

# **Shield Tunnel Boring Machine Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented By Components (Cutter Head, Shield, Belt Conveyor, Muck Chutes, Muck Ring), By Product Type (Single Shield TBM, Double Shield TBM, Gripper TBM, Slurry TBM, Earth Pressure Balance Shield TBM, Mix Shield TBM), By Tunneling Method (Segmental Lining, Pipe Jacking), By Region, By Competition, 2018-2028**

<https://marketpublishers.com/r/SD617EC916ABEN.html>

Date: November 2023

Pages: 181

Price: US\$ 4,900.00 (Single User License)

ID: SD617EC916ABEN

## **Abstracts**

Global Shield Tunnel Boring Machine Market has valued at USD 6.08 billion in 2022 and is anticipated to project robust growth in the forecast period with a CAGR of 5.19% through 2028.

The Shield Tunnel Boring Machine (TBM) market refers to the global industry involved in the design, manufacturing, distribution, and utilization of specialized tunneling equipment known as Tunnel Boring Machines. These machines are primarily designed for the excavation and construction of tunnels, particularly in challenging underground conditions. The Shield TBM market encompasses a wide range of applications, including the creation of transportation tunnels, sewage and water conduits, utility passages, and underground storage facilities. These machines are equipped with rotating cutterheads and a shield mechanism that provides stability during excavation, allowing for safe and efficient tunnel construction.

Key drivers of the Shield TBM market include urbanization and infrastructure development, environmental sustainability initiatives, the need for infrastructure

rehabilitation, mega infrastructure projects, technological advancements, and the imperative for global connectivity and trade. Additionally, government policies, regulations, and investments in infrastructure significantly influence the growth and direction of this market.

The Shield TBM market plays a pivotal role in shaping modern urban landscapes, facilitating transportation networks, and addressing environmental concerns, making it a crucial sector within the construction and infrastructure industry.

## Key Market Drivers

### Urbanization and Infrastructure Development

The global Shield Tunnel Boring Machine (TBM) market is experiencing robust growth due to the relentless pace of urbanization and the corresponding surge in infrastructure development worldwide. As more and more people migrate to urban centers in search of economic opportunities and improved living standards, cities are faced with the pressing need to expand and upgrade their transportation networks. TBMs have emerged as indispensable tools for tunnel construction in urban areas, as they offer several advantages, including reduced surface disruption, shorter construction timelines, and enhanced safety. Consequently, the increasing urbanization trend is a powerful driver of the global TBM market.

In urban centers, traffic congestion has become a major problem, leading to increased pollution and reduced quality of life. To address these issues, many cities are investing in underground transportation systems such as subways and underground railways. TBMs are the preferred choice for excavating tunnels for these projects, as they can efficiently bore through various soil and rock formations while minimizing surface disturbance. The ability to construct tunnels beneath densely populated areas is a key factor driving the demand for TBMs in urban infrastructure development.

### Environmental Sustainability and Regulatory Compliance

Environmental sustainability has become a paramount concern globally, and this focus on sustainability is driving the adoption of TBMs in tunnel construction. Traditional drilling and blasting methods for tunnel excavation can be environmentally disruptive, causing soil erosion, air and noise pollution, and habitat destruction. In contrast, TBMs are recognized for their ability to significantly reduce these negative environmental impacts.

Regulatory bodies and governments around the world are increasingly imposing stringent environmental regulations on construction projects. These regulations often require construction companies to adhere to strict environmental standards, making TBMs an attractive option due to their eco-friendly construction methods. As a result, the drive to comply with environmental regulations and minimize the ecological footprint of tunneling projects is a significant driver of the global TBM market.

### Aging Infrastructure and Rehabilitation Needs

Many countries are grappling with aging underground infrastructure, including tunnels, sewage systems, and water conduits. The maintenance and rehabilitation of these critical assets have become a pressing concern, leading to a surge in demand for TBMs. TBMs are ideal for the renovation of existing tunnels because they can work within confined spaces and deliver precise tunneling, reducing the need for extensive surface excavation.

Governments and municipalities are increasingly allocating funds to upgrade and extend the lifespan of their aging underground infrastructure. The cost-effectiveness and efficiency of TBMs in such projects make them an attractive choice for addressing these infrastructure challenges. Thus, the need to rehabilitate aging infrastructure is a compelling driver propelling the growth of the global Shield TBM market.

### Mega Infrastructure Projects

The global appetite for mega infrastructure projects, such as high-speed rail networks, major highways, and cross-border tunnels, is another significant driver of the Shield TBM market. These ambitious ventures demand cutting-edge tunneling solutions to overcome geological challenges and meet aggressive project schedules. TBMs, with their ability to efficiently excavate tunnels through diverse soil and rock formations, are often the preferred choice for such projects.

TBMs offer several advantages in mega infrastructure projects, including enhanced safety for workers, reduced labor costs, and shortened construction timelines. These benefits align with the objectives of project developers and governments, making TBMs integral to the success of these large-scale initiatives. Consequently, the pursuit of mega infrastructure projects worldwide is fueling the growth of the global TBM market.

### Technological Advancements and Innovation

The Shield TBM market is characterized by continuous technological advancements and innovation. These innovations are instrumental in enhancing the efficiency, reliability, and capabilities of TBMs, making them increasingly attractive to construction companies and governments. Some of the key technological advancements driving the TBM market include:

**Real-time Monitoring:** Advanced monitoring systems allow operators to closely track the performance of TBMs, ensuring smoother operations and timely maintenance.

**Automation:** Automation features are improving TBM operation precision and reducing the reliance on manual labor, thereby enhancing safety and efficiency.

**Cutterhead Design:** Innovations in cutterhead design are increasing the adaptability of TBMs to different geological conditions, enabling them to tackle a wider range of projects.

**Digital Twin Technology:** Integration of digital twin technology provides valuable insights into TBM performance and allows for better decision-making during tunneling projects.

**Data Analytics:** Data analytics tools are being used to analyze vast amounts of data generated during tunneling, leading to optimized project planning and execution.

The relentless pursuit of technological advancements in the TBM industry is driving market growth by offering solutions that are more efficient, cost-effective, and capable of addressing a broader spectrum of tunneling challenges.

### Global Connectivity and Trade

In today's interconnected world, the demand for efficient transportation and logistics networks is higher than ever before. This driver has a significant impact on the Shield TBM market, as it fuels the need for tunnels that facilitate global trade and connectivity. Cross-border tunnels, those that link continents, or provide access to remote regions, are crucial for economic development and international trade. These tunnels require TBMs for their construction, given their ability to create safe and reliable underground passages.

Global connectivity also encompasses projects like undersea tunnels, which connect islands or different landmasses. These projects play a pivotal role in enhancing regional

and global trade by facilitating the movement of goods, people, and resources. TBMs are the preferred choice for constructing these tunnels due to their efficiency, safety features, and ability to bore through challenging geological conditions.

In conclusion, the global Shield Tunnel Boring Machine market is experiencing significant growth driven by urbanization and infrastructure development, environmental sustainability, aging infrastructure rehabilitation, mega infrastructure projects, technological advancements, and the imperative for global connectivity and trade. These drivers collectively contribute to the expansion and evolution of the TBM market, making it a vital sector within the construction and infrastructure industry.

### Government Policies are Likely to Propel the Market

#### Investment in Infrastructure Development

One of the primary government policies shaping the global Shield Tunnel Boring Machine (TBM) market is the commitment to significant investment in infrastructure development. Governments worldwide recognize the critical role that robust infrastructure plays in economic growth, regional connectivity, and improving the quality of life for citizens.

Investments in infrastructure encompass a wide range of projects, including subways, underground railways, highways, water supply systems, and sewage networks. TBMs are pivotal in the construction of tunnels for these projects due to their efficiency and ability to minimize surface disruption. To encourage such investments, governments often allocate substantial budgets, offer incentives to private investors, and collaborate with international funding agencies to secure financing for infrastructure initiatives.

These policies drive the TBM market by creating a steady pipeline of projects and ensuring the demand for tunneling equipment remains strong. Additionally, governments may employ public-private partnerships (PPPs) to leverage private sector expertise and resources, further stimulating the adoption of TBMs in large-scale infrastructure development.

#### Environmental Regulations and Sustainability Standards

Environmental sustainability has become a key focus for governments worldwide, leading to stringent regulations and sustainability standards in construction practices. Governments are increasingly inclined to adopt policies that promote eco-friendly

construction methods and minimize the environmental impact of infrastructure projects.

In this context, TBMs are favored due to their ability to reduce surface disruption, noise pollution, and overall environmental footprint compared to traditional drilling and blasting methods. Governments often mandate adherence to specific environmental performance standards when awarding contracts for infrastructure projects. This encourages construction companies to choose TBMs to ensure compliance with these regulations.

Governments may also provide incentives and tax benefits for environmentally responsible construction practices, further incentivizing the use of TBMs. Consequently, the alignment of government policies with environmental sustainability goals is a significant driver of the TBM market.

#### Infrastructure Rehabilitation and Maintenance

Many governments are faced with aging underground infrastructure that requires renovation and maintenance. To address this issue, governments formulate policies aimed at the preservation and rehabilitation of critical infrastructure assets, including tunnels, sewage systems, and water conduits.

TBMs play a crucial role in these rehabilitation efforts due to their ability to work within confined spaces and deliver precise tunneling, reducing the need for extensive surface excavation. Governments often allocate specific budgets and implement programs to address the rehabilitation needs of existing tunnels and underground infrastructure.

Through these policies, governments create opportunities for the TBM market by ensuring a steady stream of projects focused on infrastructure maintenance and modernization. Additionally, they may offer incentives or subsidies to encourage the use of TBMs in these projects, contributing to the market's growth.

#### Mega Project Initiatives

Many governments are actively pursuing mega infrastructure projects as a means to stimulate economic growth, improve regional connectivity, and enhance their global standing. These projects, which include high-speed rail networks, major highways, and cross-border tunnels, demand cutting-edge tunneling solutions to overcome geological challenges and meet ambitious project timelines.

TBMs are frequently chosen for mega projects due to their efficiency, enhanced safety features, and ability to bore through various soil and rock formations. Governments may establish dedicated policies and agencies to facilitate the planning and execution of these mega projects. They may also allocate substantial budgets and provide financial incentives to attract private sector participation.

The pursuit of mega infrastructure projects is a significant driver of the TBM market, as it ensures a consistent demand for tunneling equipment and technology on a large scale. Moreover, these projects often serve as showcases for the capabilities of TBMs, further boosting their adoption in other infrastructure projects.

### Research and Development Support

Governments worldwide recognize the importance of innovation and technological advancement in the construction industry, including tunneling technology. To promote innovation, governments often establish policies that support research and development (R&D) in tunneling equipment and techniques.

These policies may include grants, subsidies, and tax incentives for companies engaged in R&D related to TBMs and tunnel construction technology. Governments may also foster collaboration between academic institutions and industry stakeholders to drive innovation in the field.

By encouraging R&D activities, governments play a vital role in pushing the boundaries of TBM technology, making it more efficient, cost-effective, and adaptable to diverse geological conditions. This, in turn, contributes to the growth of the global TBM market as construction companies seek advanced equipment to stay competitive and meet evolving project requirements.

### Trade and Connectivity Initiatives

Global connectivity and trade are top priorities for many governments, and this has a direct impact on the TBM market. Cross-border tunnels, undersea passages, and transport links are crucial for facilitating international trade and regional cooperation.

Governments may develop policies that support the construction of such tunnels, often relying on TBMs for their efficient and safe excavation. These policies include financial incentives, streamlined regulatory processes, and international agreements to promote cross-border infrastructure development.

In conclusion, government policies are instrumental in shaping the global Shield Tunnel Boring Machine market. Investment in infrastructure development, adherence to environmental regulations, a focus on infrastructure rehabilitation, support for mega projects, encouragement of research and development, and initiatives to promote global trade and connectivity collectively influence the demand for TBMs and drive market growth. Government policy alignment with these factors ensures a favorable environment for the continued expansion of the TBM market worldwide.

## Key Market Challenges

### Geotechnical Variability and Complex Geological Conditions

One of the significant challenges faced by the global Shield Tunnel Boring Machine (TBM) market is the inherent variability of geological conditions and the complexity of underground environments in which tunneling projects are undertaken. Geological conditions can vary widely from one location to another, presenting unique challenges for TBMs.

The geology of a particular region can include a mix of soil types, rock formations, fault lines, and water ingress issues. These variations can significantly affect the performance and efficiency of TBMs. For example:

**Rock Hardness:** TBMs are designed to handle different rock strengths, but excessively hard or abrasive rock can lead to increased wear and tear on cutterheads, necessitating more frequent maintenance and replacement of cutting tools. This can result in project delays and increased operating costs.

**Water and Groundwater:** In some tunneling projects, TBMs encounter high levels of groundwater, which can inundate the tunnel and impede progress. Managing water ingress can be complex and costly, requiring advanced dewatering techniques and waterproofing measures.

**Unpredictable Geological Faults:** Unforeseen geological faults can pose significant challenges during tunnel excavation. TBMs may encounter faults that require alterations in tunnel alignment, potentially leading to delays and cost overruns.

**Unstable Soil:** In regions with loose or unstable soil conditions, TBMs may face difficulties in maintaining tunnel stability, and ground settlement can occur, potentially



impacting surface structures and utilities.

Addressing these geotechnical challenges often requires extensive geological surveys and a thorough understanding of the subsurface conditions before starting a tunneling project. Additionally, the development of specialized TBMs with advanced cutterhead designs and adaptive control systems can help mitigate some of these challenges. However, the inherent geological variability remains a persistent challenge for the TBM market.

### Project Complexity and Coordination

The global Shield TBM market encounters a substantial challenge in managing the complexity of tunneling projects and coordinating various stakeholders involved in the construction process. Tunneling projects often involve multiple phases, require extensive planning, and demand precise coordination between various parties, including government agencies, contractors, engineers, and local communities. Several factors contribute to the complexity and coordination challenges faced by the TBM market:

**Project Scale and Ambition:** Mega infrastructure projects, such as high-speed rail networks and cross-border tunnels, often span large distances and involve extensive tunnel networks. Managing such large-scale projects requires meticulous planning and execution to ensure that timelines and budgets are met.

**Safety and Risk Management:** Tunneling projects inherently pose risks to workers' safety and the surrounding environment. Ensuring strict safety protocols and risk mitigation measures are in place is essential. Unexpected incidents or accidents can lead to project delays and reputational damage.

**Environmental Considerations:** Environmental impact assessments, regulatory compliance, and sustainability goals play a critical role in modern tunneling projects. Meeting these requirements necessitates careful planning and coordination to minimize disruption to ecosystems and local communities.

**Community Engagement:** Tunnel construction often affects nearby communities in terms of noise, vibration, and traffic disruptions. Effective communication and engagement with these communities are vital to mitigate potential conflicts and ensure project acceptance.

**Logistics and Supply Chain Management:** Coordinating the delivery of materials,

equipment, and resources to the tunneling site, especially in remote or challenging locations, can be logistically complex and impact project timelines.

**Technical Challenges:** Integrating various technical aspects of tunnel construction, such as ventilation systems, electrical infrastructure, and safety measures, requires seamless coordination to ensure the tunnel's functionality and safety.

Addressing these challenges necessitates a holistic approach that involves careful project planning, risk management, stakeholder engagement, and the use of advanced project management tools and technologies. Additionally, effective communication and collaboration among all parties involved in the project are essential to navigate the complexities of tunnel construction successfully. The TBM market must adapt to these challenges by providing comprehensive solutions and expertise to meet the demands of increasingly complex tunneling projects worldwide.

## Segmental Insights

### Cutter Head Insights

The Cutter Head segment had the largest market share in 2022 & expected to maintain it in the forecast period. The primary purpose of a TBM is to excavate tunnels, and the Cutter Head is the component responsible for this crucial function. It consists of a rotating set of cutting tools or discs that break through various geological formations, including rock, soil, and mixed conditions. The efficiency and effectiveness of the Cutter Head directly impact the TBM's ability to progress through the tunneling project. Different tunneling projects encounter diverse geological conditions, ranging from soft soil to hard rock. Cutter Heads are customized to match these conditions, with varying types of cutting tools, disc configurations, and materials. This adaptability ensures that TBMs can handle a wide range of ground conditions, making the Cutter Head a versatile and dominant component. The rate at which a TBM can excavate and advance through the tunnel is a critical factor in project timelines and cost-effectiveness. A well-designed Cutter Head can significantly enhance the TBM's productivity by efficiently breaking through the ground, minimizing downtime for maintenance, and reducing wear and tear on cutting tools. The Cutter Head plays a pivotal role in ensuring the safety of tunneling operations. It helps create a stable tunnel face, preventing collapses and ensuring the safety of workers inside the TBM. Its precision in excavation minimizes the risk of over-excavation or under-excavation, which can lead to project delays and safety hazards. The Cutter Head component has seen continuous innovation and technological advancements over the years. Manufacturers invest in research and

development to improve the design, materials, and cutting technology of Cutter Heads. This drive for innovation has led to the development of more efficient and versatile Cutter Heads, further solidifying their dominance in the TBM market. The efficiency of the Cutter Head directly impacts project costs. A well-designed Cutter Head can reduce the overall project duration, saving on labor, equipment, and other construction-related expenses. This cost-efficiency is a significant factor driving the dominance of the Cutter Head in the TBM market.

### Segmental Lining Insights

The Segmental Lining segment had the largest market share in 2022 and is projected to experience rapid growth during the forecast period. Segmental Lining is particularly well-suited for urban tunneling projects, such as subways, underground railways, and utility tunnels. In densely populated areas, minimizing surface disruption and ensuring the stability of surrounding structures is paramount. Segmental Lining accomplishes this effectively by providing a precise and structurally sound tunnel lining. One of the key strengths of Segmental Lining is its adaptability to diverse geological conditions. TBMs equipped with Segmental Lining capabilities can handle different soil types and rock formations, as well as mixed ground conditions. This flexibility makes it a versatile choice for tunneling projects in various regions and geological settings. Segmental Lining allows for a continuous and efficient tunneling process. As the TBM advances, precast concrete segments are installed to form the tunnel's lining, ensuring that the tunnel remains stable and safe. This method minimizes the need for additional support measures and allows for faster progress compared to other lining methods. Speed is critical for urban projects where minimizing disruption and meeting tight timelines are essential. Segmental lining provides a high level of structural integrity to the tunnel, ensuring long-term stability and safety. Precast concrete segments are manufactured to precise specifications, reducing the risk of issues such as tunnel deformation or settlement. This is particularly important for tunnels located beneath critical infrastructure or densely populated areas. Segmental Lining has a well-established track record of success in a wide range of tunneling projects around the world. Its reliability and performance have made it a trusted method for tunnel construction, garnering the confidence of project developers, engineers, and governments. Given the global emphasis on environmental sustainability, Segmental Lining aligns with this priority by minimizing surface disruption, reducing noise and dust pollution, and ensuring minimal impact on the surrounding environment. This aspect has become increasingly important in securing approvals for urban infrastructure projects. Ongoing advancements in Segmental Lining technology, including the design of precast segments and installation methods, have further enhanced its efficiency and suitability

for a wide range of tunneling applications.

## Regional Insights

### Asia-Pacific:

The Asia-Pacific region is the largest market for shield TBMs, driven by rapid urbanization and increasing investments in infrastructure development in countries such as China, India, and Japan. China is the largest single market for shield TBMs in the world, accounting for over 30% of the global market share.

### North America:

The North American market for shield TBMs is relatively smaller than the Asia-Pacific market, but it is expected to grow at a faster pace in the coming years. This growth is being driven by increasing investments in infrastructure projects, such as the expansion of the New York Subway system and the construction of the California High-Speed Rail.

### Europe:

The European market for shield TBMs is mature and relatively stable. However, there is still some growth potential in the region, particularly in Eastern Europe.

## Key Market Players

Herrenknecht AG

Komatsu Ltd

The Robbins Company

Mitsubishi Heavy Industries, Ltd.

Kawasaki Heavy Industries, Ltd.

Hitachi Zosen Corporation

China Railway Construction Corporation

Tianhe Mechanical Equipment Co., Ltd

Liaoning Censcience Industry Co., Ltd.

Shanghai Tunnel Engineering Co., Ltd.

Report Scope:

In this report, the Global Shield Tunnel Boring Machine Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Shield Tunnel Boring Machine Market, By Components:

Cutter Head

Shield

Belt Conveyor

Muck Chutes Muck Ring

Shield Tunnel Boring Machine Market, By Product Type:

Single Shield TBM

Double Shield TBM

Gripper TBM

Slurry TBM

Earth Pressure Balance Shield TBM

Mix Shield TBM

Shield Tunnel Boring Machine Market, By Tunneling Method:

Segmental Lining

Pipe Jacking

Shield Tunnel Boring Machine Market, By Region:

North America

United States

Canada

Mexico

Europe

France

United Kingdom

Italy

Germany

Spain

Asia-Pacific

China

India

Japan

Australia

South Korea

South America

Brazil

Argentina

Colombia

Middle East & Africa

South Africa

Saudi Arabia

UAE

Kuwait

Turkey

## Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Shield Tunnel Boring Machine Market.

## Available Customizations:

Global Shield Tunnel Boring Machine market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

## Company Information

Detailed analysis and profiling of additional market players (up to five).

## Contents

### **1. PRODUCT OVERVIEW**

- 1.1. Market Definition
- 1.2. Scope of the Market
  - 1.2.1. Markets Covered
  - 1.2.2. Years Considered for Study
- 1.3. Key Market Segmentations

### **2. RESEARCH METHODOLOGY**

- 2.1. Objective of the Study
- 2.2. Baseline Methodology
- 2.3. Formulation of the Scope
- 2.4. Assumptions and Limitations
- 2.5. Sources of Research
  - 2.5.1. Secondary Research
  - 2.5.2. Primary Research
- 2.6. Approach for the Market Study
  - 2.6.1. The Bottom-Up Approach
  - 2.6.2. The Top-Down Approach
- 2.7. Methodology Followed for Calculation of Market Size & Market Shares
- 2.8. Forecasting Methodology
  - 2.8.1. Data Triangulation & Validation

### **3. EXECUTIVE SUMMARY**

### **4. VOICE OF CUSTOMER**

### **5. GLOBAL SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

- 5.1. Market Size & Forecast
  - 5.1.1. By Value
- 5.2. Market Share & Forecast
  - 5.2.1. By Components (Cutter Head, Shield, Belt Conveyor, Muck Chutes, Muck Ring),
  - 5.2.2. By Product Type (Single Shield TBM, Double Shield TBM, Gripper TBM, Slurry



- TBM, Earth Pressure Balance Shield TBM, Mix Shield TBM),
- 5.2.3. By Tunneling Method (Segmental Lining, Pipe Jacking)
- 5.2.4. By Region
- 5.2.5. By Company (2022)
- 5.3. Market Map

## **6. NORTH AMERICA SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

- 6.1. Market Size & Forecast
  - 6.1.1. By Value
- 6.2. Market Share & Forecast
  - 6.2.1. By Components
  - 6.2.2. By Product Type
  - 6.2.3. By Tunneling Method
  - 6.2.4. By Country
- 6.3. North America: Country Analysis
  - 6.3.1. United States Shield Tunnel Boring Machine Market Outlook
    - 6.3.1.1. Market Size & Forecast
      - 6.3.1.1.1. By Value
    - 6.3.1.2. Market Share & Forecast
      - 6.3.1.2.1. By Components
      - 6.3.1.2.2. By Product Type
      - 6.3.1.2.3. By Tunneling Method
  - 6.3.2. Canada Shield Tunnel Boring Machine Market Outlook
    - 6.3.2.1. Market Size & Forecast
      - 6.3.2.1.1. By Value
    - 6.3.2.2. Market Share & Forecast
      - 6.3.2.2.1. By Components
      - 6.3.2.2.2. By Product Type
      - 6.3.2.2.3. By Tunneling Method
  - 6.3.3. Mexico Shield Tunnel Boring Machine Market Outlook
    - 6.3.3.1. Market Size & Forecast
      - 6.3.3.1.1. By Value
    - 6.3.3.2. Market Share & Forecast
      - 6.3.3.2.1. By Components
      - 6.3.3.2.2. By Product Type
      - 6.3.3.2.3. By Tunneling Method

## **7. EUROPE SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

- 7.1. Market Size & Forecast
  - 7.1.1. By Value
- 7.2. Market Share & Forecast
  - 7.2.1. By Components
  - 7.2.2. By Product Type
  - 7.2.3. By Tunneling Method
  - 7.2.4. By Country
- 7.3. Europe: Country Analysis
  - 7.3.1. Germany Shield Tunnel Boring Machine Market Outlook
    - 7.3.1.1. Market Size & Forecast
      - 7.3.1.1.1. By Value
    - 7.3.1.2. Market Share & Forecast
      - 7.3.1.2.1. By Components
      - 7.3.1.2.2. By Product Type
      - 7.3.1.2.3. By Tunneling Method
  - 7.3.2. United Kingdom Shield Tunnel Boring Machine Market Outlook
    - 7.3.2.1. Market Size & Forecast
      - 7.3.2.1.1. By Value
    - 7.3.2.2. Market Share & Forecast
      - 7.3.2.2.1. By Components
      - 7.3.2.2.2. By Product Type
      - 7.3.2.2.3. By Tunneling Method
  - 7.3.3. Italy Shield Tunnel Boring Machine Market Outlook
    - 7.3.3.1. Market Size & Forecast
      - 7.3.3.1.1. By Value
    - 7.3.3.2. Market Share & Forecast
      - 7.3.3.2.1. By Components
      - 7.3.3.2.2. By Product Type
      - 7.3.3.2.3. By Tunneling Method
  - 7.3.4. France Shield Tunnel Boring Machine Market Outlook
    - 7.3.4.1. Market Size & Forecast
      - 7.3.4.1.1. By Value
    - 7.3.4.2. Market Share & Forecast
      - 7.3.4.2.1. By Components
      - 7.3.4.2.2. By Product Type
      - 7.3.4.2.3. By Tunneling Method
  - 7.3.5. Spain Shield Tunnel Boring Machine Market Outlook
    - 7.3.5.1. Market Size & Forecast

- 7.3.5.1.1. By Value
- 7.3.5.2. Market Share & Forecast
  - 7.3.5.2.1. By Components
  - 7.3.5.2.2. By Product Type
  - 7.3.5.2.3. By Tunneling Method

## **8. ASIA-PACIFIC SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

- 8.1. Market Size & Forecast
  - 8.1.1. By Value
- 8.2. Market Share & Forecast
  - 8.2.1. By Components
  - 8.2.2. By Product Type
  - 8.2.3. By Tunneling Method
  - 8.2.4. By Country
- 8.3. Asia-Pacific: Country Analysis
  - 8.3.1. China Shield Tunnel Boring Machine Market Outlook
    - 8.3.1.1. Market Size & Forecast
      - 8.3.1.1.1. By Value
    - 8.3.1.2. Market Share & Forecast
      - 8.3.1.2.1. By Components
      - 8.3.1.2.2. By Product Type
      - 8.3.1.2.3. By Tunneling Method
  - 8.3.2. India Shield Tunnel Boring Machine Market Outlook
    - 8.3.2.1. Market Size & Forecast
      - 8.3.2.1.1. By Value
    - 8.3.2.2. Market Share & Forecast
      - 8.3.2.2.1. By Components
      - 8.3.2.2.2. By Product Type
      - 8.3.2.2.3. By Tunneling Method
  - 8.3.3. Japan Shield Tunnel Boring Machine Market Outlook
    - 8.3.3.1. Market Size & Forecast
      - 8.3.3.1.1. By Value
    - 8.3.3.2. Market Share & Forecast
      - 8.3.3.2.1. By Components
      - 8.3.3.2.2. By Product Type
      - 8.3.3.2.3. By Tunneling Method
  - 8.3.4. South Korea Shield Tunnel Boring Machine Market Outlook
    - 8.3.4.1. Market Size & Forecast

- 8.3.4.1.1. By Value
- 8.3.4.2. Market Share & Forecast
  - 8.3.4.2.1. By Components
  - 8.3.4.2.2. By Product Type
  - 8.3.4.2.3. By Tunneling Method
- 8.3.5. Australia Shield Tunnel Boring Machine Market Outlook
  - 8.3.5.1. Market Size & Forecast
    - 8.3.5.1.1. By Value
  - 8.3.5.2. Market Share & Forecast
    - 8.3.5.2.1. By Components
    - 8.3.5.2.2. By Product Type
    - 8.3.5.2.3. By Tunneling Method

## **9. SOUTH AMERICA SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

- 9.1. Market Size & Forecast
  - 9.1.1. By Value
- 9.2. Market Share & Forecast
  - 9.2.1. By Components
  - 9.2.2. By Product Type
  - 9.2.3. By Tunneling Method
  - 9.2.4. By Country
- 9.3. South America: Country Analysis
  - 9.3.1. Brazil Shield Tunnel Boring Machine Market Outlook
    - 9.3.1.1. Market Size & Forecast
      - 9.3.1.1.1. By Value
    - 9.3.1.2. Market Share & Forecast
      - 9.3.1.2.1. By Components
      - 9.3.1.2.2. By Product Type
      - 9.3.1.2.3. By Tunneling Method
  - 9.3.2. Argentina Shield Tunnel Boring Machine Market Outlook
    - 9.3.2.1. Market Size & Forecast
      - 9.3.2.1.1. By Value
    - 9.3.2.2. Market Share & Forecast
      - 9.3.2.2.1. By Components
      - 9.3.2.2.2. By Product Type
      - 9.3.2.2.3. By Tunneling Method
  - 9.3.3. Colombia Shield Tunnel Boring Machine Market Outlook
    - 9.3.3.1. Market Size & Forecast

9.3.3.1.1. By Value

9.3.3.2. Market Share & Forecast

9.3.3.2.1. By Components

9.3.3.2.2. By Product Type

9.3.3.2.3. By Tunneling Method

## **10. MIDDLE EAST AND AFRICA SHIELD TUNNEL BORING MACHINE MARKET OUTLOOK**

10.1. Market Size & Forecast

10.1.1. By Value

10.2. Market Share & Forecast

10.2.1. By Components

10.2.2. By Product Type

10.2.3. By Tunneling Method

10.2.4. By Country

10.3. MEA: Country Analysis

10.3.1. South Africa Shield Tunnel Boring Machine Market Outlook

10.3.1.1. Market Size & Forecast

10.3.1.1.1. By Value

10.3.1.2. Market Share & Forecast

10.3.1.2.1. By Components

10.3.1.2.2. By Product Type

10.3.1.2.3. By Tunneling Method

10.3.2. Saudi Arabia Shield Tunnel Boring Machine Market Outlook

10.3.2.1. Market Size & Forecast

10.3.2.1.1. By Value

10.3.2.2. Market Share & Forecast

10.3.2.2.1. By Components

10.3.2.2.2. By Product Type

10.3.2.2.3. By Tunneling Method

10.3.3. UAE Shield Tunnel Boring Machine Market Outlook

10.3.3.1. Market Size & Forecast

10.3.3.1.1. By Value

10.3.3.2. Market Share & Forecast

10.3.3.2.1. By Components

10.3.3.2.2. By Product Type

10.3.3.2.3. By Tunneling Method

10.3.4. Kuwait Shield Tunnel Boring Machine Market Outlook

- 10.3.4.1. Market Size & Forecast
  - 10.3.4.1.1. By Value
- 10.3.4.2. Market Share & Forecast
  - 10.3.4.2.1. By Components
  - 10.3.4.2.2. By Product Type
  - 10.3.4.2.3. By Tunneling Method
- 10.3.5. Turkey Shield Tunnel Boring Machine Market Outlook
  - 10.3.5.1. Market Size & Forecast
    - 10.3.5.1.1. By Value
  - 10.3.5.2. Market Share & Forecast
    - 10.3.5.2.1. By Components
    - 10.3.5.2.2. By Product Type
    - 10.3.5.2.3. By Tunneling Method

## **11. MARKET DYNAMICS**

## **12. MARKET TRENDS & DEVELOPMENTS**

## **13. COMPANY PROFILES**

- 13.1. Herrenknecht AG
  - 13.1.1. Business Overview
  - 13.1.2. Key Revenue and Financials
  - 13.1.3. Recent Developments
  - 13.1.4. Key Personnel/Key Contact Person
  - 13.1.5. Key Product/Services Offered
- 13.2. Komatsu Ltd
  - 13.2.1. Business Overview
  - 13.2.2. Key Revenue and Financials
  - 13.2.3. Recent Developments
  - 13.2.4. Key Personnel/Key Contact Person
  - 13.2.5. Key Product/Services Offered
- 13.3. The Robbins Company
  - 13.3.1. Business Overview
  - 13.3.2. Key Revenue and Financials
  - 13.3.3. Recent Developments
  - 13.3.4. Key Personnel/Key Contact Person

- 13.3.5. Key Product/Services Offered
- 13.4. Mitsubishi Heavy Industries, Ltd.
  - 13.4.1. Business Overview
  - 13.4.2. Key Revenue and Financials
  - 13.4.3. Recent Developments
  - 13.4.4. Key Personnel/Key Contact Person
  - 13.4.5. Key Product/Services Offered
- 13.5. Kawasaki Heavy Industries, Ltd.
  - 13.5.1. Business Overview
  - 13.5.2. Key Revenue and Financials
  - 13.5.3. Recent Developments
  - 13.5.4. Key Personnel/Key Contact Person
  - 13.5.5. Key Product/Services Offered
- 13.6. Hitachi Zosen Corporation
  - 13.6.1. Business Overview
  - 13.6.2. Key Revenue and Financials
  - 13.6.3. Recent Developments
  - 13.6.4. Key Personnel/Key Contact Person
  - 13.6.5. Key Product/Services Offered
- 13.7. China Railway Construction Corporation
  - 13.7.1. Business Overview
  - 13.7.2. Key Revenue and Financials
  - 13.7.3. Recent Developments
  - 13.7.4. Key Personnel/Key Contact Person
  - 13.7.5. Key Product/Services Offered
- 13.8. Tianhe Mechanical Equipment Co., Ltd
  - 13.8.1. Business Overview
  - 13.8.2. Key Revenue and Financials
  - 13.8.3. Recent Developments
  - 13.8.4. Key Personnel/Key Contact Person
  - 13.8.5. Key Product/Services Offered
- 13.9. Liaoning Censcience Industry Co., Ltd.
  - 13.9.1. Business Overview
  - 13.9.2. Key Revenue and Financials
  - 13.9.3. Recent Developments
  - 13.9.4. Key Personnel/Key Contact Person
  - 13.9.5. Key Product/Services Offered
- 13.10. Shanghai Tunnel Engineering Co., Ltd.
  - 13.10.1. Business Overview

13.10.2. Key Revenue and Financials

13.10.3. Recent Developments

13.10.4. Key Personnel/Key Contact Person

13.10.5. Key Product/Services Offered

## **14. STRATEGIC RECOMMENDATIONS**

## **15. ABOUT US & DISCLAIMER**



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