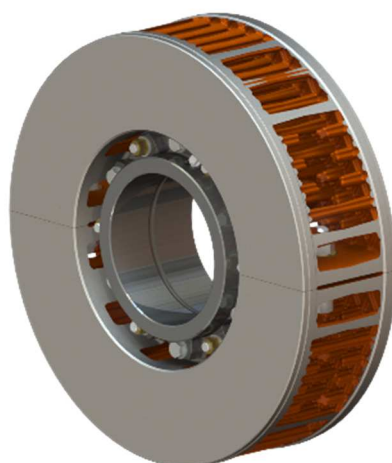


Project FUTURA



WORK PACKAGE 5 (WP5)
Validation of business model

PROJECT DELIVERABLE 5.1
REPORT ON IN-DEPTH MARKET RESEARCH IN
THE FIELD OF RFT



FUTUre RAil freight transport: cost-effective, safe, quiet and green! – FUTURA



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INDEX OF ABBREVIATIONS

ERA	European Railway Agency
DRFB	Divided Rail Freight Brake Disc
UIC	International Union of Railways
RFT	Rail freight transport
TSI	Technical Specifications for Interoperability
EU	European Union
LCC	Life Cycle Cost
OEM	Original Equipment Manufacturer
R&D	Research and Development
EN	European standards for products and services by European Committee for Standardization
IRS	International Railway Standard
ECM	Entites in Charge of Maintenance

1 INTRODUCTION

1.1 Introduction of the FUTURA project

The main objective of the FUTURA project is to improve the quality and safety of life of over 55 million EU citizens who live or work near train tracks, and prepare our ambitious, close to market technical solution – Divided, axle mounted Rail Freight Brake Disc (further referred to as DRFB disc) for commercialization, as this is a world novelty in the field of braking systems in rail freight transport (further referred to as RFT). With its innovative solution, FUTURA project will considerably influence the following 3 key elements:

- 1) safety and security,
- 2) health and environment and
- 3) cost-effectiveness in the RFT.

Noise, caused by freight trains, is the main reason for health problems of millions of people who live or work near train tracks. The social cost of rail traffic noise in the EU is estimated to be at least 2.4 billion € per year and this takes into account only effects, related to noise levels above 55 dB. Today there are three possible competitive solutions for noise decrease, of which meet the prescribed levels:

- **thread brakes (K-block)**, that use the same braking principle as cast-iron brake block, while still roughening the wheel surface, however to a smaller extent than cast-iron blocks,
- **Compact brake system**; It is fitted with a welded H-shaped frame with no end sills. The frame is made of a box type member and two closed box type longitudinal beams. The bolster is supported on bottom strips of longitudinal beams and on their internal webs, and the structure is welded. Compact brake offer space and weight advantages as well as less installation and maintenance work, depending on the manufacturer. But this brake system also damage the wheel surface and from this reason increase the maintenance cost of re-profiling of wheel and changes of wheel.

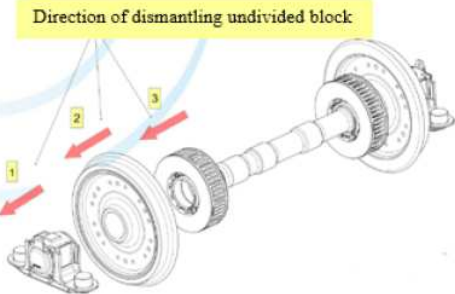

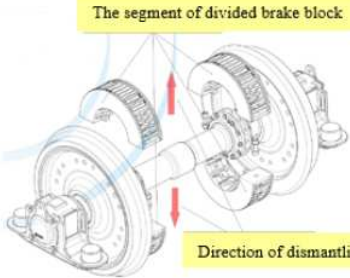
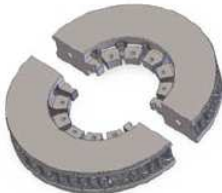
- **disc brakes (non-divided version)**, is the only solution, accepted in long-term for RFT of the future; where the brake disc is installed independently of the wheels and not causing wheel roughness. Disc brakes are, compared to K-block brakes, used to a smaller extent due to cost-ineffectiveness (only around 10% of all freight wagons). But these have substantial advantages before K-blocks: better reliability in all weather conditions, better heat dissipation and a shorter braking distance.

Today, the new freight wagons are mostly equipped with inferior K-block brakes due to cost-effectiveness despite longer braking distances and higher noise and vibration levels. K-block braking system is cheaper than the disc braking system system and compact braking system as well. Disc brakes can mostly be found only on wagons that cover over 100,000 km per annum, which in practice touches only those that carry containers and trucks. Disc brakes are also found on wagons that must cover large height differences and therefore need to brake more often and must be more reliable.

Commercialization of DRFB discs with a lower LCC than the K-Block brakes will give no more reasons to freight wagons to continue using the inferior K-Block brakes.

Today Kavis is one of 2 leading producers of brake discs for freight trains (state-of-the-art product) in the EU (the other one is Knorr-Bremse AG). After the end of action, when DRFB hits the market, the consortium will be the only provider of this type of divided brake discs for freight in the world.

Table 1: Comparison of DRFB disc with current state-of-the-art.

State of the art: Brake disc – non-divided	Our Solution, beyond state of the art: DRFB disc - divided
<ul style="list-style-type: none"> • Brake crown is composed of one piece. • More cost-ineffective (+24%) due to high maintenance costs – if replaced, the whole axle needs to be dismantled,  <ul style="list-style-type: none"> • Leading producers: KOVIS d.o.o., Knorr-Bremse AG. 	<p>INNOVATION POTENTIAL of our solution:</p> <ul style="list-style-type: none"> • The crown of DRFB disc is made of two parts, bolted together with self-developed bolts, • There is no need to dismantle the axle and other mechanical parts (bearings, wheels, hubs); one only needs to replace the brake crown, which enables a considerably easier and cheaper assembly/dismantling and influences the decrease of LCC,  <ul style="list-style-type: none"> • 21% less weight, 11% better efficiency and longer life-cycle, 10-15 dB lower noise emissions. • It will offer much lower LCC than non-divided brake disc (-24%) and even lower LCC than K-block (-13%). • The consortium will be the only producer worldwide. 

The biggest problem of RFT in the area of brakes is that the current state-of-the-art brake system (non-divided brake disc), even though thought of as a superior solution, is not often used in practice, because it is considered too expensive. Our ambitious idea will solve this problem. DRFB disc is technologically beyond state-of-the-art and it is cost-effective. It will solve the presented challenges in the area of **safety and security** (too many accidents of freight trains at level crossings, accidents while transporting dangerous goods, increased safety of RFT at higher velocities (120 km/h and above, decrease of vibrations), **health and environment** (too high noise level, large amplitudes and unfavorable vibration frequencies, emissions of dangerous freight into the environment) and **cost-effectiveness** (too high LCC of non-divided brake discs, lack of weight at freight compositions due to using less effective brake systems and too small volumes of freight, transported via rail).

For effective market take-up, the DRFB disc must be **compliant with UIC** (International Union of Railways) **standards** which will be achieved within UIC testing in a certified laboratory. A detailed business model has been developed that defines the sales model of DRFB disc more specifically. During the action, the business model have been checked and will be validated in next stage; if

needed, also refined to the actual situation for a successful commercialization at all planned markets and with all key customers.

Type of market target is niche market. DRFB discs set trends in the area of brake systems in RFT. The target market is specific and it includes producers, owners, and service and maintenance workshops of rail freight wagons. Due to a very strict environment legislation and promotion of freight transfer from roads to rail, the field of rail freight rolling vehicles and their parts represents a large potential.

Market size: Total available market size for freight wagons is around 12 billion € per year. Top 3 regions with 87% of the total transport performance are concentrated in China, USA and Russia (Figure 1).

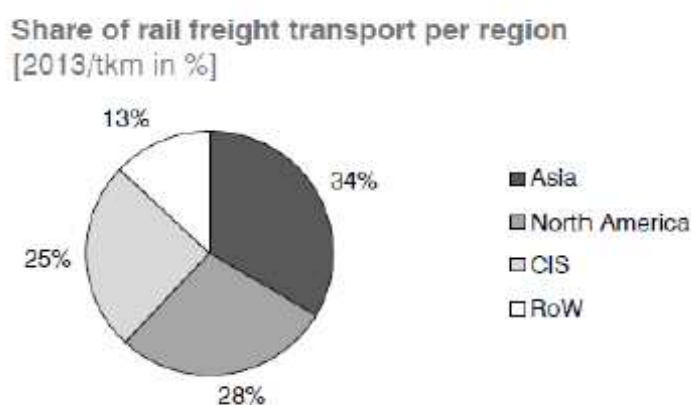


Figure 1: Share of RFT/region¹

In the EU, the total market includes some 500,000 freight wagons (EU transport in figures, Statistical pocketbook 2014), in the world, this number exceeds 1 million. It is estimated that we will have to equip more than 350,000 wagons with DRFB discs (2/3 of the wagons are owned by state railways, 1/3 of wagons are in private ownership), which is a large potential for sales of a new product in the amount of 1.58 billion €. In accordance with the market research of SCI Verkehr GmbH, good perspectives are planned for worldwide RFT: growth expected in every market region (Figure 2).

¹SCI Verkehr GmbH. 2014.

Furthermore, sustainable development of bulk goods traffic and dynamic growth of intermodal transport is foreseen as well.

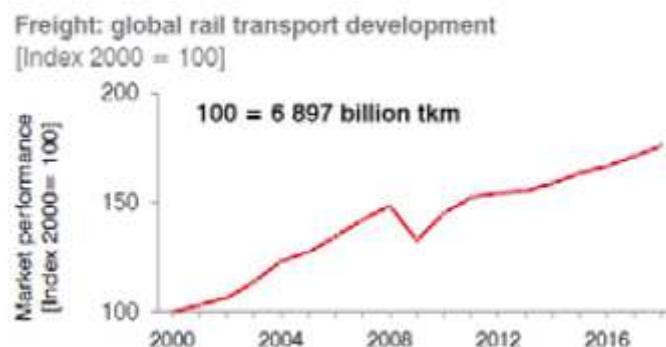


Figure 2: Trends in RFT²

Main markets (China, USA and Russia) are expected to accelerate growth in the short-term. Highest growth rates are expected in Asia, Africa, Middle East, and South/Central America (SCI Verkehr GmbH, 2014).

A large potential market is the whole EU market, where due to the EU directive (Directive 2012/34/EU) one must decrease noise of freight wagons by the year 2025 to between 8-10 dB (in Germany, this goal is that by 2020 there will be at least 80% of all wagons classified as "silent or nonnoise making", which stands for 180,000 wagons). The fastest growing global markets with a large sales potential for DRFB discs are: EU, USA, Russia, China, India, Canada and Brasil. But for the remain potential markets outside EU need to take in consideration, that first need to be change the transport policy, regulation and all other authorities (AAR, UIC, ...).

1.2 Concept

The biggest problem of RFT in the area of brakes is that the current state-of-the-art brake system (non-divided brake disc, where the brake crown is made of one piece), even though thought of as a superior solution, is not often used in practice, because it is considered too expensive. Our ambitious idea will solve this problem. DRFB disc is technologically beyond state-of-the-art and it is

² SCI Verkehr GmbH. 2014.

cost-effective. It will solve the presented challenges in the area of safety and security as shown in Figure 3 (too many accidents of freight trains at level crossings, accidents while transporting dangerous goods, increased safety of RFT at higher velocities (120 km/h and above, decrease of vibrations), health and environment (too high noise level, large amplitudes and unfavorable vibration frequencies, emissions of dangerous freight into the environment) and cost-effectiveness (too high LCC of non-divided brake discs, lack of weight at freight compositions due to using less effective brake systems and too small volumes of freight, transported via rail).

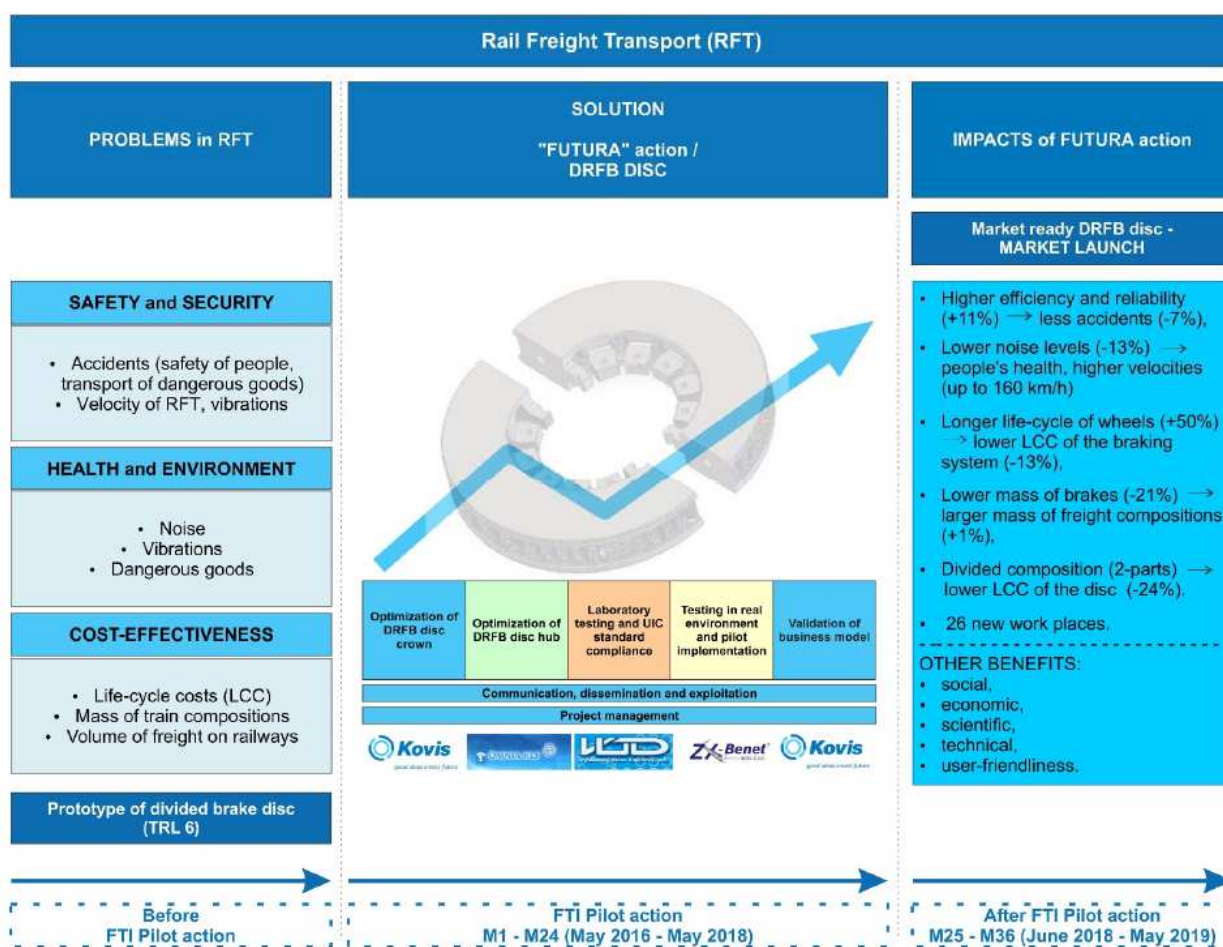


Figure 3: The concept of FUTURA action

The FUTURA action will finalize and confirm the prototype of DRFB disc, including the pilot production of DRFB disc up to the level of TRL 9 when the disc is prepared for serial production and commercialization. Through this, planned effects of the action will be reached – better safety, increased efficiency (+11%), lower mass (-21%), lower level of noise (-10-15 dB), longer life-cycle (+50%) and higher cost-effectiveness of rail freight wagons.

Five key steps for pilot implementation of DRFB disc for placing it on the market are classified into the following 5 content sections (see Figure 3): "Optimization of DRFB disc crown", "Optimization of DRFB disc hub", "Laboratory testing and UIC standard compliance", "Testing in real environment and pilot implementation" and "Validation of business model".

For effective market take-up, the DRFB disc must be compliant with UIC (International Union of Railways) standards which will be achieved within UIC testing in a certified laboratory. A detailed business model has been developed that defines the sales model of DRFB disc more specifically.

FUTURA project presents a strong EU-added value. Through a reduced weight of DRFB discs alone (-21%), the RFT industry in the EU will be able to transport 2,100 tons of freight more within a life-cycle of the wagon (or 336 million tonnes in case DRFB discs will be installed in 20% of all wagons), which stands for a saving of 2 billion € on annual basis. The action's results will be directly usable in all EU Member States and other countries worldwide.

2 METHODOLOGICAL APPROACH

2.1 Application of research methods and approach

In-depth analysis of new markets the world market has been divided into seven world market regions: Europe, North America, South America, North Africa, Asia, Saudi Arabia and the middle east and Australia.

Overview of the current legislation and UIC standard compliance and adjusting the prototype documentation with actual legal and standard compliance requirements was implemented. Collecting data on requirements of each market through personal contacts, rail fair visits and prototype presentation. Checking the suitability of suggested sales channels; in-depth analysis of sales and distribution conditions, distribution channels, and calculation of the product price. The information was collected in time from November 2016 till August 2017. The study is supported by qualitative and quantitative analysis based on statistical data.

2.2 In-depth analysis through face to face interview

To enable constant growth of company KOVIS is necessary to introduce always new competitive products into the market. We understand that product launches help increasing sales revenue and expanding the customer base. To be successful and attract the customer attention, Kovic new product must fulfill their needs and maintain the brand promise. That we will get this Feedback from customer, we decided to use the additional research method face to face interview (Annex 1) with new, potential and existing customer.

With this interviews we got first impression and Feedback about our development process of new generation of DRFB discs. By face to face interviews we used standardized questions according the Kovic template Face to Face interview. This method we choose, because give us more additional advantages as follows:

- Personal contact, motivation source.
- We can help the participant to understand the question.
- We can use different techniques: open- ended question, under questions, visual aids, answers scales, etc.

- Convenient for the participant, especially in their company.
- Use additional questions to collect detailed information.
- Body language and reaction of both sides.

The 1st, 2nd and 3rd prototype of DRFB disc and test results were presented through the face to face dialogues and exhibited on three international fairs dealing with railway industry.

Till the end of May 2017, Kovis, ZX-Benet and Omnia KLF conducted together 38 face to face interviews.

The customers with whom were made the face to face interviews are from the freight railway industry and are connected with braking system in some way. Presented was positive influence of the FUTURA project on safety in rail transport, influence on health, environment, and quality of life for those who live and work near train tracks. At the face to face interview was introduced and made the overview of the possibilities of cooperation in the field of divided brake discs for freight program.

During the meeting, to the customers were presented the specialties, advantages and the potential of the use of disc. Feedback from the market are positive.



Figure 4: Face to face interview with DAKO

Table 2: Face to face dialogues – Kovis

No.	When	What	To whom	Who	Where	Customer
1st prototype of DRFB - KOVIS						
1	24.3.2016	Face to face dialog - PN20160072	Presentation of 1st prototype to the MIBA FRICTION FACTORY	Matjaž Volk	Austria	Friction materials
2	4.4.2016	Face to face dialog - PN20160086	Presentation of 1st prototype to the Ferroviaria Torino	Matjaž Volk	Italy	ITALY'S SHOWCASE FOR RAILWAY TECHNOLOGY, PRODUCTS AND SYSTEMS
3	19.4.2016	Face to face dialog - PN20160097	Presentation of 1st prototype to the KES, HANNING&KAHL, BTDE SIEGEN	Matjaž Volk	Germany	KES has long-standing experience in the field of development and production of micro-electronic controls and components for railed vehicles.
4	22.4.2016	Face to face dialog - PN20160098	Presentation of 1st prototype to the OEGB	Matjaž Volk	Austria	Austrian Federal Railways
6	3.5.2016	Face to face dialog - PN20160107	Presentation of 1st prototype to the DAKO, TRINITES	Matjaž Volk	Czech Republic	DAKO BRAKE SYSTEMS DAKO-CZ is a leading manufacturer of pneumatic, electro mechanic and hydraulic brake for rail vehicles with 200 year proven track record.
7	9.5.2016	Face to face dialog - PN20160115	Presentation of 1st prototype to the WIENER LINIEN	Matjaž Volk, Alen Šinko	Austria	Wiener Linien (Vienna Lines) are the company running the largest part of the public transit network in the city of Vienna, Austria
8	16.5.2016	Face to face dialog - PN20160116, 20160117	Presentation of 1st prototype to the TCDD ISTAMBUL, YD	Matjaž Volk	Turkey	Turkish State Railways
9	22.5.2016	Face to face dialog - PN20160125	Presentation of 1st prototype to the CAF, STADLER VOSSLOH, RENFE, METRO, TALGO	Matjaž Volk	Spain	CAF is a leader of the railway industry offering one of the most comprehensive and flexible arrays of products in railway related markets, such as rolling stock, components, infrastructure, signalling and services (maintenance, refurbishing and financial services) Vossloh is a leading global provider in the rail infrastructure industry. Renfe is a state-owned passenger and freight rail transport operator overseen by the Ministerio de Fomento. Talgo is leading company in the Spanish railway sector.
10	22.6.2016	Face to face dialog - PN20160175	Presentation of 1st prototype on VPI conference, Germany	Andrej Hočevar	Germany	
11	19.7.2016	Face to face dialog - PN20160214	Presentation of 1st prototype to the BTDE, SIEMENS	Matjaž Volk	Austria	Siemens as a single-source supplier and system integrator, Siemens combines all the expertise necessary for sustainable solutions in all areas of rail transportation.
12	19.7.2016	Face to face dialog - PN20160215	Presentation of 1st prototype to the VBK Verkehrsbetriebe Karlsruhe GmbH and Darmstadt Verkehrsbetrieb	Andrej Hočevar	Germany	Conference for railway industry
13	31.8.2016	Face to face dialog - PN20160249	2016-08-31; Presentation of 1st prototype to the Škoda Transportation	Mitja Črpič	Czech Republic	Producer of Rail Transport
14	2.11.2016	Face to face dialog - PN20160343	2016-11-02; Presentation of 1st prototype to the Trenitalia	Andrej Hočevar	Italy	Trenitalia is the primary train operator in Italy.
15	9.11.2016	Face to face dialog - PN 20160349, 20160348	2016-11-09; Presentation of 1st prototype to the Bonatrans	Mitja Črpič, Šinko Alen	Czech Republic	Bonatrans is producer of wheelset for railway industry.
16	16.11.2016	Face to face dialog - PN20160352	2016-11-16; Presentation of 1st prototype to the ZNTK Opole	Mitja Črpič	Poland	ZNTK Opole offer services in range of repairs of carriages as well as production and repairs of freight cars.

No.	When	What	To whom	Who	Where	Customer
2nd prototype of DRFB - KOVIS						
17	4.12.2016	Face to face dialog - PN20160372	2016-12-04; Presentation of 2nd prototype to the DB, Gmeinder, Kessel, BT, ETS, H&K	Andrej Hočevar	Germany	DB AG is a German railway company. Gmeinder is dealing with development, manufacture and maintenance of locomotives.
18	6.12.2016	Face to face dialog - PN20160374	2016-12-06; Presentation of 2nd prototype to the Smart Corporation a.s., Trinites, Wagony Swidnica..	Mitja Črpič	Slovakia	Smart Corporation a.s.
					Czech Republic	Trinites is producer for rolling stock industry.
					Poland	Swidnica wagons specializing in the manufacture and repair of railway wagons.
19	7.12.2016	Face to face dialog - PN20160377, 20160375	2016-12-07 Presentation of 2nd prototype	Alen Šinko, Smolej Ivan	Czech Republic, Slovakia	Česke drahy (ČD) is the main railway operator in CZ providing regional and long-distance services.
20	8.12.2016	Face to face dialog - PN20160395	Presentation of 2nd prototype	Alen Šinko	Turkey, Greece	The Turkish State Railways operate freight trains on all of their lines.
21	9.12.2016	Face to face dialog - PN20170009, PN20170010	Presentation of 2nd prototype	Alen Šinko, Smolej Ivan	Austria	Siemens Transportation.
22	11.12.2016	Face to face dialog - PN20160384	2016-12-11; Presentation of 2nd prototype to the Kurimoto, Dusseldorf	Mitja Črpič	Germany	Kurimoto has been widely supplying brake discs used in various rolling stocks.
23	15.12.2016	Face to face dialog - PN20160385, 20160386	2016-12-15; Presentation of 2nd prototype to the S.C. Astra Rail Industries	Mitja Črpič, Rožman Marko	Romania	Astra Rail Industries, a company steeped in tradition, is an innovative developer and manufacturer of cutting-edge freight wagons and bogies.
24	6.2.2017	Face to face dialog - PN20170061	2017-02-06; Presentation of 2nd prototype to the Bonatrans, Wagony Swidnica, Novexim, Pesa Bydgoszcz, Dako	Mitja Črpič	Czech Republic	Bonatrans is producer of wheelset for railway industry.
						DAKO BRAKE SYSTEMS DAKO-CZ is a leading manufacturer of pneumatic, electro mechanic and hydraulic brake for rail vehicles with 200 year proven track record.
						PESA is the largest Polish manufacturer of nearly all types of railway vehicles - electric and diesel multiple units, railway engines and tram cars.
25	11.2.2017	Face to face dialog - PN20170049	2017-02-11; Presentation of 2nd prototype in Mexico	Mitja Črpič	Mexico	Ferracarril Mexicano, S.A. de C.V. operate the largest railroad network in Mexico, with more than 10,000 km of track covering the major industrial and commercial zones in the country.
						Kansas City Southern de Mexico (KCSM) is a company dedicated to freight transportation using rail in the northeastern part of Mexico
						Ferrosur is a railroad that serves the south-eastern regions of Mexico.
26	16.2.2017	Face to face dialog - PN201700	2017-02-16; Presentation of 2nd prototype to the VTG and BVV	Andrej Hočevar	Germany	VTG AG is a publicly traded and leading international wagon hire and rail logistic company with around 80,000 railcars on its books at the current time - the biggest privately owned fleet in Europe.
						BVV manufacture a wide variety of wheelsets for all types of railway vehicles and applications for domestic and foreign rail companies as well as manufacturers of railway vehicles.
27	23.2.2017	Face to face dialog - PN20170066	2017-02-23; Presentation of 2nd prototype to the DAKO	Ivan Smolej	Czech Republic	DAKO BRAKE SYSTEMS DAKO-CZ is a leading manufacturer of pneumatic, electro mechanic and hydraulic brake for rail vehicles with 200 year proven track record.
28	26.2.2017	Face to face dialog - PN20170068	2017-02-26; Presentation of 2nd prototype to the R&T, Stadler Valencia, Renfe, CAF Beasain	Mitja Črpič	Spain	CAF is a leader of the railway industry offering one of the most comprehensive and flexible arrays of products in railway related markets, such as rolling stock, components, infrastructure, signalling and services (maintenance, refurbishing and financial services)
						Vossloh is a leading global provider in the rail infrastructure industry.
						Renfe is a state-owned passenger and freight rail transport operator overseen by the Ministerio de Fomento.
29	29.3.2017	Face to face dialog - PN 20170097, 20170098	2017-03-29; Presentation of the 2nd prototype to the SALZBURG AG	Marko Rožman, David Deržič	Austria	SALZBURG AG
30	12.4.2017	Face to face dialog - PN20170124	2017-04-12; Presentation of 2nd prototype to the Trinites, Trade Dam, Tatravagonka	Mitja Črpič	Slovakia	Trinites is producer for rolling stock industry.
						Trade Dam Tatravagonka - product capacities is more than 100 different design types of wagons.
31	19.4.2017	Face to face dialog - PN 20170134	2017-04-19; Presentation of the 2nd prototype to the Tradegal, Metro de Porto	Mitja Črpič	Portugal	Tradegal is specialising in representing worldwide products within the Portuguese and Spanish market place.
						Metro de Porto is part of the public transport (mass transit) system of Porto.
3rd prototype of DRFB - KOVIS						
32	25.4.2017	Face to face dialog - PN 20170140	2017-04-25; Presentation of 3rd prototype to the DSB, Copenhagen, // KPH, PPI-Astra Trading,	Mitja Črpič	Denmark	DSB is an independent public corporation owned by the Danish Ministry of Transport KPH, PPI-Astra Trading
33	3.5.2017	Face to face dialog - PN 20170142, 20170143	2017-05-03; Presentation of 3rd prototype to the ČD, NDT, Wagony Swidnica	Mitja Črpič, David Deržič	CZ	Česke drahy (ČD) is the main railway operator in CZ providing regional and long-distance services. Wagony Swidnica
34	22.5.2017	Face to face dialog - PN 20170172	2017-05-22; Presentation of 3rd prototype to the Pääkaupunkiseudun Junakalusto Oy	Mitja Črpič	Finland	Pääkaupunkiseudun Junakalusto Oy are rolling stock owners, responsibility to organise maintenance of the fleet;

Table 3: Face to face dialogues – ZX-Benet

No.	When	What	To whom	Who	Where	Customer
1st prototype of DRFB - ZX-BENET						
1	28.7.2016	Face to face dialog	Presentation of 1st prototype to the LEGIOS A.S., Louny	Petr Beránek	Czech Republic	Important activities of company LEGIOS cover: the production and sale of new railway freight wagons, locomotives and railway spare parts; service, repairs, modernization and remotorisation of used railway cars of all brands; renovation of all historic railway locomotives and cars manufactured during the initial years of railway transport.
2nd prototype of DRFB - ZX-BENET						
2	24.2.2017	Face to face dialog	Presentation of 2nd prototype to the Express Group A.S.	Zdeňka Poskočilová	Slovakia	Express Group, a.s. offers an integrated network through the railway, container, truck, sea and river transport, and also railway carrier services, as well as the leasing of wagons.

Table 4: Face to face dialogues – Omnia KLF

No.	When	What	To whom	Who	Where	Customer
2nd prototype of DRFB - OMNIA KLF						
1	27.1.2017	Face to face dialog	Presentation of 2nd prototype to the TRADE-DAM	Peter Duchovič, Barbora Klimeková	Slovakia	Trade Dam
2	20.2.2017	Face to face dialog	Presentation of 2nd prototype to the Framag Industrieanlagenbau GmbH and	Peter Duchovič, Barbora Klimeková	Slovakia	Technipoint, s.r.o. - representatives for Framag



Figure 5: Face to face interview with Trade DAM

3 SECTOR OF PRODUCTION OF RAILWAY VEHICLES, COMPONENTS AND SERVICE

Rating of the worldwide market for new construction of freight wagons is 11,5 billion per year and around 10 billion is the estimated worldwide market for maintenance of wagons (after-sales services). The biggest and fastest rising global markets are USA, Russia, China, India, Canada, Germany, Brazil (Balzner et al., 2015).

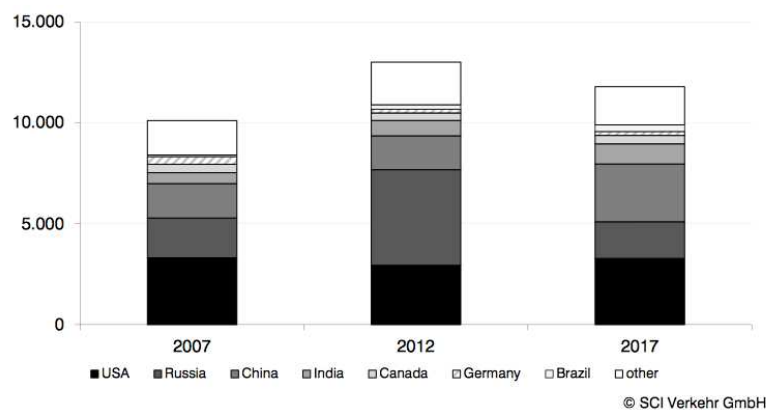


Figure 6: World Market volume (in Mio €)³

Figure 7 shows that OEM rail world market loses ground to the After-Sales segment. After Sales market will growth with +3,2% p.a., while for OEM market is predicted +1,3% p.a.

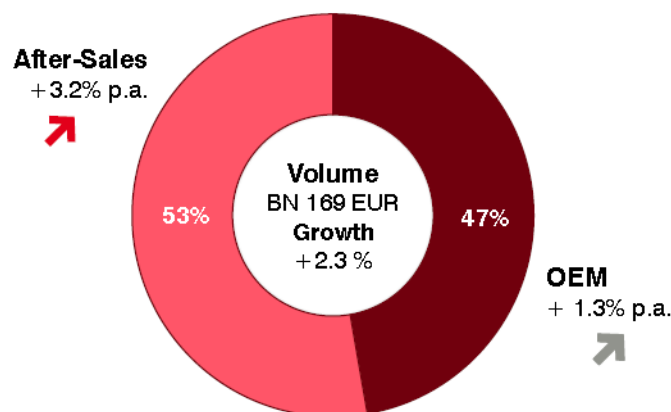


Figure 7: Share of After-Sales and OEM segment in % until 2020⁴

Overview of the developments in the sector of production of the railway vehicles, components and services in different world regions (The worldwide market for railway industries, 2016, 22-23):

³ Source: Balzner et al., 2015

⁴ Source: SCI, The worldwide market for railway industries. 2016.

Europe

Demand in Europe has substantially declined and remains at a low level, which is leading to massive overcapacities among the manufacturers. The current OEM market volume for freight wagons in Europe amounts to just EUR 500 million per year, with growth of c. 4% expected in the forecast period.

The most important European markets are Germany, France and Poland. In the total OEM world market Europe represents 4% share.

Procurements are likely to increase significantly again after the transport market has recovered and the high number of large stocks has been disposed of:

- Declining trend for European fleet: state railways carrying out major scrapping programmes.
- Procurements are driven by leasing companies, not state railways.
- Number of procured wagons is below the level of market needs.

Technical level in Europe:

- Noise problems are very significant.
- Reduction of certain freight wagon types.
- Deployment of logistically optimized wagons (Austria, Switzerland).

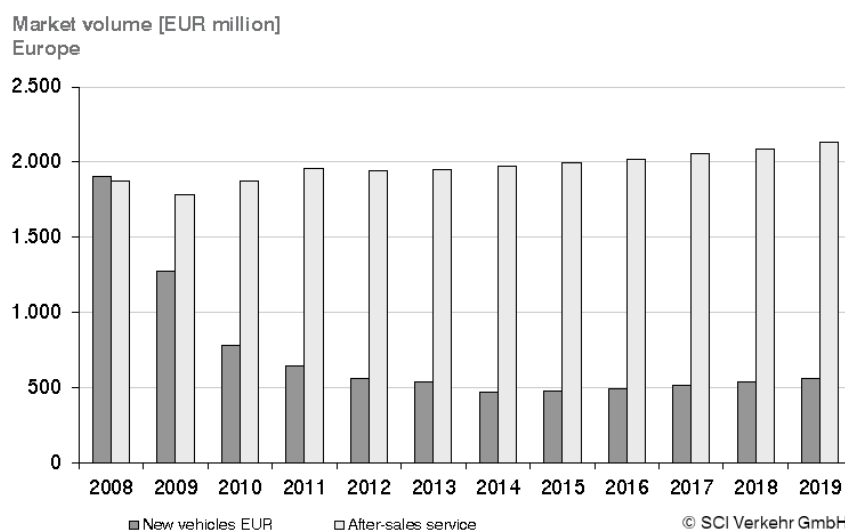


Figure 8: European Market volume (EUR million)

Asia

Growth rates in the Asian market have slowed down but procurements nonetheless remain at a high level. The Asian freight wagons market currently has an OEM volume of around EUR 2.4 billion and represent 21% of total market OEM.

Development of the Asian freight wagon market is determined by China and India, which operate over 90% of the region's fleet and are responsible for almost 95% of the order volume.

Solid growth rates of 4,4% up to 2019 expected for OEM market, but nonetheless a slowdown compared to expectations two years ago.

Merger of state giants China North Locomotive & Rolling Stock Industry Group (CNR) and China South Locomotive & Rolling Stock Industry Group (CSR) will push forward expansion plans and export activities, including in the field of freight wagons.

The Indian freight wagon market is characterized by a low level of dependence on the development of the global economy. The market has been growing constantly at nearly 10% p.a. for years, but suffered significantly from a severe crisis in freight wagon procurements in the financial year 2014. Despite provisions of the five-year plan, Indian Railway did not release any significant wagon tenders, putting the domestic freight wagon industry in a precarious situation.

North America

North America (US and Canada) is reporting moderate growth in demand, but the number of freight wagons planned to be purchased up to 2019 is the largest in the world. This has been influenced by a new safety standard announced for tank wagons and also by the rapidly increasing oil production volumes and the lack of significant pipelines. The current OEM market volume for freight wagons is EUR 4.5 billion per year. The installed base with 1,960.000 freight wagon is the largest in the world.

North American's share in total market OEM is 39%.

The OEM market will grow by c. 2,4% per year to 2019; procurement volumes for vehicles will stay at a high level.

High demand can in some cases not fully be met due to shortage of components within the market: consequently, high delivery volumes will be achieved in the next few years.

South America

The freight wagon market in South America will see a positive development in the long term despite procurement figures varying considerably from year to year: procurement figures declined significantly to only 2.600 wagons in 2013, and jumped again to 5.000 units in 2014.

Current market volume for new vehicles p.a. (EUR million) in South America is 4.500 wagons, with 2,4% p.a. average market development.

Australia

After several years of high procurement figures, the OEM market in Australia will decline substantially at -3,2% per year up to 2019.

Operators have already begun reducing their stocks, or are on course to do so.

Domestic manufacturers are under massive pressure – Chinese competitors have captured more than half of the market.

The market still has future potential, with demand primarily driven by open wagons:

- Mining projects worth several hundred billion dollars are planned
- Rising coal exports will result in additional transport to ports.

Africa / Middle East

Considerable increases are likely in Africa in the medium term, which will also largely be influenced by the raw material market; investments in freight wagon procurement have been too low for a long time.

The share in total market OEM is 2%.

The region with the highest growth rates worldwide: procurement volumes for new vehicles will grow at 9% per year up to 2019 starting from a very low level.

Transnet's extensive procurement programme for c. 25.000 freight wagons from 2014-2020 will account for 60% of procurements within the region. A large proportion will be produced by its own subsidiary Transnet Rail Engineering.

Notable numbers of freight wagons are being imported from China.

3.1 Inquiry for services for railway vehicles⁵

After-sales for freight wagons include all service activities such as maintenance, running repairs, inspections and possibly accident repair or refurbishment of freight wagons after they have been put into operation.

A comprehensive refurbishment offers the opportunity to extend the service life of freight wagons and reduces maintenance expenditure. In addition, it enables the vehicle to adapt more successfully to the operational purpose at hand. It is generally not possible to increase the permissible axle load, however. Freight wagons which are subjected to very high operational demands may suffer such severe material wearing that refurbishment is no longer an option.

The economically reasonable useful life of freight wagons depends on the type and intensity (mileage) of operation. This is around 30 years for container wagons and can reach 40 years for some tank wagons. On average, freight wagons can be expected to last around 35 years. In some market regions, considerably longer service lives are achieved due to lacking new procurements, although the maintenance requirements for older vehicles increase considerably.

⁵ Source: Balzner et al., 2015, page 50-51.

3.1.1 Projection of the market size of new construction of railway vehicles in the World⁶


Worldwide Market Overview Freight wagons					
	S t o c k	Units 2014	5,940.00	→	
		Average development 2014-2019	0,20%		
		Average age 2014 (in years)	20		
	N e w v e h i c l e s	Average volume 2013-2015 (EUR million per annum.)	11.500	→	
		Average development 2014-2019 (per annum.)	0,90%		
		Volatility market volume 2014-2019 (SAW)	1,70%		
↓ strong growth ↗ small growth → stagnation ↘ small decrease ↓ clear decline					
Volume:	> +5% p.a.	+2 to +5% p.a.	0 to +% p.a.	-2 to 0% p.a.	< -2% p.a.
Stock:	+1.5% p.a.	+0,5 to +1.5% p.a.	-0.5 to +0.5% p.a.	-1.5 to -0.5% p.a.	<-1.5% p.a.

Figure 9: Market overview of stock and new vehicles

The worldwide market for new freight wagons has a volume of around EUR 11.5 billion, with North America, the CIS and Asia the largest markets. Overall, the world market for freight wagons in therefore stagnating, as losses in the CIS cannot be compensated for by growth in North America and Asia.

In Europe, the current OEM market volume for freight wagons amounts to EUR 500 million per year. The market has reached its lowest level and will grow with a CAGR of more than 4% up to 2019.

In the last five years, the average number of procurements were 6.000-7.000 freight wagons. This number is below the level of market needs. This trend of under-investment is expected to end at the end of the forecast period.

⁶ Source: Balzner et al., 2015

Current procurements in the market are driven by leasing companies, despite the plans of incumbents for fleet renewal. The landscape on the leasing market is undergoing changes. After the acquisition of AAE, VTG became the largest leasing company in Europe.

Low procurement volumes have caused massive overcapacities among manufacturers. The rail freight manufacturer market is on a course for consolidation. The European freight wagon market is largely served by Eastern European manufacturers: the three largest (Astra Rail, Greenbrier and Tatravagonka) of these have a share over 50% in the overall market.

On the technical side, the retrofitting of freight wagons with low-noise brakes is a significant point driving the after-sales market.

3.1.2 Projection of the market size of the maintained railway vehicles in the World⁷


Worldwide Market Overview Freight wagons					
	A f t e r s a l e s	Average volume 2013-2015 (EUR million per annum.)	9.900	↗	
		Average development 2014-2019 (per annum.)	2.4%		
		Volatility market volume 2014-2019 (SAW)	0.3%		
↓ strong growth ↗ small growth → stagnation ↘ small decrease ↓ clear decline					
Volume:	> +5% p.a.	+2 to +5% p.a.	0 to +% p.a.	-2 to 0% p.a.	< -2% p.a.
Stock:	+1.5% p.a.	+0.5 to +1.5% p.a.	-0.5 to +0.5% p.a.	-1.5 to -0.5% p.a.	< -1.5% p.a.

Figure 10: Market overview of After-sales; freight wagons, world

The after-sales segment for freight wagons comprises regular wagon inspections, conversions and refurbishments. Worldwide turnover figures in the after-sales segment has reached a volume of almost EUR 10 billion. Growth here will continue at a rate of c. 2,4%, whereas it expects only moderate growth of 0.9% for the OEM market. The largest volume for after-sales services can be found in North America, due to having the largest fleet worldwide. Market volumes in the CIS and Europe are of comparable size, resolved due to higher European prices for maintenance and components, despite the far greater fleet in the CIS.

⁷ Source: Balzner et al., 2015

In Europe the after-sales volume is currently at around EUR 2 billion per year and will moderately increase in the next few years. This market is very fragmented due to a large number of countries under consideration with their own specific features.

Table 5: Freight wagons – After-sales service

Freight wagons: After-sales Service			
Region	Current market volume after-sales service p.a. (EUR million)	Average market development 2014–2019 (in % p.a.)	Volatility of market development 2014–2019 (in % total)
Europe	2 000	+ 1.6	0.3
Asia	1 480	+ 5.0	0.1
North America	3 800	+ 2.2	0.1
South/Central America	260	+ 2.8	0.1
CIS	2 000	+ 1.2	1.4
Africa/Middle East	240	+ 3.6	0.2
Australia/Pacific	140	+ 2.5	0.7
Total	9 930	+ 2.4	0.4

4 CURRENT LEGISLATIONS

Railway transport is the most suitable transport mode, as it consumes less energy, need less space and produces less CO₂, than any other transport mode.

The rail sector has to deal with regulations and demands from the European Commission, national authorities, regional and city authorities, citizen groups and individuals, and to align these requirements with the railways` own strategies. Rail transport has a complex and evolving structure with many different stakeholders, these include:

- The operating companies (running the trains)
- The vehicle owners (often leasing companies)
- The infrastructure managers, responsible for planning, construction and maintenance of the tracks

There are many differences in how rail networks and national authorities across Europe manage environmental noise, this partly due to variation in population density, urbanization and geography, and national noise legislations.

The European Commission has a range of policies designed to foster the development of a single European railway. In support of this, a set of common technical specifications, known as Technical Specifications for Interoperability (TSI) have been developed by the European Railway Agency (ERA).

4.1 TSI Noise legislation (Regulation No 1304/2014)

Rolling noise is the most important type of noise associated with the railway system. This occurs as an effect of the interaction between vehicle and track. For this reason, a whole system approach involving all of the relevant stakeholders (operators, vehicle owners and infrastructure managers) is often required in order to effectively reduce noise emissions.

The legislation of rail freight is moving toward decreasing the allowed noise levels. It is estimated that within next ten years only disc brakes will be able to ensure sufficiently low level of noise. Due to very strict environment legislation and promotion of freight transfer from road to rail, the field of rail freight rolling vehicles and their parts represents a large potential.

Noise creation is legislated at European level, while noise reception is submitted to subsidiary principles and legislated at national level. The European Rail Agency (ERA), on behalf of the EU Commission, developed the Noise TSI (Regulation No 1304/2014 of 26 November 2014, known as TSI NOI) which sets out noise limits for new rail vehicles in addition to renewed or upgraded wagons.

12.12.2014

EN

Official Journal of the European Union

L 356/421

COMMISSION REGULATION (EU) No 1304/2014

of 26 November 2014

on the technical specification for interoperability relating to the subsystem 'rolling stock — noise' amending Decision 2008/232/EC and repealing Decision 2011/229/EU

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community, and in particular Article 6(1) thereof ⁽¹⁾,

Whereas

Figure 11: TSI NOI (Regulation No 1304/2014)

In this TSI different values are defined for various types of rolling stock like freight wagons, locomotives, multiple units and coaches. These values include stationary, starting and pass-by noise for all types of rolling stock. For environmental noise, the limits for pass-by noise are the most relevant. The limits are presented in picture below:

Limit values for pass-by noise (dB)		
Category of the rolling stock subsystem	$L_{A_{pQ,Tp}}$ at 80 km/h	$L_{A_{pQ,Tp}}$ at 250 km/h
Electric locomotives and OTMs with electric traction	84	99
Diesel locomotives and OTM's with diesel traction	85	n.a.
EMUs	80	95
DMUs	81	96
Coaches	79	n.a.
Wagons (normalised to APL = 0.225)	83	n.a.
APL = the number of axles divided by the length between the buffers (per m)		

Figure 12: Limits for pass-by noise

4.2 TSI freight wagons legislation (Regulation No. 321/2013)

On the other side, the EU is constantly adjusting the legislations related to safety and security parameters in transport, as well as secure performance of wagon equipment (i.e. brake equipment). The latest requirements were set by EU Commission is regulation TSI (Technical Specifications for Interoperability) No. 321/2013, relating to the 'rolling stock-freight wagons' subsystem of the entire European Union's rail system.

The TSI Noise requires only new rolling stock placed on the market since 2006 and renewed or upgraded rolling stock to comply with strict noise limits. Therefore there is still a large amount of older rolling stock that does not comply with the TSI. This is why noise mitigation measures to this stock, particularly retrofitting freight wagons that are currently equipped with cast-iron brake blocks, is being considered since composite brake blocks or brake discs are deemed to be TSI compliant.

This TSI applies to requirements for freight wagons with the maximum speed lower than or equal to 160 km/h, and maximum axle load of 25 tones.

The new DRFB disc needs to fulfil the requirements concerning the brake performance from section 4.2.4 of TSI No. 321/2013. Demand for fulfilling this requirement is thermal capacity of the DRFB disc (section 4.2.4.3.3 from TSI), which needs to be verified by physical test in UIC accredited laboratory.

II

(Non-legislative acts)

REGULATIONS

COMMISSION REGULATION (EU) No 321/2013
of 13 March 2013

concerning the technical specification for interoperability relating to the subsystem 'rolling stock — freight wagons' of the rail system in the European Union and repealing Decision 2006/861/EC

(Text with EEA relevance)

Figure 13: TSI (Regulation No 321/2013)

4.3 UIC standard compliance conditions

Another legislation for DRFB disc is compliance to International Union of Railway (UIC) 541-3 standard. This standard describes the UIC railways technical requirements for disc brakes, in particular for the brake pads used on disc brakes. It contains the general conditions for disc brakes and their equipment.

UIC supports retrofitting of freight wagons by providing the framework for brake disc/pad combination homologation, by considering funding and financing issues. The obligation to comply with the standard UIC 541-3 may be defined in laws, regulations or contracts.

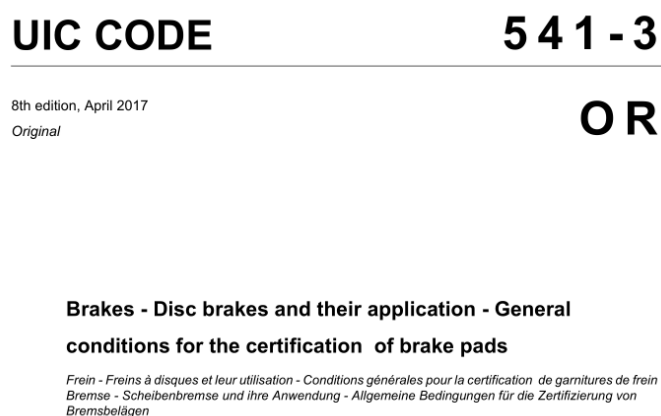


Figure 14: UIC 541-3

The certification procedure for brake discs and pads, including the test programmes to be used for each type is described in this standard. The main purpose of this standard is to check frictional properties of brake disc and pad combination in dry and wet conditions.

This certification is done by physical test in UIC accredited laboratory on special dynamometric machines. In new, eight edition of UIC 541-3, the test program for freight wagons brake discs was introduced.

In case of DRFB disc, to check its characteristics, program B.1 (Brake discs of energy class A1) shall be used.

Appendix B - Test Programs A1 to G1

B.1 - Test Programme: Brake Pads on Discs of Energy Class A1

Program A1 - Freight wagons in SS traffic with max. speed 120 km/h, mass per axle ≥ 4.7 tons (tare) and ≤ 22.5 tons (laden), and deceleration rate 0.88 m/s^2
(for application with masses < 4.7 tons per axle (tare) and > 22.5 tons per axle (laden) use a generic program with masses, power of drag braking and other parameters adjusted)

Brake pads	Sintered/organic: preferably "UIC175 size", Fig. 3 - page 81		
Disc	Axle mounted disc, 590 mm outer diameter, width ≥ 140 mm		
	Energy class A1 according to EN 14535 (6.3 MJ max energy)		
Mass	2,35 t and 11,25t	Wheel diameter	890 mm

No. Brake	Speed v (km/h)	FB (kN)	In. temperature θ_0 (°C)	Mass per disc (t)	Comments	Priority

Figure 15: Test program B.1

4.4 EN 14535-1 standard compliance (documentation)

Adjusting the prototype documentation with actual legal and standard compliance needs to be done in order to fulfil the requirements of EN 14535-1 standard.



SLOVENSKI STANDARD
SIST EN 14535-1:2006+A1:2011
01-september-2011

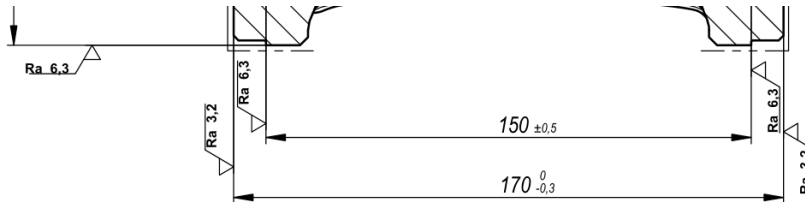
Železniške naprave - Kolutne zavore za železniška vozila - 1. del: Kolutne zavore (diski), nameščene na osi s hladnim ali vročim postopkom, mere in zahteve za kakovost

Railway applications - Brake discs for railway rolling stock - Part 1: Brake discs pressed or shrunk onto the axle or drive shaft, dimensions and quality requirements

Figure 16: EN 14535-1 standard

EN 14535-1 specifies requirements for design, dimensions, performance, and testing of the brake disc. This standard applies to discs mounted on the axle or drive-shaft of railway rolling stock by cylindrical interference fit.

Each DRFB disc prototype was designed to meet the compliance to standard requirements, especially from dimensions point of view. As it can be seen from picture below, each prototype drawing contains label “EN 14535-1”, which means that DRFB disc is compliant to this standard.



ZONE		REV.	DESCRIPTION			DATE	APPROVED
		A	PRVA IZDAJA / FIRST EDITION			19.04.2017	B. BLAŽINČ
		FINISH: $\sqrt{\text{Ra } 6.3}$ $\sqrt{\text{Ra } 3.2}$ $\sqrt{\text{Ra } 1.6}$		CASTING TOLERANCES ISO 8062-CT10	DIMENSIONS WITHOUT TOLERANCES EN ISO 2768-mK	DO NOT SCALE DRAWING Designation acc. EN 14535-1 :	REVISION A
				ISO 8062-CT10	EN ISO 2768-mK	EN14535-1 2 C V S 590 325 170 Dx 150 KOVIS MP12761	
	NAME	SIGNATURE	DATE	POSITION	MP	TITLE:	
DRAWN	B. BLAŽINČ		19.04.2017		12761	BRAKE DISC OD590/325/170/10/150 Futura prototype 4	
CHK'D				The reproduction, distribution and utilization of this document as well as the communication of its contents to others without explicit authorization is prohibited.			
APPVD	I.SMOLEJ		19.04.2017	MATERIAL:			DWG NO.
Q.A	S.M. BRCE		19.04.2017	BOM			K-7-16-27-04-00
				WEIGHT: 114.32 kg		SCALE: 1:3	SHEET: 1 OF 1

Figure 17: EN 14535-1 label

5 MARKETING MIX OF NEW KOVIS DIVIDED BRAKE DISCS FOR FREIGHT WAGONS

Based on the market analysis, competitors analysis, face to face interviews with existing and potential customers and regulations we will define the most prospective markets and market segments for our new developed product – divided brake discs for freight. However we will define different marketing strategy for different markets even that we will offering the same product.

In stade of different marketing strategy for different market we define the basic Marketing mix as a tool, which can help us to influence on customer demand.

Product

Divided Rail Freight Brake Disc (DRFB Disc) is a revolutionary solution, influencing 3 key elements in the rail freight transport: 1. Safety and security; 2. Health and environment; 3. Cost-effectiveness with strong horizontal and vertical spill over effects and crucial social, economic and technical impacts. The main advantages of our new DRFB Disc are to 15 dB lower noise, 11% shorter braking distance, 14% less vibrations, 21% lower mass, 7% less accidents, 12% less damage of freight wagons, 50% longer life cycle of wheels, 13% lower LCC of the disc.

DRFB disc provides significant value added for both operators as well as the owners of freight wagons; improved technical features and a reduction in the disc's weight, increased life cycle, lower wagon maintenance costs and reduced noise.

Price

Based on different market and market segments we will consider different pricing strategies. Our pricing strategies selection will be based on our product (new brake discs for freight wagon), customer demand, the competitive environment and also other indicators. For pricing strategies we will use next three pricing policies (Ehmke, Fulton, Lusk, 2013):

- **Cost-plus:** Adds a standard percentage of profit above the cost of producing a product. Accurately assessing fixed and variable costs is an important part of this pricing method.

- **Value – based:** Based on the buyer's perception of value (rather than on your costs). The buyer's perception depends on all aspects of the product, including non-price factors such as quality, healthfulness, and prestige.
- **Competitive:** Based on prices charged by competing firms for competing products. This pricing structure is relatively simple to follow because you maintain your price relative to your competitors' prices. In some cases, you can directly observe your competitors' prices and respond to any price changes. In other cases, customers will select vendors based on bids submitted simultaneously. In those cases, gathering information will be more difficult.

LCC calculation

DRFB disc will considerably improve the economic effectiveness of the RFT, which is shown in Table 4 with the calculation and comparison of LCC between two existing competitive solutions (K-block and non-divided brake disc) and the innovation (DRFB disc). The wagon price amounts to app. 100,000 € in all three cases.

Table 6 also shows that the LCC of the new product (calculations are made for 1 wagon) is by 4,098 € lower as compared to the K-block brake system at 4-axle wagon, and by 5,838 € lower at 6-axle wagon. Compared to the non-divided brake disc, the LCC will be lower by 7,560 € at 4-axle wagon, and by 9,840 € at 6-axle wagon. For an operator that owns about 1,000 6-axle wagons (for example), the savings for all wagons within a life cycle would amount to 5,838,000 € in comparison with K-block and 9,840,000 € in comparison with non-divided brake disc.

Table 6: LCC calculations – comparison of our innovation with two existing competitive solutions

Brake types	K-block	Brake disc (non-divided)	Innovation - DRFB disc
Price of the complete brake system			
4-axle wagon	6,000 €	16,000 €	13,000 €
6-axle wagon	9,000 €	24,000 €	21,000 €
Maintenance/replacement interval	150,000 km	380,000 km	400,000 km
Cost of replacement	112 €/wagon	80 €/wagon	70 €/wagon
Wheel life-cycle	600,000 km	900,000 km	900,000 km
Annual maintenance costs (annual LCC)			
4-axle wagon	984.27 €	766.33 €	614.33 €
6-axle wagon	1,510.27 €	1,143.67 €	915.67 €
Total LCC			
4-axle wagon	29,528 €	22,990 €	18,430 €
6-axle wagon	45,308 €	34,310 €	27,470 €
Total LCC including purchase of the brake system* per unit			
4-axle wagon	35,528 €	38,990 €	31,430 €
6-axle wagon	54,308 €	58,310 €	48,470 €
Annual savings in favour of DRFB disc per unit			
4-axle wagon	4,098 €	7,560 €	-
6-axle wagon	5,838 €	9,840 €	-
Savings in life-cycle in favour of DRFB disc per 1,000 units			
4-axle wagon	4,098,000 €	7,560,000 €	-
6-axle wagon	5,838,000 €	9,840,000 €	-

Place / distribution channel

Distribution channel ensure us, that our selling activities efficiently address customer's needs. These activities include company sales force, distributors, independent representatives, direct sales, internet sales and also activities such as trade shows/fairs. We will awarded sales and distribution channels based on specific market and customer specific needs

Direct Sales:

Kovis direct sales process is characterized with direct contact to final customer. They are conducted from fixed company location supported with customer visits. Direct sales Kovis cover all international market and specific local knowledge is required. Selling usually relies personal presentations, phone calls (cold or hot), and visiting trade shows, generating leads.

Distributors:

Distributors in Kovis are middlepersons that conduct sales activities to end customers. Distributors usually have their own workforce (sales people) that execute sales activities. These distributors are treated as final customer to base company and are added to customer base, resources are to allocated to support sales activities. Building good relationship with distributors is key of success of

our company, as some specific market require local presence, knowledge, experience and acquaintance.

Representatives person / Agents:

In Kavis we use also representatives persons for selling. They represent our company to the end customer. Representatives are because of their small size limited in operations are require more help to Kavis sales team and they usually cannot hold stock or execute logistic operations. They are typically compensated via commission base. Because representatives are payed based on commission sales cost are variable and strictly tied to performance which is cost effective for suppling company.

Trade shows

Trade shows are getting very importance sales and distribution channel in Kavis. On the industry specific exhibitions and trade shows we present our company, products, novelties... Aim of trade shows is strengthening existing business operation and creating new leads and opportunities for future business, meeting with competitors, suppliers... Trade shows are also positive for non-selling activities such as strengthening company brand name.

Promotion:

Sales promotion in Kavis is one of the most important success factors that affect the success of a product launch. Sales promotion is made through our motivation activities, which will encourage the customers to purchase a new brake discs for freight wagons. We are using a lot of different sales promotion tools to increase the confidence by customers. To promote the new brake discs we will use:

- Product brochure
- Product presentation
- Product Data - Sheet
- News Release Reprint
- Advertising / Articles in publications
- Presentation for Agent, Distributors

6 REPORTING RESEARCH FINDINGS

The railway industry is facing several challenges. One of the most important challenges is railway noise, especially the emitted from freight trains. Not only because freight trains run more frequently in the sensitive night period, but also because freight trains are about 10 times noisier than modern passenger trains. One could say that modern passenger trains during the day are 100 times less annoying than a conventional freight train during the night. The noise level of freight trains can be traced back to the type of braking system.

Technological trends in the manufacture of brake systems for freight rolling vehicles are focused on ensuring greater safety in the rail freight and passenger traffic (shorter braking distance), increasing axle loads on freight wagons, ensuring a lower level of noise and a higher level of efficiency. The conventional cast iron brake blocks spoil the smoothness of the wheel surface, thus causing vibration and a high level of noise in the environment.

The European community supports noise reduction and has addressed this issue in several documents; one of the most important being the TSI – Technical Specification of Interoperability. The acoustics requirements for new rail cars are defined in the TSI.

These new standards and requirements presented business opportunities and a development challenge for Kovis. The aim of the project is to develop a new generation of brake discs for freight wagons, i.e. divided, axel mounted brake discs. During the development and research process we pursued the following main objectives:

- Noise reduction by up to 10dB
- More effective braking of freight wagons – shorter braking distance
- Enable higher speed of freight trains – up to 160 km/h
- Up to 20% lower weight of brake discs – more tonnage for goods transport
- Divided brake discs enable the reduction of maintenance costs in the life span of the freight wagon
- Lower life- cycle cost (LCC)

During the development process of the new generation of divided brake discs for freight (DRFB discs) we developed 5 different prototypes, which we extensively tested and fine-tuned for the

purpose of achieving the right results. These tests and prototypes showed us, that we were going to achieve, and exceed, all the objectives which we defined in our R&D project. This means, that with the new generation of brake discs we will solve some of the problems of our existing and potential customers and create value for them. In the development process we took into account all the Information and observations, which we received through different research methods. One of the most important market research tools was an interview with our existing and potential customers. During these interviews in the various development stages we got a better understanding of our new product and customer opinions. We considered all these opinions in the development process.

From our research, and attendance at international fairs, we can say with some certainty that there is a huge potential for our DRFB discs in the European market, especially Germany, Switzerland, Austria and France, where, due to an EU Directive, the noise level of freight trains must be reduced to between 8-10 db by the year 2025. In Germany and Switzerland the aim is that by 2020, 80% of all freight wagons will be classified as “silent or non-noise making”. This represents 180,000 wagons.

Based on a worldwide market analyses of freight wagons we found that, at the moment, the biggest potential market for sales of this new DRFB disc is in Europe, because the owners of wagons, transport providers, and state railways must follow the Regulations and Directives of EU. They must ensure silent freight wagons by 2025. We did not find similar regulations and obligations on other continents. From face to face interviews and attendance at international fairs, we noted that on the rest markets (non EU markets), despite the weak legislation, exist great interest for DRFB disc, but in narrow version. This was a trigger for decision to start with development of 5. prototype, which will covered the needs after narrower and even lighter brake disc. After the end of the project we will be able to offer on the market two type of brake disc, now called 4. and 5. prototype.

Market analyses showed us, that the market for and the maintenance of freight wagons is the most developed in Europe. In the future, we can expect that some of the markets outside Europe will consider this good business practice from EU and issue their own Regulations and Directives. Based on worldwide demographic trends, we need to be aware, that the issue of the health and safety of people is of the utmost importance. Other issues, such as CO2 reduction, energy consumption,

megacities, aging populations, will also bring some additional changes in the transportation market. Noise reduction is certain to be one of them.

We have defined three different market segments for which we will prepare different marketing strategies with a different marketing mix.

- **Owners of Freight Wagons and ECM holders (Entity Charge of Maintenance):** This group of existing and potential customers is very important. Its goals vary and it is looking for benefits such as; lower LCC, lower maintenance cost in the life span of wagons, lower weight of brake discs, less damages on the wheel surface and wheel sets.
- **Producers of Freight Wagons and Wheel sets:** This group needs to fulfill the requirements of investors as well the regulatory requirements (in Europe – TSI; USA – AAR.). They are looking for good services, good quality of product, longer lifespan due to wear of brake discs, simple montage of products, lower weight, higher speeds. They are looking for additional advantages of products, which will bring them some added value and greater success.
- **State and private Railways, Logistic and Transport providers:** This group is the smallest and for them the Regulations and Directives are very important. The most important decision factor is price.
- We also researched our competitors. In the analyses we concentrated on the producers of brake discs (braking system with disc for freight). We have three main competitors for brake discs who also produce the complete braking system. Worldwide we compete with Knorr Bremse, Faivelely and Wabtec. In Europe, Ibre and Poli S.r.l. We found other producers from China, Japan, India.

From a technical point of view the development of the new generation of brake discs is currently in its final stage. This means that, after completing the current tests, we will get the approval that we have developed a high quality brake disc for freight wagons, which will bring much better results and benefits for its users, as defined at the beginning of the project. The new brake disc will be lighter, will be easily interchangeable with existing brake discs, will ensure a longer lifespan, with lower LCC costs. It will also be the first divided brake disc in the world for freight wagons. At the end of the project a new generation of divided brake discs for freight wagons will be ready to be launched on the market.

7 METADATA

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ANNEX 1: FACE TO FACE INTERVIEW GUIDE: DEVELOPMENT OF NEW PRODUCT

To enable constant growth of company KOVIS is necessary to introduce always new competitive products into the market. We understand, that product launches help increasing sales revenue and expanding the customer base. To be successful and attract the customer attention, Kovic new product must fulfill their needs and maintain the brand promise. That we will get this Feedback from customer, we decided to use the additional research method face to face interview with the customer.

In Kovic we defined, that an interview is a two-way communication process. Which give us the opportunity to find out more about some specific topics. In this method customer interact with aspects of Kovic product and then express his concerns, views and difficulties.

KEY SECTIONS:

- Preparation
- Product Concept
- Questions to ask the interviewer

1. PREPARATION

Preparation is the first essential step towards a successful face to face interview and we need to be aware about:

- Make sure, that you will know exact location, time and date of the interview and interviewers full name.
- Always wear smart business clothes.
- Investigate specific, relevant facts, about the company of interviewer's.

Think about what question you want to ask the interviewers. Remember an interview is a two way process, you should to some relevant information for Kovic new product.

2. PRODUCT CONCEPT:

Short presentation of new product which has been developed in Kovis. Product needs to fulfill the customer needs, or satisfaction. In short product presentation need to be present the major benefits / advantages of new product and which problems or difficulties can be solved with our new product.

3. QUESTIONS TO ASK THE INTERVIEWER

- What do you think about our new product?
- Seems to you interesting our new product? (If not, What kind of such product will be interesting for you? Please describe..)
- Will you be prepared to use / buy our new product?
- How much will you be prepare to pay for such new product?
- Based on your opinion is our new product much more attractive from existing products/solutions on the market?
- Based on your opinion, which are the main advantages of our new product?
- Please define your three main decision factors for buying such new product?
- Will our new product present good solution for your problem/needs?
- Which solutions / product do you use now?
- Do you think, that with our new technical solution by this new product you will be more competitive on the market?
- Who is taking the decision about new product in your company?
- Can you describe me your approval process of new products?
- What are the company's key objectives for the next 3 years?