Navigating the IIoT Landscape:
From Theory to Practice

PRESCOUTER 2023

IIoT has the power to drive transformative change, but without the right guidance and expertise, it can also lead to costly missteps and missed opportunities.

IIoT is a key component enabling Industry 4.0 that will unlock higher efficiencies and new capabilities for the companies that are able to integrate it into their processes. However, implementing IIoT solutions without the proper guidance and expertise can lead to costly missteps and missed opportunities. Understanding the benefits, requirements, and use cases of IIoT can lead to a range of benefits for organizations, including improved operational efficiency, increased production capacity, reduced costs, enhanced safety and security, and the ability to create new products and services.

This Intelligence Brief provides an in-depth overview of the advances in IIoT and its associated benefits, requirements, and use case applications for successful integration into a company's operations. In addition, we outline best practices for leveraging IIoT to maximize its potential and insights into choosing the right IIoT strategy for any organization.

Contents

The manufacturing industry generates a vast amount of untapped data that can be exploited by adopting Industry 4.0.

Industry 4.0 is a new round of industrial transformation characterized by bridging of physical industrial objects with digital technologies.

Manufacturers who embrace the digitization brought about by Industry 4.0 will gain a competitive edge.

By using the information provided by their data sets, manufacturers can optimize performance, availability, and outcomes in their production lines.

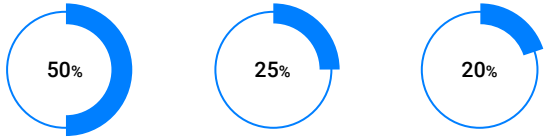
The average factory creates

1 TB of production **data** daily

<1% is actually being analyzed by manufacturers

2019 IBM report "*Industry 4.0, the Fourth Revolution Challenges, Benefits, Adoption and How to Begin*"

Intel used data analytics to help predict equipment failure in one of their microchips and reported:



reduction in maintenance time

higher yields

reduction in the cost of spare parts

$3M saved

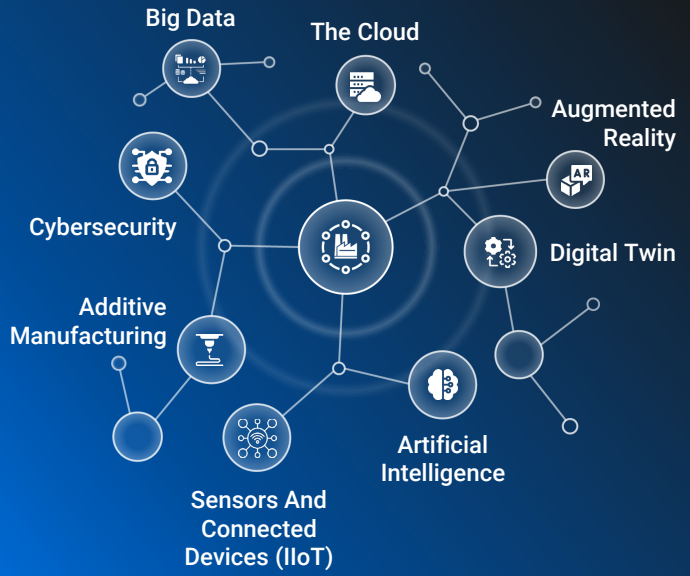
IIoT relies on various technologies, with key ones including AI, cybersecurity, cloud computing, edge computing, and data mining.

Implementing Industry 4.0 technologies has several benefits for businesses mainly around reducing downtime and improving cost-efficiency. These can help industrial systems reach higher manufacturing standards and customizations, and improve security, safety and energy efficiency.

Key Industry 4.0 benefits include:

- Obtaining, evaluating, and distributing data
- Improved operational metrics
- Predictive fault detection
- Greater flexibility to adapt to changing conditions
- Cost savings through higher production efficiency, lowered downtime, and improved quality control

Industry 4.0 Sub Technologies/Components:



Using industrial IoT (IIoT) platforms, companies can connect, monitor, analyze, and act on industrial data in newer ways to improve efficiency, and reduce costs.

Industrial internet of things (IIoT) is a subset of Internet of Things (IoT), leveraging smart sensors and actuators to enhance manufacturing and industrial processes. IoT focuses on consumer convenience, while **IIoT focuses on return on investment (ROI)**.

	IoT	IIoT
System focus	Improving the aspects of an individual's' daily life such as smartphones, smart homes, and smart cities	Improving business processes by optimizing performance of a device, machine, or entire business process used in industries
Types of devices included in the environment	Consumer-grade devices with well localized risks and failure that affects only a given consumer	More critical machines, complex automations and analysis and failure of such systems can even lead to life-threatening or other emergency situations.
Data volumes processed	Relatively small	Very large
Security Aspects	Components have lesser threat and focus is more on identity and privacy protection.	Cybersecurity threats are high and hence requires stronger security requirements to protect data and prevent breach
Life cycle of components	Short	Very long

The State of IIoT

A rising demand for automation in manufacturing and remote monitoring coupled with the decreasing cost of sensors and storage have pushed the adoption of IIoT in recent years.

The IIoT market has substantial growth potential. There are several estimates ranging from the conservative growth forecast of **$263.4 billion** in 5 years by Machine Metrics to the more optimistic projection of $500 billion in 3 years by McKinsey & Company.

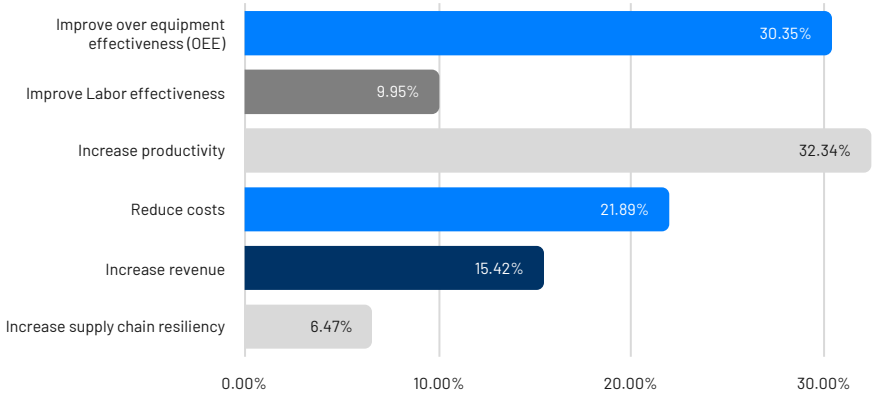
IIoT Growth Drivers

	Early 2000s	Today
Sensor cost	The average unit price per sensor was >USD 130	Unit price has fallen to <USD 0.50 per sensor
Data storage cost	Storing 1 GB of data would cost >USD 500	1 GB of data can be stored for as low as USD 0.02
Device ubiquity	IoT devices were largely limited to specialized applications, e.g., security cameras	8.4 billion IoT devices are in use: the average digital consumer owns ~4 connected devices
Connectivity	Phones ran on 2G networks at ~50kbps; Wi-Fi and Bluetooth were just introduced	The 5G mobile network supports up to 20 GB (400,000x increase); Wi-Fi and Bluetooth are standard technologies

IIoT focuses on return on investment (ROI)

Manufacturers are shifting toward advanced manufacturing to increase resilience, allowing them to react quickly to external and internal changes through modern digital work-planning tools.

Increased productivity and improved overall equipment effectiveness are the top benefits companies expect to gain from implementing IIoT systems, according to a 2022 survey. This is no surprise as process manufacturers lose a whopping $1 trillion yearly due to inefficient operations, according to Refining and Petrochemical Benchmarks, API, Solomon, the Occupational Safety and Health Administration, IHS Markit, and company reports.



*Adapted from the IIoT World Survey Results: Building IIoT Systems, prepared by IIoT World with support of HiveMQ, October 2022. All results are based on the interviews of 402 industrial representatives.

$1 trillion

is lost every year due to inefficient manufacturing operations

Companies that do not invest in IIoT will be at a competitive disadvantage compared to their peers that have already begun implementation.

The current level of IIoT adoption is on the rise. Surveying 402 industrial representatives revealed that **67%** of the companies **have already deployed or are in the process of developing an IIoT strategy**. Approximately one third are **still researching IIoT solutions**.

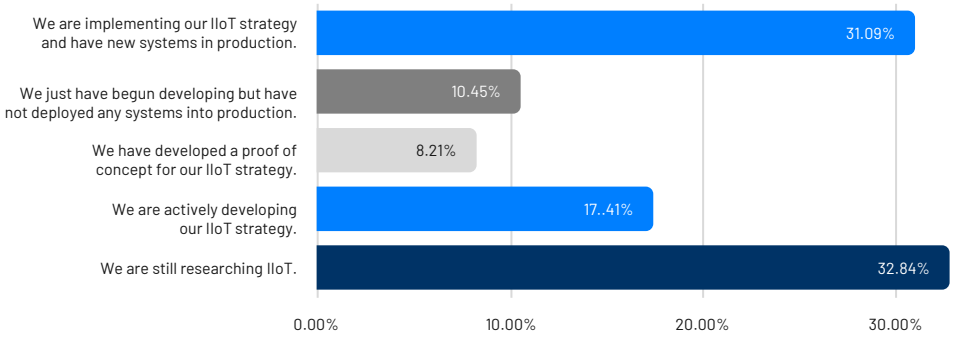


Figure: What is the current level of adoption. Source: IIoT World Survey October 2022.

The key challenges in implementing a new IIoT system are related to support from leadership and cybersecurity-related concerns.

Understanding IIoT:
Infrastructure, Requirements & Use Case Applications

IIoT relies on various technologies, with key ones being AI, cybersecurity, cloud computing, edge computing, and data mining.

Each IIoT ecosystem consists of:

- Connected devices that can sense, communicate, and store information about themselves.
- Public and/or private data communications infrastructure.
- Data analytics and applications for generating insights and business information from raw data.
- Data storage
- People managing the system.

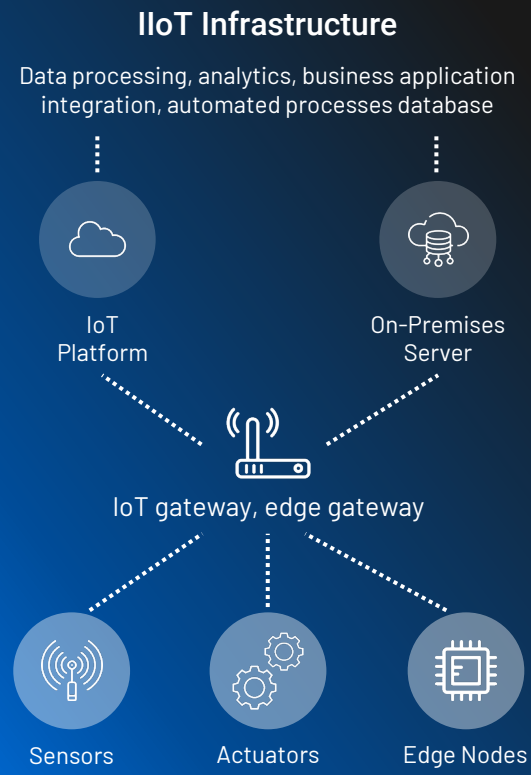
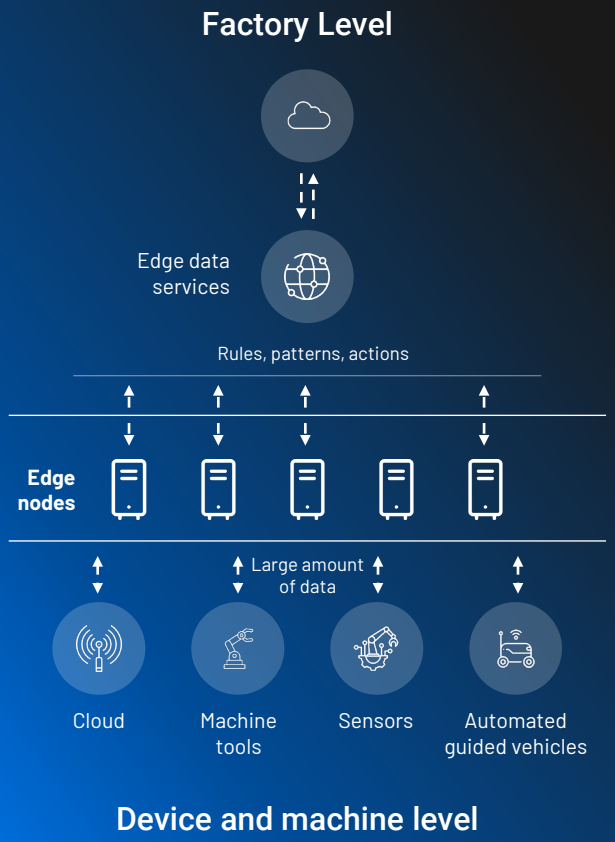


Figure. IIoT infrastructure components include the IoT or edge gateway, sensors, actuators, v and edge nodes. Source: Planet Technology USA.

IIoT requires a solid framework for long-term, robust development of IoT projects in industrial settings. This includes more than just connecting devices to the internet. A robust infrastructure is a crucial component of this framework.

Requirements for implementing an IIoT system include:

- Network connectivity: Wi-Fi, Bluetooth, 4G, 5G
- IoT hub
- Aggregation and analytics: Software tools for processing, analysis, visualization, and driving ML. (e.g., SQL vs. NoSQL or static vs. streaming).
- Device management and control
- Security (e.g., Intrusion detection and prevention systems, antimalware tools, ransomware protection)



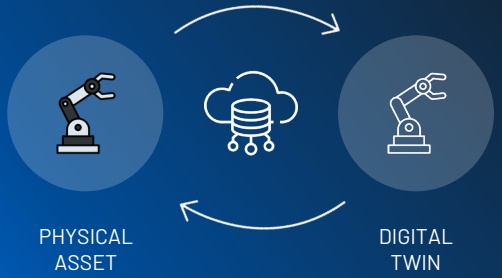
Tapping into the competitive advantage that IIoT offers requires understanding the key applications.

Key players and developers of Industry 4.0 solutions with IIoT support

Integrating an IIoT platform with existing manufacturing execution systems (MES) helps maximize a company's ROI on their MES investment.

MES can connect with the cloud and to any Industrial IoT. Such IIoT-based MES software can connect multiple plants, sites, and vendors' live production information and integrate easily with equipment, controllers, and enterprise business applications. IIoT-based MES can aid in complete visibility, control, and manufacturing optimization of production and processes across the enterprise.

IIoT can help in creating digital twin models by generating data and aggregating various digital twins into a common platform.



IIoT can aid in better asset management and monitoring in 4 ways.

1

Overall equipment effectiveness (OOE) optimization

Incorporating IIoT into asset management helps analyze and monitor the quality, availability, and performance of machines in real time. It helps in reducing operational costs, increasing customer satisfaction, and enhancing business performance.

OEE = *Availability * Performance * Quality*

A manufacturing process with a 100% OEE score produces only high-quality products (100% quality) as quickly as possible (100% performance), with no downtime (100% availability).

2

Predictive maintenance

Sensors attached to various assets provide data related to performance, which is beneficial in predicting the functionality of the assets just before equipment downtime or end-of-life. Predictive maintenance promises savings in maintenance costs, increased system availability, and reduced quality cost.

3

Reduced human intervention using sensors.

4

Enhanced workflow support and security

The adoption of bank-level AES-256 data authentication and encryption techniques ensure the security of data collected through sensors.

Predictive maintenance is currently the most mature application of IIoT with reported benefits and savings.

KONE Corp. used the IBM Watson IoT platform to help predict the condition of the elevators and escalators and suggest resolutions to potential problems.

Helped reduce equipment failures and downtime, and improve performance and usage. It also improved "people flow" in tall structures and provided a better user experience, resulting in less waiting time and fewer delays.

Sugar Creek Brewery used IBM Watson to make equipment-level improvements.

Helped save $30,000 per month in lost revenues from reducing spillage of their bottling system.

How to choose the right IIoT strategy?

- Effective Planning
- Supplier Selection

Effective planning during the initial stages of IIoT projects can increase the chances of success.

Questions to start with:

- How can an ideal IIoT solution help achieve specific short-term goals?
- How can an IIoT digital transformation contribute to the development of future company-wide objectives?
- Do you want a ready-made solution delivered by a professional team, or do you want to create your own custom solution?

The most common mistakes are:

- Too ambitious plans
- The lack of a clear path to follow
- Extracting data from machines on a factory floor without a clear strategy for interpreting and applying the insights from that data, leading to a dead-end solution

70%

of IoT projects (including industrial) fail because of poor planning in the initial stages.

Supplier selection is an integral next step in any company's digital transformation plan.

Supplier selection is of two types:

- Selecting an IIoT **system** provider if you choose to partner with a company to deploy for you.
- Selecting an IIoT **sensor** provider if you choose to develop your own IIoT solution.

Key factors to consider when selecting vendors:

- Investment costs as the cost of adoption and implementation is high
- Training and experience of in-house IT staff
- **Security:** must have a clear IIoT security strategy and bring security practices into alignment with the organization's broader risk frameworks and integrate security technologies into operational processes
- **User Interface:** A user-friendly, customer-oriented interface of any system influences the time needed for a team to start with a new tool and its effective deployment.

The most common models of work with IIoT vendors are:

Hands-off answers

Client sets objectives and shares data, but remains hands-off from uncovering a solution.

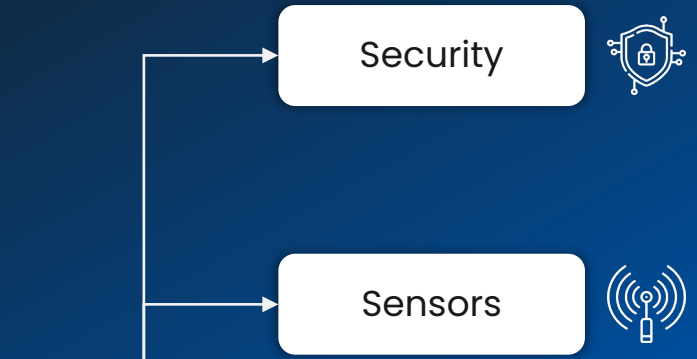
Analytics without analysis

Offers efficient visualization tools and uses IIoT to seamlessly link clients assets, systems, and people into a system. It visualizes what happened in the past and what may happen in the future, but the data analysis shall be performed by the client himself.

Analysis, Analytics, and Autonomy

Suppliers that perform a deep study of the client's case, create and implement a change management philosophy.

What to take into account when developing your own IIoT solution?



Security

An IBM report highlighted that manufacturers were the most frequently targeted industry for cyberattacks in 2021, due to the high adoption rate of IIoT products in these companies.

Combining physical and cyber operations by collecting and analyzing data can greatly benefit sourcing, fabrication, manufacturing, processing, and transportation operations in the industry.

Experts predict that the trend of data collection and analysis will reach its peak around 2025, at which point it is expected that 75% of operational data in industrial settings such as plants and distribution centers, will be gathered and processed using edge computing.

How to Avoid Failure in IIoT Projects:

- Avoid using manufacturer-default passwords. Research from Deloitte in 2020 found that as many as 70% of connected sensors and devices use these types of passwords.
- Implement structured update processes for industrial IoT security.
- Consider bringing on an outside management team for additional expertise.
- Outsource connected technologies for added security.
- Segment IT networks and implement robust device management to further strengthen security.

Example companies developing industrial security solutions:

KPMG NCP SECURE COMMUNICATIONS IBM HMS

Sensors

Tips for choosing the best fitting IIoT sensors

1 **Reliability and robustness:**

- Industrial-grade sensors should be long-living and well-adapted to the primary use scenarios, for e.g., to harsh environments during routine operating conditions.
- When selecting from the candidate sensor devices, check whether the sensor has a proof of compliance with the quality standards.
  - For waterproofing, it could be IP68 / NEMA 6P, or some independent certifications
  - For explosive environments, it could be HazLoc, or an AS9100 Certification required for companies developing aerospace products.

Examples of companies providing sensors with proof of compliance certification:

IP68 / NEMA 6P

AS9100 Certification

HazLoc

Sensors

Tips for choosing the best fitting IIoT sensors

2 Accuracy

Hardware interoperability and the ability to monitor critical parameters are key evaluation criteria when selecting a sensor to support the full breadth of the monitoring effort the client is hoping to undertake.

3 Power efficiency

The IIoT solutions need ultra-low-power energy consumption in all parts of the system.

- ↳ This is critical to ensure a long maintenance cycle.
- ↳ The sensors should feature short wake-up times and long stabilization intervals to maximize the effectiveness of the entire IIoT ecosystem.

4 Universality

When possible, select sensors that can be placed in-line or are submersible.

- ↳ Such sensors are much more universal, can be installed in almost in any place needed, have high robustness and low maintenance overhead.

5 Price optimality

it is crucial to remember that majority of IIoT solutions require enormous amount of midpoints and endpoints, so the sensor price must be at a level compatible with the financial scope of the projects that the customer is targeting to attain.

Sensors

Examples of Popular IIoT Sensors:

1. **Vibration Sensors -** Monitor the vibration levels of certain assets
2. **Temperature Sensors -** Usually ensure that an asset stays within a safe temperature range
3. **Proximity Sensors -** help alert an operator when one piece of equipment is too close to another piece of equipment
4. **Gas Sensors -** alert if smoke or another unwanted gas leaks into an area
5. **Security Sensors -** can be placed near key windows and doors to monitor motion in the areas.
6. **Humidity Sensors -** a facility may need to monitor surrounding humidity levels, an acceptable range can be set, and when levels fall out of range, alerts can be immediately sent.
7. **Pressure Sensors -** can set the maximum pressure allowed for a particular asset.
8. **Level Sensors -** can monitor the level of a particular fluid in a piece of equipment.
9. **Infrared Sensors -** emit or detect infrared radiation or measure released heat.
10. **Theft Sensors -** can be attached to valuable items to ensure they stay within an acceptable location.

About the Authors

Ekaterina Balandina

Project Architect

Ekaterina received Dipl.-Ing. and M.Sc. degrees in Mathematical Provision and Administration of Information Systems from Yaroslavl State University. Ekaterina started PhD studies at University of Oulu. Later she moved to the Tampere University of Technology, where she is currently finalizing the dissertation. Her research interests include intelligent networks, smart spaces, Internet of Things, location-aware solutions, and protocol design. She is an author of over 25 research publications, including one book.

Sofiane Boukhalfa, PhD

Technical Director

Sofiane earned his B.S. in Materials Science and Engineering from The University of Illinois at Urbana-Champaign, and his Ph.D. in Materials Science and Engineering from the Georgia Institute of Technology, where his research focused on nanotechnology and energy storage. Before joining PreScouter, Sofiane worked as an emerging technology and business strategy consultant. He specializes in the high tech and aerospace and defense sectors, in addition to working closely with private equity and venture capital clients. Sofiane is based in Paris, France.

Emil Jose

Analyst

Emil is a Mechanical Engineering graduate with a keen interest in AI/ML, blockchain, philosophy, and aerospace and defence. He brings high-quality analysis and innovative thinking to his role at PreScouter, leveraging his experience in content development for ed-tech companies and an AI startup focused on Artificial General Intelligence. Emil's research on the role of blockchain technology in modern supply chain management has given him a strong understanding of his areas of interest, enabling him to help PreScouter's clients gain a competitive edge on disruptive technologies.

Potential Next Steps

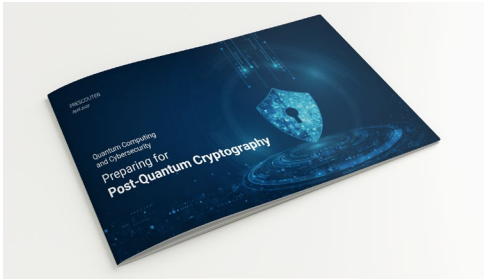
PreScouter can find the most suitable IIoT providers (system providers and/or equipment providers)

PreScouter can provide insights about best practices and reasons/stories of failures.

PreScouter can provide Conference-as-a-Service by finding the right conferences to attend, and highlight the most relevant technologies discussed.

Other reports from PreScouter that you might like

Applications of robotics in quality assurance and maintenance



Quantum Computing and Cybersecurity: Preparing for Post-Quantum Cryptography

Disruption in Human Robot Collaboration

Engage our network of experts and analysts on your topic.

CONTACT US HERE

About PreScouter

PRESCOUTER PROVIDES CUSTOMIZED RESEARCH AND ANALYSIS

PreScouter helps clients gain competitive advantage by providing customized global research. We act as an extension to your in-house research and business data teams to provide you with a holistic view of trends, technologies, and markets.

Our model leverages a network of 4,000+ advanced degree researchers, industrial experts, engineers, and analysts across the globe to tap into information from small businesses, national labs, markets, universities, patents, startups, and entrepreneurs.

CLIENTS RELY ON US FOR:

Innovation Discovery: PreScouter provides clients with a constant flow of high-value opportunities and ideas by keeping you up to date on new and emerging technologies and businesses.

Privileged Information: PreScouter interviews innovators to uncover emerging trends and non-public information.

Customized Insights: PreScouter finds and makes sense of technology and market information to help you make informed decisions.

500+ CLIENTS WORLDWIDE

5,000+ RESEARCH REPORTS CREATED

150,000+ HOURS OF RESEARCH COMPLETED FOR CLIENTS

PRESCOUTER

About PreScouter

Please note that the information presented in this report is intended for informational purposes only and should not be used in place of consultations with our expert advisors. No third parties were involved in the preparation of this report. All information regarding mentioned companies was sourced from publicly available information. No sponsorship, endorsement or approval of this content by any mentioned entities is intended, expressed or implied.

Visit **prescouter.com** to learn more.

@PreScouter

@prescouter

@PreScouter

PRESCOUTER