



Long-Term Relations Between Joint Venture Partners – A Supplier's Perspective.

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Herrenknecht Group and Core Markets.

Corporate
Brand

HERRENKNECHT

Core
Markets



Core
Brands



Group
Brands

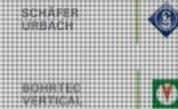
Additional Equipment



Additional Equipment



Additional Equipment



Services



Services



Services



Herrenknecht. Pioneering Underground Technologies



Lived CSR at Herrenknecht | Base of a long-term relationship.

Ethics. As a global player in plant manufacturing, Herrenknecht is active in numerous countries with different **values, political systems, legal orders** & makes a **binding commitment** to them.

→ **Worldwide active in more than 80 countries**

Partnership. It is our ultimate goal to support the project challenges of our customers at the highest level at all times. Herrenknecht sees itself as a **team partner** in **all project phases** & for all parties substantially involved in a tunnelling project. Teamwork based on **trust** is our guiding principle.

→ **70% of our TBM sales is induced by long-term customer relationships**

Respect. The **recognition of the achievements** of our employees as well as **respectful & open relationships** with each other – **irrespective of cultural & ethnic backgrounds** – play an important role in our corporate culture & our global business relations.

→ **5000 employees in 40 countries**

Lived CSR at Herrenknecht | Base of a long-term relationship.

Sustainability. Our products secure the essential requirements for **environmentally friendly mobility** of people & goods, for a sustainable **use of valuable natural resources**, & for the **targeted exploration of raw material deposits & energy sources**. We make sure that **environmental standards** are adhered to already during the production of our tunnel boring machines.

→ **More than 2,850 successfully finished infrastructure projects**

Sustainability. What is more, the **remanufacturing approach** of Herrenknecht is setting a global standard in the manufacturing of tunnel boring machines. The re-use of field-proven components in new projects lowers carbon dioxide emissions & **reduces the energy & resource consumption** for manufacturing significantly.

→ **Most powerful remanufacturing plant in the industry**

Lived CSR at Herrenknecht | Base of a long-term relationship.

Transparency. We offer our customers tailor-made solutions in the sense of “full-range solutions” which are comprehensively adjusted to their projects. **Clear value propositions, measurable benefits** for the customer & transparency play an important role in this.

→ **Technical and economical transparency by lived partnership**

Safety. The success of our company is based on the **high quality & technical standards** of our core products, additional equipment & services. Our tunnelling systems provide high levels of safety for **site personnel, people, infrastructure & buildings**.

→ **more than 1000 km of metro tunnel safely produced with
Herrenknecht technology**

Chances & Challenges of global business.

An **international supply chain network** creates additional options for production and delivery in terms of efficiency, capacity, and speed.

Diversification of market risks with a global sales market.



Different certifications pose a challenge for our reman business

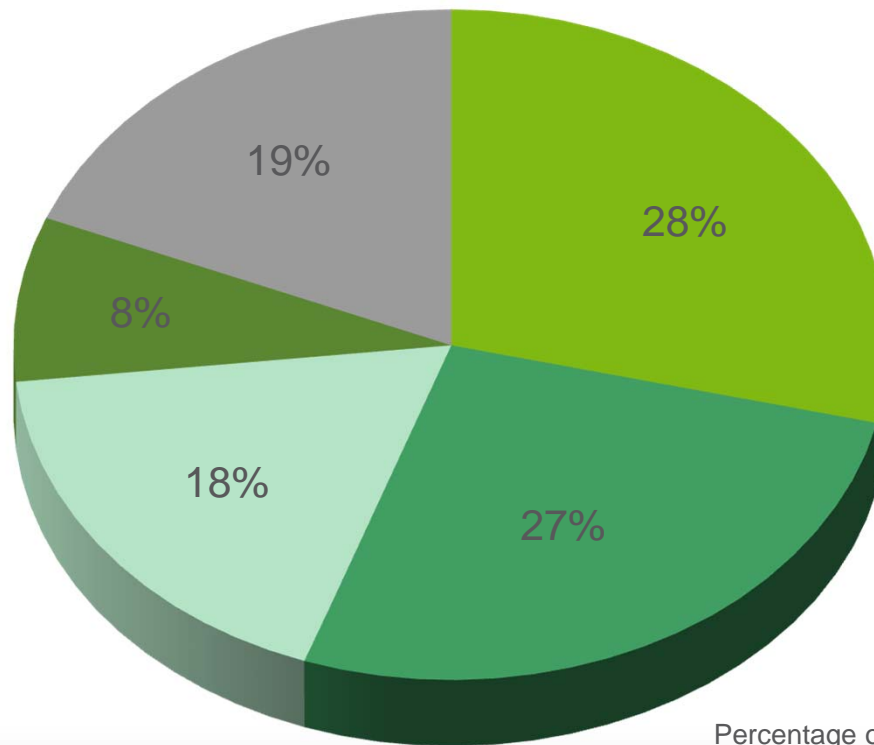
Globally active construction companies & changing joint ventures put the **contract management** to the test.

Observation & implementation of **country-specific social legislation** when sending service personnel abroad.

The reality is that close relationships can often make the difference between long-term sustainability of the business and short-run dissolution.

[Matthew B. Myers, Nestlé Professor University of Tennessee-Knoxville]

70% of our TBM sales is induced by long-term customer relationships.



70% of our TBM sales

- 6 - 10 Years
- 11 - 15 Years
- 16 - 20 Years
- 21 - 25 Years
- 26 - 30 Years

Percentage of long-term customers,
business relationship > 6 years



Success factors in a long-term relationship.

Quality of the product
and the service

Honesty and trust

Mutual exchange of know-how

Tailor-made
solutions for customer
requirements

Unique products and
services compared with
competitors

Shared advantages of long-term customer relationships

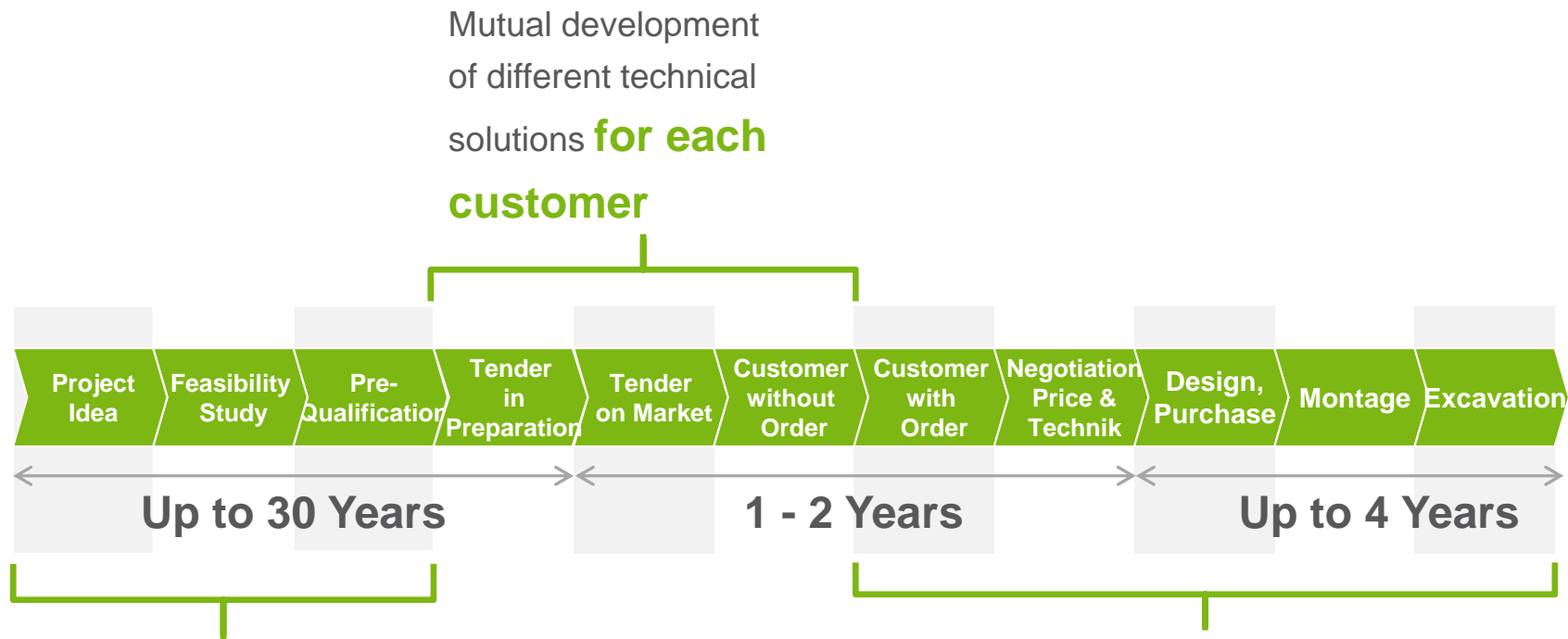
Reduction of technical and economical risks

Optimization of project costs

Joint technological progress



Mutual development of technical innovation in every phase. Together with the customer.



Larger and larger together with the customer. Development history of the shield diameter.



HERA
5.95 m

Sydney
10.70 m

Hamburg
14.20 m

Shanghai
15.43 m

Hong Kong
17.60 m

1985

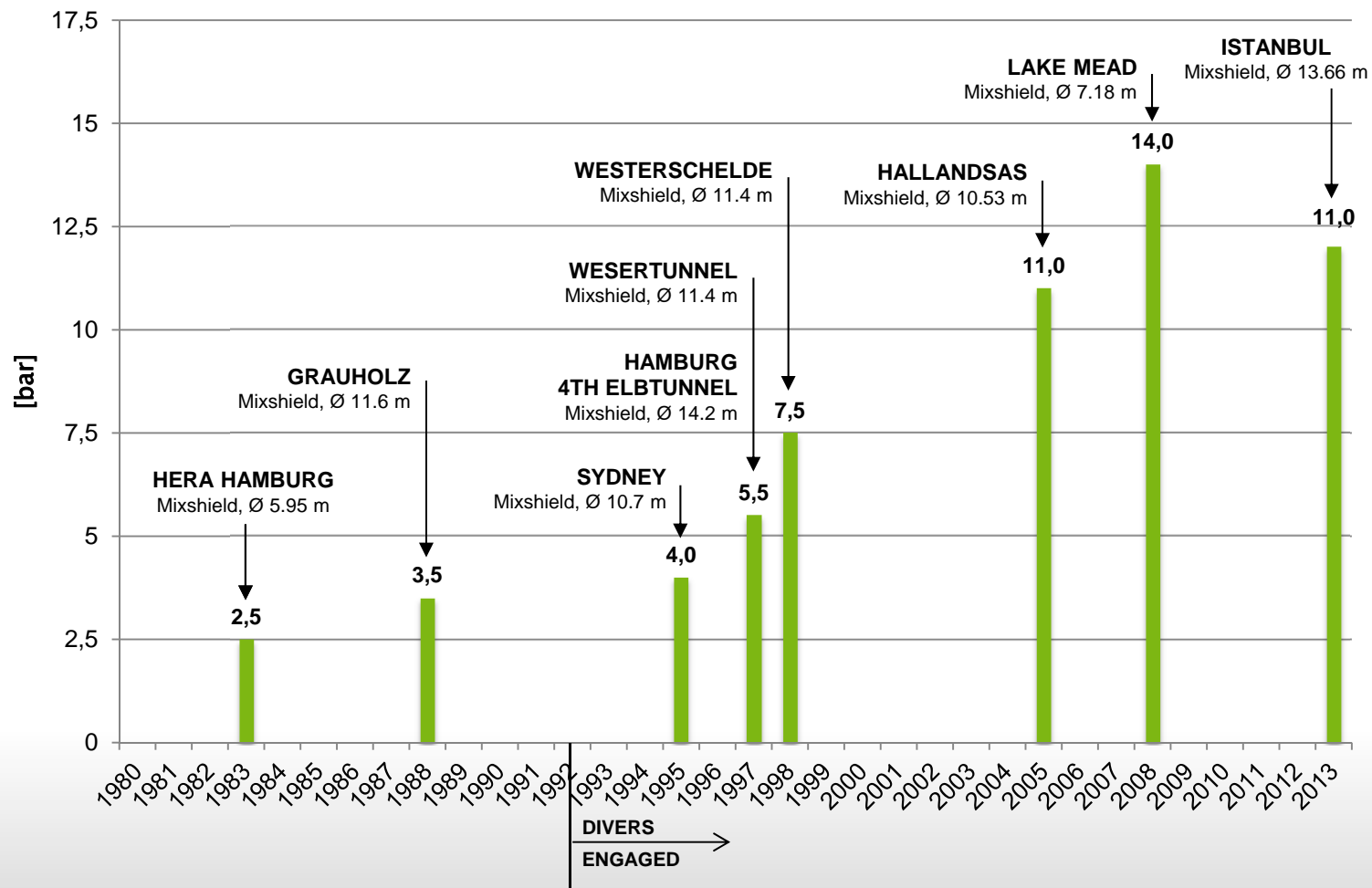
→ 2014

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Handling pressure together with the customer.

Development history of tunnelling under high pressure.



Long-term customer relationships pay off.

Milestones of technology development – extract.

- ▶ 1985: Center-free drive with floating cutting wheel support S-12
- ▶ 1987: Center flushing S-21
- ▶ 1988: Grout injection via tailskin S-41
- ▶ 1988: Jaw crusher in the bottom area S-47
- ▶ 1989: First convertible Mixshield S-50
- ▶ 1992: Active center cutter S-68
- ▶ 1996: Roller crusher S-103
- ▶ 1997: Accessible cutting wheel S-108
- ▶ 2000: Sealed off invert segment S-152
- ▶ 2005: Machine designed for water pressure of up to 13 bar S-246
- ▶ 2006: Accessible cutting wheel with atmospheric tool change S-317/18

Long-term customer relationships pay off.

Milestones of technology development – extract.

- ▶ 2008: Machine designed for water pressure of up to 17 bar S-502
- ▶ 2012: Newly developed machine technology: Variable Density MRT Project
- ▶ 2012: Enhanced accessible cutting wheel, newly developed lock system for compressed air entry at far more than 5 bar S-762
- ▶ 2013: World's largest TBM S-880

HERA Hamburg.

Development of the

Mixshield Principle

together
with our customer (Wayss &
Freytag)

Diameter of **5,950 mm**

Technical Innovation:

Center-free drive with floating
bearing of the cutting wheel





4th Elbetunnel.

With a diameter of **14.20** meter, it was at that time (1990) the **largest tunnel boring** machine in the world

Herrenknecht developed **special cutting wheel spokes** accessible under atmospheric conditions

Another innovation used with TRUDE was the **SSP System** (Sonic Softground Probing)

5.5 bar ground water pressure



Hallandsas.

The client, customer and Herrenknecht have beaten an extremely complex mountain to create twin tunnels

8.7 km long

Abrasive rock with up to **250 MPa**

Water pressures of up to

10 bar

One of the **most challenging projects** worldwide



Madrid.

World's largest Earth Pressure Balance Shield to date (2005)

Upward gradients of **five percent**

Two cutting wheels that could turn independent from each other in both directions

Excavation diameter of **15.20** meter



Shanghai.

Diameter of **15.43** meter

Depth of up to **65 meter** and
under a water pressure of up to
6.5 bar

The Mixshields achieved **top**
performances
of up to 26 meters

Project finished 10 months **ahead**
of schedule



Lake Mead.

15 Bar

Tunnelling under highest water pressure
- an absolute novelty in mechanized
tunnelling

Herrenknecht and customer **jointly
mastered** even unpredictable
conditions with a powerful TBM

Unique project

at Lake Mead:
140 m depth, 4.4 km tunnel length,
3 years of determined work



Istanbul.

Diameter of **13.66** meter

Depth of more than **100 meter**
and under a water pressure of up to
11 bar

A tunnel under the Bosphorus,
**a link between the
continents**

Hong Kong.

Biggest, longest and deepest underwater tunnel in

Hong Kong

Biggest TBM in the world with diameter of **17.60 meter**

MOBYDIC real-time geological mapping of rock faces

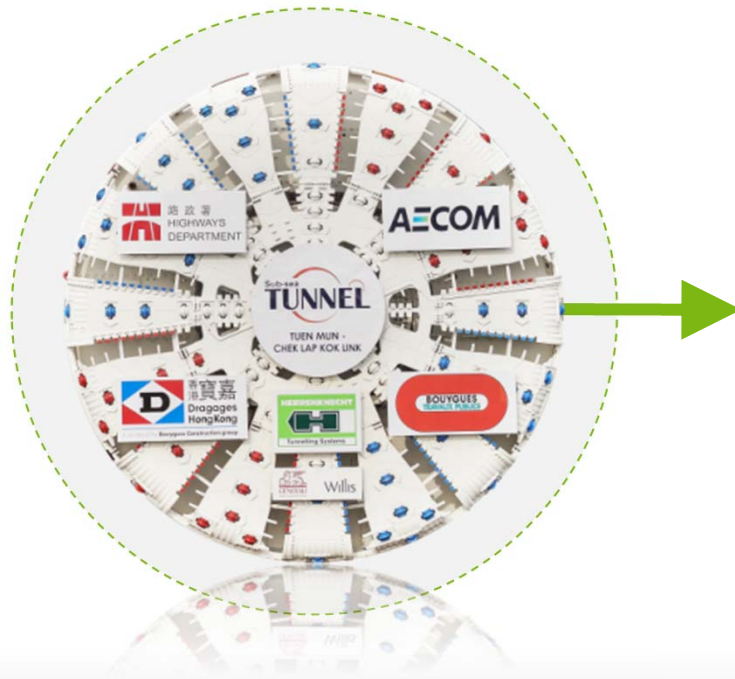
SNAKE robotic detection of damaged components of the cutterhead



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Outlook | Mutual Challenges / Market Expectations.



Diameters

EPB Shield 22m (doable today 16m)

Mixshield 22m (doable today 18m)

Face Support Pressure

EPB Shield 25bar (doable today 6bar)

Mixshield 25bar (doable today 14bar)

Equipment

Automatic Cutting Change

Non-circular cross section Hard Rock

Variable overcut in small dia. Hard Rock TBM

More conditioning lines into cutterhead



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