

KNORR-BREMSE



Capital Market Lunch

RALPH HEUWING | CFO

DR. PETER LAIER | HEAD OF CVS

DR. JÜRGEN WILDER | HEAD OF RVS

SEPTEMBER 12, 2019



Knorr-Bremse Capital Market Lunch – Agenda

1.	Introduction	Ralph Heuwing
2.	Financial results H1/19	Ralph Heuwing
3.	Deep Dive CVS	Dr. Peter Laier
4.	Deep Dive RVS	Dr. Jürgen Wilder

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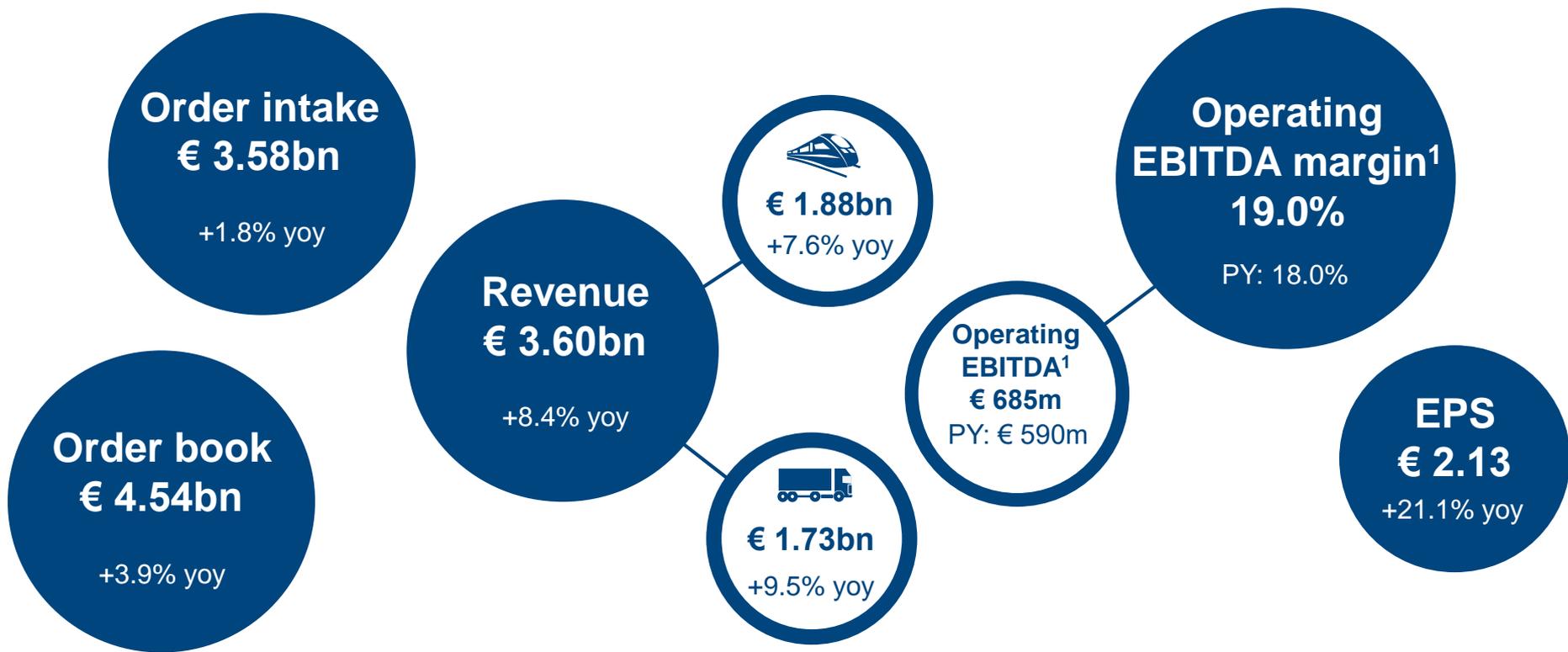
Capital Market Lunch

Financial Results H1/19

RALPH HEUWING | CFO
SEPTEMBER 12, 2019



Financial highlights H1/19 – once again, we delivered on our IPO promise



Resilient outperformance thanks to high-quality business model

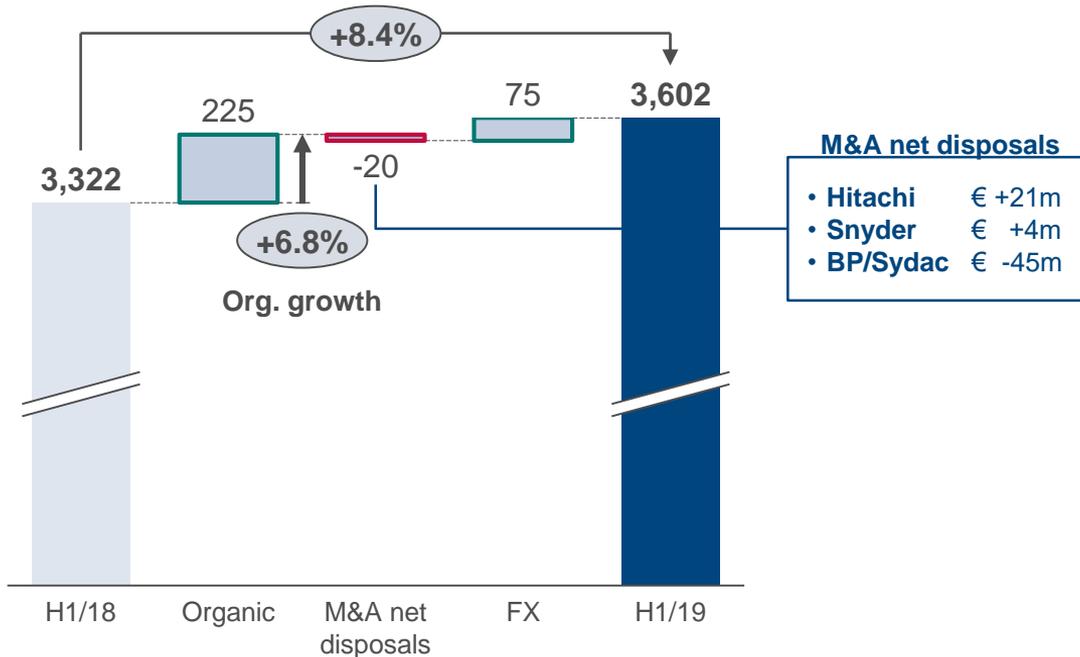
1	Global #1	Number one supplier for braking systems and a leading supplier of other safety critical rail and commercial vehicle systems protected by <u>high barriers to entry</u>
2	Synergistic business	<u>Technology</u> and <u>scale benefits</u> between rail and commercial vehicles
3	Market outperformance	Consistent outperformance of attractive end-markets driven by <u>megatrends</u> and <u>increasing content per vehicle</u>
4	The industry innovator	Driving innovation in <u>mobility and transportation</u> technologies through <u>R&D</u> , <u>quality excellence</u> and edge in connected systems
5	Resilience	Resilient business model, supported by broad geographical and customer diversification, <u>high aftermarket exposure</u> and <u>strong localisation</u>
6	Superior financial profile	Strong <u>growth</u> , <u>profitability</u> , and <u>cash generation</u> with high earnings visibility
7	Leadership excellence	Highly <u>experienced management</u> team with <u>strong track record</u> and clear vision for future value creation and firm commitment to Knorr-Bremse

Continued strong growth, clearly outperforming underlying markets and peers

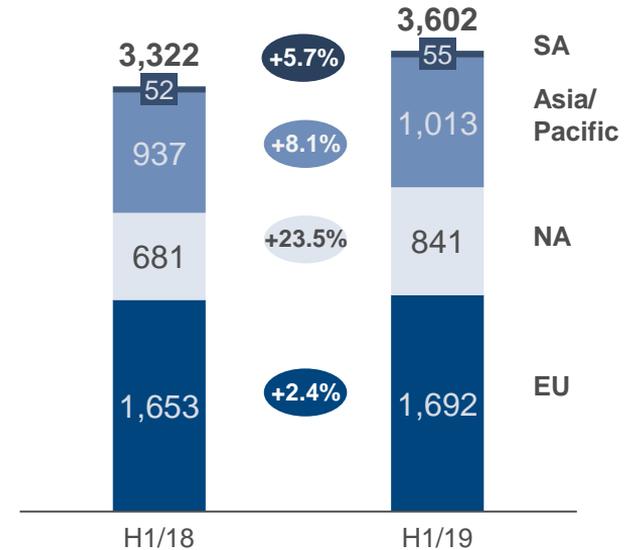
Revenue

€m

By type



By region

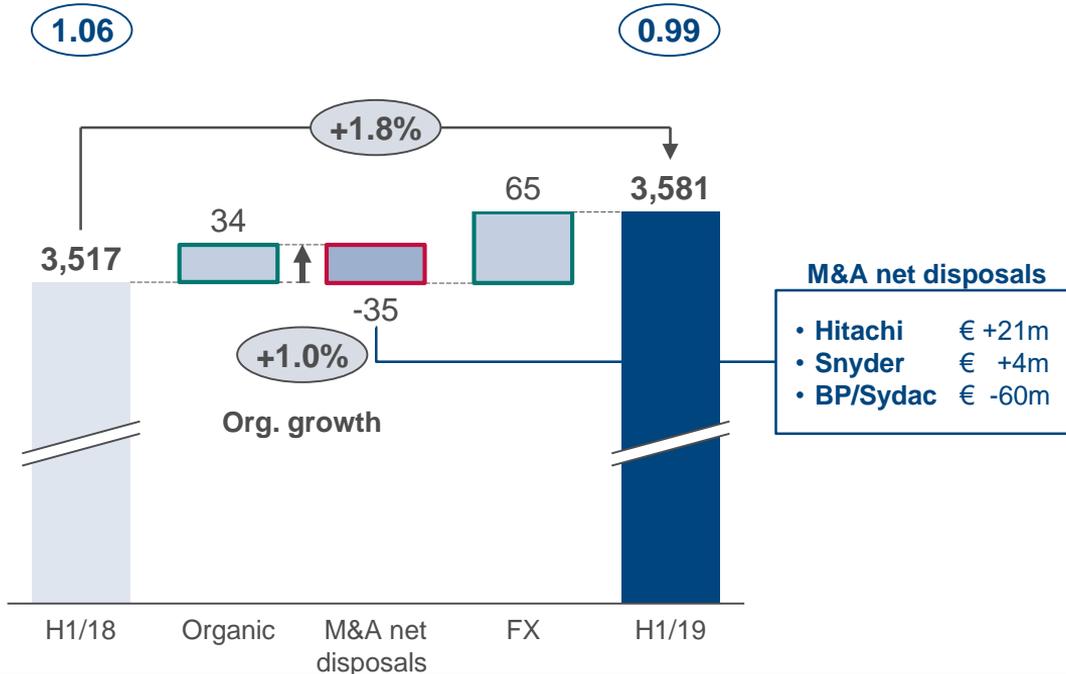


Healthy order book and continued good visibility

Order intake

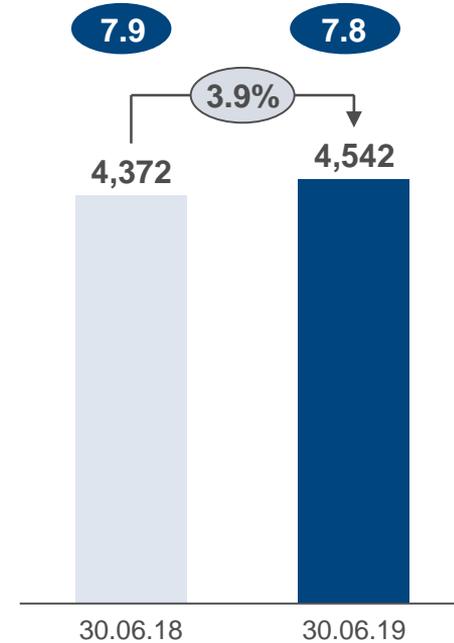
€m

By type



Order book

€m



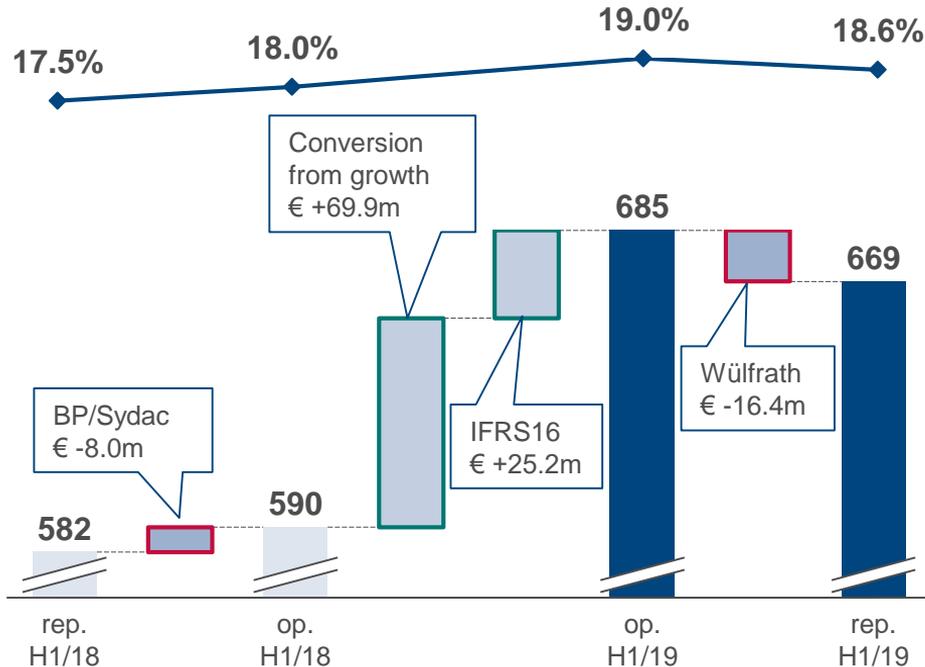
M&A net disposals

- Hitachi € +21m
- Snyder € +4m
- BP/Sydac € -60m

Strong EBITDA margin development in H1/19, particularly in Q2/19

EBITDA

€m ◆ Margin



Q2/19 with strongest quarterly operating EBITDA (€ 352m) since 2017

- Operating EBITDA margin increased by 210bps to 19.1% in Q2/19, despite lower AM share (down from 34% to 32%)

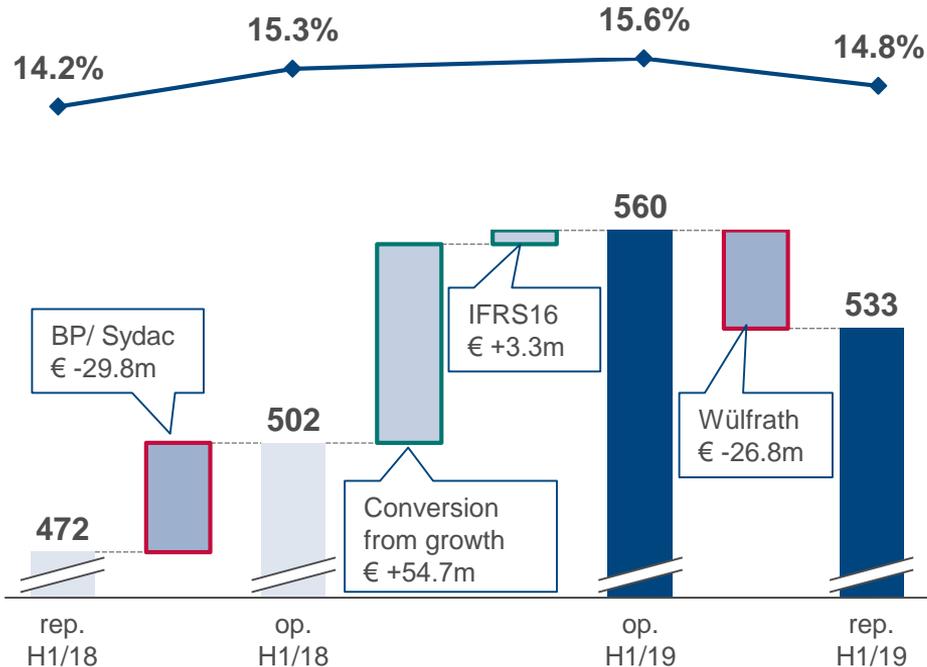
Both divisions contribute

- RVS:** Healthy mix, strong AM, operating leverage, increased productivity, benefits from disposals
- CVS:** Resilient performance, content per vehicle, market share gains

Strong EBIT margin development in H1/19, particularly in Q2/19

EBIT

€m ◆ Margin



Operating EBIT strongly increased from € 244m (Q2/18) to € 285m (Q2/19)

- Growth solely driven by organic growth
- Operating EBIT margin advanced 100bps to 15.5% in Q2/19

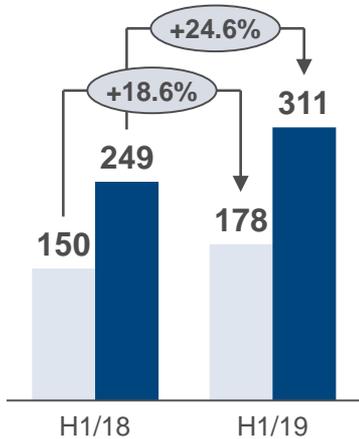
D&A increase Q2/19 vs. Q2/18:

- Wülfrath € 10.4m
- IFRS16 impact € 11.2m

Strong improvements in operating and free cash flow in H1/19

FCF & OCF

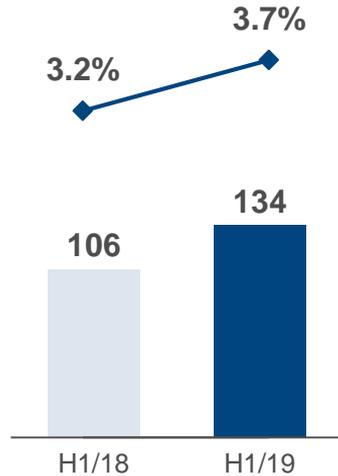
€m ■ FCF ■ OCF



Strong increase in FCF & OCF, reflecting positive EBIT development and strong cash conversion

CapEx¹

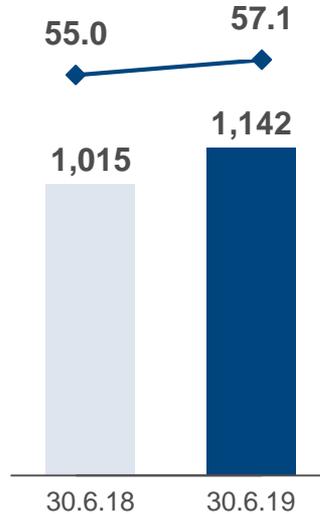
€m ◆ % of sales



CapEx following trend in Q1/19: site development Munich & NA, IT projects

NWC

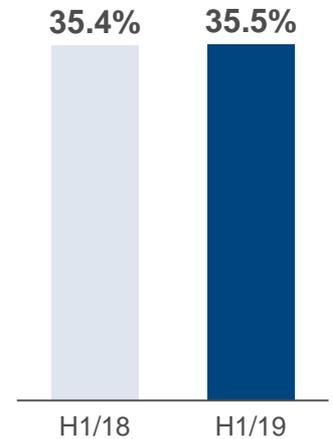
€m ◆ Scope of days



Decent level, improvement of NWC expected towards year-end

op. ROCE² (annualized)

%



Operating ROCE at continued high level

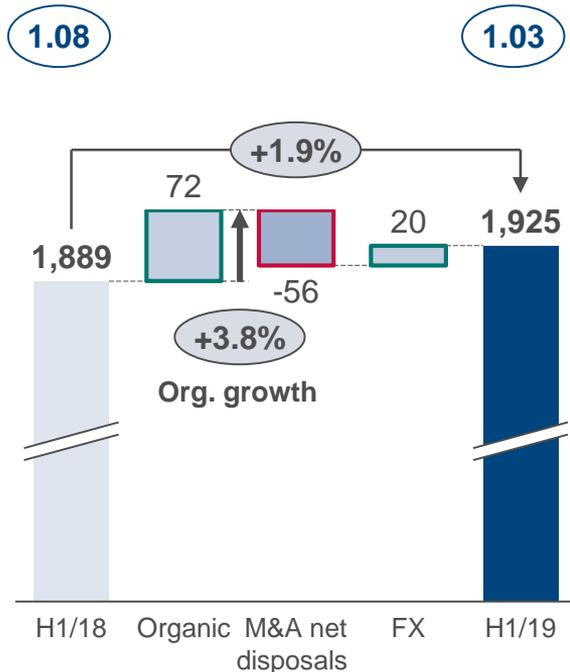


RVS: Strong order book and high visibility

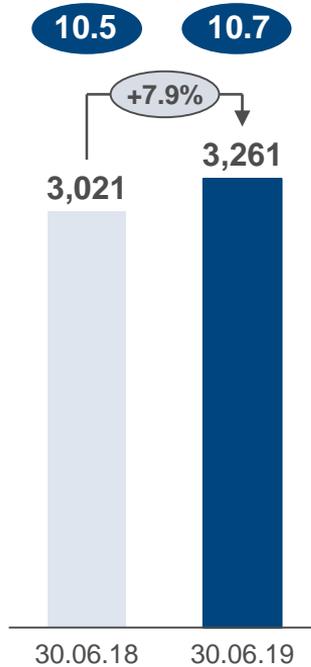
Order intake

€m

By type



Order book



Organic order intake up 3.8% in H1/19

- Project rollover from Q2/19 to Q3/19 (temporary fluctuation)
- Freight & Locomotive, Mass transit and AM with strong growth in NA
- Growing order intake Asia through AM China and bulk order HVAC
- Tougher comps in Q2/18: Blueprint added € +48m (sold in H2/18) & one-time bulk order at Kiepe € +72m

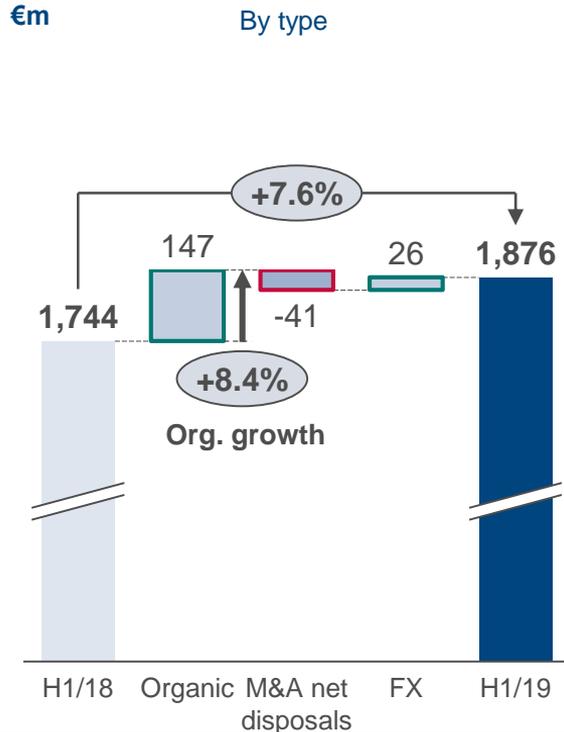
Solid growth in order book continued: € +240m

- Visibility of 11 months remaining on high level

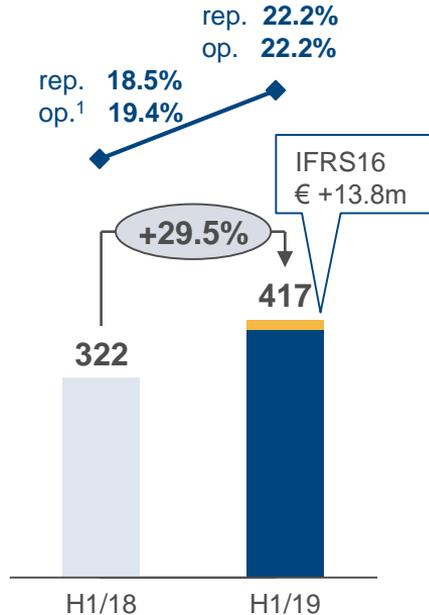
RVS: Strong revenue growth with particularly strong margin expansion



Revenue



EBITDA



Continued strong organic revenue growth of € +61m (+6.7%) more than compensated divestments (€ -25m) in Q2/19

- EU: Good development of regional/commuter, HS, freight and strong AM business (ex disposals)
- Asia: Strong growth of AM in China & India
- NA: Positive development in brakes, strong AM as well as locomotive and freight business
- Organic AM increased by 6.3% in Q2/19 (revenue share AM Q2/19: 42%; Q2/18: 43% ex disposals)

Particularly strong EBITDA margin development in Q2/19

- Operating leverage and performance improvement
- Improved OE/AM mix effect in Q2/19 vs. Q1/19

CVS: Order growth positive with help from FX and M&A

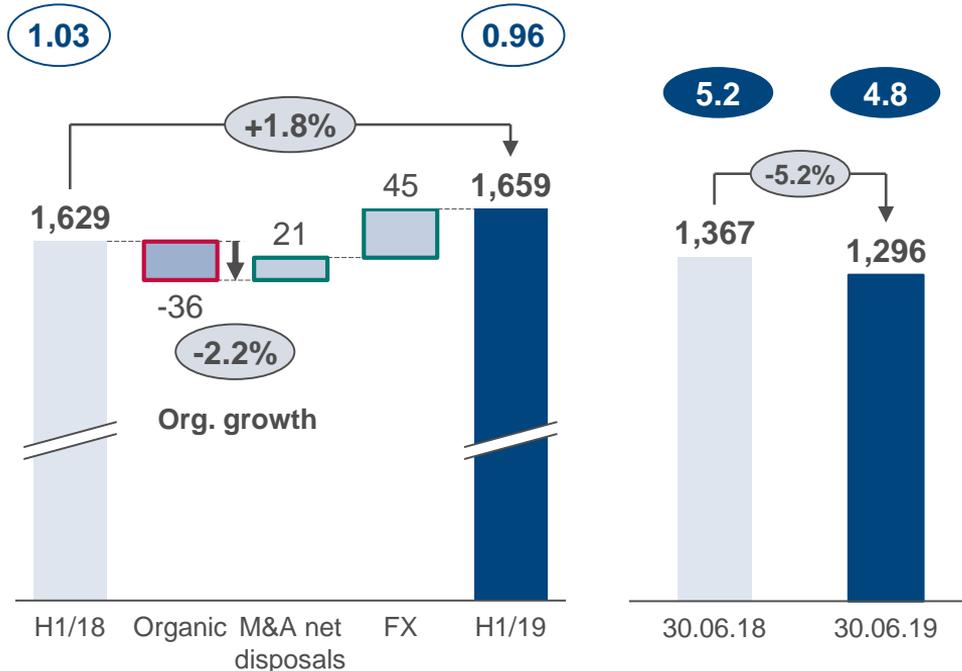


Order intake

Order book

€m

By type



Organic order intake Q2/19 slightly down by -1.9% y-o-y

- North America continued to support organic order intake in Q2/19, due to increase of content per vehicle (ADB, EBS, Steering) and market share gains
- Organic order intake down in Europe
- Double digit organic growth of order intake in Asia

Order book moderately lower with 4.8 months of visibility



CVS: Strong revenue growth at stable operating margin

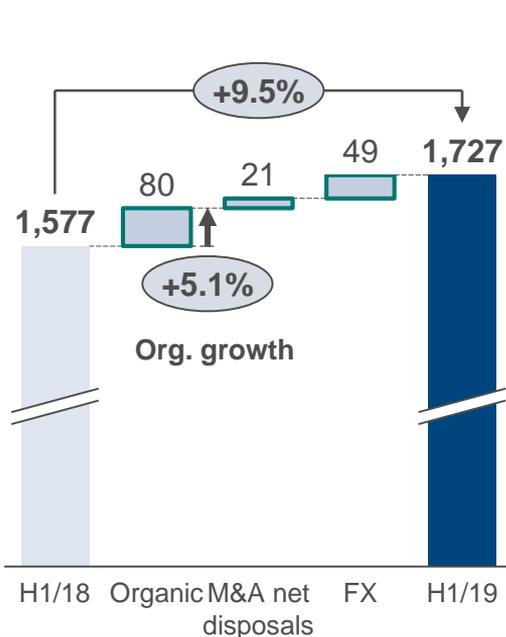


Revenue

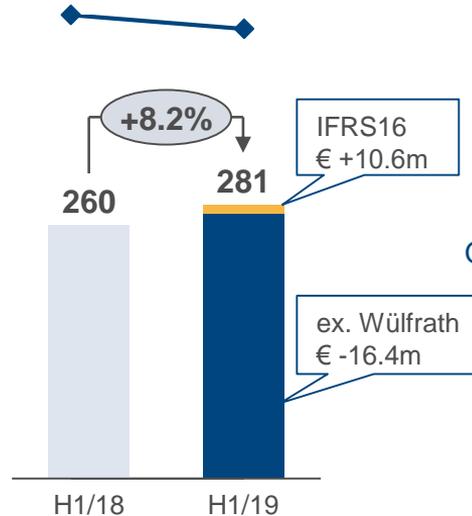
EBITDA

€m

By type



rep. 16.5% op. 16.5% rep. 15.3% op.¹ 16.3%



Revenue growth drivers

- Growing content per vehicle clearly outperforming TPR
- Global TPR on comparable level vs. H1/18 (-1%)
- **EU:** Moderate OE growth vs. decreasing AM
- **Asia:** Strong OE growth, plus Hitachi € +21m in Q2/19
- **NA / SA:** Strong OE growth from market and content
- AM revenue flat in Q2/19 y-o-y and revenue share at 22%; driven by strong OE and de-stocking of AM customers

Q2/19 operating EBITDA margin of 15.9%

- Adverse OE/AM mix effect
- Lower operational performance of Wülfrath
- Material cost and supply chain situation still challenging
- Continued R&D outspending in megatrend technologies and ADAS/HAD



Guidance confirmed for 2019

Market developments and KB response

Market developments

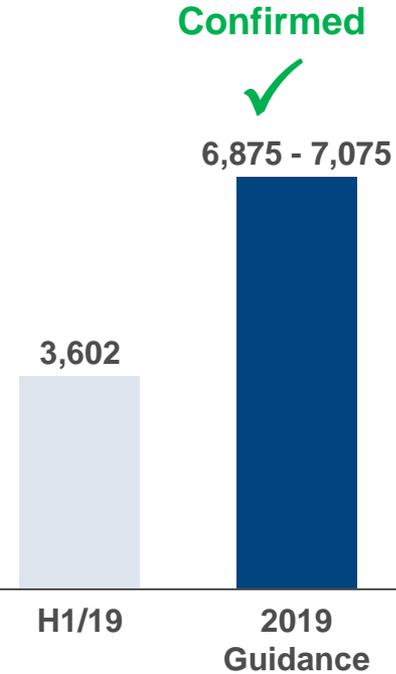
- Political uncertainties, but supportive interest rate outlook
- CVS: slowing order momentum
- RVS: continued strong demand

KB response

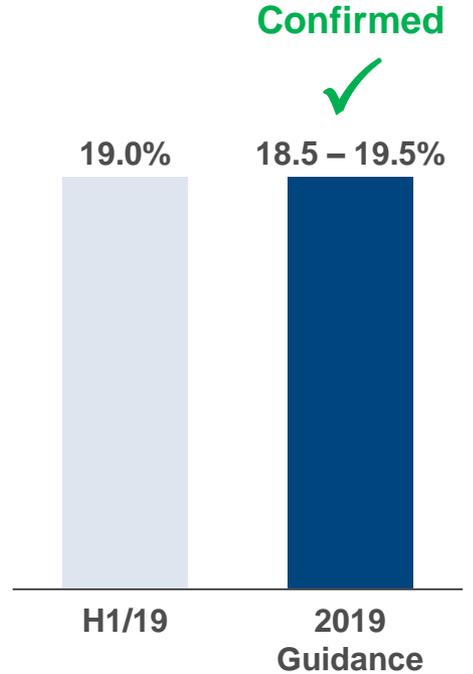
- Global footprint and strong localisation
- CVS: cost program for margin stability and plant closure in Wülfrath
- RVS: ensuring strong conversion from growth
- Cash program (NWC, Capex)



Revenue
€m



op. EBITDA margin¹



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Capital Market Lunch

Deep Dive CVS

DR. PETER LAIER | HEAD OF CVS
SEPTEMBER 12, 2019



CVS with high-quality business model – Outperformance and resilience



1	Market leadership	<u>Global market leader</u> with increasing market share
2	Technology leadership	<u>Technology leader</u> with innovation power shaping major industry trends
3	High barriers to entry	<u>Safety-critical highly technological products</u> One of only two suppliers with global technology know-how and capabilities
4	Strong growth profile	<u>Attractive end market</u> in goods and people transport (incl. buses) Continuously <u>outperforming markets</u> through content and market share growth
5	Resilience	<u>Strong aftermarket share</u> and <u>content per vehicle growth</u> Strength in cost efficient operations
6	Profitability	<u>Attractive margins</u> based on differentiation, scale advantage and consequent cost management

Knorr-Bremse Capital Market Lunch – Deep Dive CVS

1. **CVS Revenue Development and Market Development**

2. Drivers for Revenue Growth

3. Technology Leadership

4. Operational Excellence

5. Conclusion

CVS strongly outperformed – revenue CAGR +8% vs. TPR CAGR +3.5%

Revenue

€m

By region ¹⁾

By channel

CAGR 2010 - 2018

CAGR 2010 - 2018

+8%

+8%

3,160

3,160

2%

16%

34%

48%

SA
Asia/
Pacific

NA

EU

AM

OE

1,701

1,716

10%

29%

55%

37%

63%

-6%

+15%

+10%

+6%

+4%

+10%

Growth surpassing TPR CAGR mainly driven by **content per vehicle** and **market share** increase

Disproportional growth in OEM due to **strong acquisition of customer projects**

2010 ³⁾

2018

2010

2018



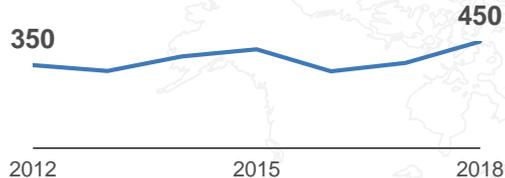
Truck cycle 2020 – leading indicators guide to weaker TPR in NA and Europe

	GDP growth	Industrial production rate	Truck tonnage / Freight transportation volume	Net orders heavy duty trucks
North America				
Europe				
Asia / Pacific				

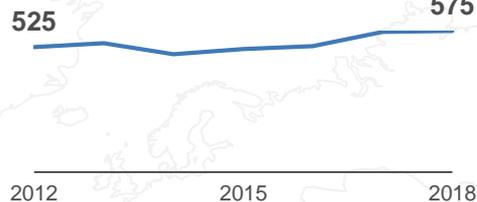
Forecasts indicate TPR slowdown in 2020 from high levels

North America

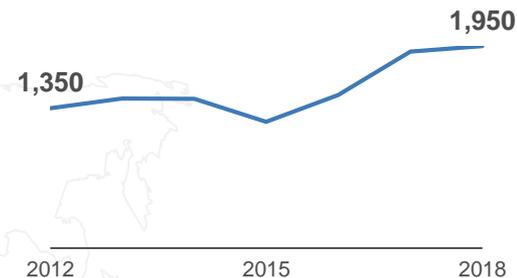
Truck
Production
Rate
2012 – 2018¹⁾
in '000 units



Europe



Asia / Pacific



Share of CVS
Revenue 2018

34%

48%

16%

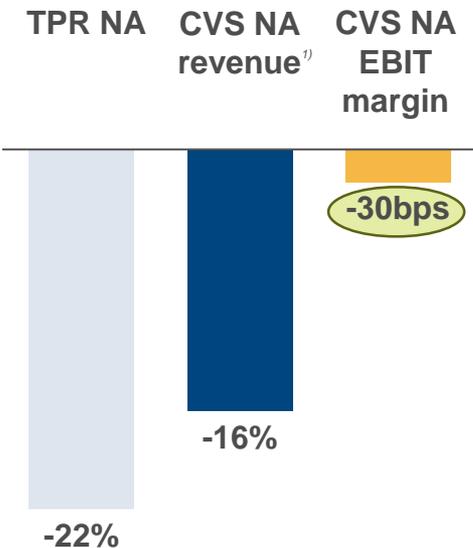
Estimated
TPR by
banks
2019-2021



How will CVS respond to a possible slowdown in truck production?

North America 2016: proof point of CVS' resilient business model

Development 2015 – 2016



Reasons for resilience

- Strong **BENDIX brand**, market leading position and long-standing **customer relationships**
- **Product portfolio met market demands exactly** at right time, e.g. ADAS
- **Localization of own manufacturing and supply base**, incl. increase of footprint in Mexico
- **Market share increase and content per vehicle growth** mitigated partly
- **Favorable FX**
- CVS NA management introduced quick and effective counter-measures:
 - Rigorous management of **overheads, e.g. headcount reduction** of -8%
 - **Consequent supplier management**: stabilized gross margins
 - Effective **aftermarket campaigns**; only ~2% revenue decrease in AM
 - **Premium freight reductions**
 - **Further strict reductions** incl. discretionary spend, labor savings, material savings

Knorr-Bremse Capital Market Lunch – Deep Dive CVS

1. CVS Revenue Development and Market Development
- 2. Drivers for Revenue Growth**
3. Technology Leadership
4. Operational Excellence
5. Conclusion

Revenue of CVS mainly supported by three growth drivers

Organic growth

TPR



Number of trucks produced by OEMs

Content per Vehicle



Number of products and value sold per truck

Market Share



Relative performance and share of wallet

Non-organic growth

M&A



Long track record of successful M&A

Short term potential:



Medium term potential:



Ongoing market screening

Regular M&A pipeline update

Continued content growth expected in all regions

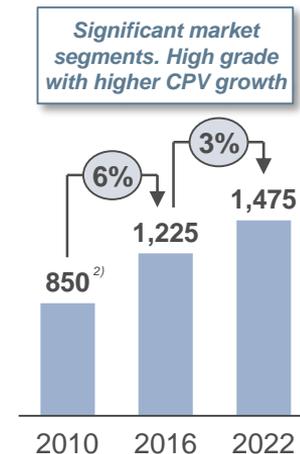
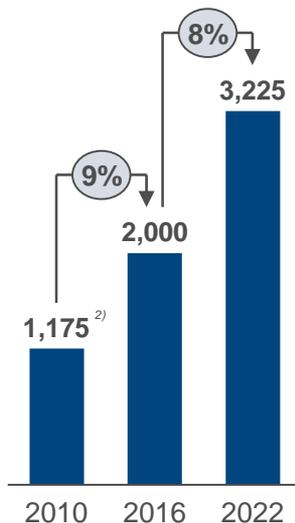
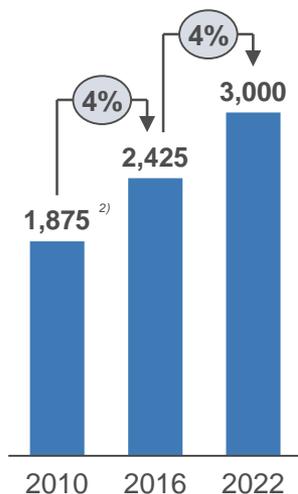
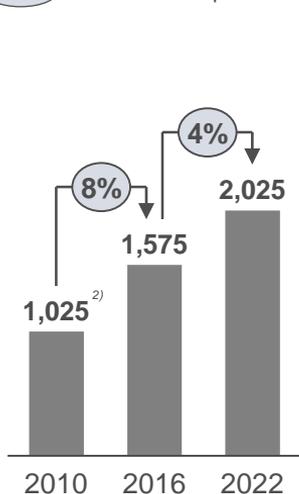
World

Europe

North America

Asia / Pacific

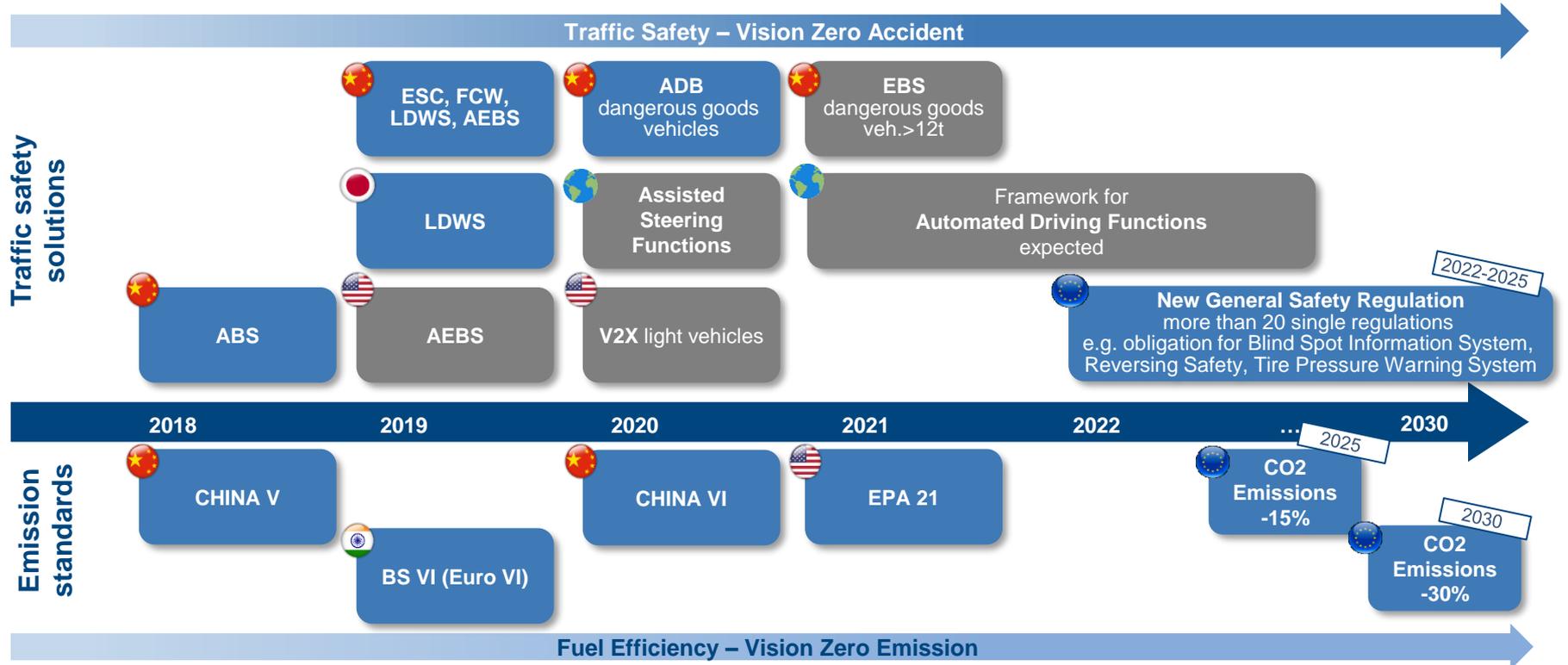
% CAGR Content per Vehicle 2010 - 2016 / 2016 - 2022 ¹⁾



Growth of content per vehicle mainly driven by local regulation and total cost of ownership

Notes: CPV data rounded to nearest €25; ¹⁾ CPV for four specific categories analysed in Roland Berger market study: Trends in the truck & trailer market (August 2018): Braking systems, Powertrain, Steering and ADAS; Roland Berger scope excludes Valves / Pedal Unit, Actuators, Compressors, Air Treatment and Others; ²⁾ Implied; applying Knorr-Bremse proprietary market growth CAGR 2010-2016 (made comparable to Roland Berger's market definition) to Roland Berger's 2016 absolute CPV data; Source: Knorr-Bremse internal market research for the CAGRs 2010-2016 and commentary; Roland Berger market study: Trends in the truck & trailer market (August 2018) for 2016 and 2022 CPV data as well as for the CAGRs 2016-2022; Data for Asia/Australia for 2016-2022 calculated based on separate Roland Berger data for (i) Asia/Pacific without China and (ii) China

New regulations and emission standards will support CVS' growth strongly in future



Case study 1: Content per vehicle increase through legislation

The penetration of driver assistance systems is increasing globally

Goals and advantages

- Advanced safety features are able to reduce the number of accidents
- Reduction of Total cost of ownerships (TCO)
- Increased vehicle up-time
- New business models via connectivity and new functions

Drivers

- Advanced driver assistance systems (ADAS) add significant value to vehicle
- New regulation and legislation standards are major drivers for increasing penetration of ADAS
- Truck OEMs implement safety features to expand and differentiate their product portfolio
- Fleets invest in ADAS functions because they offer improved TCO and up-time

Market growth
for CV ADAS systems at a
CAGR of 16.5-18.5%¹⁾
between 2018-2022.



CVS to participate in ADAS market growth through its strong product offering and stable order book.
CVS is market leader for ADAS in North America.

Case study 2: Content per vehicle increase through superior functionality Shift from manual to automated manual transmissions (AMT)

Goals and advantages

AMT vs. MT (manual transmission):

- Reduced fuel consumption and increased comfort
- Miss-use protection (increased lifetime, increased up-time of vehicle)
- AMT enables advanced driver assistance and autonomous driving
- AMT share is increasing globally

Drivers for increasing penetration

- AMTs improve TCO for fleets via reduced fuel consumption and miss-use protection
- AMT systems attract young driver generations (counteracting driver shortage)
- High content of mechatronics increases content per vehicle

Penetration of AMT in **Europe** today already at **87%**, market prospected to be nearly saturated **by 2030**.

In **North America** currently at **40%**;
in **2030 expected to be at ~95%**.

In **China** today at **1%**;
in **2030 expected to be at 30-50%**.



AMT actuator for DongFeng (China)



TRS AMT actuator for FAW (China) & Hino (JP)



ZF Traxon AMT with KB gear control module

Business field extension

- In April 2017 Knorr-Bremse acquired **Bosch TRS**:
- strengthen Asia Pacific AMT footprint
 - access to Japanese/Korean AMT market & expansion of Chinese AMT market share
 - access to additional technologies (e.g. electro-mechanic actuator)
- Bosch TRS revenue 2018: ¥ 5.0bn (~ € 40m)

CVS offers full range of AMT actuators and control solutions with important customers in Europe and in China. Further projects for next generation AMTs in Europe and North America secured.

Case study 3: Content per vehicle increase through superior functionality Shift from Foundation Drum Brake (FDB) to Air Disk Brake (ADB)

Goals and advantages

- ADB is a higher performing and reliable technology with improved brake control
- ADB shows a better serviceability in comparison to FDB

Drivers for increasing penetration

- Superior product technology ADB increases content per vehicle
- ADB revenue **CAGR 2017 – 2019 of ca. 19%**¹⁾
- Increasing ADAS and automated driving functions additionally drive technology shift to ADB:
 - Improved brake performance required for emergency braking
 - Functions like platooning and highway pilot require superior brake performance



European market widely saturated (ca. 90%)

Growth market **North America:**
ADB adoption rates expected to increase
from 26% in 2018 to 47% in 2024

Next growth market **Asia / Pacific,**
e.g. in China ADB penetration currently ca. 10%,
leaving large untapped market potential

CVS as global market and technology leader (ADB market share of 61%) benefits overproportionally from shift to ADB.

Case study 4: Content per vehicle increase through superior functionality

Shift from manual to torque overlay steering

Goals and advantages

- Torque Overlay Steering (TOS) technology enables new ADAS functions such as lane keeping assistant
- TOS and brake control are the relevant actuators for vehicle dynamics control
- TOS is mandatory for highly automated driving (HAD)

Drivers

- New steering technologies support content per vehicle
- TOS based ADAS functions improve TCO through higher vehicle up time
- Knorr-Bremse CVS Truck Motion Control as a combined approach of TOS and brake control enables superior vehicle dynamics

Market growth for steering systems:
CAGR 8-9%¹⁾
(2018-2022)



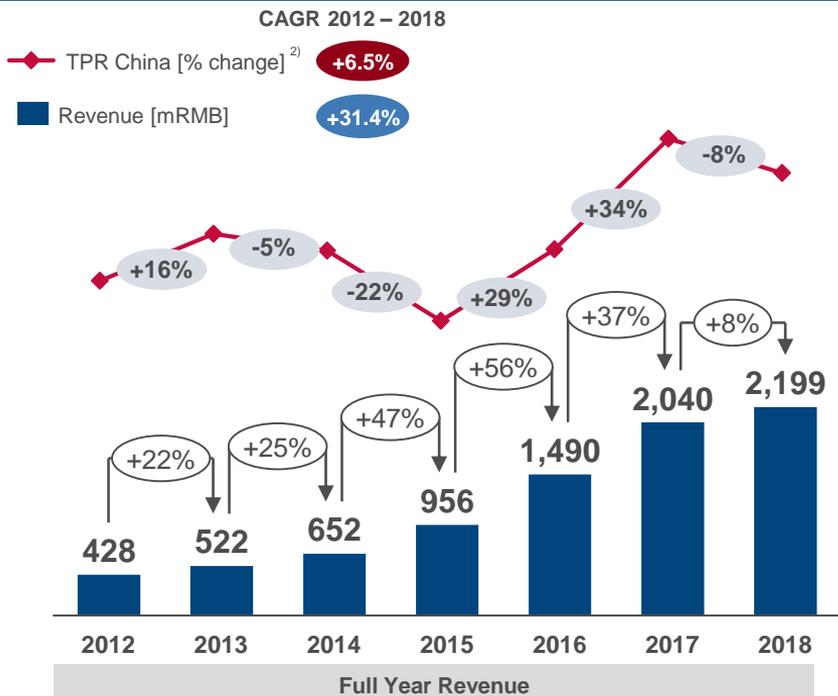
Steering Strategy

- Successful acquisition of **Hitachi CV Steering Business**
- KB Steering Japan is lead unit for global steering push
- KB Steering Japan is market leader for CV steering in Japan
- First projects won in NA and EU
- Integration well on track; business strategy and execution plan implemented

Steering products enhance CVS product portfolio and enable to offer additional ADAS functions and HAD system

Case study 5: Content per vehicle increase through market share increase CVS with sustained growth in a volatile China market

CVS China Revenue Development ¹⁾



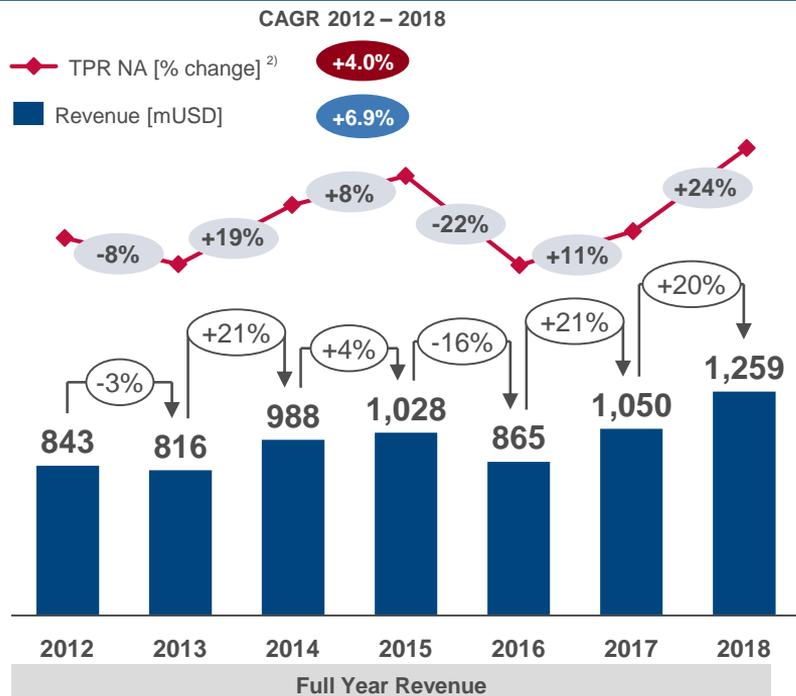
Key messages

- Significant market share gain since 2012 through building up strong position in compressor, damper, electronics, APU and ADB business
- Strong customer relationship and reputation with Top Chinese truck OEMs
- Established KB-DETC JV in 2015 and successfully integrated Dongfeng compressor business in 2018
- Market leadership in brakes business in Chinese market since 2018
- Breakthrough in Trailer business through close cooperation with top trailer axle manufacturers in 2018

Case study 6: Content per vehicle increase through market share increase

Overall outperformance of TPR in North America

CVS NA Revenue Development ¹⁾



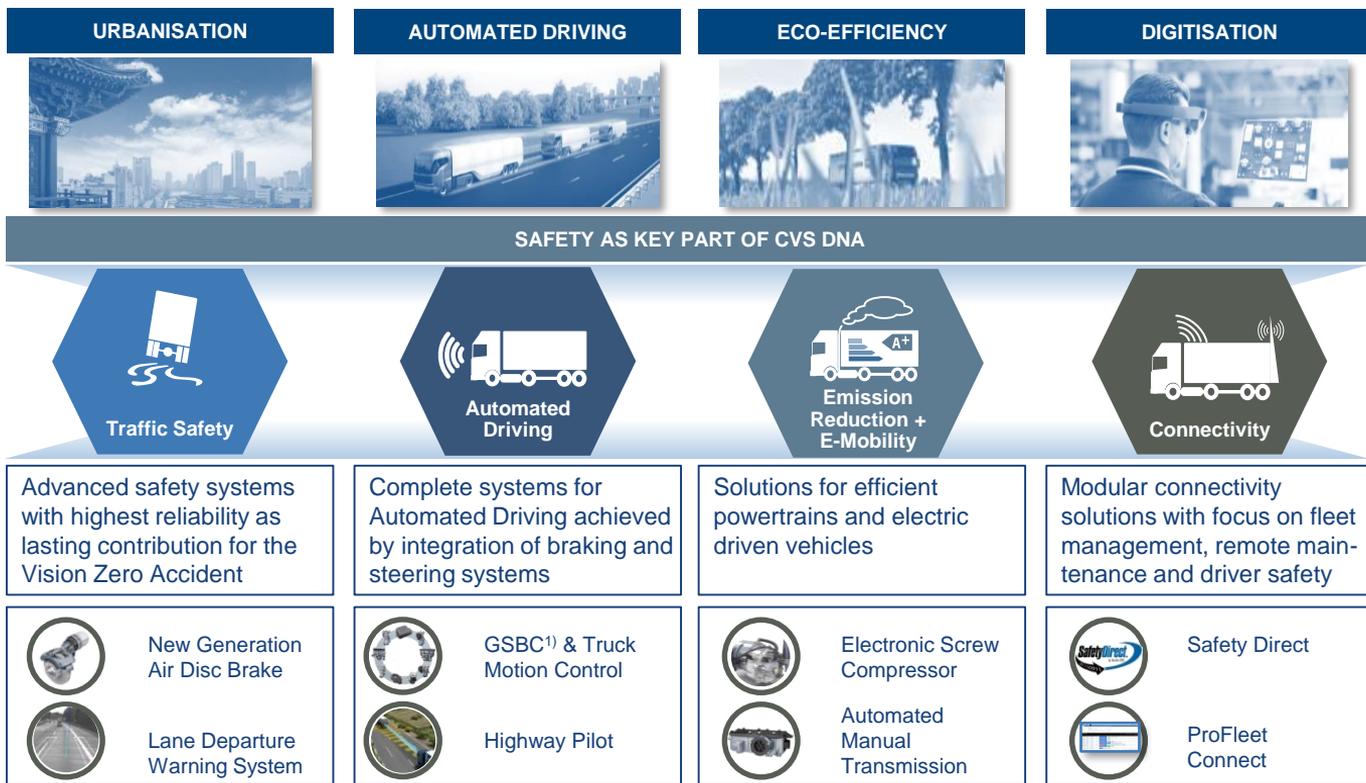
Key messages

- Strong BENDIX brand, market leading position and long-standing customer relationships drove outperformance vs. market
- Strong relationship with truck OEMs and truck fleet operators; CVS convincing especially through high quality and technology leadership
- Continuously dominant market leadership in ADB and leading position in Advanced Driver Assistance technologies foster constant content per vehicle growth and market share gains
- Content per vehicle increase mitigated lower TPR in some years
- Aftermarket: Solid growth driven by increasing installed base

Knorr-Bremse Capital Market Lunch – Deep Dive CVS

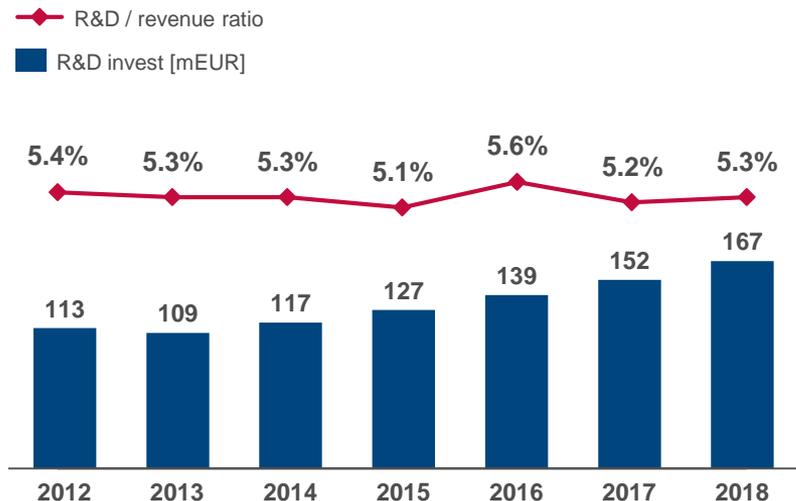
1. CVS Revenue Development and Market Development
2. Drivers for Revenue Growth
3. **Technology Leadership**
4. Operational Excellence
5. Conclusion

CVS's innovation agenda based on four major industry trends



CVS continues R&D invest to maintain technical leadership

CVS R&D cost development



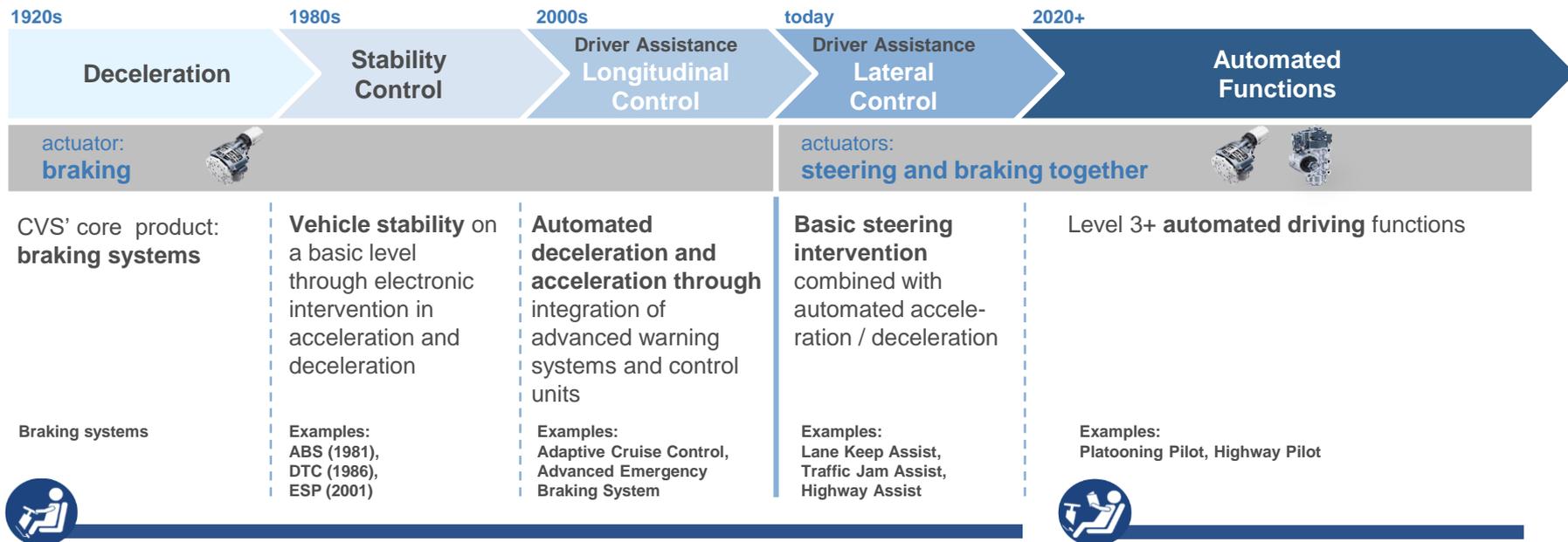
TOP R&D priorities

- Innovation in **core business fields**
- Constant focus on **VA/VE** (Value Analysis/ Value Engineering = systematic method to improve a product's ratio of function to cost)
- Development of products in **new business fields** (e.g. steering)
- Development of products and technologies responding to **industry megatrends**

R&D invest strictly separated in base R&D projects for existing product portfolio and projects responding to industrial trends

Megatrend: Automated Driving

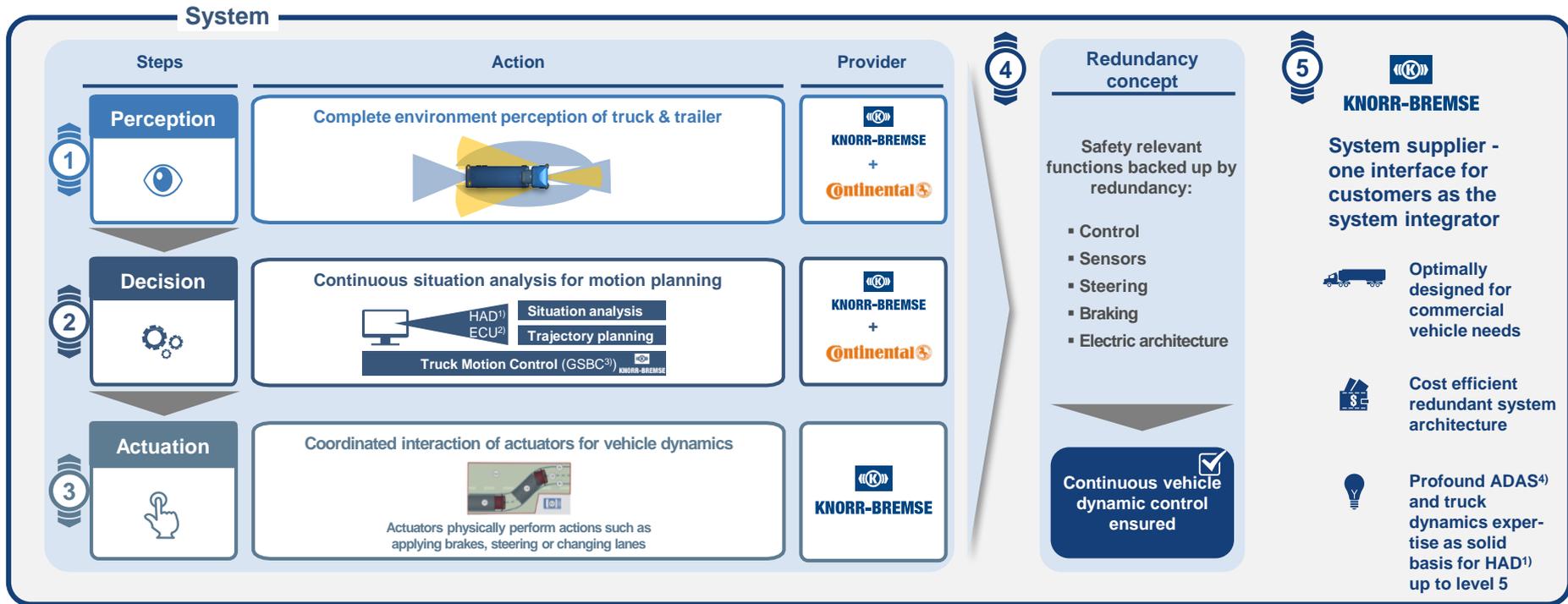
From braking systems manufacturer to automated systems supplier



Combination of braking and steering systems will create new profitable growth markets

Megatrend: Automated Driving

CVS supplies the entire system concept for automated driving



Knorr-Bremse Capital Market Lunch – Deep Dive CVS

1. CVS Revenue Development and Market Development
2. Drivers for Revenue Growth
3. Technology Leadership
4. **Operational Excellence**
5. Conclusion

CVS bottomline is backed by operational excellence

Permanent programs

Continued cost focus KB 2020



- Continuous **site improvement program**
- **Best in class purchasing** with global set-up
- **Continuous VAVE**
- **High level of localization in best cost countries**
- **Asset light** approach

Special programs

Margin stability



- Program set up in each region in order to **ensure expected profitability**
- Savings plan with **dedicated programs** for each subunit, e.g. relocation of valves manufacturing from Europe to India, planned closure of plant in Wülfrath
- Regularly **reviewed by Executive Board**
- **Significant savings already achieved**

Market down-swing



- Different measures designed for each region (e.g. TPR scenario -15% /-25%)
- Launch of specific **counter measures** decided by region after strict investigation
- Gradual **implementation of measures by scenario and region**; e.g.: flexibilization of variable costs, short-time work, focussed R&D

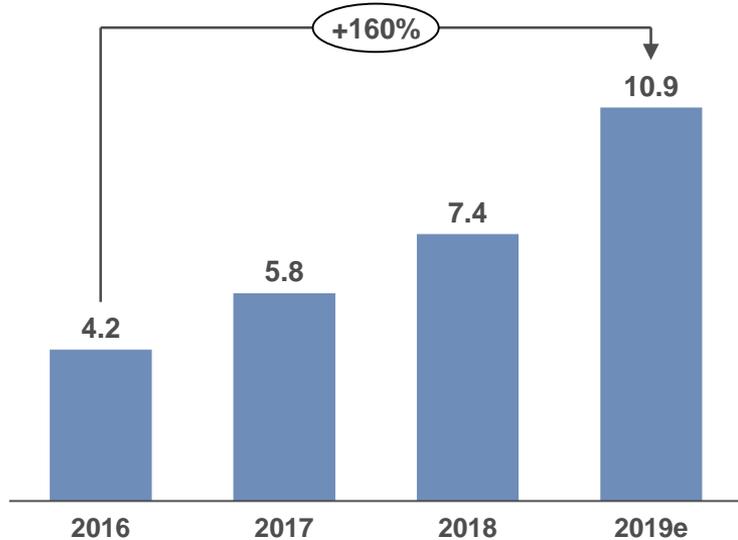
CVS is prepared in case of market downswing

Example cost saving measures:

The production of valves was relocated from Europe to India resulting in savings

NPV development since project start¹⁾

€m



Production line for export in Pune

- Production of valves for European market was **moved from locations in Italy and Hungary to India**
- Relocation started in 2016, last steps to be finished **by 2021**
- Production cleared by customers
- **Net Present Value** is consequently increased through additional measures



The relocation of valves production is generating sustainable savings

Knorr-Bremse Capital Market Lunch – Deep Dive CVS

1. CVS Revenue Development and Market Development
2. Drivers for Revenue Growth
3. Technology Leadership
4. Operational Excellence
5. **Conclusion**

CVS confirms mid-term¹ guidance of 4 to 5% revenue growth over the cycle

CVS is well prepared for the future and well positioned in the market



Increase of **content per vehicle** in all markets mitigating TPR volatility



Market share increases in growth markets



Fostering of **technological leadership** through consequent invest in R&D



Operational excellence



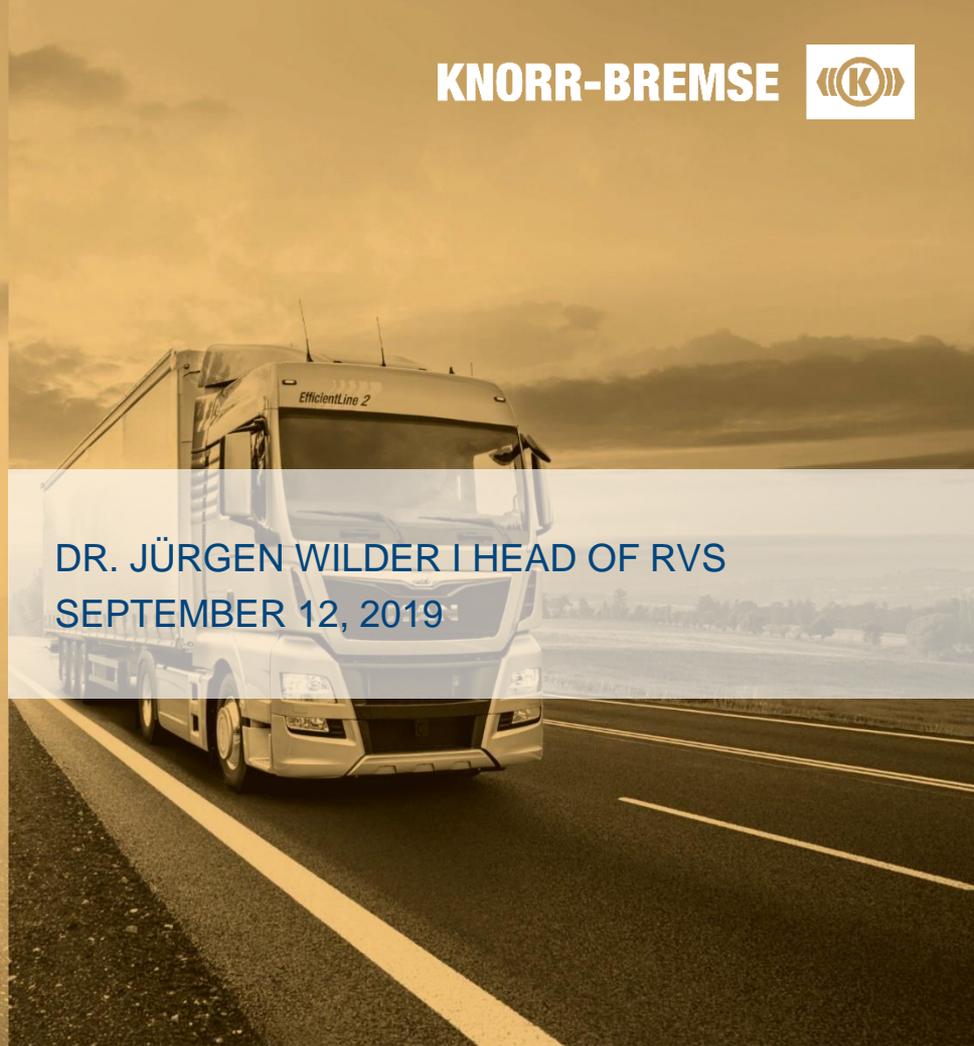
Targeted **cost optimization programs** to protect margins



Excellent **customer relationships**

Capital Market Lunch

Deep Dive RVS



DR. JÜRGEN WILDER | HEAD OF RVS
SEPTEMBER 12, 2019

RVS with high-quality business model – Outperformance and resilience



1	Market leadership	<u>Global market leader</u> , scale advantage
2	Technology leadership	<u>Strong technology innovator</u> shaping industry standards, return on R&D spend outperforming peers
3	High barriers to entry	<u>Safety-critical products</u> with significant homologation barriers, RVS only supplier certified for all standards and norms globally
4	Strong growth profile	Attractive transportation and mobility end-markets, <u>long track record of outperforming underlying markets</u> – through both OE and AM business
5	Resilience	Steadily growing business through customer/region/product mix, <u>strong aftermarket</u>
6	Profitability	<u>Outstanding profit margins</u> and track record of margin expansion and cost management

Knorr-Bremse Capital Market Lunch – Deep Dive RVS

1. **Market Opportunities**

2. Aftermarket Growth (RailServices)

3. Innovation

4. Summary

RVS sees continued growth with increasing profitability

Car builders confirm a positive market trend and report a strong order backlog

“ At € 40.0bn on June 30th, 2019, the current backlog provides strong visibility on future sales.
 Alstom

“ Transportation’s backlog of USD 33.6bn [...] positive market outlook for the rail industry remains unchanged.
 Bombardier

“ Record year for train deliveries and orders. Order intake 12% higher than forecast at YEN 714.6bn with book-to-bill ratio of 1.16.
 Hitachi

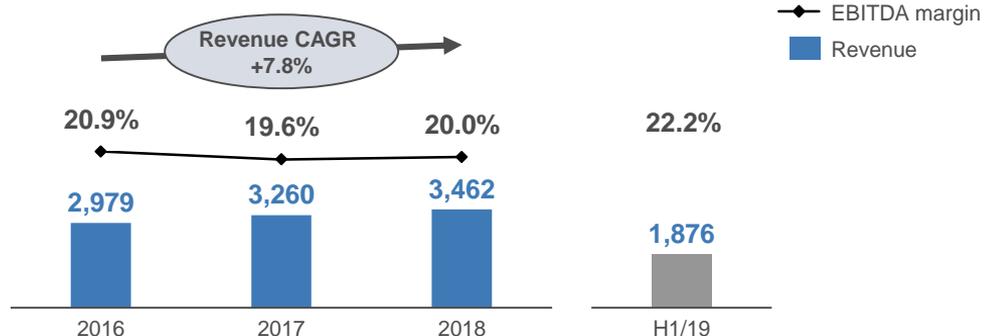
“ Orders rose on higher volume from large orders.
 Siemens

“ Year-on-year growth of 44% in Rolling Stock net revenues and 10% in the Service and Components business.
 Stadler

“ Intense order intake raised the CAF Group backlog to a new all-time high of € 8.8bn (+11%).
 CAF

RVS revenue & EBITDA margin

[€m, IFRS]



Global market position of RVS



Brake systems



Entrance systems



HVAC systems



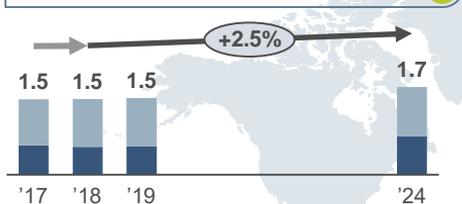
Underlying global rail market with steady and robust growth

Development of markets

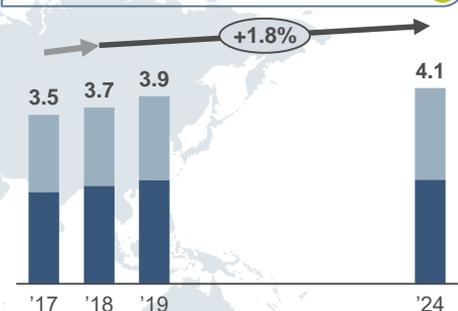
Market volume Brakes, Doors, HVAC, incl. labour [€bn, CAGR in %]

AM OE

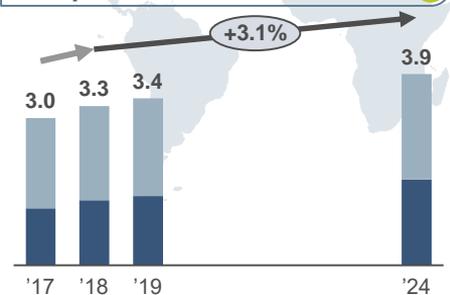
North & South America



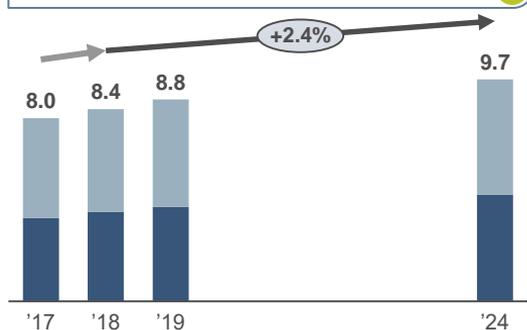
Asia Pacific



Europe / Africa



World



Aftermarket

- Aftermarket growth in all regions, volume wise mainly in Europe and Asia Pacific

Original Equipment

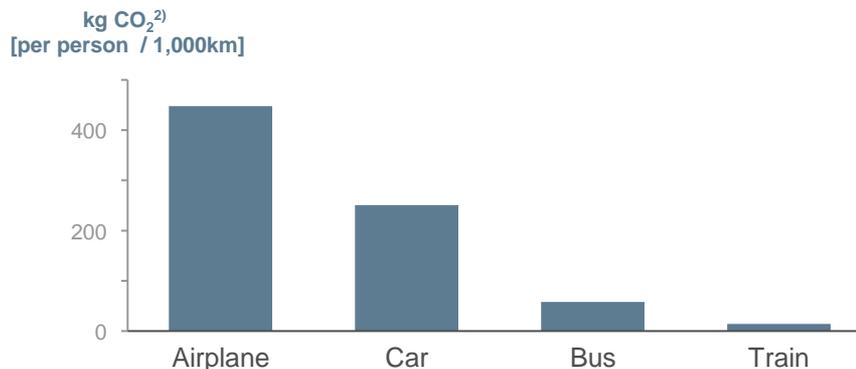
- Europe and Asia Pacific will see a further increase in the Passenger market until 2021
- North America expects a slow down in Freight business, but an increase in Passenger business from 2020 on

Rail market will get additional tailwind from latest climate discussions

Megatrends with impact on the Rail industry

- Urbanisation
- **ECO-EFFICIENCY**
- Automated Driving
- Digitization
- Safety

CO₂ emissions in passenger transport



Transport is the only sector with an increase in emissions to a level well above their 1990 levels – despite a 60% reduction target by 2050¹⁾

Only with a shift to rail the climate targets in the transport sector will be reached



RVS is #1 in almost all strong growth markets

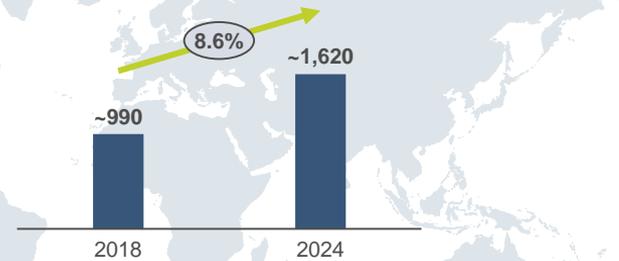
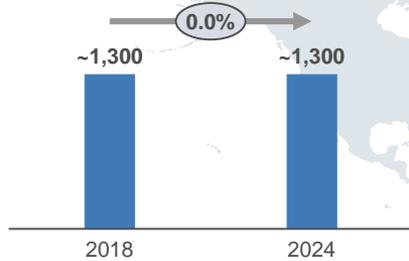
OE market development

Market volume Brakes, Doors, HVAC [€m, CAGR in %]

China¹⁾



Selected biggest growth markets



	CAGR '18-'24	 ²⁾
North America & Mexico MT	~6%	
France	~11%	
Italy	~13%	
Russia & CIS (High Grade)	~6%	
Scandinavia	~17%	
Spain & Portugal	~35%	
India (High Grade)	~5%	
SEA Hong Kong & Taiwan	~15%	
Selected biggest growth markets	~9%	
RoW ³⁾	~2%	

1) High Grade only, w/o conventional market 2) Brakes, Doors, HVAC 3) Rest of World w/o selected biggest growth markets & w/o China





Example China: RVS growth is fueled by profitable aftermarket business

Market development



High government spending

- 5-year-plan with investment level at **RMB 3,500bn** (~ € 448bn as of 2017)



Fastest growing Rail network globally

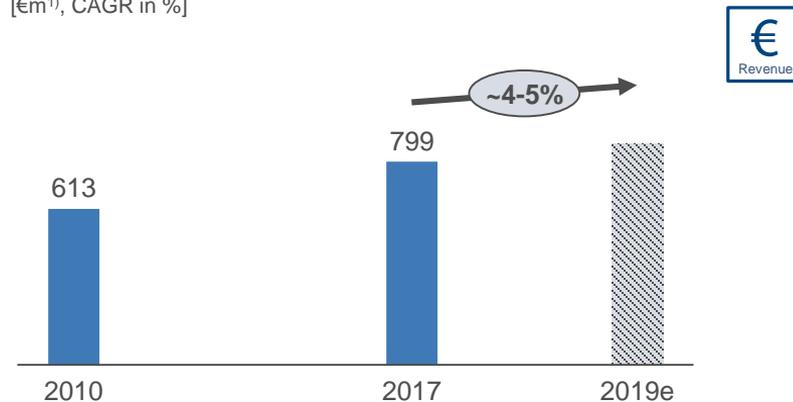
- **175,000km total length** expected to reach by 2025
- Connect **>80% of cities with >1m population** by high speed train rail
- Improved development in rural areas
- **~60% urbanization ratio** of permanent residents require further mass transit development, **Metro growth**
- Government projects (e.g. **Belt and Road Initiative**) creates significant long-term growth opportunity



High number of recent installations drive aftermarket potential

RVS' revenue China

[€m¹], CAGR in %]



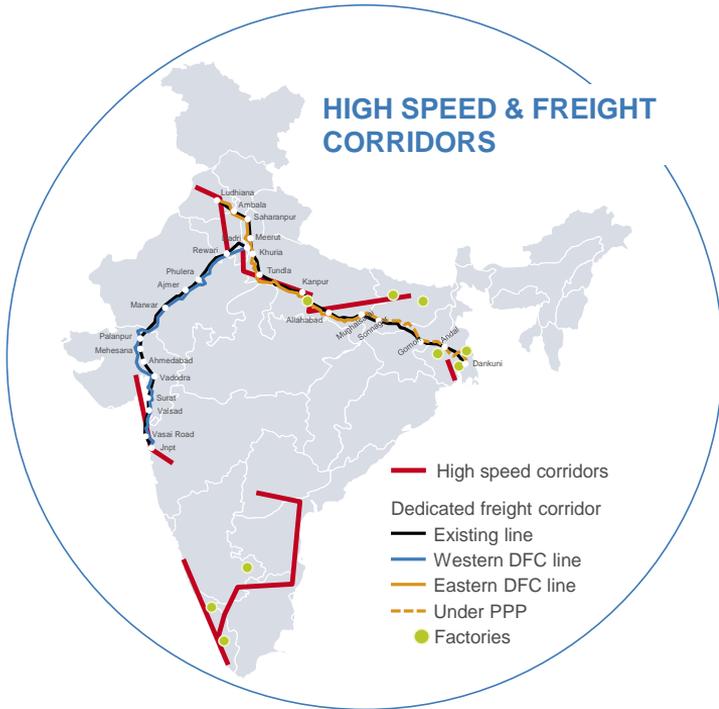
- OE business with an overall stable development, with a RVS revenue increase in Metro business
- RailServices growth from a large installed base, esp. MU high speed deliveries
- Increased aftermarket share has positive impact on profitability
- Aftermarket share growing



Example India: Significant growth opportunity over next several years

Market growth drivers

-  **Electrification**
 - 35,000km railway lines targeted, production of **E-Locos** from 250 to 600 p.a.
-  **Passenger coach production growth**
 - ~5,000 – 6,000 LHB (Linke Hofmann Busch) coaches p.a.
-  **EMUs development**
 - **Train 18, Train 20**: increased demands for Electric Multiple Units
-  **High speed corridors**
 - 7 high speed corridors (10,000km) and € 140bn investment in next 10 years
-  **Dedicated freight corridors**
 - **3,338km** to be completed by Dec-20 for Western & Eastern freight corridor: Delhi – Mumbai (1,839km, until Dec-19) and Ludhiana–Dankuni (1,499km, until Dec-20)
-  **Metro**
 - Currently 9 major cities covered¹⁾ with ~3,500 cars, potential for additional 26 cities (cities > 2m inhabitants)
 - ~550 cars p.a. for 2018 – 2023 expected





Example India: RVS with excellent market position based on local presence already since the 1990's



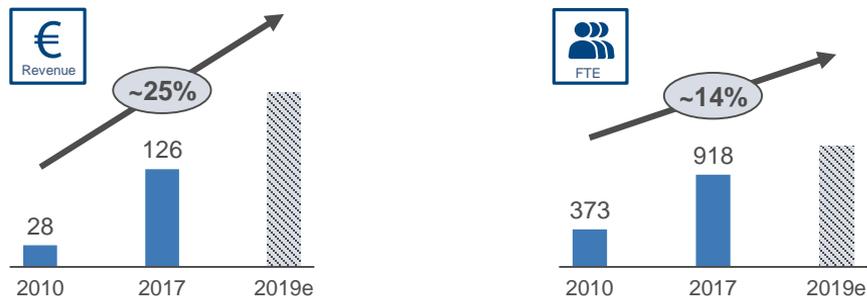
Knorr-Bremse India, Palwal

Local production

- Brake control systems
- Bogie equipment
- Air dryers
- Contactors, resistors
- Dampers

RVS' revenues and headcount

[€m¹], CAGR in %]



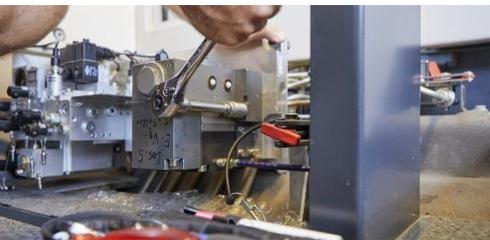
RVS growth factors for the future

- Addressing the market with a broad product portfolio since 1993
- Local manufacturing, engineering and service footprint
- State-of-the-art production facility in Palwal
- Capacity enhancement & factory expansion
- Further localization of production

Knorr-Bremse Capital Market Lunch – Deep Dive RVS

1. Market Opportunities
2. **Aftermarket Growth (RailServices)**
3. Innovation
4. Summary

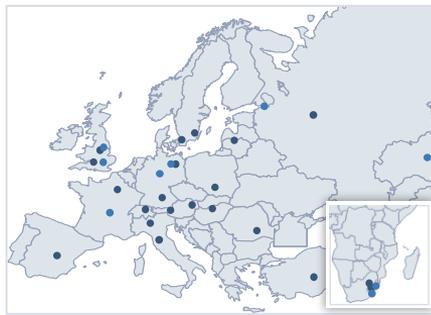
Aftermarket business is a local business – well served by RVS' set-up



Americas



Europe



Asia



Short lead time in repair business & local regulations can only be catered by local presence.

Total

40 Major service centers¹⁾
&

21 Major service locations at customers' premises

2k Service personnel²⁾

Aftermarket (RailServices) strategy targeting significant growth: ~45% of RVS' revenue by 2024, coming from ~40% in 2018



Servicing the installed base

- Efficient spare part solutions
- Service of Knorr-Bremse products
- Obsolescence management



Modernization

- Modernization of Knorr-Bremse as well as non-Knorr-Bremse products
- Upgrade solutions
- Increased scope by cross-product solutions



New service models & digital solutions

- Digitization
- Development of new customer value driven service models
- Service of third party Rail components
- Co-operations & partnerships



Aftermarket (RailServices) business expected to grow beyond € 2bn by 2024

Characteristics aftermarket

- Long customer relationships & loyalty of >30 years
- Through tear & wear very attractive, high margin business
- Underlying global Rail market 2010-2016 CAGR 2-3%

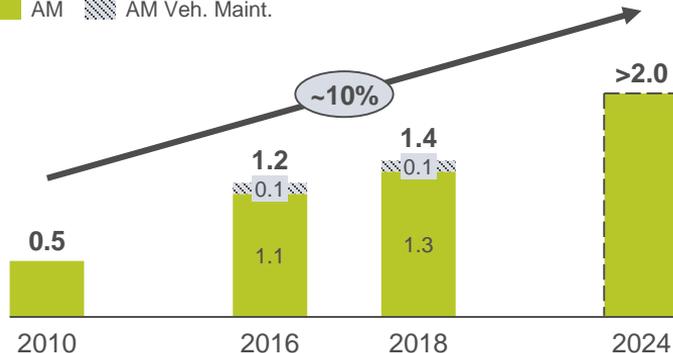
Development aftermarket

- Higher focus on **lifecycle costs** and **availability commitments** (contractually binding)
- **Digitization** with new players
- Increased business demand for **reduced energy** consumption

RVS aftermarket

Revenue development [€bn] ¹⁾

■ AM ■ AM Veh. Maint.



- Global footprint with a strong local presence
- High installed base
- High customer retention rate
- Additional data driven business models
- Development of energy efficient solutions

RAILSERVICES
always on track

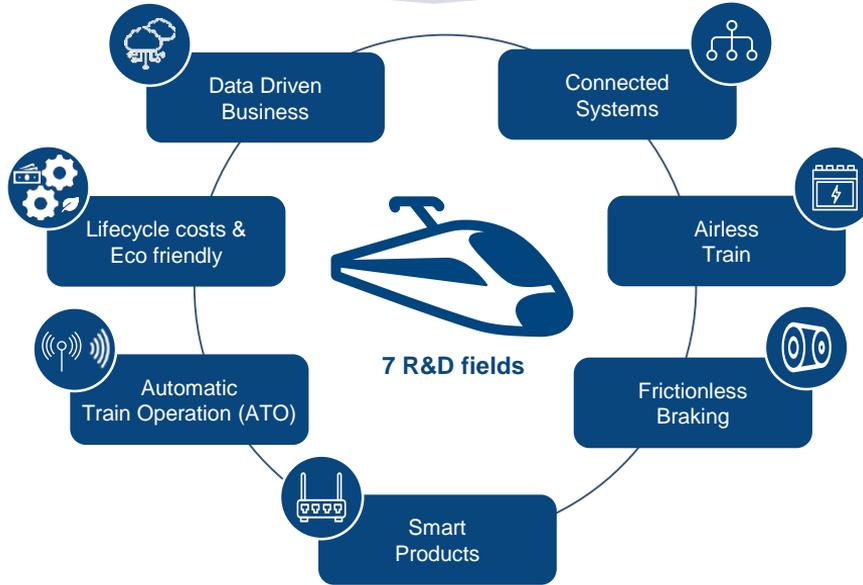


Knorr-Bremse Capital Market Lunch – Deep Dive RVS

1. Market Opportunities
2. Aftermarket Growth (RailServices)
- 3. Innovation**
4. Summary

RVS' R&D agenda is focused on customers' needs – staying ahead of competition

Technology and market trends

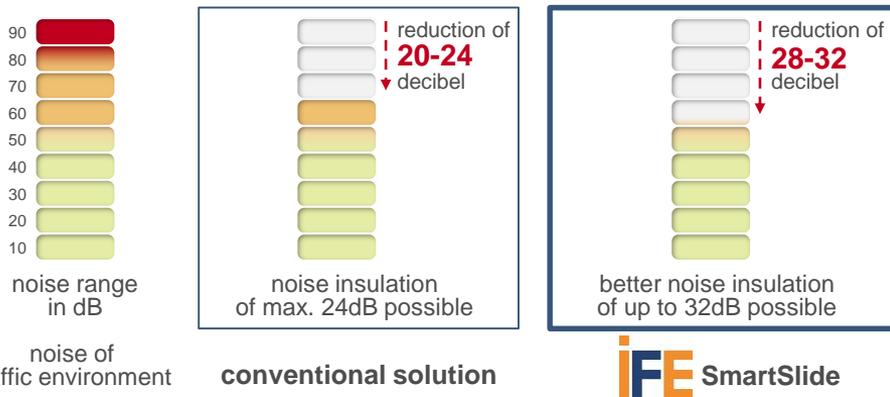
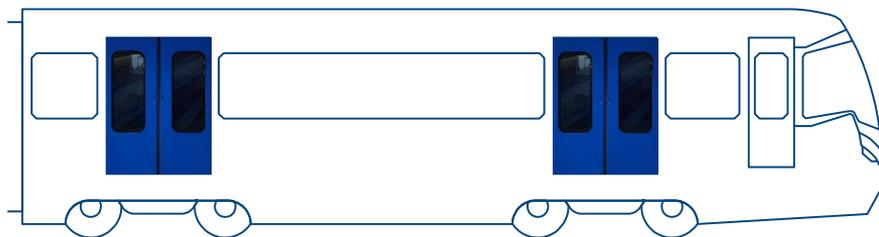


Key future customer needs

Deep Dive Knorr-Bremse solutions for specific customer needs

- Optimized lifecycle costs
- Standardized solutions
- More intensive use of existing infrastructure
- Reliability & passenger comfort

IFE doors increase passengers' comfort and provide shorter dwell times in stations



Key Facts

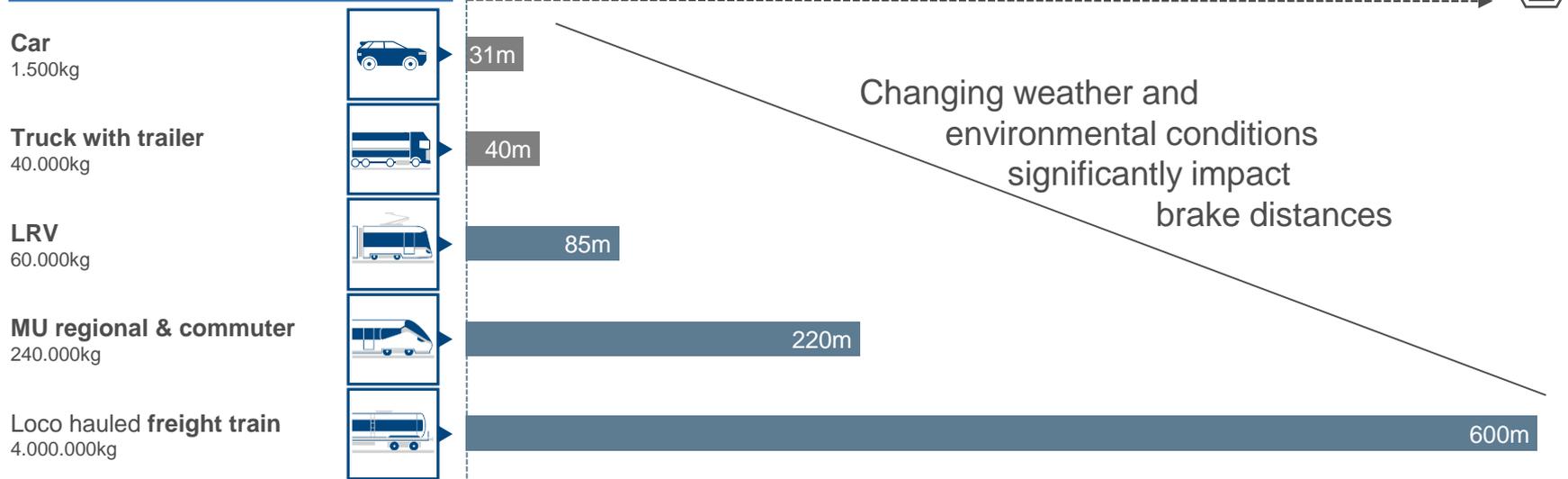
- Significant noise reduction is reached by the IFE patented lifting kinematics for sliding door systems
- Successful market launch:
2 megacities decided in favor of this solution:
Beijing - Metro Line 17, Moscow - Metro 2020
further projects in the tender pipeline

Customer Benefits

- Setting a new standard for passenger comfort in metro applications of sliding door systems
→ better noise insulation (up to 32dB)
- Shortened opening and closing times compared to sliding plug doors
→ shorter dwell times in stations
→ increased passenger flow and capacity utilization of existing infrastructure

The enormous brake distances in Rail require outstanding braking performance

Different braking distances at 80km/h



Different braking distances at 330km/h



New smart products keep us ahead of the competition

Unique Selling Proposition

- **Standardized** solution across train types reduces complexity at operators & car builders
- **Reduced life cycle costs & increased reliability**
- Lighter and requiring a **smaller installation envelope**
- **Software** updates provide **new features** e.g. for optimized braking performance

enabler for
Automatic Train Operations (ATO)

New brake control system EP2002 3.0



Urbanization demands increased Rail transport capacity, which can be most economically satisfied by improved use of existing infrastructure

Urbanization

Increasing need for transport capacity



Optimized use of existing Rail infrastructure – Reduced train headway



Automatic Train Operation

RVS innovations



Reproducible
Brake Distance



Environment
Observation

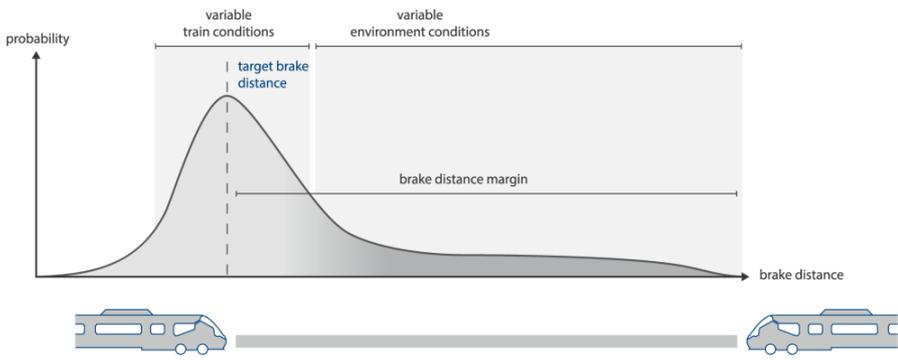


Digital
Communication

Reproducible Brake Distance is a key technology for automatic train operation (ATO) and higher utilization of infrastructure

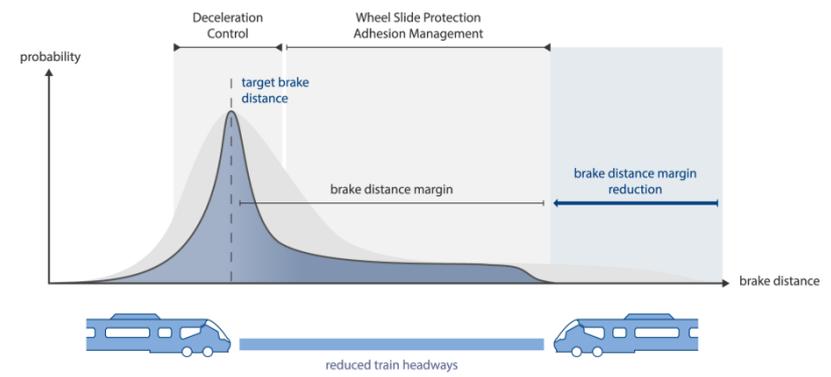
Situation

- **Unpredictable stopping accuracy** in ATO
- ↓
- Reduced operational stability
- ↓
- High signal headways
- ↓
- **Inefficient infrastructure utilization**



Solution: Reproducible brake distance

- **Deceleration Control** compensates brake system variations
- ↓
- Wheel Slide Protection and **Adhesion Management** compensates track condition variations
- ↓
- **Reproducible Brake Distance**





Environment Observation (EO) is not only a key enabler of ATO, it also opens up numerous additional growth opportunities

RailVision technology / application

Automatic environment recognition

- Detects objects in a distance of 2km under all weather conditions
- Very high resolution



detection, identification and classification

challenge



modern sensors combined with artificial intelligence

solution

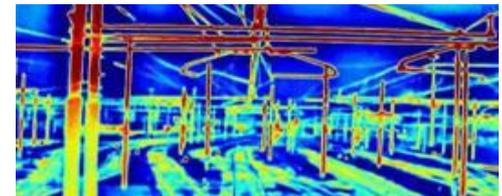
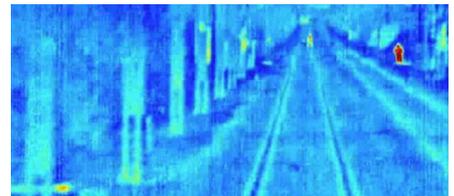
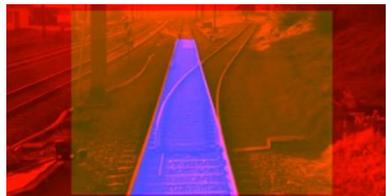


corrective (automated) actions

options / outcome

Additional customer value proposition using EO technology:

- Platform & infrastructure monitoring
- Automated railway network mapping
- Visually assisted geo positioning
- Remote train operation



Knorr-Bremse Capital Market Lunch – Deep Dive RVS

1. Market Opportunities
2. Aftermarket Growth (RailServices)
3. Innovation
4. **Summary**

RVS confirms positive market outlook and mid-term guidance of 5 to 6% revenue growth



- Steadily growing market with record backlog for RVS customers
- RVS #1 market position in key growth markets
- Dense service network & new service models will lead to > € 2bn aftermarket business by 2024
- Key innovations will open doors for software-based feature upgrades in products
- Margin expansion primarily through aftermarket growth and efficiency improvements

BACKUP

KNORR-BREMSE



Financial calendar

Upcoming events

Event	Date	Location
UBS Quo vadis	20.09.19	Munich
Berenberg & Goldman Sachs 8 th German Corp. Conf.	23. & 25.09.19	Munich
Baader Investment Conf.	24.09.19	Munich

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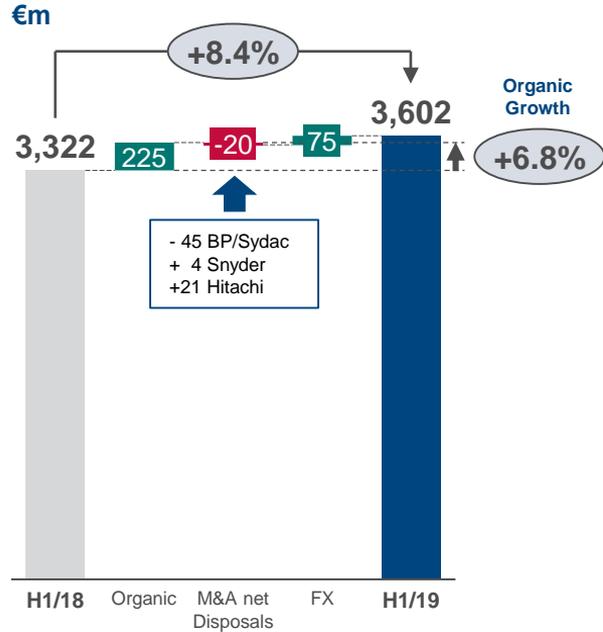


Justinian Späth

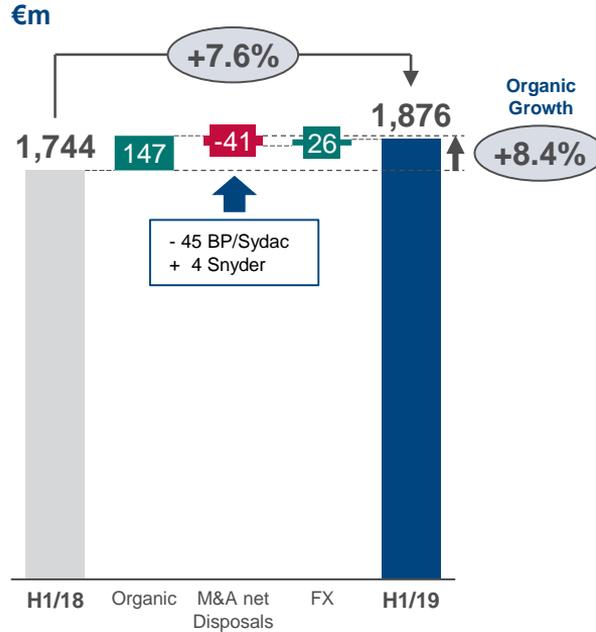
Phone: +49 89 3547 181085
Mobile: +49 160 6149309
Email: Justinian.Spaeth@knorr-bremse.com

Revenue Group, RVS & CVS (H1/19)

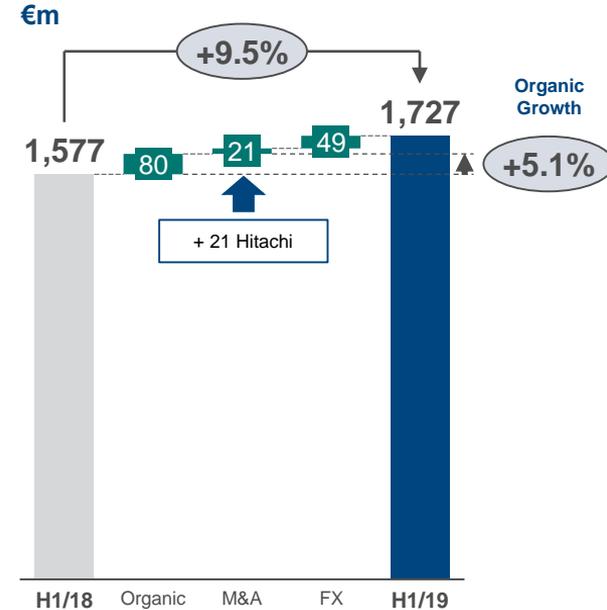
Group – Revenue



RVS – Revenue

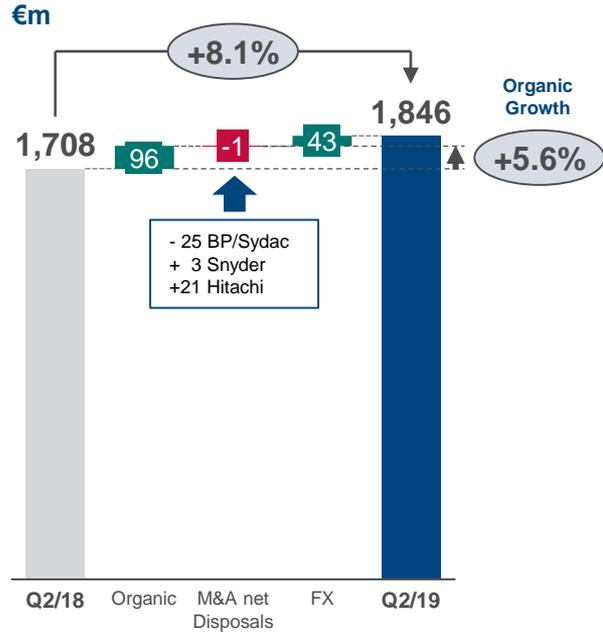


CVS – Revenue

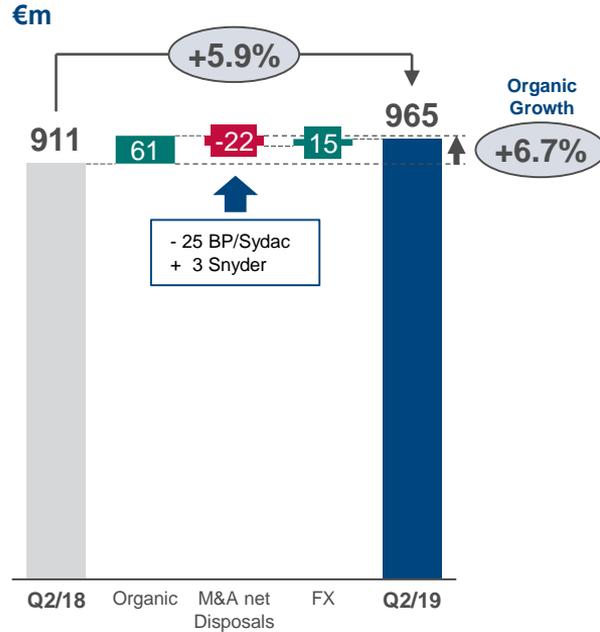


Revenue Group, RVS & CVS (Q2/19)

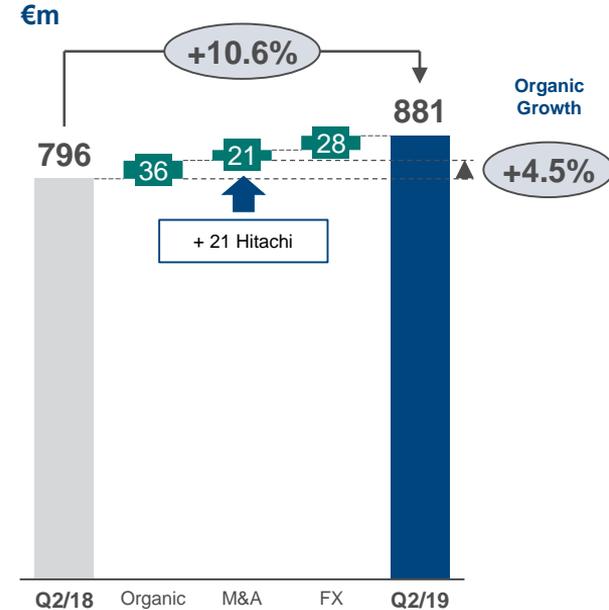
Group – Revenue



RVS – Revenue

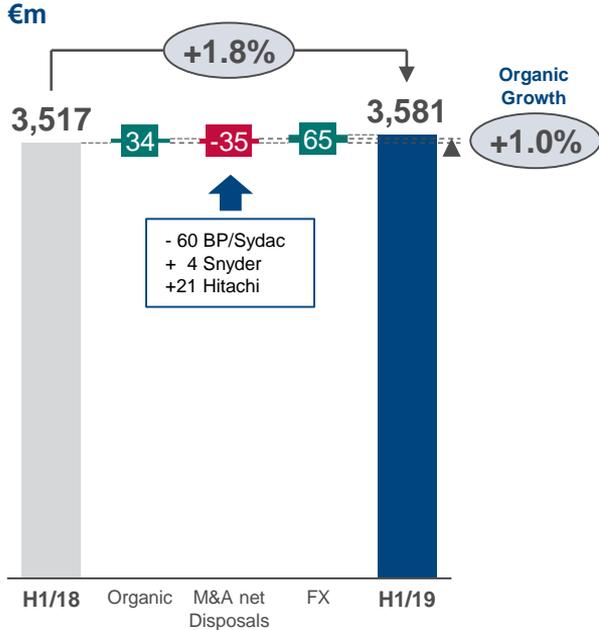


CVS – Revenue

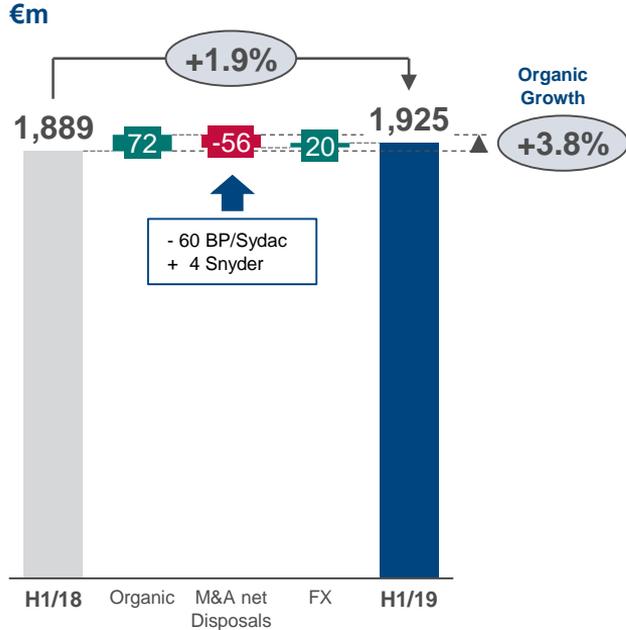


Order Intake Group, RVS & CVS (H1/19)

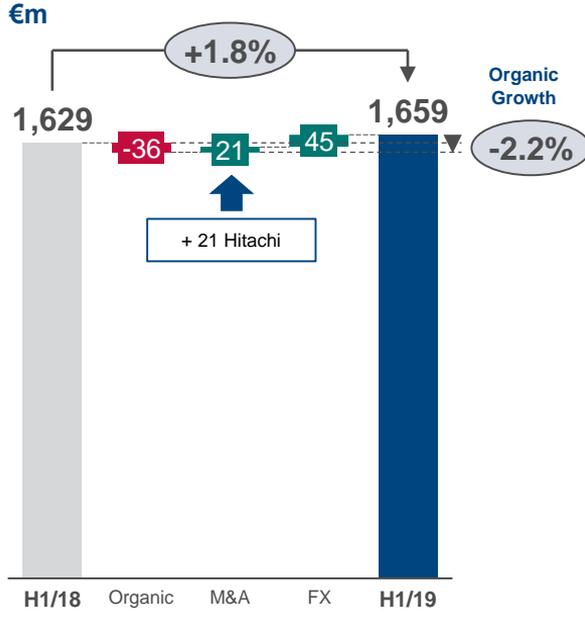
Group – Order intake



RVS – Order intake

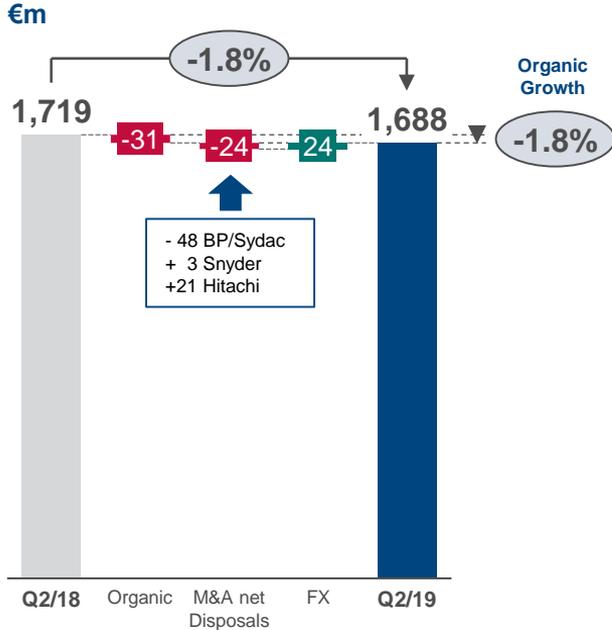


CVS – Order intake

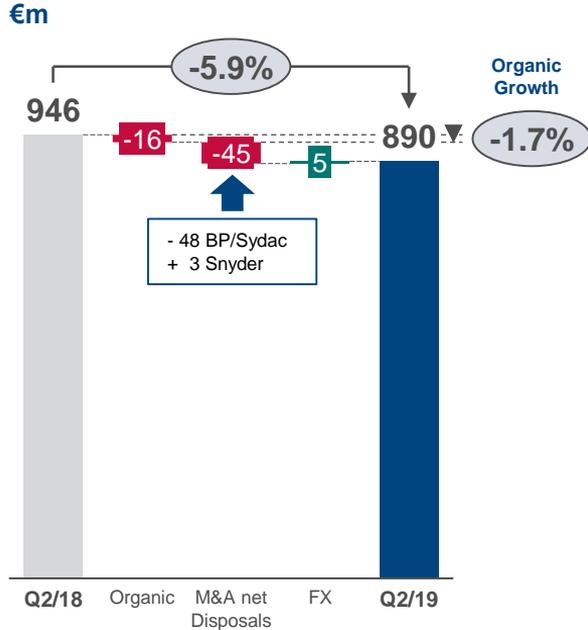


Order Intake Group, RVS & CVS (Q2/19)

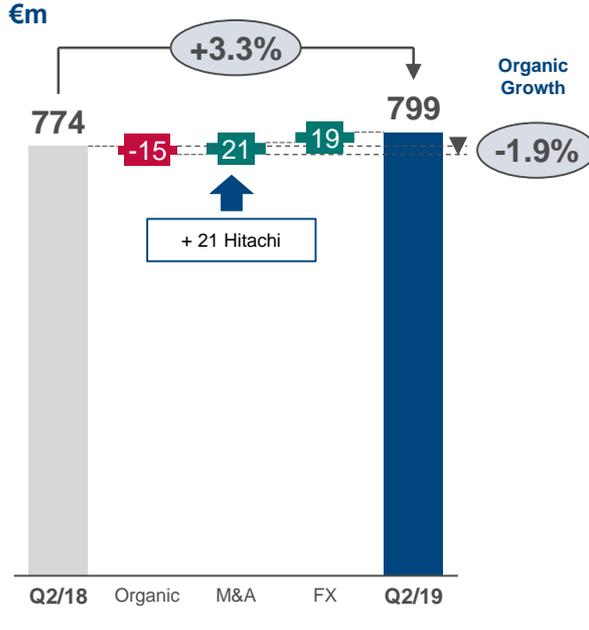
Group – Order intake



RVS – Order intake



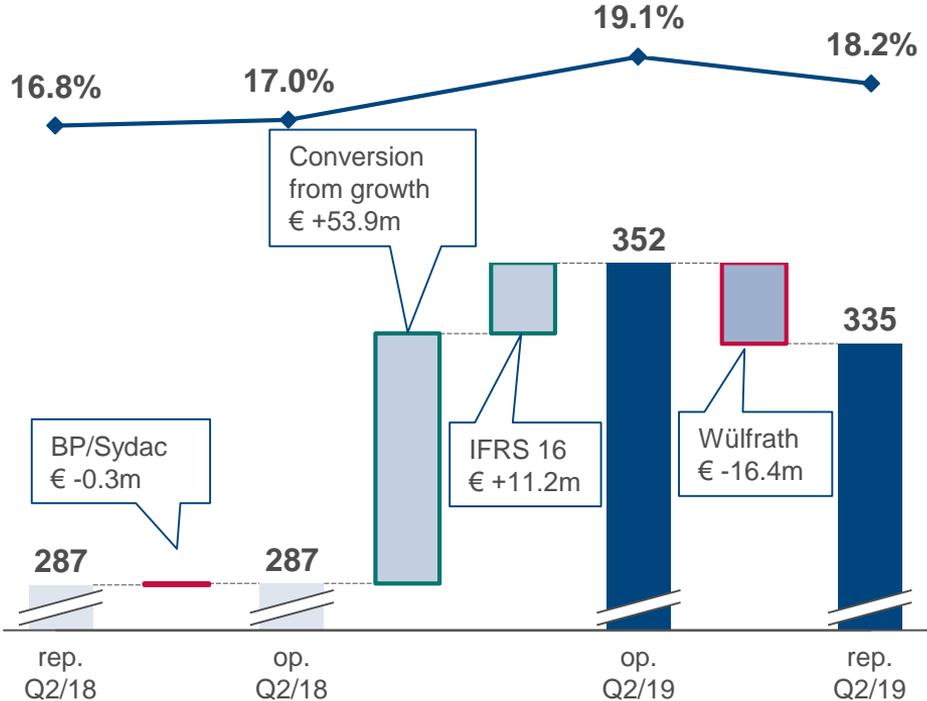
CVS – Order intake



EBITDA Group (Q2/19)

EBITDA Q2/19

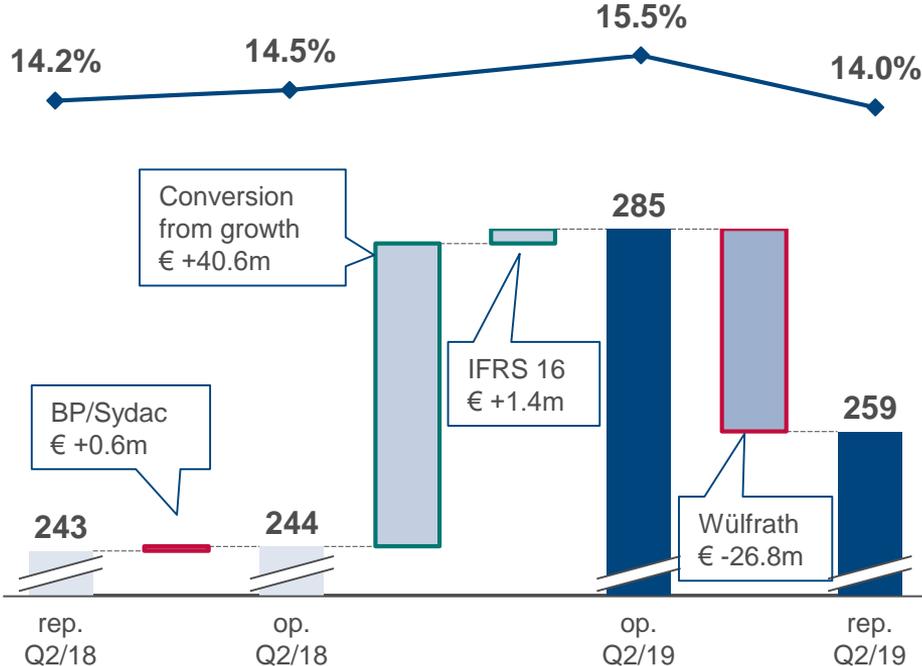
€m ◆ Margin



EBIT Group (Q2/19)

EBIT Q2/19

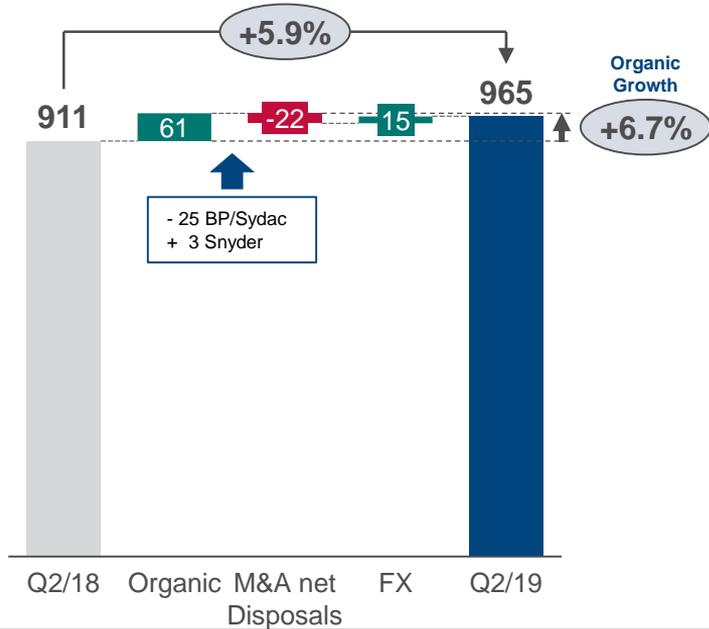
€m ◆ Margin



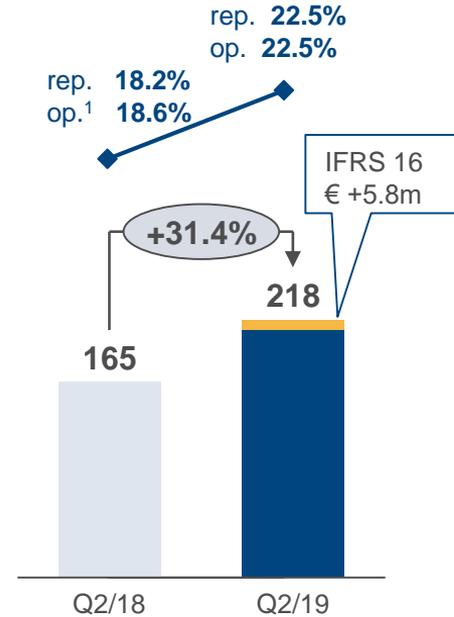
Revenue and EBITDA RVS (Q2/19)

Revenue

€m



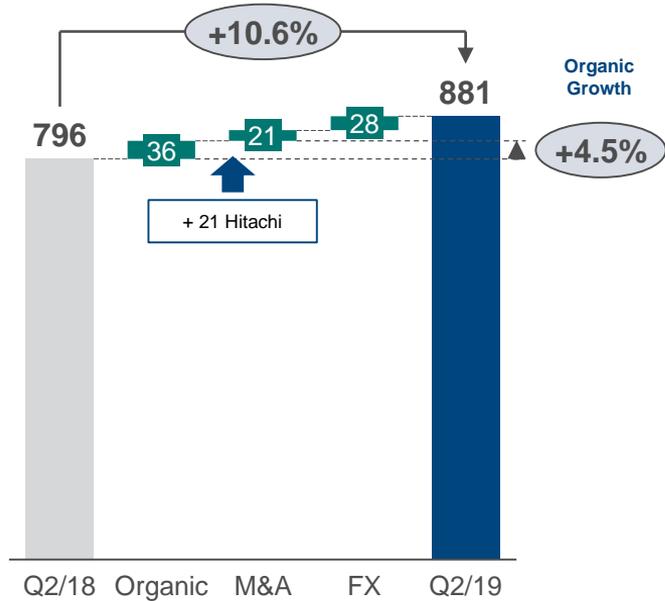
EBITDA



Revenue and EBITDA CVS (Q2/19)

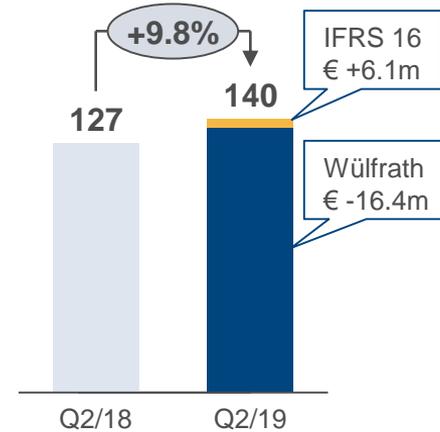
Revenue

€m



EBITDA

rep. 16.0% rep. 14.0%
 op. 16.0% op.¹ 15.9%



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