since the basis of the investigation was essentially a standard system the costs for some players did not in many cases accrue to the full extent. On the other hand it should not be considered that in general no additional costs occur. In the approximation used for IMs and

⁷⁶ Thus for example a wagon which runs from Rotterdam to Milan needs to be recorded in Holland, Germany, Switzerland and Italy if it is quiet. For this wagon therefore it would be possible to apply for a bonus in all four countries.

⁷⁷ In view of the frequently observed non uniformity in the European area this position is extremely optimistic. The causes of this may be less to do with the European level and more to do with the national level. The following publication pleads for a standard regulation: KCW, SDG, TU Berlin (2009): 'Analyses of preconditions for the implementation and harmonisation of noise-differentiated track access charges'.

⁷⁸ It was decided not to produce individual figures because of the chosen methodology (approximation).

RUs and consignors the costs from Germany were transferred for each case in the same way. For consignors, operators and 2nd RUs only 25% of the costs of the German results were assumed in order to cover the possibility of synergies.⁷⁹ The assumptions definitely hide risks (e.g. too high figures from foreign incumbents, uncertainties about synergy effects), but can be accepted on the investigation level as sufficiently accurate. Better values can only be achieved by means of a detailed market analysis in all the countries considered, which is not subject of this investigation.

For the RFID models, in addition, the costs for the RFID – infrastructure on the basis of the accurate network lengths were calculated in comparison to the figures for Germany. Wagons and locomotives were not considered. The costs of fitting wagons and locomotives throughout Europe are comparatively small and should lie over eight years in the low two figure million range.

Annual Fixed Costs of the Operation

Like the costs in Germany, the fixed costs of the operation are derived starting from the one-off IT costs as well as expenditure for management. The transaction costs for the European countries are therefore taken from the German figures in a similar way to the one-off costs.

Process Costs

For the calculation of the process costs in other European countries the two important drivers of this cost block – daily train runs and wagons eligible to receive a bonus / pay a penalty – are the relevant input parameters. Their respective shares are first set in relation to the German results for each incentive model. Next the values were weighted according to the frequency in the country being investigated.⁸⁰

Table 28 below shows the results for seven of the eight incentive models. It was decided not to show the direct support here since a total of the transaction costs throughout Europe would be in the range of lower two figure millions euro. In view of the lack of detailed knowledge available on wagon

⁷⁹ This assumption considers necessary speech synthesizers for the software as well as possibly adjustments for country specific peculiarities, which nevertheless can occur. Incidentally, it is not excluded that the costs produced could be covered with non standard systems. At least the players must be interested to adjust their IT systems so that with them different incentive models can be introduced in different countries.

⁸⁰ This calculation using the reference figures from Germany is suitable for a simplified cost calculation, although it should be mentioned that from a method point of view this is not completely problem free for two reasons. Firstly national peculiarities are not considered, which under some circumstances can lead to cost changes. Secondly national wage rates are not considered. Both factors can be neglected for the desired degree of detail of the investigation, but should inevitably be considered as part of a detailed analysis for the individual countries. Especially for the incentive models with a high percentage of process dependent costs there can be large differences in the calculated results in cases of doubt.

keepers and wagon distribution in Europe and the individual countries, an approximate transaction costs calculation that is similar to the other seven incentive models is not possible.

The illustration shows the figures for the France, Italy, Holland, Austria and Switzerland compared to Germany. The right column shows the cumulative figures for all countries investigated (with Germany).

Table 28: Estimate of the Transaction Costs for Selected European Countries (in million EUR)

	Germany	France	Italy	Netherlands	Austria	Switzerland	Europe (Total)
ND-Bonus Model	76 - 87	35 - 43	38 - 47	39 - 48	29 - 36	39 - 47	418 - 505
NDTAC IT Bonus	464 - 523	178 - 217	170 - 208	134 - 163	167 - 204	160 - 196	2,288 - 2,811
NDTAC IT Bonus-Penalty	746 - 838	317 - 387	304 - 372	242 - 296	279 - 341	287 - 350	3,894 - 4,686
NDTAC IT Bonus-TAC-rise	581 - 654	209 - 255	196 - 240	140 - 172	212 - 259	180 - 210	2,771 - 3,425
NDTAC RFID Bonus	641 - 742	322 - 394	250 - 305	141 - 172	199 - 243	172 - 210	3,185 - 3,851
NDTAC RFID Bonus-Penalty	931 - 1.066	469 - 574	395 - 482	266 - 325	313 - 383	311 - 380	4,791 - 5,783
NDTAC RFID Bonus-TAC-rise	760 - 874	357 - 436	279 - 341	151 - 185	244 - 298	195 - 239	3,724 - 4,497

Source: Own chart

The results for the individual countries show the same trends as the figures for Germany even if slight differences between countries are obvious. This can be explained, however, by the different weighting of the individual quantity drivers. It should be explained again here that the figures, with the exception of those for Germany, were calculated on the basis of a simplified analogous procedure. National peculiarities (market structure, detailed market characteristics, etc.) have been ignored, but can actually effect the results to a greater or lesser extent. Also no conclusion is possible on the extent to which players involved in international traffic might try to harmonise their internal systems and what that finally might mean for the total transaction costs in Europe. This applies incidentally even if different systems were introduced in all European countries. In this case there would indeed be an additional cost increase, but it is not possible to say how much this might be.

8 Qualitative Assessment of the Incentive Models

A brief assessment of the individual incentive models is given below. This is not a detailed analysis but should bring out the core points of a qualitative assessment. The assessment criteria were worked out jointly with the client of this study. The following assessment was made on this basis. Incentive Models 2 and 3 were largely based on the pure bonus model for clarity and supplementary assessments made for the two further variants.

The assessment of the incentive models was done with respect to the following criteria:

- Incentive effect: Assessment of the effect of the incentive (bonuses, penalties) on the objective of the incentive (retrofitting of the wagons, possibly traffic control).
- Feasibility and practicability: Assessment of whether it is possible to decide on the feasibility by 2013 as well as a brief analysis of general retrofitting difficulties and their practical resolution.
- Market effects: Estimation of the likely effects on the rail freight market.
- Transaction costs: Assessment of the absolute transaction costs as well as sketching the quantity drivers and their influence on the effectiveness of the use of funds.

8.1 Incentive Effect

8.1.1 ND Bonus model

The retrofitting incentive (bonus) acts directly on the wagon keeper, thus the player who takes the financial risk of the retrofitting. As a result there is a comparatively high incentive effect for the achievement of the incentive target of a faster retrofitting.

The coupling of the bonus to the actual costs of the new brake blocks provides an effective incentive for the wagon keeper. For wagons with a high annual mileage there must be a minimum limitation of the incentive effect due to the upper limit of the bonus or limit of the mileage.⁸¹

A further limitation is due to the planning uncertainty for the individual players. In particular where the incentive model is only valid nationally,

⁸¹ Moreover this estimation can stand in the way of a cost development of the new brake block technologies. The statements of the industry regarding the extent to which prices will change are at the present time too inaccurate.

players with a high proportion of wagons running in international services, as in the other models, are in some cases at a disadvantage due to the difficulty of planning wagon use.⁸²

8.1.2 NDTAC-IT Models

NDTAC-IT Bonus

The most important criticism of the NDTAC is that it is an unnecessary mixture of different incentive aims: reduction of the noise by operating measures and fast retrofitting of the wagon fleet to composite brake blocks.

Both objectives do indeed have a similar result but address different players. The retrofitting incentive should go down well with the wagon keepers and in view of the fixed costs per wagon-km is not differentiable. The noise reduction in operation on the other hand depends on the people responsible for the deployment if a differentiation (route, time) is expressly requested. The traffic control objective is indeed explicitly mentioned in the recast of the European Commission, but whether this affects the deployment decisions is questionable.

If the two incentive aims are separated in the imagination, a high incentive effect is given to the retrofitting bonus in spite of the scheduling by the RU and not by the wagon keeper, provided the assumed transfer functions. Since there is no bonus upper limit here the incentive is theoretically higher than in the ND-Bonus model, which provides for a limit to the public funds.

Analogous to the ND-Bonus model all NDTACs are subject to use uncertainties of the players concerned, who have no influence on the wagon use. The assessment with respect to a pure national solution is similar.

Even the deployment bonus can theoretically work if it is passed forward as described. However, its absolute level must be above the level of the costs caused by setting up a system to protect the operating interests of the people who organise the deployment on the NDTAC. These are firstly the transaction costs, secondly, however, the relationships in the production and logistics chains which hardly any players would be ready to change.⁸³

⁸² It is reported that planning uncertainty affects the lessors more than the RUs or consignors, since the latter are more able to plan the use of their wagons.

⁸³ See further considerations in Chapter 8.2.

While a high incentive effect is assumed for the retrofitting bonus if all the process chains function, this is not even produced with the deployment bonus and there is not, therefore, sufficient incentive for the players.⁸⁴

NDTAC-IT Bonus-penalty

Retrofitting bonus and deployment bonus are supplemented in the bonus-penalty form by negative elements (penalties). There is therefore a 'push and pull' effect, that is to say a positive incentive for quiet wagons and a negative incentive on loud wagons. This can theoretically lead to a further strengthened incentive effect.⁸⁵ The financing of the system within the railway sector on the other hand reduces the incentive since with this incentive model there is no financial assistance from outside the industry. Beside the transaction costs the bonuses also have to be completely offset by means of penalties within the sector.⁸⁶

With regard to the deployment bonus the same statement applies as in the pure bonus form, that is to say the incentive effect is estimated to be broadly lower.

NDTAC-IT TAC-rise

In many parts the conclusions on the incentive effect for the pure bonus NDTAC can be applied. As a result of the refinancing of the bonuses by the sector through the increased track access charges, as well as their reimbursement, the incentive effect is considerably reduced. This effect is even stronger than in the bonus-penalty model since the financing and reimbursement, regardless of the brake status of the wagon (quiet or loud), first affects the RU and then the player who provides the wagon and it would not, therefore, be better off with quiet wagons.

8.1.3 NDTAC-RFID Models

For all three RFID models the conclusions of the equivalent models without RFID can be applied, since the reimbursement of the bonuses on the wagon keepers is identical to the simple NDTAC.

⁸⁴ Indeed there are no specific deployment bonus sums in the public discussion, however, it should be assumed that they are not critically different from the retrofitting bonuses and may even lie below them.

⁸⁵ But even this is only valid for the case that the assumed bonus calculation will actually take place.

⁸⁶ The winners are just a few players, who only have, or deploy quiet wagons. This would only concern, at least in the initial phase, at most a small number of players.

8.1.4 Direct Funding Scheme

The incentive effect of the direct support is the highest of all incentive models, since it grants the support payment to the wagon keeper before the - retrofitting, while the other models must first be financed in advance. Therefore planning uncertainties are minimised even if they are not completely avoided due to the obligation to produce certificates on minimum running times / distances.

8.2 Feasibility and Practicability

8.2.1 ND Bonus Model

The simple arrangement of the system favours its rapid introduction. Also because of the relatively simple IT standards there are few risks which would delay a technical implementation. Advantageous for the ease of implementation is, in addition, the use of existing structures (AVV, NVR). In addition the application system is based on voluntary actions, that is to say wagon keepers can after internal delays become involved later.

One negative aspect is the current not entirely satisfactory mileage transmission by some RUs which can be problematic for wagon keepers if significant mileage data is missing for them. The positive assessment of the customers with regard to an assumed improvement was contradicted by some of the people interviewed even if the authors to a large degree share the assessment of the customers in this respect.⁸⁷

The implementation of the ND-Bonus model for the time scale envisaged in the cost model from 2013 is thus definitely possible.

Moreover just the purchase of the data provision in accordance with a contract put into practice on the European level (AVV) offers the preconditions for an extension of the ND-Bonus model to a pan-European solution.

⁸⁷ Beside the improvement in the safety requirements there is also probably a market effect, that is to say RUs which habitually fail to deliver mileage data or deliver inaccurate data could in future have problems in the use of foreign wagons. Should this discussion between market players be interpreted as an obligation for the RUs to supply the mileage as specified by GCU, this would be a further pressure on the RU.

8.2.2 NDTAC-IT Models

NDTAC-IT Bonus

Compared with the ND-Bonus model this model is much more complicated. Thus, in some cases there are legal obstacles (e.g. adjustment for rail freight traffic). In addition the necessary IT and its networking between players constitute a risk. For the individual players the level of IT appears technically possible as was clear in the discussions with market players. However, the systems of the individual players must be harmonised with one another which is much more difficult to arrange. Since the incentive system cannot be voluntary because of the train recording, it is necessary for all the players to have their systems suitably modified and ready to use.

Furthermore, a major obstacle is the operating practice. Thus, there are limits imposed on the bonus differentiations and the deployment incentives. The ability to plan the operating practice by means of possible bonus payments is excluded for the majority of the traffic since the deployment decision is more influenced by other aspects.⁸⁸

In general the system in the planned form is not practical and the maintenance is much too expensive for the players. Therefore in the authors' opinion it should be expected that the upstream players will look for alternatives to the reimbursement, since these players can theoretically withdraw the reimbursement because of the system structure. The IMs and RUs do not have this possibility. The RUs should at least be able to put forward alternatives regarding the reimbursement, if they result in cost reductions. These considerations have hardened after the discussions with the market players, since they are frightened by the high costs for checking and querying and are looking for simpler solutions. In as far as the reimbursement is not legally binding; in view of the high transaction costs of the NDTAC model discussed here the players will try to find ways to reduce these costs.⁸⁹ Also the ten-

⁸⁸ Only mentioned as examples: Restrictions on available paths during the day which forces rail freight traffic to run at night, networking of the transport into logistics chains, holding of rail freight trains to make way for passenger trains, dependence on routes and departure times of the consignor. In addition the problem of occasional paths must again be mentioned here. The characteristics of these make planning in advance difficult.

⁸⁹ A market solution could lie in including the price of the bonuses in the consignor or lease price, that is to say, for example, quiet wagons would have a higher lease price, and in return the RU would retain the bonuses. This idea was also put forward by the discussion partners during the 'interviews' carried out. It is not normal in railways for all the costs that were previously put in the player's calculation one after the other to be accurately calculated. It is much more usual today for RUs to work out a transport price for their customers on the basis of a mixed calculation in which among other things proportionate track access charges, vehicle costs, traction energy, staff, etc. as well as risk surcharge and profit margin are included. The inclusion in the price of the possible bonuses would basically increase this calculation by a further component. In this case as well there might, however, be considerable additional administrative costs compared with today. It should be mentioned that even with a 'market solution' the basic weaknesses of NDTAC, e.g. lack of incentive effect, cannot be remedied. In addition the objective of such incentive models –

endency for work sharing in the net product chain should not be underestimated, by which consignors want to see themselves explicitly relieved from essential transport problems.

From a legal and a technical point of view an introduction of the incentive system by 2013 is ambitious but theoretically possible. However regardless of the technical feasibility, it is doubtful if the incentive system can be introduced on the assumptions made here.

NDTAC-IT Bonus-penalty

In general the conclusions are the same as in the previous section, but the introduction of a penalty makes the system more complicated to apply in practise. The IT costs are higher, and because of the penalty recording are considerably more subject to the promoter, which places even more demands on the functioning of the IT. The greater the complexity the greater the risk that it cannot be fully introduced. Either the high calculated transaction costs are incurred or the players will look for an alternative solution to the reimbursement. Due to the higher complexity caused by the penalty imposition a market solution will produce corresponding higher resulting costs than in the pure bonus model.

NDTAC-IT TAC-rise

The previous conclusions are also appropriate to the NDTAC with increased track access charges. The accurate invoicing of the increased track access charges on the wagon provider is likewise only the second best solution after the inclusion of the price increase or, if necessary, also price rises carried just by the RU.⁹⁰

8.2.3 NDTAC-RFID Models

The conclusions on the introduction in respect of the settlement of the incentive (bonuses-penalties) for the NDTAC apply in general also to the RFID variants. Therefore, reference is made to the previous statements for the NDTACs.

With regard to the feasibility there is however the additional obstacle of the lineside and vehicle technical equipment for RFID supported models. The latter is comparatively simple since for instance standing times can be used to fit the wagon with RFID. The equipment of the line is much more complicated

incentivisation to put a specific wagon in a specific train – would be circumvented, which is why this approach was not pursued in the previous study.

⁹⁰ In this case there is no other situation available as with other increases in track access charges. Finally the market power of the individual players decides to what extent this type of price increases can be passed on by the RU or not.

since thousands of portals would have to be set up which would take several years.⁹¹ In addition a test operation would be necessary for the system in order to resolve any problems before the installation. The system could not be introduced before 2015 even if an announcement was made quickly, and probably it would take longer.⁹² There is also uncertainty about the charging for foreign wagons which do not have any RFID. This can be neglected in a pure bonus model, but is problematical in a penalty model, since a considerably higher cost would be produced for manual recording.

8.2.4 Direct Funding Scheme

Since direct support is the simplest form without special requirements for IT - its introduction by 2013 is definitely possible. It is the optimum solution from the players point of view and could be introduced by all players without delay.⁹³

8.3 Market Effects

8.3.1 ND Bonus Model

Because of the low overall transaction costs distributed among the players no market effects are expected in the sense of intermodal switching. Possible price increases for consignors will at most be small.

The financing of the bonuses by the public authorities would have a positive effect on the sector, that is to say at worst there will be charges due to the pre-financing of the retrofitting.⁹⁴

⁹¹ Important reason for this is the necessary line possession in order to safely install the portals. This would incidentally give rise to opportunity costs resulting from the capacity reduction.

⁹² It is doubtful whether such a system is really still necessary since some of the wagons may already be fitted or will be replaced by new wagons. Also a significantly later starting date stands in the way of the political wish for quick noise reduction.

⁹³ It appears, however, equally clear that the public has strong reservations about direct support and this applies in particular to the politicians who take the decisions. In spite of its undisputed advantages and introduction in Switzerland, its introduction in Germany is therefore very unlikely.

⁹⁴ Even this problem can, for example, be solved by loans or securities from the Kreditanstalt für Wiederaufbau (KfW) [KfW Banking Group], as, for example, suggested by Land Rheinland-Pfalz for its similar incentive model.

8.3.2 NDTAC-IT Models

NDTAC-IT Bonus

It is also true here that as the public authorities would be taking over the bonus payments a large part of the costs do not have to be borne by the rail sector. This applies naturally not for the high transaction costs, which the rail sector must pay itself in any case. This means, in our opinion, that there will be a general worsening of the intermodal market position of the railway sector.⁹⁵

NDTAC-IT Bonus-penalty

Beside the even higher transaction costs in comparison to the NDTAC (bonus) the sector itself must pay the penalties from the bonus payments. That this would happen without an even more severe intermodal disadvantage of rail is most unlikely. Therefore, in highly contested markets the competitive position of the railway would be endangered. Since the loading is unevenly distributed, and especially affects players who operate loud wagons, these players are somewhat more worried by the market rejection than for instance players whose wagon fleet is more modern.

NDTAC-IT TAC-rise)

The effects on the rail freight market are largely similar to those in the NDTAC in which the bonus and penalty are recorded. If the reimbursement is as assumed in the investigation all wagon providing players will be similarly charged, regardless of how large their ratio of quiet and loud wagon is.

8.3.3 NDTAC-RFID Models

Essentially the statements for the NDTAC apply, that is to say even with the RFID recording there will be a worsening competitive position of the railway sector, in particular if in the Incentive Models 3.2 and 3.3, the sector has to carry the costs of the retrofitting itself.

A further potential effect should be ascribed to the operation of the RFID portals. If an external supplier were to take this over, this operation has to be financed somehow. If the recording is organised by one or more IMs this can probably be put onto the track access charges.⁹⁶

⁹⁵ This can in some cases have different effects. The principle applies that where rail is already in a weak position it will deteriorate further.

⁹⁶ A legal test is necessary for this in order to clear the question of whether the operation of such a recording system by network operators as part of the track access charge can be invoiced to the RUs. If this is acceptable an additional charge will be imposed on railway freight traffic.

8.3.4 Direct Funding Scheme

If the direct support scheme is implemented there are not expected to be any negative effects on the competitive position of the railway sector.

8.4 Transaction Costs

8.4.1 ND Bonus Model

- The mileage and noise differentiated bonus model has the smallest transaction costs of all mileage-run based incentive systems. Since the biggest part of the costs are wagon based the costs arise only if a wagon is entitled to a bonus. The use of funds for bonuses is very effective in relation to the transaction costs.

8.4.2 NDTAC-IT Models

NDTAC-IT Bonus

- The cumulative transaction costs in the pure bonus variant are at least six times those of the ND-Bonus model. In addition a higher share of the costs is train based, that is to say these costs also accrue when no or only a few wagons entitled to a bonus run in the train.
- Provided the model continues after the eight year period specified, the fixed operating costs and process dependent costs continue to accrue. Since there are hardly any benefits, the transaction costs also become increasingly unnecessary. This does not apply for traffic control where costs and benefits, in general, are not in a suitable relation to one another.

NDTAC-IT Bonus-penalty

- As far as the transaction costs are concerned the bonus-penalty model is still about EUR 300 million dearer than the pure bonus variant. The disadvantages of the pure bonus model described above apply here as well. Indeed the wagon basis remains the main cost driver, but this does not save the effectiveness of the system.

NDTAC-IT TAC-rise

- Reference is made to the statements for the NDTAC (bonus).

8.4.3 NDTAC-RFID Models

NDTAC-RFID Bonus

The bonus model in the RFID variant is almost EUR 200 million more expensive than without RFID. This is mainly due to the high additional costs for the Infrastructure Managers which are not, in general, included in the incentive system. This means that the money put in is not very effective at achieving the objective (the reduction of noise).

In addition there is in all RFID models a cost uncertainty, as happens in many big projects, because the preliminary cost estimates in the end turn out to be optimistic. This uncertainty is due, in our opinion, to the requirements connected with the RFID recording.⁹⁷

In addition the estimation of all NDTACs on RFID basis is in many parts identical with the NDTACs without RFID.

NDTAC-RFID Bonus-penalty

The implementation of the RFID-NDTAC with bonus-penalty system would be extremely expensive as according to the calculation it would cost about EUR one billion. These high transaction costs are particularly ineffective, since they exceed the retrofitting costs (LL blocks, including operating costs) even with the lowest band width assumption.

NDTAC-RFID TAC-rise

Reference is made to the statements for the NDTAC (RFID [bonus]). Just as in the bonus-penalty variant of the RFID-NDTAC the costs for the retrofitting were exceeded by the transaction costs in all cases.

8.4.4 Direct Funding Scheme

The direct Funding system would give rise to by far the lowest transaction costs of the incentive models investigated here. Due to the wagon procurement the funds are effectively used, however with a rather lower effect than in the case of the ND-Bonus model, for instance, since the direct mileage is missing⁹⁸.

⁹⁷ In addition IT adjustments need to be made in all NDTAC systems, however these are divided among many players, so the IT costs per player are in this respect reasonable so exorbitant cost increases are not to be expected. This is different with RFID since one individual player must implement a big technical solution.

⁹⁸ The question of how effective are the funds put in, depends to a large extent on how high is the mileage. Indeed while the rail freight business would become much quieter with a complete retrofitting if it is a question of a class of wagons where the distance travelled lies

8.5 Summary

In the following overview the qualitative assessments outlined above are shown for the individual incentive models.

Table 29: Qualitative Assessment of the Incentive Models Investigated

	ND Bonus Model	NDTAC-IT Bonus Model	NDTAC-IT Bonus-penalty Model	NDTAC-IT TAC-rise Model	NDTAC-RFID Bonus Model	NDTAC-RFID Bonus-penalty Model	NDTAC-RFID TAC-rise Model	Direct Funding Scheme
Incentive Effect	very good	medium	medium	medium	good	very good	good	very good
Feasibility/Practicability	very good	medium	very poor	poor	poor	very poor	very poor	very good
Negative Impact on Rail Freight Market	very poor	medium	very high	very high	medium	very high	very high	very poor
Level of Transaction Costs Imposed	very effective	In part effective	ineffective	In part effective	very ineffective	very ineffective	very ineffective	effective

Source: Own chart

Starting from the transaction costs and the simplified assessment of the incentive models the ND-Bonus model is best suited to achieve the objectives of noise reduction as a result of a quick retrofitting of freight wagons to quiet brake block types. Unlike the NDTAC a conscious finiteness of the incentive model is specified in order to provide stringent and fast achievement of objectives without market distortions.

There are further points of development for all the incentive models investigated in order to optimise their working, effectiveness and transaction costs. In particular all incentive models allow combined financing from the public authorities and the railway sector in order to be able to take suitable account of the budgetary policy requirements of the public authorities. How this will actually turn out depends on further investigations and discussions with the players concerned.

below the resulting costs (which depend on the mileage), the funds would, in our opinion, be less effectively used.

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