

Industrial Computed Tomography Market – Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented By Offering (Equipment, Services), By Type (High-voltage CT, Micro CT, Others), By Scanning Technique (Fan-beam CT, Cone-beam CT, Others), By Application (Flaw Detection and Inspection, Failure Analysis, Assembly Analysis, Dimensioning and Tolerancing Analysis, Others), By Vertical (Oil & Gas, Aerospace and Defense, Automotive, Electronics, Others), By Region, By Competition , 2018-2028

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Abstracts

Global Industrial Computed Tomography Market has valued at USD 670 Million in 2022 and is anticipated to project robust growth in the forecast period with a CAGR of 8% through 2028. The Global Industrial Computed Tomography (CT) Market is experiencing significant growth driven by its indispensable role in non-destructive testing and inspection across diverse industries. Industrial CT technology enables three-dimensional visualization of the internal structures of objects, aiding in the identification of defects, faults, and quality control. Its widespread adoption is observed in automotive, aerospace, electronics, and manufacturing sectors, where precision and reliability are paramount. The market's expansion is further fueled by the continuous evolution of CT scanners, offering higher resolutions and faster scanning speeds, enhancing efficiency and accuracy. Moreover, stringent industry regulations and the imperative need for quality assurance are propelling the demand for industrial CT solutions. As industries strive to minimize production errors and ensure the integrity of their products, the

versatility and advanced capabilities of industrial CT systems make them a preferred choice. With the ever-increasing emphasis on product quality and safety, the Global Industrial Computed Tomography Market is poised for sustained growth, as it addresses these critical requirements and becomes an integral part of modern manufacturing and inspection processes.

Key Market Drivers

Enhanced Imaging Capabilities

Advancements in imaging technology are the primary driving force behind the growth of the global industrial computed tomography (CT) market. Industrial CT scanners have revolutionized the way objects are analyzed and inspected by capturing high-resolution 3D images. These scanners utilize X-ray technology to penetrate materials and generate cross-sectional images, providing a wealth of valuable insights into the internal structures and components of objects.

The enhanced imaging capabilities of industrial CT scanners have opened up a world of possibilities for industries across various sectors. One of the key advantages is the ability to perform non-destructive testing, which allows for thorough analysis without causing any damage to the object being examined. This is particularly beneficial in industries such as automotive, aerospace, electronics, and healthcare, where the integrity of components and structures is of utmost importance. In the automotive sector, industrial CT scanners are being widely adopted for quality control and inspection purposes. These scanners enable manufacturers to detect defects and anomalies in automotive components with high accuracy and precision. By conducting non-destructive testing, automotive companies can ensure the safety and reliability of their products, leading to improved customer satisfaction and reduced warranty claims.

Similarly, the aerospace industry has also embraced industrial CT scanners for various applications. These scanners are used to inspect critical components such as turbine blades, composite materials, and welds. By obtaining detailed 3D images, aerospace companies can identify any structural flaws or defects that may compromise the performance and safety of their aircraft. This allows for timely repairs or replacements, minimizing the risk of catastrophic failures. In the electronics sector, industrial CT scanners play a crucial role in the inspection of printed circuit boards (PCBs) and electronic components. These scanners enable manufacturers to detect any manufacturing defects, such as soldering issues or component misplacements, which could lead to malfunctioning or unreliable electronic devices. By ensuring the quality

and reliability of their products, electronics companies can maintain their reputation and gain a competitive edge in the market.

Furthermore, the healthcare industry has also witnessed significant benefits from the adoption of industrial CT scanners. These scanners are used for medical imaging, allowing for detailed visualization of anatomical structures and the detection of abnormalities or diseases. Industrial CT scanners provide healthcare professionals with valuable information for diagnosis, treatment planning, and monitoring of patients, leading to improved healthcare outcomes.

Improved Quality Control and Inspection

Industrial CT scanners play a vital role in the field of quality control and inspection processes, serving as indispensable tools for various industries. These scanners offer highly detailed 3D images, enabling businesses to effectively identify defects, measure dimensions, and verify the integrity of components. By doing so, they ensure that products meet the required quality standards and specifications, which is crucial for maintaining customer satisfaction and brand reputation. One of the key advantages of industrial CT scanners is their ability to detect internal defects that may not be visible through traditional inspection methods. These defects include cracks, voids, and inclusions that can significantly compromise the performance and reliability of a component. By utilizing CT scanning technology, industries can thoroughly examine the internal structure of an object without causing any damage. This non-destructive testing approach not only saves time and resources but also reduces waste and improves overall efficiency. The comprehensive nature of industrial CT scanning allows for a more thorough inspection process. Traditional inspection methods often rely on visual inspection or limited sampling, which may not provide a complete understanding of the object's quality. In contrast, CT scanners capture detailed cross-sectional images of the entire object, providing a comprehensive view of its internal structure. This enables businesses to identify even the smallest defects and make informed decisions regarding the quality of their products. Moreover, industrial CT scanners offer precise dimensional measurements, allowing businesses to ensure that components meet the required specifications. These scanners can accurately measure complex geometries, including internal features, which may be challenging to assess using traditional measurement techniques. By obtaining precise measurements, industries can guarantee the proper fit and functionality of their products, reducing the risk of costly errors and rework.

In industries where precision and reliability are paramount, such as aerospace, automotive, and medical device manufacturing, the use of industrial CT scanners has

become essential. These scanners provide a comprehensive and non-destructive means of quality control and inspection, enabling businesses to deliver products that meet the highest standards. By leveraging the capabilities of industrial CT scanning technology, industries can enhance their quality control processes, minimize defects, and ultimately improve customer satisfaction.

Rising Demand for 3D Metrology

The global industrial CT market is experiencing significant growth due to the increasing demand for 3D metrology. Industrial CT scanners provide accurate and precise measurements of complex geometries, allowing industries to perform dimensional analysis and metrology with high efficiency. These scanners can capture detailed 3D data of objects, which can be used for reverse engineering, CAD comparison, and virtual assembly. The ability to obtain precise measurements and perform 3D metrology using industrial CT scanners has become crucial in industries such as automotive, aerospace, and manufacturing, where tight tolerances and precise measurements are required. The rising demand for 3D metrology is driving the adoption of industrial CT scanners across various sectors.

Non-Destructive Testing in Manufacturing

Industrial CT scanners have become a vital tool in the manufacturing industry for non-destructive testing (NDT) purposes. NDT techniques play a crucial role in ensuring the structural integrity and reliability of various components and products. By utilizing industrial CT scanners, manufacturers are able to conduct comprehensive NDT assessments, which involve the detection of internal defects, analysis of material properties, and evaluation of overall quality. The primary advantage of industrial CT scanners lies in their ability to detect internal defects within objects. These defects may include cracks, voids, porosity, or other imperfections that are not visible to the naked eye. By capturing high-resolution X-ray images from multiple angles, CT scanners generate detailed 3D representations of the object's internal structure. This enables manufacturers to identify and analyze any potential flaws or irregularities, ensuring that only components and products of the highest quality are released into the market. Furthermore, industrial CT scanners facilitate the analysis of material properties. By examining the density, composition, and distribution of materials within an object, manufacturers can gain valuable insights into its structural characteristics. This information is crucial for determining the object's strength, durability, and performance capabilities. By identifying any material inconsistencies or deviations, manufacturers can take appropriate measures to rectify or improve the quality of their products.

In addition to defect detection and material analysis, industrial CT scanners enable the evaluation of overall quality. By conducting a comprehensive assessment of an object's internal and external features, manufacturers can ensure that it meets the required specifications and standards. This non-destructive approach eliminates the need for destructive testing methods, such as cutting or disassembling the object, which not only saves time but also reduces waste and costs. The ability to perform non-destructive testing using industrial CT scanners has become increasingly crucial in industries where safety, reliability, and quality are paramount. Industries such as aerospace, automotive, electronics, and medical devices heavily rely on NDT techniques to ensure the integrity of their products. By utilizing industrial CT scanners, manufacturers can enhance their quality control processes, minimize the risk of product failures, and ultimately deliver superior and reliable products to their customers.

Advancements in Software and Data Analysis

The global industrial CT market is being driven by advancements in software and data analysis capabilities. Industrial CT scanners generate large volumes of data in the form of 3D images, which require advanced software tools for analysis and visualization. The development of sophisticated software solutions, including image reconstruction algorithms, segmentation techniques, and visualization tools, has significantly enhanced the usability and effectiveness of industrial CT scanners. These software advancements enable industries to extract valuable insights from the 3D data, perform accurate measurements, and visualize complex structures. The integration of artificial intelligence and machine learning algorithms with industrial CT scanners further enhances the data analysis capabilities, allowing for automated defect detection, anomaly identification, and predictive maintenance. The advancements in software and data analysis are driving the adoption of industrial CT scanners across various industries.

Key Market Challenges

Limited Adoption and Awareness

The global industrial computed tomography (CT) market faces a significant challenge in terms of limited adoption and awareness among organizations. Many businesses, particularly in industries such as manufacturing and aerospace, may not fully understand the importance and advantages of implementing industrial CT solutions. This lack of awareness can result in organizations relying on traditional inspection methods that may be time-consuming, less accurate, and unable to detect certain

defects. To address this challenge, comprehensive educational initiatives are needed to highlight the benefits of industrial CT, such as its ability to provide non-destructive testing, dimensional analysis, and internal structure visualization. Real-world case studies and success stories can help organizations grasp the potential of industrial CT and encourage wider adoption.

Complexity and Integration Issues

The implementation and integration of industrial CT systems can pose complex challenges for organizations, particularly those with limited technical expertise or resources. Configuring and calibrating CT equipment effectively, as well as integrating it with existing inspection processes and software, can be technically demanding. Compatibility issues may arise during integration, leading to delays and suboptimal performance. To overcome these challenges, it is crucial to simplify the deployment and management of industrial CT solutions. User-friendly interfaces, intuitive calibration processes, and seamless integration options should be provided to streamline setup and customization. Additionally, organizations should have access to comprehensive support and guidance, including documentation, training, and technical experts who can assist with integration and troubleshooting. Simplifying these aspects of industrial CT implementation can lead to more efficient inspection processes and improved quality control.

Accuracy and Image Quality

Industrial CT systems rely on the accuracy of imaging and the quality of reconstructed 3D models to detect defects and analyze internal structures. However, challenges related to image resolution, noise reduction, and artifacts can affect the accuracy and reliability of CT inspection results. Organizations need to address these challenges by investing in advanced CT equipment that offers high-resolution imaging capabilities and advanced noise reduction algorithms. Continuous research and development efforts should focus on improving image quality and reducing artifacts to enhance the accuracy of defect detection and dimensional analysis. Additionally, organizations should ensure that their personnel receive proper training to interpret CT scan results accurately and make informed decisions based on the obtained data.

Regulatory Compliance and Safety Standards

The industrial CT market is subject to various regulatory compliance requirements and safety standards, particularly in industries such as automotive, aerospace, and

healthcare. Organizations must ensure that their industrial CT systems meet these standards and comply with regulations to avoid legal and safety issues. This challenge can be addressed by working closely with regulatory bodies and industry associations to stay updated on the latest requirements and standards. Manufacturers of industrial CT equipment should prioritize compliance and safety features in their product development processes. Additionally, organizations should establish robust quality management systems and implement regular audits to ensure ongoing compliance with regulatory requirements.

Data Management and Analysis

Industrial CT generates vast amounts of data, including 3D models, images, and inspection reports. Effectively managing and analyzing this data can be a challenge for organizations, particularly when dealing with large volumes of scans and complex inspection projects. To overcome this challenge, organizations should invest in advanced data management and analysis tools that can handle the storage, retrieval, and analysis of CT data efficiently. Automation and artificial intelligence (AI) techniques can be employed to streamline data analysis processes, identify patterns, and detect anomalies more effectively. Implementing robust data management and analysis systems will enable organizations to derive valuable insights from their industrial CT data and make data-driven decisions to improve quality control and process optimization.

Key Market Trends

Rise in Demand for Non-Destructive Testing

The global market for industrial computed tomography (CT) is experiencing a rise in demand due to the increasing need for non-destructive testing (NDT) in various industries. Non-destructive testing plays a crucial role in ensuring the quality and integrity of industrial components and products without causing any damage. Industrial CT technology offers a non-invasive method of inspecting internal structures, detecting defects, and analyzing material properties. This capability makes it highly valuable in industries such as automotive, aerospace, electronics, and manufacturing, where the quality and reliability of components are of utmost importance. As the demand for high-quality products continues to grow, the adoption of industrial CT for non-destructive testing is expected to increase significantly.

Advancements in CT Technology

The global industrial CT market is witnessing advancements in CT technology, which are driving its adoption across various industries. These advancements include improvements in resolution, speed, and accuracy, enabling more detailed and precise imaging of complex structures. Additionally, the development of multi-energy CT systems allows for enhanced material discrimination and identification of different materials within an object. This capability is particularly beneficial in industries where the composition of materials is critical, such as in the analysis of composite materials in aerospace applications. Furthermore, the integration of artificial intelligence (AI) and machine learning (ML) algorithms into industrial CT systems is enhancing their image reconstruction and analysis capabilities, leading to more efficient and accurate defect detection. These advancements in CT technology are enabling industries to achieve higher levels of quality control and inspection, thereby driving the growth of the global industrial CT market.

Increasing Application in Additive Manufacturing

The application of industrial CT in additive manufacturing, also known as 3D printing, is a significant trend in the market. Additive manufacturing processes often involve complex geometries and internal structures that are challenging to inspect using traditional methods. Industrial CT provides a non-destructive and comprehensive solution for inspecting 3D-printed components, ensuring their dimensional accuracy, structural integrity, and absence of defects. By utilizing industrial CT, manufacturers can identify and rectify any issues early in the production process, reducing waste and improving overall product quality. The growing adoption of additive manufacturing in industries such as automotive, healthcare, and aerospace is driving the demand for industrial CT systems specifically designed for inspecting 3D-printed parts.

Integration with Industry 4.0 Technologies

The integration of industrial CT with Industry 4.0 technologies is another significant trend in the market. Industry 4.0 aims to create smart factories by leveraging technologies such as the Internet of Things (IoT), big data analytics, and automation. Industrial CT systems are being integrated into these smart factory environments to enable real-time monitoring, data analysis, and automated decision-making. By connecting industrial CT systems to the IoT, manufacturers can collect and analyze data from multiple CT machines, enabling predictive maintenance, optimizing inspection processes, and improving overall operational efficiency. The integration of industrial CT with Industry 4.0 technologies is expected to revolutionize the way inspections are

conducted in manufacturing facilities, leading to increased productivity and cost savings.

Segmental Insights

Type Insights

In terms of type, the market is classified into high-voltage CT, micro CT, and others. The high-voltage CT segment dominated the overall market, gaining a revenue share of 42.7% in 2022. It is expected to grow at a CAGR of 7.5% throughout the forecast period. High-voltage CT scanners are used to scan dense and large objects such as car engines.

For instance, for scanning a piece of steel with a thickness of 30 mm, a high-voltage X-ray source of above 200 kV would be required. High-voltage CT scanners are relatively costly in comparison to micro CT scanners. Market players offer high-voltage CT equipment and services. For instance, U.S.-based North Star Imaging Inc. (Illinois Tool Works Inc.) provides high-energy industrial CT X-ray systems, and Canada-based Jesse Garant Metrology Center offers high-energy CT scanning services.

The micro CT segment is expected to grow at the fastest CAGR of 8.7% during the forecast period. Micro CT scanners are among the most affordable industrial CT scanners, with the price of research-grade variants ranging from USD 200,000 to USD 1 million. Standard micro CT scanners generally use X-ray sources of voltage ranging from 60 kV to 160 kV. Small to medium-sized components such as plastic, ceramics, and aluminum can be inspected using a standard X-ray voltage source of 60 kV to 160 kV. The availability and affordability of micro CT scanners are expected to drive the segment's growth.

Scanning Technique Insights

In terms of scanning technique, the market is classified into fan-beam CT, cone-beam CT, and others. The fan-beam CT segment has dominated the market with a revenue share of 44.1% in 2022 and is expected to witness a CAGR of 7.3% during the forecast period. Fan-beam CT scanning technique is generally used to scan dense and large components, requiring high-energy scanning of over 450 kV of the X-ray voltage source. Fan-beam CT scanning produces higher-quality images, and the scan is focused on a single area of interest. The ability to scan large objects and high image quality are likely to contribute to segment growth.

The cone-beam CT segment is anticipated to witness the fastest CAGR of 7.9% throughout the forecast period. Cone-beam CT scanning technique is suitable for scanning electronic components and medium-sized cast elements. Cone-beam CT requires lower scan times, recording a typical data set within a quarter of an hour. According to U.S.-based Baker Hughes Company, a typical fan-beam CT scan needs 1,000 minutes to scan 1,000 slices, whereas a cone-beam CT scan requires 10 minutes. Cone-beam CT applications in electronics and shorter scan times are expected to drive segment growth.

Application Insights

In terms of application, the market is classified into failure analysis, assembly analysis, flaw detection and inspection, dimensioning and tolerancing analysis, and others. The flaw detection and inspection segment held the maximum share in the market, with a share of 25.0% in 2022, and is expected to witness the highest CAGR of 8.6% throughout the forecast period.

The increasing need for inspection of the products to detect any flaw, crack, damage, or variation from the designed product has been the key driver for the high share of this segment. Using industrial CT systems for product inspections helps the manufacturer considerably reduce production/manufacturing costs. In addition, industrial CT scanners can quickly test and analyze minor defects that are not efficiently and effectively traceable using traditional inspection methods.

The assembly analysis segment is anticipated to grow at a CAGR of 7.2% throughout the forecast period. Assembly analysis is increasingly being used in industries such as automotive, aerospace, and electronics, which require the inspection and analysis of the assembled products to gain insights into the placement and condition of smaller/minor internal components without disassembling or destroying the product. Computed tomography can help in detecting incorrectly assembled or missing components.

Regional Insights

Asia Pacific dominated the overall market in 2022, with a revenue share of 33.6%. It is expected to grow at the fastest CAGR of 8.2% throughout the forecast period. Asia Pacific has prominent market players such as Japan-based Nikon Corporation, OMRON Corporation, and Shimadzu Corporation. High manufacturing activities, especially in countries such as China, Japan, and India, are driving market growth in the region. According to United Nations Industrial Development Organization (UNIDO)'s world

manufacturing production quarterly report, in the fourth quarter of 2022, Asia & Oceania held a share of 51% in global Manufacturing Value Added (MVA).

North America is expected to grow at a considerable CAGR of 7.6% during the forecast period. North America has a developed technology infrastructure and presence of industrial CT market players such as U.S.-based Baker Hughes Company and North Star Imaging Inc. (Illinois Tool Works Inc.). The increasing number of investments in the adoption of new & advanced technologies by key industry players is expected to drive the regional market growth. Moreover, North America has a presence of several industrial CT inspection services providers, such as Canada-based Jesse Garant Metrology Center and U.S.-based Exact Metrology.

Key Market Players

Nikon Corporation

OMRON Corporation

Baker Hughes Company

Comet Group

ZEISS Group

Shimadzu Corporation

North Star Imaging Inc. (Illinois Tool Works Inc.)

Werth Inc.

Rigaku Corporation

VJ Technologies

Report Scope:

In this report, the Global Industrial Computed Tomography Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Industrial Computed Tomography Market, By Offering:

Equipment

Services

Industrial Computed Tomography Market, By Type:

High-voltage CT

Micro CT

Others

Industrial Computed Tomography Market, By Scanning Technique:

Fan-beam CT

Cone-beam CT

Others

Industrial Computed Tomography Market, By Application:

Flaw Detection and Inspection

Failure Analysis

Assembly Analysis

Dimensioning and Tolerancing Analysis

Others

Industrial Computed Tomography Market, By Vertical:

Oil & Gas

Aerospace and Defense

Automotive

Electronics

Others

Industrial Computed Tomography Market, By Region:

North America

United States

Canada

Mexico

Europe

France

United Kingdom

Italy

Germany

Spain

Belgium

Asia-Pacific

China

India

Japan

Australia

South Korea

Indonesia

Vietnam

South America

Brazil

Argentina

Colombia

Chile

Peru

Middle East & Africa

South Africa

Saudi Arabia

UAE

Turkey

Israel

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Industrial Computed Tomography Market.

Available Customizations:

Industrial Computed Tomography Market – Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmen...

Global Industrial Computed Tomography 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).

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