Measure What Matters in Your Warehouse with Performance Analytics
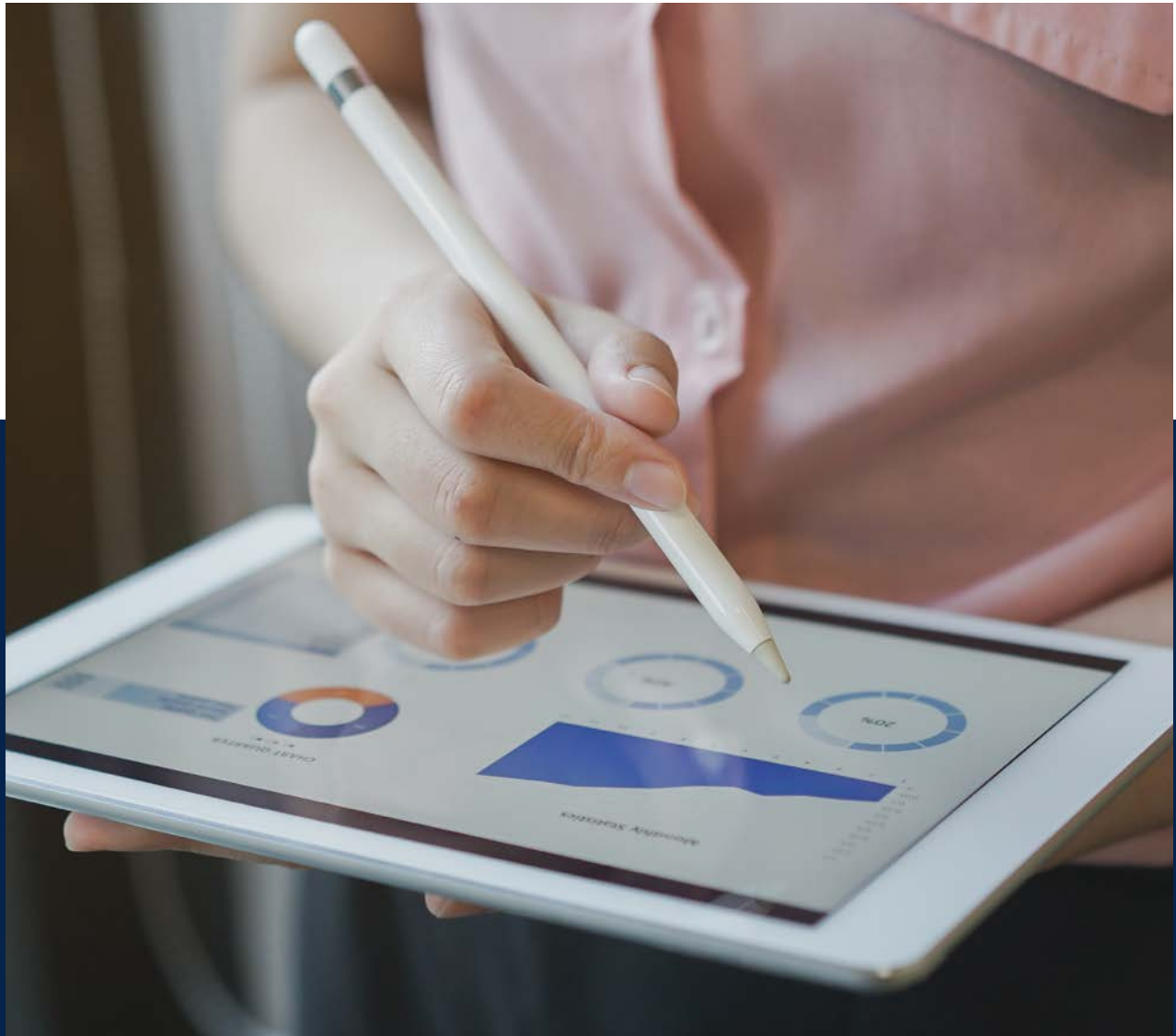
The KPIs you should be measuring, but probably aren't

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About the Authors

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With 13 years of experience in the robotics and industrial automation field, Shri joined OPEX in February 2020. He has a diverse range of experience in various aspects of automation, like SCADA, HMI, Supervisory Control, data collection and reporting. His deep technical expertise has helped him recognize the value of machine data and how data can drive improved operational efficiencies. Shri has a master's degree in Robotics from Clemson University and an MBA from Virginia Tech.

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Jay has over 20 years of experience in sales and customer service. He has helped businesses of all sizes, including Fortune 100 companies solve their problems in the manufacturing, technology and financial services sectors. Currently, Jay brings his wealth of knowledge to OPEX's Warehouse Automation customers in his role as Service Business Development Manager. Jay has a bachelor's degree from The University of New Haven.

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Contents

Introduction – Warehouse KPIs

Do your machines need maintenance before regularly scheduled service appointments? Are you spending more than you need to on spare parts? Are there ways to potentially improve your warehouse equipment performance?

If you don't know the answers to these questions, you aren't alone.
When most people discuss warehouse analytics, they are talking about common Key Performance Indicators (KPIs) such as:

| Carrying cost of inventory and inventory turnover | Order picking accuracy | Inventory accuracy and inventory to sales ratio | Units per transaction | Back order rate, perfect order rate, and rate of return[1] |

While those measurements are certainly important for operations to run efficiently, you need to dive deeper into warehouse machine data to truly determine how to impact your everyday KPIs.

This eBook defines performance analytics and explores how these five not-as-common (but just as impactful) areas can help streamline operations and boost warehouse productivity.

| Diagnostic data and equipment status | Overall equipment effectiveness | Machine throughput | Data for predictive maintenance | Parts usage data and analysis |

[1] LEGACY Supply Chain Services

Chapter 2

Performance Analytics 101

Warehouse managers are always looking for ways to streamline operations in order to maximize the productivity of their supply chains, and data analytics is a key way to do just that.

One of the key elements of the modern warehouse, performance analytics is the engine that takes raw data, uncovers patterns and insights, and reveals potential areas of improvement and hidden value.

ABI Research forecasts that in 2026, manufacturers and industrial firms will be spending $19.8 billion on data management, data analytics and associated professional services.[2] However, many operatoins have not yet tapped into one of their most significant data assets: Machine data.

The enormous volumes of data generated by warehouses contain a mountain of potential intelligence. Performance analytics is the key to scaling that mountain. Today's affordable computational power and rapidly advancing analytics faciliate warehouses in putting their data to work.

Performance analytics produces data insights that uncover concrete steps to reduce cost, boost operational productivity, and profitability. Warehouses not only improve their uptime, quality, and safety metrics,they also alleviate bottlenecks, and ensure scalability and flexibility.

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[2] "Data Management on the Factory Floor," Michael Larner, May 22, 2020;
https://www.abiresearch.com/blogs/2020/05/22/data-management-factory-floor/

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Getting Started: Understanding Key Requirements

In this era of digital transformation, it's the everyday aspects that can make a significant impact. Performance analytics that can provide daily trends and real-time actionable insights are critical. Before we explore the different KPIs and metrics that can get us there, let's discuss the four-part framework necessary to measure and analyze data in an industrial environment.

Warehouse connectivity

In Industry 4.0 manufacturing, machines need to be cyber-physical. This environment integrates sensing, computation, control, and networking into physical objects and infrastructure, connecting them to the internet and to each other. Machine connectivity delivers mission-critical data to operators, supervisors, and management.

Software and hardware capabilities

The machines must be able to measure and capture the data required for analytics. If you cannot capture the right data, you cannot utilize it.

Explore the impact of adding automation

In order to extract and transform the machine data in meaningful ways, it needs to be available in the cloud. This also allows warehouse operations staff to keep a finger on the pulse of the machines in real-time, regardless of their physical location.

Front-end dashboard

Various stakeholders, both technical and non-technical, need reports and dashboards to be able to make sense of the data and understand key trends and insights.

Getting Started: Questions To Ask

What problem are we trying to solve?

It's essential to start with this basic question. Often, the root cause of the problem is not what you expected. Don't try to determine that out up front — you'll accomplish more by taking a step-up approach.

What data sources are available?

Most, if not all, organizations store vast amounts of data, so examine your existing internal databases and sources. It generally makes sense to use your original data source when possible. If you have the data but access is a challenge, you could use a tool like Remote Performance Monitor software (RPM) to help analyze different types of machine performance.

What types of data are available?

Due to privacy and security concerns, your company may have restrictions on the types of data available for use.

What is the quality of the data?

Many companies assume their data is complete, accurate, and unique to their needs, but that's not always the case. However, the data doesn't need to be pristine in order to get started — you can clean it as you go.

What tools are available?

Your business may already be using tools that can help you present and analyze data, such as Excel, Sequel, or Tableau.

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Chapter 3

Diagnostic Data and Equipment Status

Warehouse management involves a world of complex tasks, massive amounts of data, and dozens of potential performance measurements. The basic ability to keep daily operations running smoothly is a top priority in every warehouse. In order for that to happen, you need to track and measure machine diagnostics and real-time equipment status. By monitoring the machines in the warehouse, you can instantaneously examine and troubleshoot the reason behind a stoppage or identify equipment that is frequently failing.

This data typically consists of:

Real-time machine status

Recent interruptions

Reasons for stoppage

Dashboards or heat maps are great visual tools to display diagnostic data and equipment status. You can also set up real-time status notifications via text or email in order to quickly alert users of any operational stoppages.

Heat map visualizations

Heat maps can help visualize warehouse performance and highlight areas ripe for optimization. They involve a combination of colored rectangles, each representing an element or area of the warehouse. By adding heat map visualization to a dashboard, management can quickly and easily understand the state and impact of many variables at once.

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Chapter 4

Overall Equipment Effectiveness

The gold standard for measuring manufacturing productivity, overall equipment effectiveness (OEE), identifies the percentage of manufacturing time that is truly productive. It also highlights improvement opportunities for every machine or piece of equipment. OEE analyzes each machine's availability, performance, and quality in order to determine how well it runs each and every item perfectly, compared to what it should run in the allocated time. For 100% OEE, a machine would need to achieve:

- ✓ 100% quality (no rejects)
- ✓ 100% performance (running as fast as possible)
- ✓ 100% availability (no downtime)

By measuring OEE, warehouses can gain important insights about potential ways to systematically improve equipment performance. With more robust OEE data, you also have the tools you need for better long-and short-term decision making.

Related Metric: Uptime

To keep machinery working as efficiently as possible, it can also be helpful to measure machine uptime, specifically the percentage of uptime, and jam time.

Quality Check

OEE data allows the service department to:

Identify potential machine issues before they occur

Examine the frequency of particular machine problems

Understand the root cause of issues

Discover long-term fixes

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Chapter 5

Machine Throughput

Machine throughput, another common performance measurement in the warehouse environment, explores the rate of production, or how many units can be processed over a certain period of time.

Throughput can be analyzed from a machine perspective or an overall site perspective. When looking at individual machines, this metric can pinpoint bottlenecks in the system by highlighting an area of the warehouse that is operating slower than other areas. Low throughput numbers may mean that a machine is experiencing operational issues which should be addressed. If all machines are performing as expected based on their theoretical throughput levels, then a low site throughput level may suggest that more machines are required for a particular part of operations to handle the load.

From an operations and business perspective, determining system bottlenecks can help the warehouse achieve production goals. Analyzing machine throughput can mean the difference between keeping customers or losing them to a competitor who can produce more in less time.

Eliminating Another Warehouse Bottleneck: Storage

IDC predicts that by 2023, **65%** of warehousing activities will use robots and situational data analytics to enable storage optimization, increasing capacity by over 20% and cutting work order-processing time in half.[3]

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[3] IDC FutureScape: Worldwide Supply Chain 2020 Predictions;
https://www.idc.com/research/viewtoc.jsp?containerId=US45573518

Data for Predictive Maintenance

Warehouses typically maintain operational machines based on a preventive maintenance schedule in order to reduce the likelihood of failure. Time-based preventive maintenance is based on regular inspections of critical pieces of equipment that would severely impact production in the event of a breakdown. Usage-based preventive maintenance triggers an inspection and/or service call after a certain number of miles, hours, or cycles.

The preventive maintenance strategy falls between reactive (or run-to-failure) maintenance and predictive maintenance, which is based on real-time condition monitoring. To integrate a predictive maintenance strategy, warehouses can use condition-monitoring tools and techniques to track the performance of equipment during operation. Measurements from key hardware components on the equipment, such as sensors and actuators, allow warehouses to detect possible defects and fix them before a failure occurs.
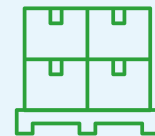
Preventive Data Analysis

By analyzing different data points, such as run time hours of usage and miles of usage, warehouses can:

Optimize preventative maintenance calendars

Maximize machine uptime

Increase efficiency

Achieve key operator goals

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Parts Usage Data and Analysis

Spare parts usage is one often-overlooked area of performance analytics that can significantly impact operations. Even if operations are running smoothly based on machine data analysis, ignoring parts usage and inventory data can lead to long, unexpected shutdowns if replacement parts are unavailable. By having a deeper understanding of when replacement parts are needed, you can mitigate the risk of parts being unavailable for days, or even weeks.

According to a *Modern Materials Handling* survey about the challenges associated with managing spare parts, 46% of the respondents listed unnecessary downtime at the top, followed closely by poor tracking of spare parts at 41%.[4]

In parts usage analysis, every replacement part can be tracked according to time of installation, reason for the change, and machine of installation. For more comprehensive analysis, warehouses also log specific usage details, like type and serial number.

Analyzing parts usage data and tracking history enables warehouses to:

- Maintain sufficient spare parts inventory

- Correlate the root cause of part failures with specific problems in the equipment

- Eliminate downtime caused by the unavailability of spare parts

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Field Service Reports

Each time a technician services a machine, a Field Service Report (FSR) is completed. The FSR details the parts used to fix the equipment. Over time, the data collected in FSRs highlights trends related to equipment issues, cost/spend at specific locations, and recurring problems. For example, if a machine is replacing the same part over and over, there's likely an underlying issue that can be addressed to save time and costs in the future.

[4] Reader Survey: Annual report card on Maintenance Repair and Operations (MRO) Management, March 10, 2020; https://www.mmh.com/article/reader_survey_annual_report_card_on_maintenance_repair_and_operations_manag

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Conclusion

If you're still monitoring production data manually, or don't have access to real-time machine data, you could be missing out on opportunities to:
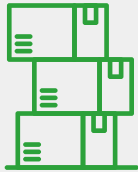
Improve production bottlenecks	Optimize maintenance processes	Maximize production efficiency

This is where performance analytics comes into play. With the right framework, tools and partner, the machine data already available to you can be consolidated and instantly analyzed for a clear picture of points of failure, opportunities for improvement and long-term trends. Is it time to turn your machine data into actionable intelligence that can drive performance, quality and efficiency improvements in your warehouse?

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