ALTIZON
The Industrial IoT Company

DRIVING PAYBACK THROUGH INDUSTRIAL INTERNET OF THINGS

Content

DRIVING PAYBACK THROUGH INDUSTRIAL INTERNET OF THINGS

The Internet of Things or IoT is a network of physical devices or ‘things’ that are interconnected and can exchange information about their operation and about the environment in which they function.

The application of IoT to industrial assets is termed as The Industrial Internet of Things or IIoT. These assets could be within a manufacturing facility, such as manufacturing plants or remote assets distributed across a geographical area. IIoT platforms are specialized forms of generic IoT platforms that offer enhanced functionality in asset connectivity, data analytics and AI models that are more suited to industrial assets.

The rise of IIoT has also given rise to several business initiatives that are interrelated and significantly overlap, as outlined below.

- **SMART MANUFACTURING:** Connecting manufacturing processes and assets and using analytics for improved performance and quality
- **DIGITAL TRANSFORMATION:** Digitizing and transforming processes, specifically in related manufacturing operations
- **SMART FACTORIES:** Building a production facilitythat is connected and leverages smart manufacturing and digital transformation
- **INDUSTRY 4.0:** An umbrella term that is equivalent to a smart factory

IIoT platforms act as a foundation layer for these initiatives.

The rapid expansion of IoT and its wide application in smart manufacturing can be attributed to advancement in several complimentary areas.

- **NETWORK:** Improving data bandwidth along with the rise of efficient and low power networking and communication protocols such as LoRa and ZigBee that are suited for connected devices
- **SENSORS:** Robust and affordable sensor technology that has the ability to communicate built in
- **CLOUD COMPUTING:** On-demand availability of compute and storage resources that can process, store and analyze the tremendous amount of information generated by IoT
- **EDGE COMPUTING:** Technology that enables processing of sensor data and related information close to its source thus saving on bandwidth and improving response time
- **BIG DATA ANALYTICS:** Software frameworks and analysis techniques that can be used to make sense of the tremendous amounts of data being generated by IoT
- **MACHINE LEARNING:** Advancements in AI that let you build a 'digital twin' of an asset and predict outcomes on how that asset will behave

The focus of this whitepaper is to help provide a clear perspective to organizations on IIoT, offer insights on realizing payback across various verticals and provide a framework for a successful IIoT implementation.

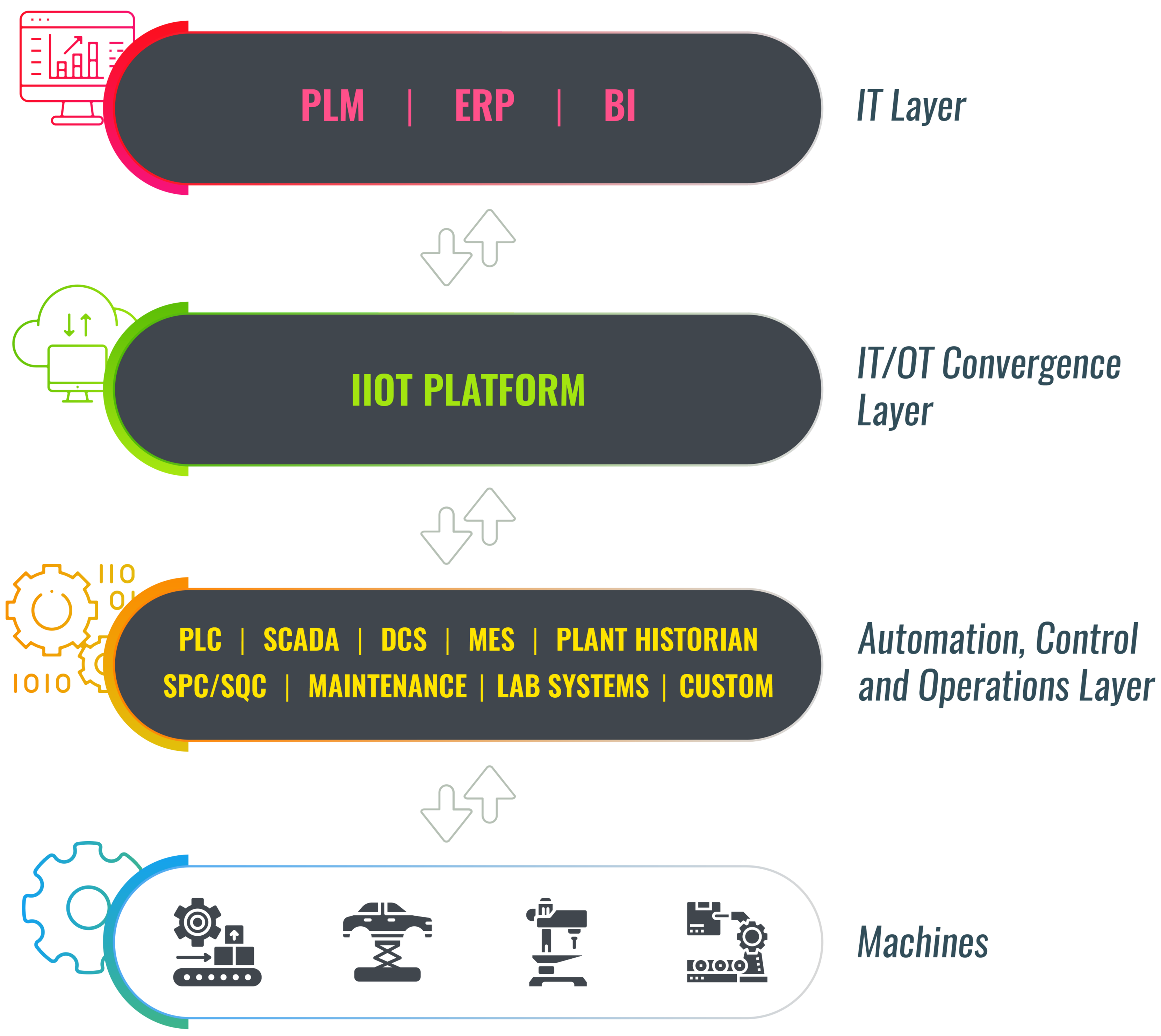
IIOT PLATFORMS IN AN INDUSTRIAL ENVIRONMENT

An industrial environment is extremely complex with several elements that can be broadly classified into:

- **INDUSTRIAL MACHINERY AND EQUIPMENT:** These perform the core functions and operations within a factory
- **SENSORS:** These measure the performance of the machinery and the environment or condition in which they function
- **AUTOMATION, CONTROL AND OPERATIONS SYSTEMS:** These are software systems such as SCADA, DCS, MES, Historians and Quality Management Systems that are used for the day-to-day operations of a plant
- **IT SYSTEMS:** These are software systems used for managing business processes – these include PLM, ERP and Business Intelligence solutions

In this multi-process milieu, an IIoT platform acts as a convergence layer, with IT Systems on one side and Operations Systems, machines and sensors on the other. Information from these systems is unified to create a manufacturing operations data lake. Analysis of this data allows for wide-ranging and global decision making.

FIGURE 1. IIOT PLATFORM IN AN ENTERPRISE



Existing IT and Operations Systems have started acquiring IIoT platform-like capabilities. Such approaches, however, are topical at best and cannot scale as the scope of the implementation expands. It is, therefore, important to understand what constitutes an IIoT platform so that the right parameters for putting the system in place are established.

THE LAYERS OF AN IIOT PLATFORM

An IIoT platform consists of the following layers or sub-components:

THE EDGE

The Edge is the software component installed at the edge of the network, close to the source of data. It might run on dedicated IoT gateway hardware or on servers within a plant network.

The Edge layer is responsible for collecting data from machines and operations systems and sending it reliably to the manufacturing data lake. IIoT data can be extremely large so the Edge is also responsible for processing the data locally for improved throughput and scale. The Edge can perform advanced analytics and AI, and has the ability to power local applications.

THE MANUFACTURING DATA LAKE

The Manufacturing Data Lake is the repository for all machine and manufacturing operations data across the enterprise. The Edge layer streams data in real-time to this layer. It is necessary for the Data Lake to be highly scalable to deal with the sheer volume of data.

ADVANCED ANALYTICS AND MACHINE LEARNING

This layer provides the ability to analyze manufacturing operations data. It is powered by big-data technology designed to handle the volume, velocity and variety of data across the enterprise. This layer should have the ability to perform standard and advanced analytics. It should also have the capability to build machine learning models of the data to create a digital twin of the asset or operation being analyzed.

MANUFACTURING INTELLIGENCE

This is a vertical-specific layer that provides standard implementations of critical KPIs across Productivity, Quality, Planning and Maintenance. This layer allows for rapid implementation and fast payback for IIoT in an enterprise.

INTEGRATIONS

The integrations layer provides standard modules to rapidly connect manufacturing operations data to IT systems such as ERP, PLM and BI. Open data accessibility is key to a successful IIoT implementation.

SECURITY AND DEPLOYMENT FLEXIBILITY

It is important for an IIoT platform to run on any infrastructure — including all major public and private cloud vendors. It should also have the ability to be deployed fully on-premise. The platform should be multi-tenant, allowing for rapid rollouts across the enterprise. The platform should also be fully compliant when it comes to global information security standards.

Having established the layers of an IIoT platform, it is important to identify those use cases that will help drive payback.

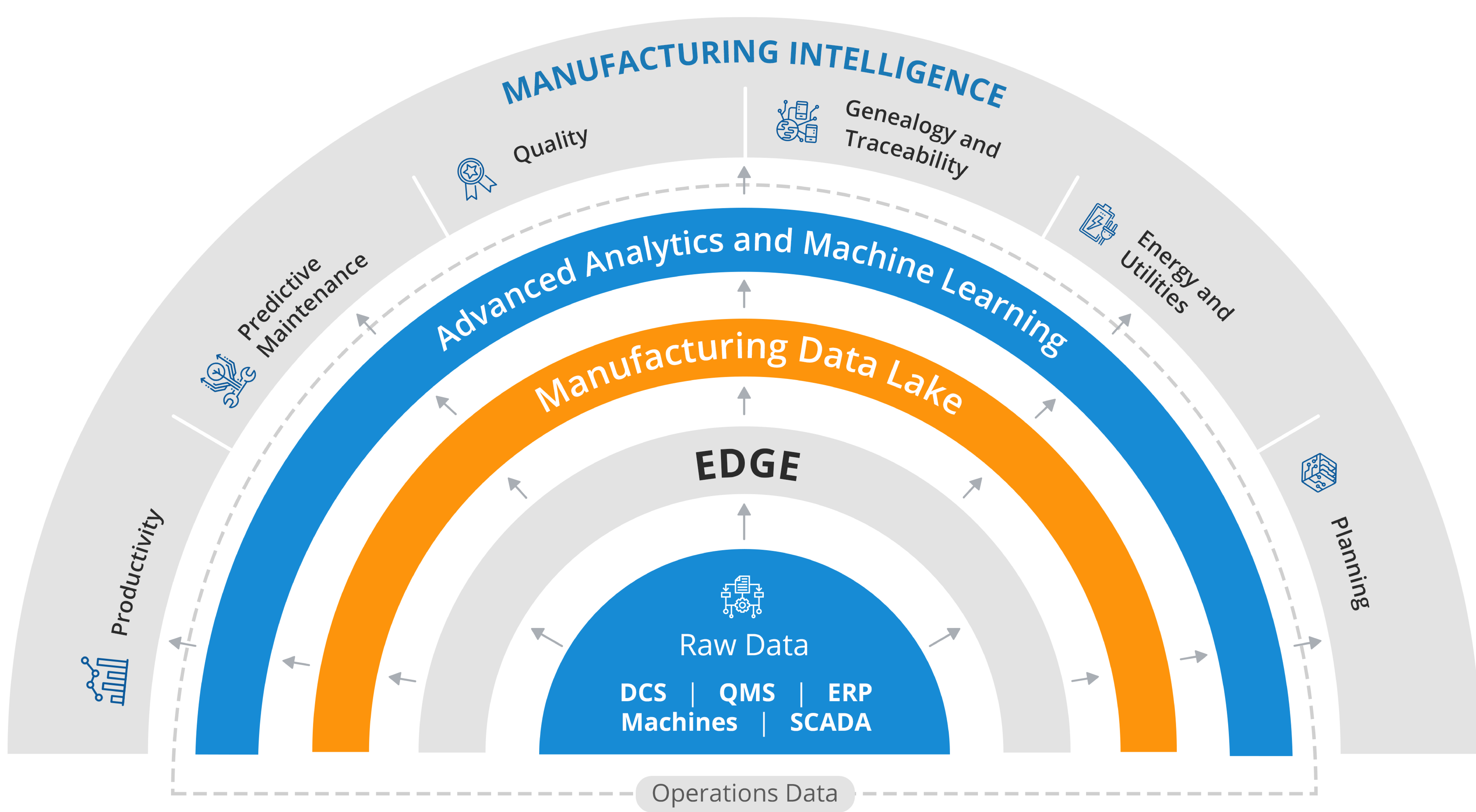
Within manufacturing plants, the following IIoT use cases have the most significant business impact:

KEY IIOT USE CASES

PRODUCTIVITY: Significant system-level throughput improvement with optimal conversion cost

- Real-time and accurate measurement of Overall Equipment Effectiveness (OEE) of critical machines and bottlenecks
- Identification of top reasons behind unplanned downtime, followed by the identification of root causes to minimize them
- Instantaneous production monitoring, booking and inventory updates in ERP/Planning Systems
- Close monitoring and control to sustain actions for improvement

FIGURE 2. **SUB-COMPONENTS OF AN IIOT PLATFORM**



PREDICTIVE MAINTENANCE: Extended asset life, reduced downtime and reduced cost of spare parts and tooling

- Real-time monitoring of critical machine parameters, enabling a change from time based to condition-based maintenance followed by predictive maintenance

- Applying machine learning techniques on historical operational data of an asset to build a digital twin – this represents the normal operating condition of the asset

- Leveraging the twin to predict failure when the performance of the asset deviates from normal

- Multi-dimensional modeling where data from traditional techniques such as vibration monitoring, thermography, tribology and visual inspection is correlated with machine operating variables such as load, speed and product quality, leading to the root cause of mechanical and electrical failures

QUALITY: Significant reduction in direct material costs and expenses owing to poor quality; improvement in overall rolled throughput yield and cutback on rework

- Real-time monitoring of machine process parameters that impact part quality characteristics

- Correlation between input – process – output leading to a more informed root cause and CAPA analysis

- In-process Poka-Yoke to eliminate product defects

- Machine learning-based models to predict potential quality failures and prescription of settings to avoid them
- Digital audit compliance and baseline for FMEA

GENEALOGY AND TRACEABILITY: Significant reduction in liabilities linked to non-compliance with various standards

- Linking of critical process and operational data to the product as made in the manufacturing value chain from upstream to downstream

- Early warning signals of potential process capability deterioration

- Complete operations traceability that enables compliance in the event of product quality audit, withdrawal or recall

- Extension of the system to critical part suppliers in the supply chain

ENERGY AND UTILITIES: Significant reduction in energy and utilities consumption leading to lower conversion cost, reduction in system level energy leakages, compliance with ISO 50001 and lower carbon footprint

- Monitoring and analysis of critical utilities such as electrical energy, compressed air, steam and water

- Establishment of specific consumption patterns across product categories

- Analysis and identification of opportunities for reduction in consumption

- Deployment of sensors at critical points in the energy network to identify leakages in real-time
- Prediction of sub-optimal consumption patterns

PLANNING: Leveraging operations data for improved planning reliability and effectiveness, enhanced fill rate, dynamic master data updates and better customer satisfaction

- Real-time visibility into status of planned orders and likely deviations from promised due dates
- Notification on significant events that may need re-planning
- Monitoring and reporting of significant changes in master data linked to bill of materials, routings and lead times
- Machine learning-based decision support system for planning and scheduling optimization
- Enabling a system to reach near-zero latency state in supply chain planning and optimization, problem identification, re planning for feasibility and optimality, and implementation of changes

Having identified these IIoT use-cases, their applicability and potential to generate rapid payback across various industry verticals can be examined.

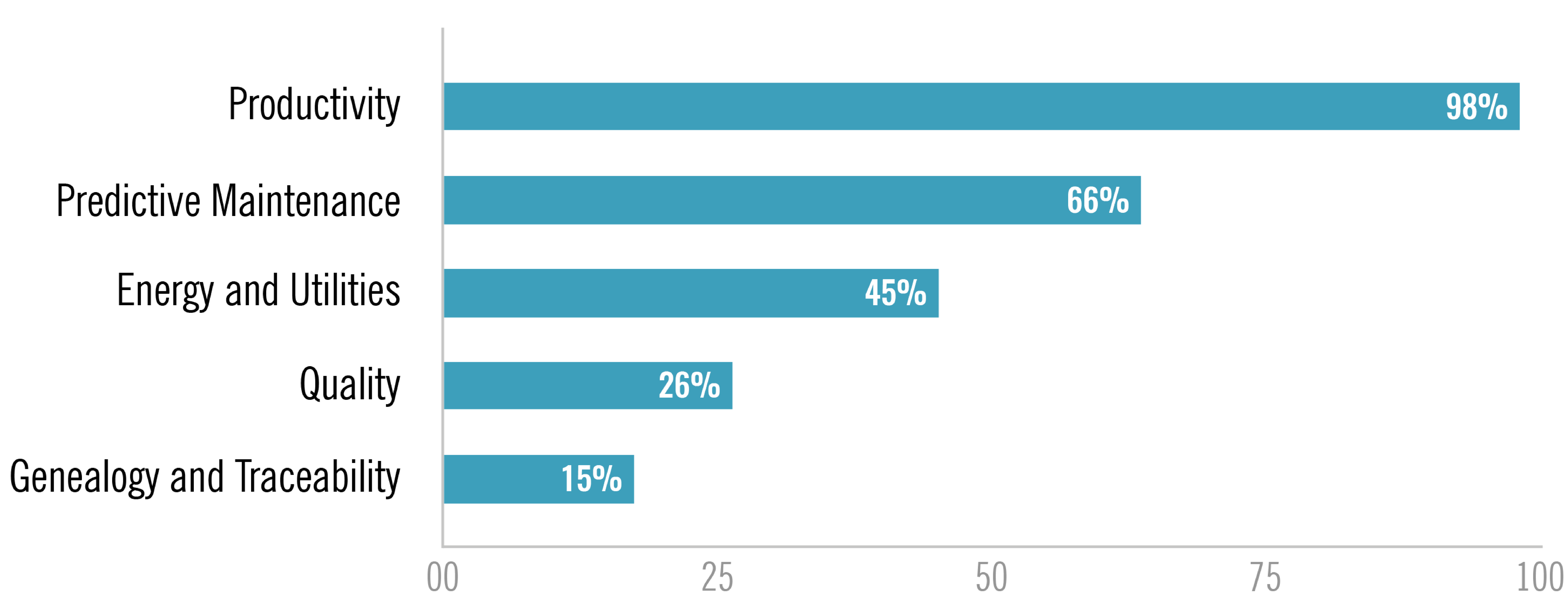
APPLICABILITY AND PAYBACK PERIOD OF IIOT USE CASES FOR SPECIFIC VERTICALS

Altizon has been closely working with manufacturing companies across various industrial verticals since 2013. In this period, repeatable patterns have emerged on the kind of problems that IIoT can solve. This section provides an analysis of problem classification and payback periods for key use cases across Automotive, Tire, Chemicals, Textiles and CPG.

AUTOMOTIVE PLANTS

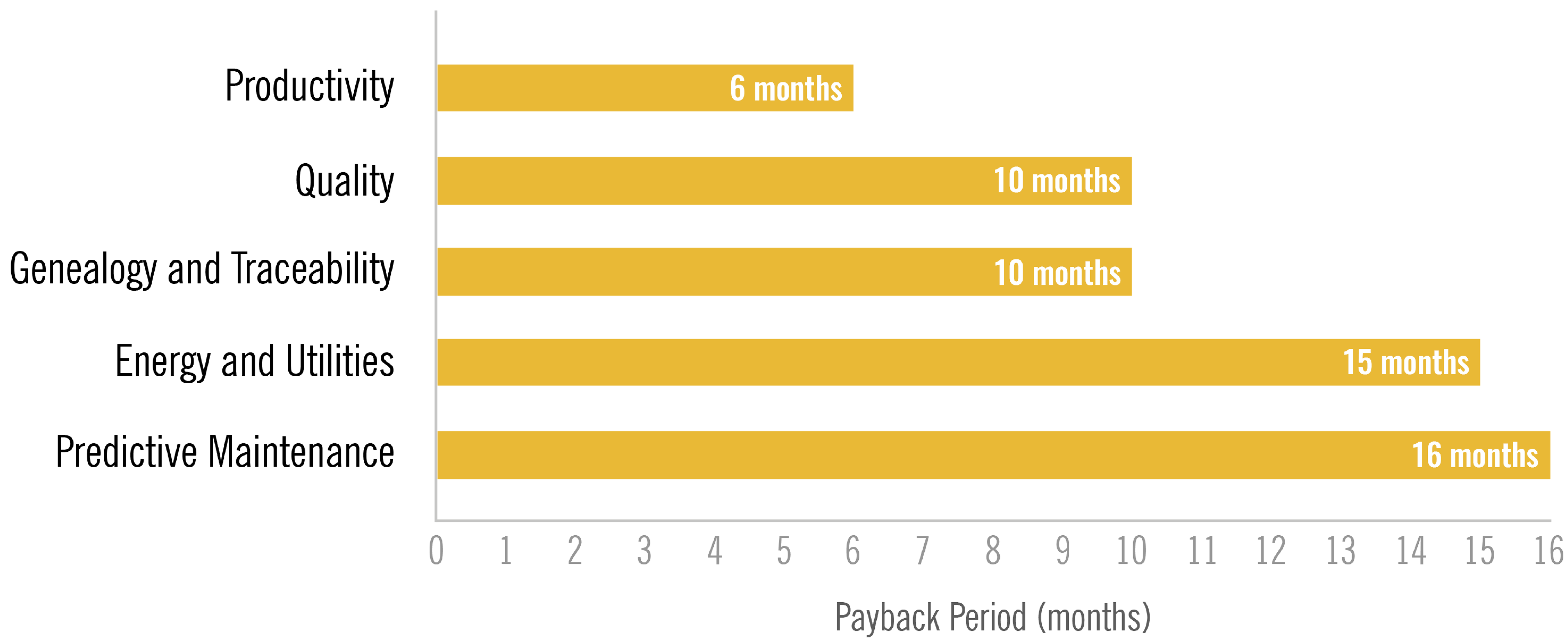
In this world of connected cars and electric powertrains, automotive plant operations are gearing to go digital across their entire supply chain. The adoption of industrial IoT has mainly been focused around removing the bottlenecks in operations and controlling conversion costs.
Productivity is the most prevalent use case followed by predictive maintenance.

FIGURE 3. **USE CASE PERCENTAGE IN AUTOMOTIVE PLANTS**



Productivity has been the use case with the earliest payback period of 6 months on average followed by Quality and Traceability.

FIGURE 4. **AUTOMOTIVE USE CASES WITH ASSOCIATED PAYBACK PERIOD IN MONTHS**

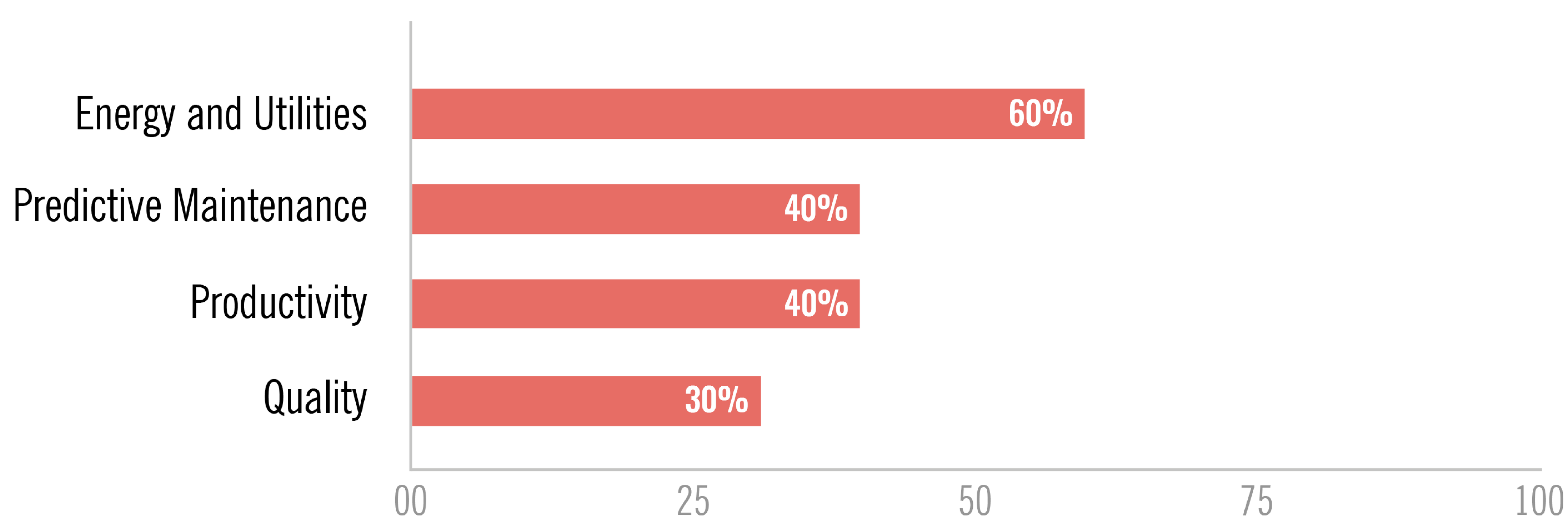


TIRE PLANTS

Electric vehicles are presenting a unique opportunity to the tire industry in design and manufacturing. Increasing product variety, volatile raw material prices and asset and energy-heavy production processes are putting significant pressure on traditional tire manufacturers to innovate.

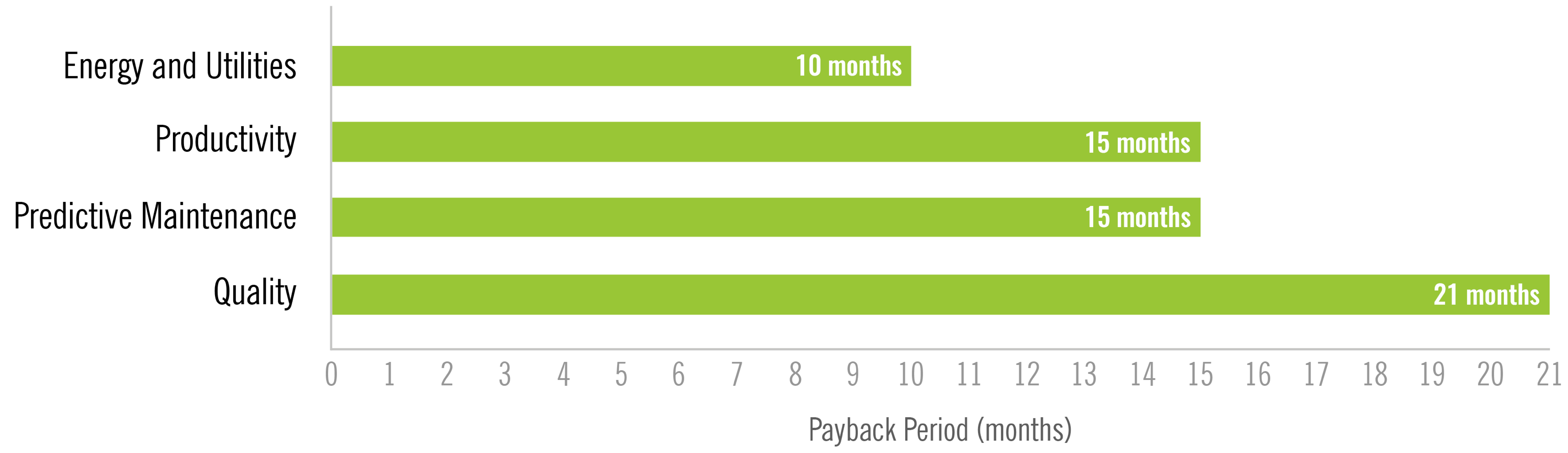
Altizon has deployed its platform at multiple tire manufacturing sites to introduce predictability in operations, reduce energy and utilities cost, and improve productivity.

FIGURE 5. **USE CASE PERCENTAGE IN TIRE PLANTS**



Energy and Utilities cost reduction in the Tire industry vertical has been the use case with the earliest payback period of 10 months on average.

FIGURE 6. **TIRE MANUFACTURING USE CASES WITH ASSOCIATED PAYBACK PERIOD IN MONTHS**

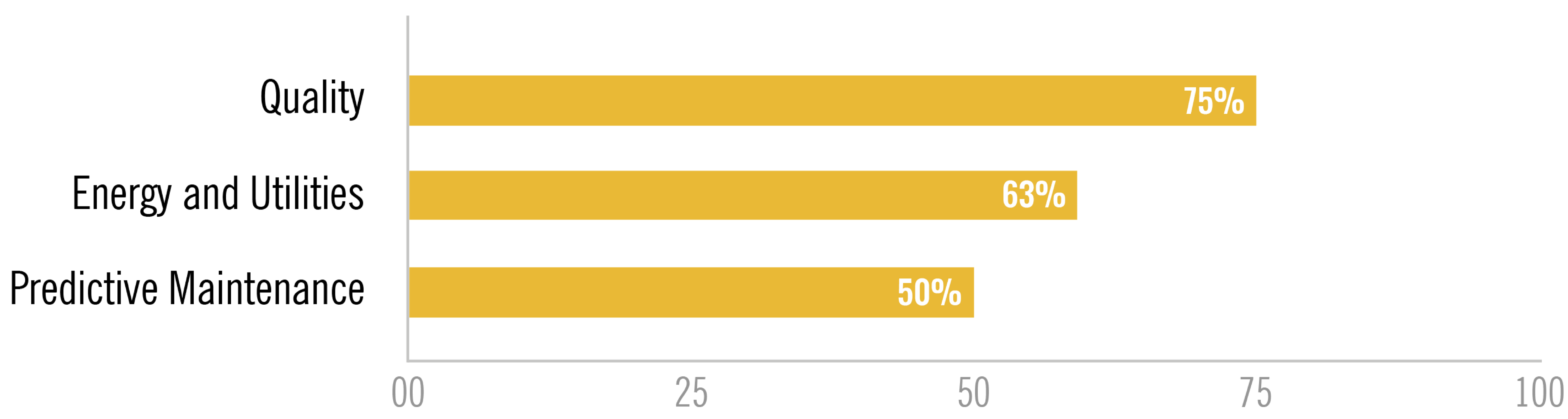


CHEMICAL MANUFACTURING PLANTS

Chemical manufacturing plants engage in continuous process or batch manufacturing. Most of these plants have been connected and controlled for decades with data being generated in silos.

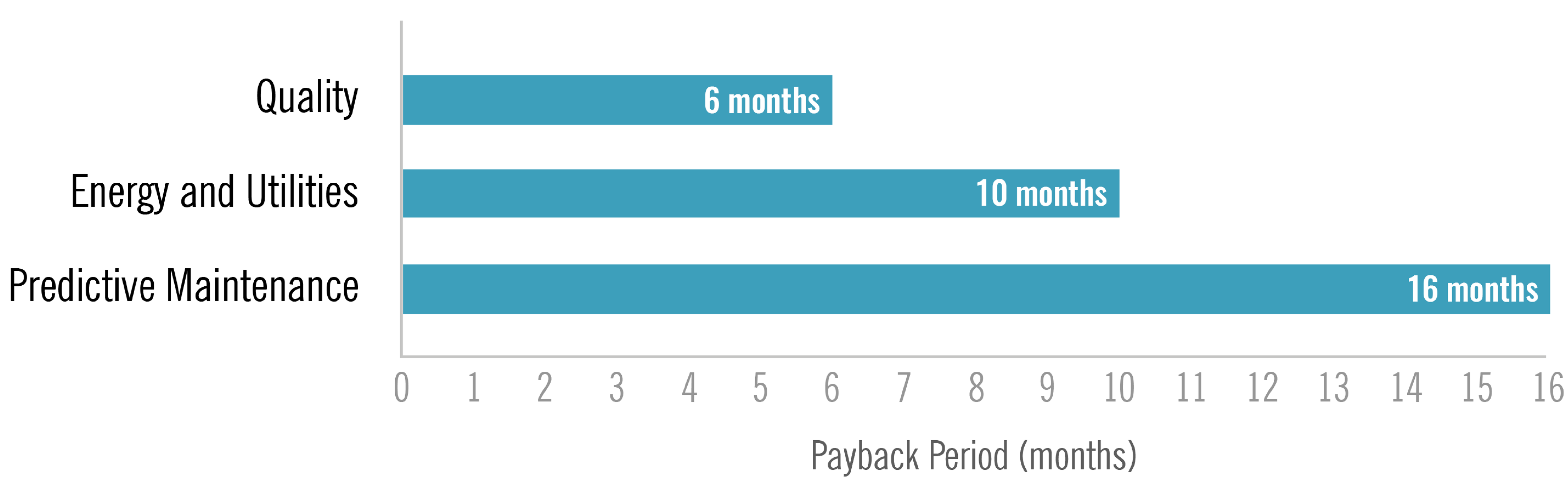
Primary use cases at chemical manufacturing plants revolve around improving overall rolled throughput yield, optimizing golden batch parameters, reducing energy and utilities consumption, and predictive maintenance. Quality is the most prominent use case followed by energy and utilities cost reduction.

FIGURE 7. **USE CASE PERCENTAGE IN CHEMICAL MANUFACTURING PLANTS**



Quality Improvement in chemical manufacturing plants has been the use case with the earliest payback period of 6 months on average.

FIGURE 8. **CHEMICAL MANUFACTURING USE CASES WITH ASSOCIATED PAYBACK PERIOD IN MONTHS**

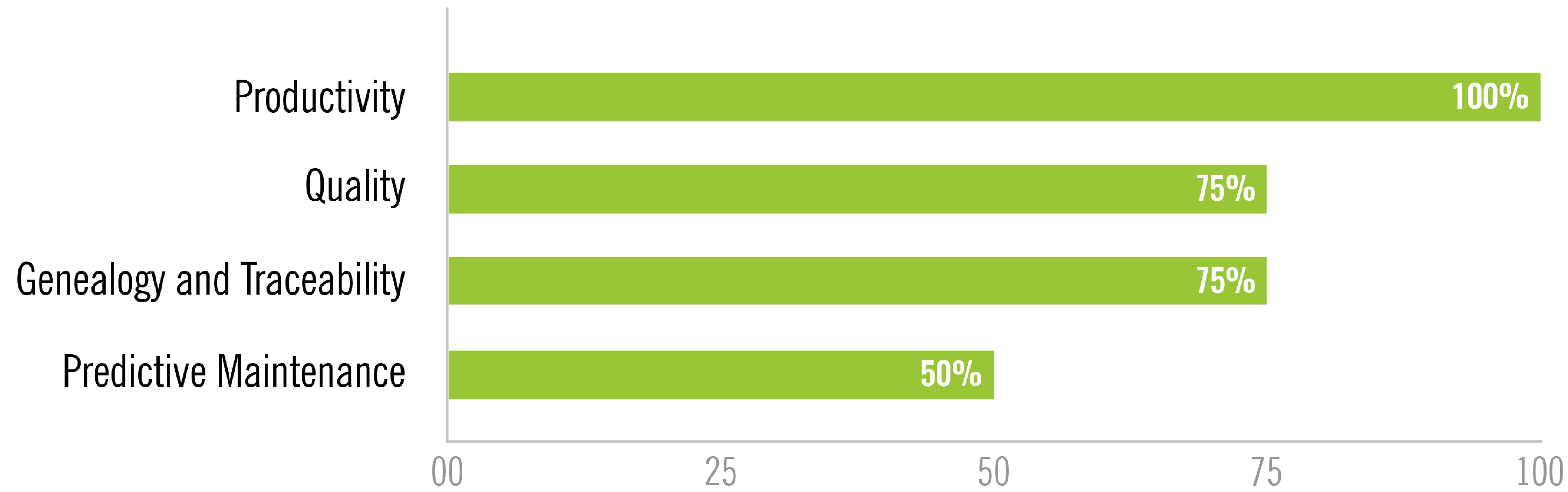


TEXTILE MANUFACTURING PLANTS

Textile manufacturing is characterized by increasing product variety, decreasing batch sizes and immense pressure to reduce material and conversion cost. There is also an endeavor to reduce impact on the environment and focus on employee health.

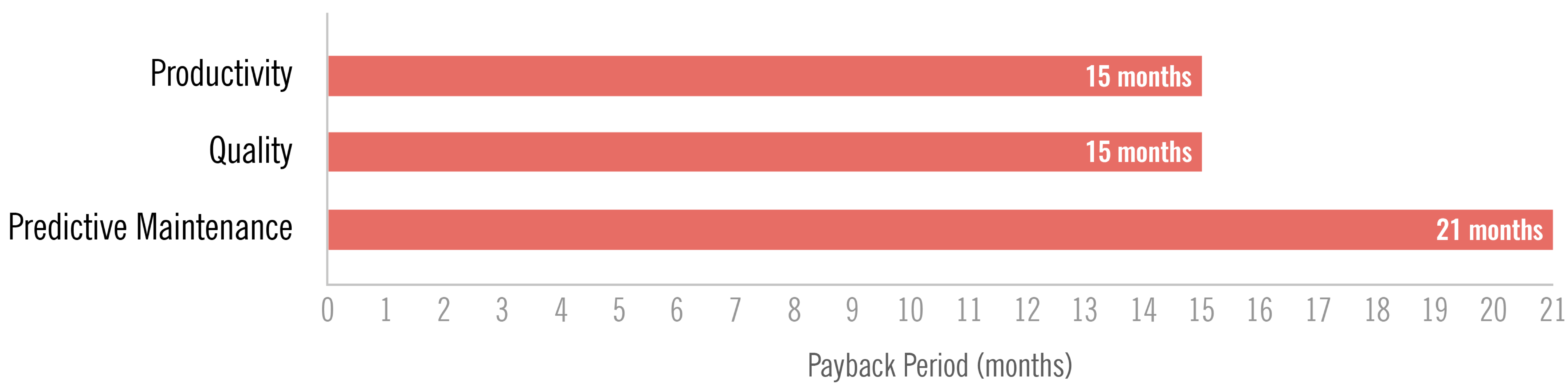
Primary use cases at textile manufacturing plants include unplanned downtime reduction and process adherence. Productivity is the most prominent use case followed by quality and process adherence.

FIGURE 9. **USE CASE PERCENTAGE IN TEXTILE PLANTS**



Textile plants often require capex investment in machine and infrastructure upgrades to be IIoT ready. Due to this, average payback periods tend to be longer, with a minimum 15 months for all use cases.

FIGURE 10. **TEXTILE MANUFACTURING USE CASES WITH ASSOCIATED PAYBACK PERIOD IN MONTHS**

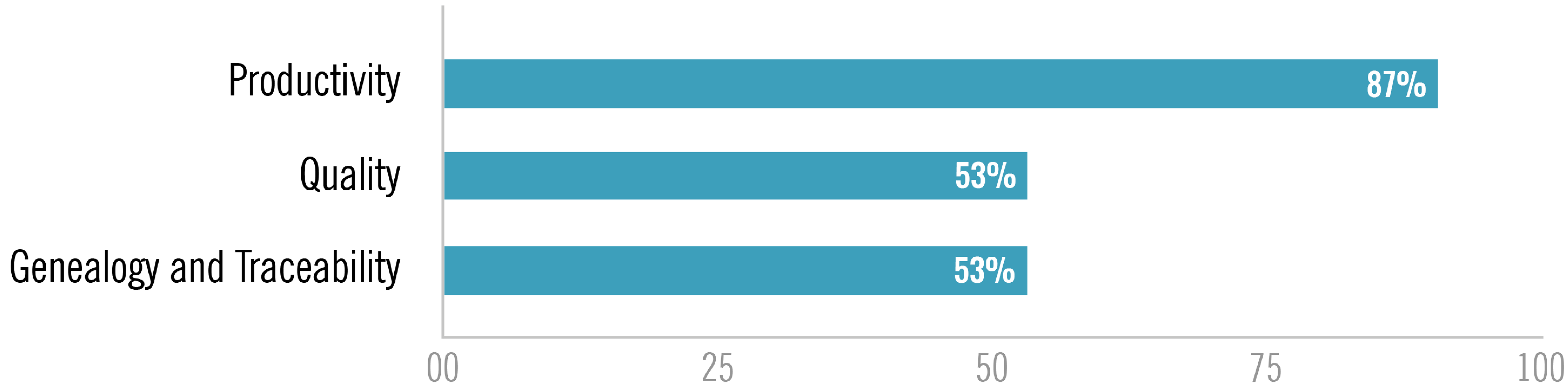


CPG

Predictability in CPG/Food/Beverage supply chain and operations is critical for the industry to improve sales at the lowest possible cost. This industry usually has a growing product mix and small packaging sizes, with customers demanding a digital trace to raw material sources and processing conditions. Industrial IoT use cases in CPG span the supply side (raw materials processing, storage), core manufacturing and downstream packaging operations.

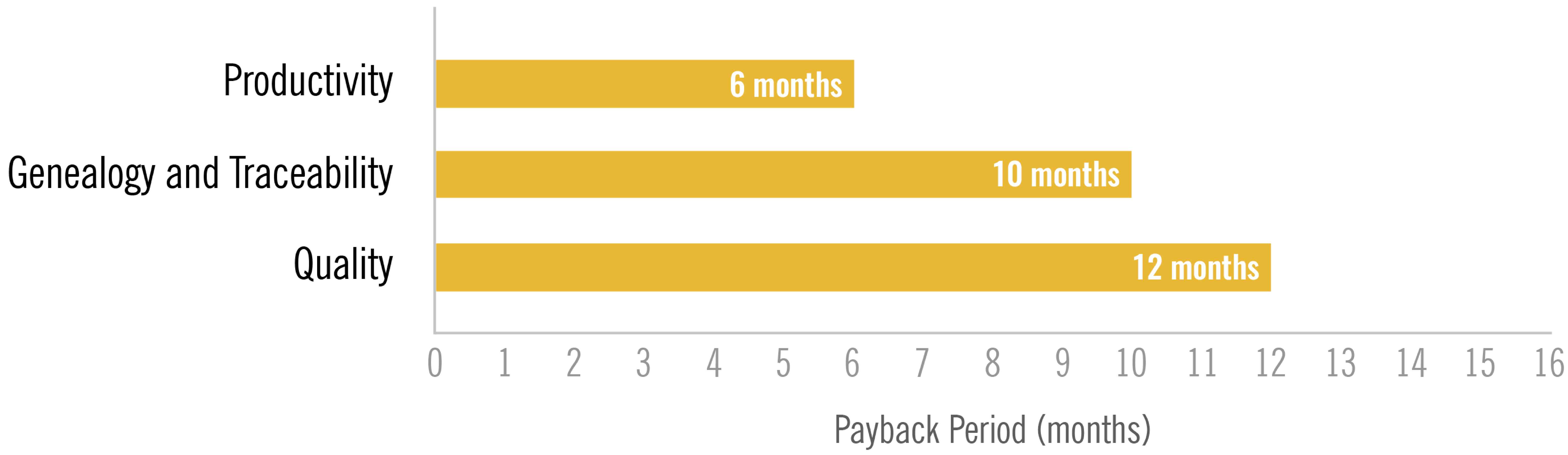
Productivity has been the most prominent use case in CPG (focused primarily on line speed and changeover analysis) followed by Quality and Traceability.

FIGURE 11. **USE CASE PERCENTAGE IN CPG PLANTS**



Productivity has been the use case with the earliest payback period of 6 months on average followed by product Genealogy and Traceability.

FIGURE 12. **CPG USE CASES WITH ASSOCIATED PAYBACK PERIOD IN MONTHS**



PRINCIPLES THAT GOVERN A SUCCESSFUL IIOT IMPLEMENTATION

As organizations get started with their IIoT initiatives, it is critical to keep best practices in mind to ensure success and maximum payback. Here's how:

- Select one end-to-end qualified partner for the complete digital transformation initiative.
- Avoid over-strategizing. Define KPIs best suited to the vertical in question and begin small. Fail fast, learn faster.
- Establish a strong Project Management Office that is multi-disciplinary.
- Use the first implementation to build a template for every subsequent implementation. This methodology will provide insights and highlight issues in infrastructure, process and people, which is its intended purpose.
- Adhere to First Principles of Manufacturing Excellence (Toyota Production Systems, Lean Six

Sigma, Industrial Engineering, Theory of Constraints) to bring focus to the use case and its benefits.

- Have local plant leaders and managers take responsibility for behavioral change management, training and implementation. The IT and the Chief Digital Office should advise and facilitate the plant's IIoT journey.

- Integrate with IT systems such as ERP, Planning, QCM and CRM early on to ensure that operations data forms an integral part of the decision making process.

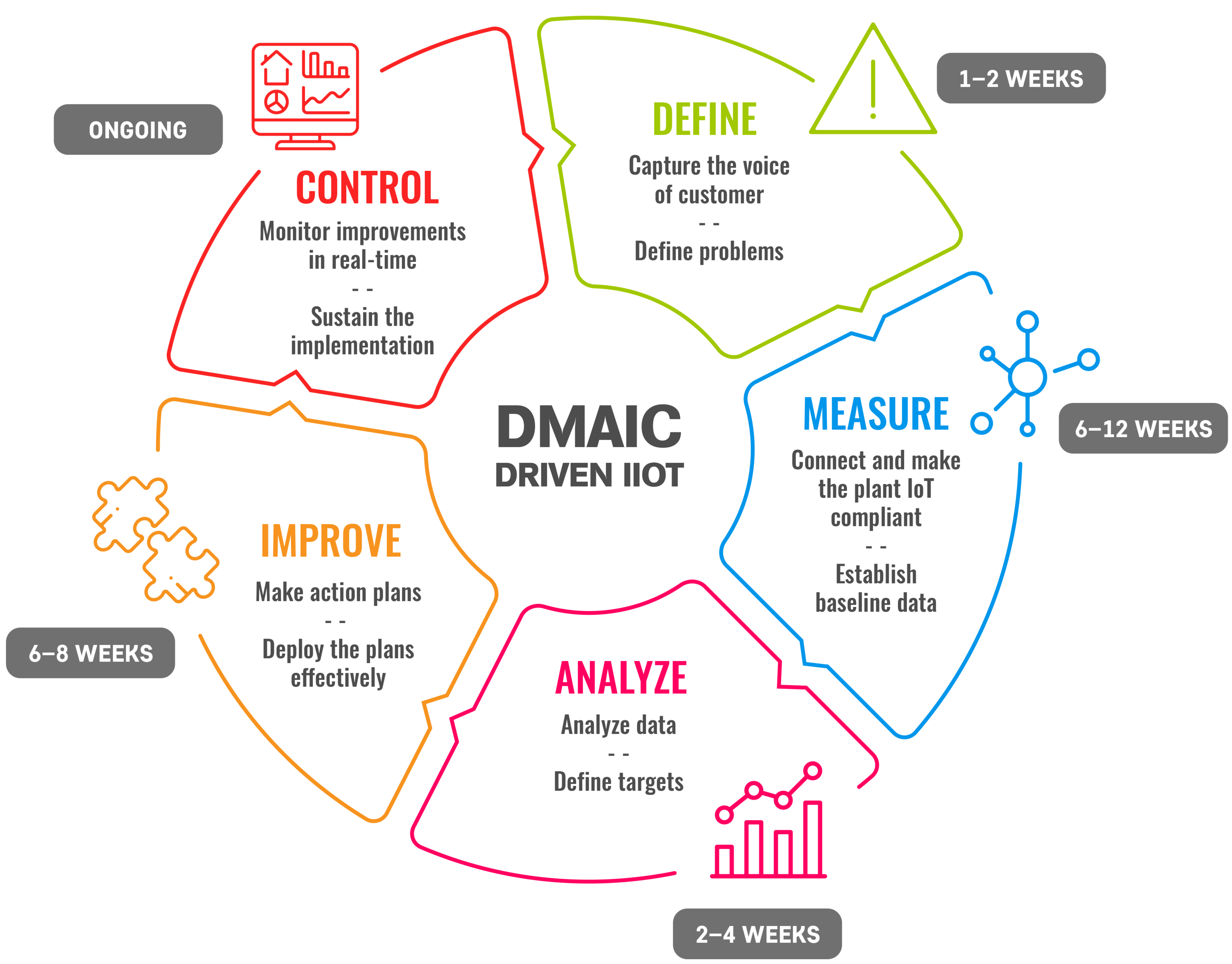
- Start with the power of correlations before going down the path of elusive root cause analysis.

- Become an engineer again. In the long term, the responsibility of change management must shift from managers to engineers and should be driven by data. Technical discipline matters.

DIGITAL TRANSFORMATION WITH DMAIC

Follow a DMAIC (Define – Measure – Analyze – Improve – Control) data-driven approach to drive, improve and stabilize business processes. DMAIC is an integral part of Six Sigma and has proven to be effective in IIoT-driven digital transformation initiatives.

FIGURE 13. **DMAIC MODEL FOR IIOT**



THE VARIOUS STAGES OF DMAIC ARE DETAILED BELOW:

DMAIC	TIME	PROCESS	DETAILS	BENEFITS
DEFINE	1 – 2 Weeks	Capture The Voice Of Customer Define Problems	• Identify Focus Areas • Identify High-Level Use Cases • Run A Techno-Functional Assessment	Rapidly Converge On The Problem
MEASURE	6 – 12 Weeks	Connect And Make The Plant Iot Compliant Establish Baseline Data	• Retrofit Hardware An Ensure Availability Of Critical Parameters • Deploy, Connect And Configure • Establish Baseline Data For At Least 4 Working Weeks	Ensure That All The Dependent Systems Are Ready To Provide Data Identify Opportunities For Payback
ANALYZE	2 – 4 Weeks	Analyze Data Define Targets	• Perform Exploratory Analysis • Prioritize Causes • Define Target Conditions • Create Project Charters	Leverage Data To Gain Insight Identify Solutions And Firm Up The Approach
IMPROVE	6 – 8 Weeks	Make Action Plans Deploy Plans Effectively	• Implement Process Changes • Conduct Trials And Fine Tune Strategy • Institutionalize	Start Applying And Scaling Up The Solution
CONTROL	Ongoing	Monitor Improvements In Real-Time Sustain The Implementation	• Set Up A Continuous Monitoring Mechanism • Perform Deeper Data Analysis For Continuous Improvement	Ensure That The Payback Is Measured And Is Tracking According To Plan

Having a combination of technology, domain understanding, process improvement techniques and rapid deployment will help ensure a successful IIoT implementation with payback that is predictable and meaningful.

METHODOLOGY

The information presented is based on Altizon's IIoT driven Digital Transformation and Smart Factory implementations. The primary research was done using a combination of data analysis and workshops with key customer personnel involved in these initiatives.

Disclaimer: The results mentioned in this study is an average across implementations in each vertical.

ABOUT ALTIZON

Altizon, a global industrial IoT company, powers digital revolutions by helping enterprises leverage machine data to drive business decisions. Altizon's Datonis Manufacturing Suite applies advanced analytics and machine learning algorithms to accelerate smart manufacturing initiatives, modernize asset performance management and pioneer new business models for service delivery.

Altizon has been spearheading digital transformation initiatives in Industry 4.0 across a range of industry verticals, including Automotive, Tire, CPG, Chemicals and Remote Industrial Assets.

Altizon is headquartered in Palo Alto (USA) with offices in Boston (USA) and Pune (India).

For more information, visit: www.altizon.com