



Nutanix Xi IoT Solution for Machine Condition Monitoring

ACHIEVING MANUFACTURING EXCELLENCE AT YOUR FACTORY FLOOR

With the global industrial Internet of Things (IIoT) market anticipated¹ to reach ~\$110 B by 2025 with a CAGR of 7.4% annually, the need for industries to transform is further cemented. The number of IoT-connected devices is expected to reach 43 billion² by 2023, an almost threefold increase from 2018. This increase in adoption of IIoT is triggered by the integration of IoT devices with machines, required to reduce occurrences of downtime at a factory floor.

Any unplanned downtime can cause hefty financial damages. Every hour of downtime for a company can cost \$100,000 on average³, and this cost varies across different industries. For instance⁴, in the paper and pulp industry, every hour of downtime can cost more than \$20,000 on average⁵, whereas the cost can go up to \$130,000 and \$200,000 per hour in metals and mining and automotive industries⁶ respectively. Studies⁷ indicate that 82% of companies experience unplanned downtime, and 64% of that downtime is related to equipment failures.

Without visibility, manually inspecting the equipment and replacements can make these damages very costly. The risks and high costs of downtime demand predictive maintenance solutions in a connected factory layout. Machine Condition Monitoring (MCM) is the first step toward achieving predictive maintenance capabilities at the factory floor. As the demand for predictive maintenance continues to grow, the global MCM market⁸, currently valued at ~\$2.6 B, is also poised to reach ~\$4 B by 2025, growing at CAGR of 7% annually.

ANALYZING DATA FROM MULTIPLE SENSORS TO MONITOR ASSET HEALTH

MCM is a simple, impactful step in the journey to collect and transform machine data and derive powerful insights from that data. MCM solutions, aimed to improve machine performance and reduce machine downtime, have always been around; however, with the increasing interest toward IIoT, MCM solutions are steadily growing. MCM solutions have increasingly been deployed on smaller machines as well, primarily due to declining cost of sensors, storage, data lake connectivity, and other business analytics solutions.

1. Markets and Markets: <https://www.marketsandmarkets.com/PressReleases/industrial-internet-of-things.asp>

2. McKinsey Research: <https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/growing-opportunities-in-the-internet-of-things>

3,6. HID Global Research: https://www.hidglobal.com/sites/default/files/resource_files/idt-hid-condition-monitoring-wp-en.pdf

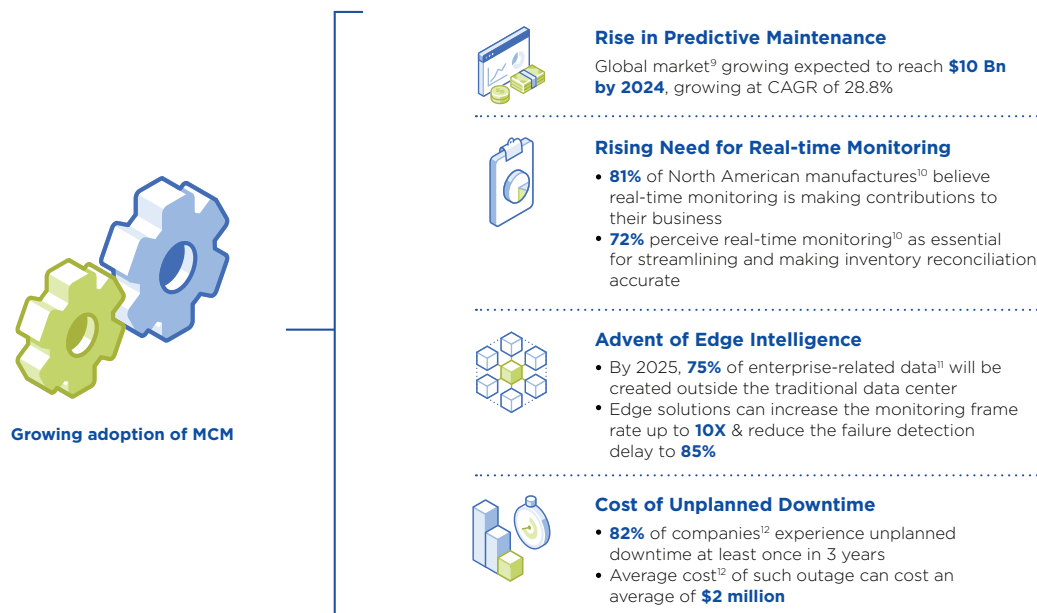
4. Boltstress Blog: <https://www.boltstress.com.au/blog/webpage-content/cost-of-downtime-when-machinery-breaks-down-in-the-mining-industry>

5. Customer Case Study: <https://customers.aafintl.com/Portal%20News/-/media/product%20media/Case%20Studies/Paper%20Mill%20Uses%20SAAFShield%20to%20Ensure%20Productivity%20GPF%206%20104%20AUG12%20pdf.ashx>

7. The Manufacturer: <https://www.themanufacturer.com/articles/unplanned-downtime-affecting-82-businesses/>

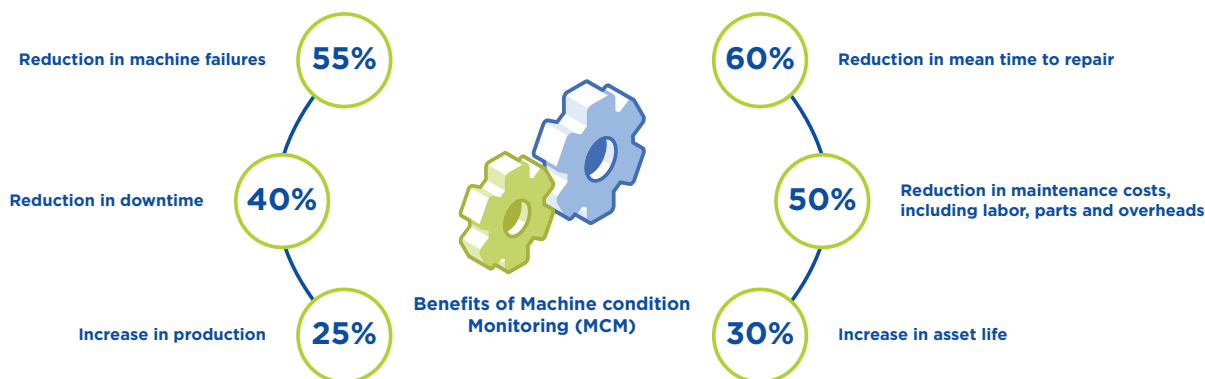
8. Markets and Markets: <https://www.marketsandmarkets.com/Market-Reports/machine-health-monitoring-market-29627363.html>

After implementing MCM solutions, enterprises can measure multiple parameters such as temperature, current, vibration, and heat and RPM and can identify points of potential failures if parameters go beyond the defined threshold values. The success of any MCM solution depends on Operational Technology (OT) available at the factory floor since OT is responsible for monitoring and controlling machinery, equipment, tools, and assets. MCM solutions usually offer fault detection, diagnostics, and prognostics alternatives.



BENEFITS OF USING MCM SOLUTIONS:

Using insights from MCM solutions, companies can tailor schedules to real performance, reducing downtime and avoiding unnecessary expenditures. Studies¹³ indicate that enterprises are able to achieve significant benefits after implementing predictive maintenance solutions at the factory floor:



9. Markets and Markets: <https://www.marketsandmarkets.com/Market-Reports/operational-predictive-maintenance-market-8656856.html>

10. Manufacturing Business Technology: <https://www.mbtmag.com/best-practices/article/13250836/seven-ways-realtime-monitoring-is-driving-smart-manufacturing>

11. Gartner: <https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders/>

12. Field Service Digital: <https://fsd.servicemax.com/2017/10/19/the-cost-of-unplanned-downtime-and-the-rally-for-digital-transformation/>

13. Parker Solutions: http://images.solutions.parker.com/Web/Parker/%7Bf7a4ab05-e8bf-4ed8-aeac-f2ce26aa20dd%7D_FCG_QCD_SensoNODE_Preventative_Maintenance_Whitepaper.pdf

UNLOCKING MCM BENEFITS REQUIRES REDUCING OT COMPLEXITY:

To reap the benefits of MCM, it is critical to reduce the complexity around legacy sensors and SCADA systems. Enterprises today tap, transform, and visualize data from different IIoT silos. Multiple silos hinder effective communication between OT and IT systems, which further inhibits enterprises from leveraging gathered data and actionable business insights. Thus, there exists a need to reduce OT complexity, which can be achieved from the convergence of IT and OT.

The rise of IoT and Edge computing, along with the advent of 5G, is accelerating this convergence. This need is also driven by the demand for amalgamated IT or OT skill sets. Since the available operational technologies include existing controllers, Programmable Logic Controllers (PLCs), and Remote Terminal Units (RTUs), sensors and other equipment with embedded systems, neither IT nor OT staff can deploy these systems with advanced edge computing technology on their own. Researchers¹⁴ have predicted that IIoT platforms, coupled with edge computing, will account for up to 60% of IIoT analytics by 2020.

THE NUTANIX MCM SOLUTION

What does Nutanix offer for MCM?

Solutions helping enterprises monitor the conditions of machines using the data gathered from different sensors have been around for years now, but traditional solutions do not utilize the data generated to its fullest. Researchers¹⁵ predict that IoT data is growing at more than 35% per year, with new data being created in the range of 44 zettabytes every year. Studies¹⁶ suggests that fewer than 1% of unstructured data generated is currently being used to create any actionable insights. Thus, it is clear that enterprises must analyze the data where it is being generated. Nutanix's Xi IoT platform leverages artificial intelligence, IoT, and edge computing to offer a simple, yet powerful solution to build basic MCM capabilities and gradually developing them into more advanced predictive maintenance capabilities.

How does Nutanix's approach to MCM work?

Nutanix's MCM solution, using the Nutanix Xi IoT platform, eliminates OT complexity, streamlines the collection of data, and elevates IT to focus on the business logic for data processing. The Xi IoT Edge platform allows admins to configure and allocate resources on a shared infrastructure. Data variety is handled by establishing necessary protocol drivers within the Xi IoT Edge software stack, which includes MQ Telemetry Transport (MQTT), Real Time Streaming Protocol (RTSP), Factory

Interface Network Service (FINS), and more. Moreover, the Xi IoT Edge platform is extensible, so any other protocol driver can easily be ported onto the platform. Data collection feeds the sensor data into a common Xi IoT Edge in memory message bus, which has the ability to scale to tackle the massive volume of data. Data is sent across the cloud, which can be used to build custom dashboards using third party ISVs to visualize real-time insights:



Fig. Seebo Dashboard

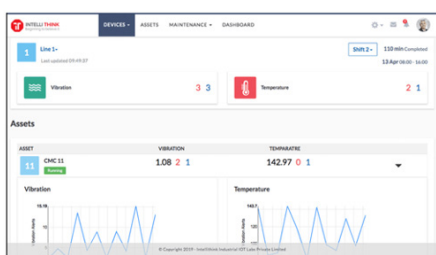


Fig. Intellithink Dashboard



Fig. Bosch Dashboard

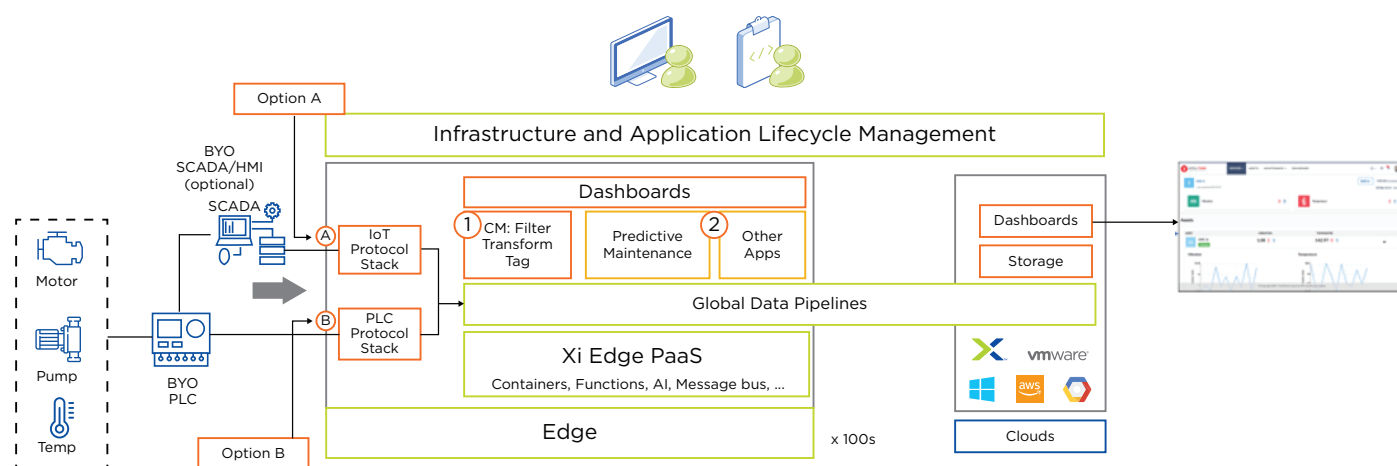
14. Gartner IIoT Platform Report 2019

15. Forbes: <https://www.forbes.com/sites/gilpress/2016/08/05/iiot-mid-year-update-from-idc-and-other-research-firms/#6567358d55c5>

16. Harvard Business Review: <https://hbr.org/2017/05/whats-your-data-strategy>

XI IOT AND EDGE ARCHITECTURE

The Nutanix Xi IoT platform is a software-defined solution that offers AI-driven processing for your edge devices to deliver real-time business insights. Nutanix Xi IoT comprises of a SaaS infrastructure, an application lifecycle management plane, and Xi IoT Edge software running on a variety of edge hardware. SaaS management provides an end-to-end view that is centrally managed from the cloud through a user-friendly interface for application development and operations, capable of easily deploying thousands of edge locations. The Edge Platform-as-a-Service (PaaS) supports easy-to-use developer APIs, reusable data pipelines, Kubernetes apps (containers-as-a-service), serverless functions, and pluggable machine learning architecture to enable the rapid development and global deployment of modern IoT and AI applications.



The selection of hardware has always been challenging. Nutanix Xi IoT can run as bare metal on any specialized hardware or as VM on any public or private cloud. Nutanix Xi IoT offers a hosted cloud environment as well, which allows developers to quickly start the deployment without waiting for the provisioning of edge hardware.

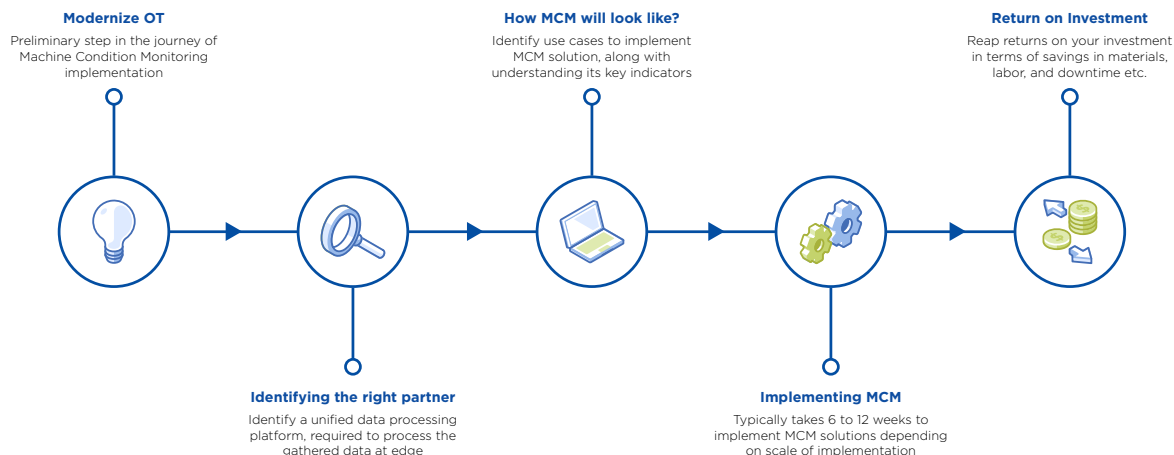
BENEFITS OF THE NUTANIX XI IOT PLATFORM

Xi IoT also offers AI-driven processing at the edge with a zero-touch software platform that powers real-time business insight and simplifies operations at planet scale. The business benefits can range from fast and efficient execution in constrained environments to the identification of trends and insights to enhance planning for more forward-looking schemes. The key benefits of this solution for manufacturers include:

- Enhanced operational visibility across multiple factory floors, even from remote locations
- Real-time monitoring and computation of data gathered from thousands of sensors
- Faster single to multi-location deployment options
- Increased production uptime by eliminating possible machine failures

IMPLEMENTATION GUIDE FOR MCM SOLUTIONS

Implementing an MCM Solution



1. Modernizing OT at the factory floor:

Industrial Control Systems (ICS) devices run on OT network are responsible for supporting mission-critical workloads. The core focus of the OT network has always been reliability, and OT doesn't undergo any significant changes year to year. Traditionally, OT networks run in silos, disconnected from the outside world to avoid any malicious actions that can impact the uptime of the network. The segmented network offered a basic level of security but did not offer any opportunities to streamline operations across multiple sites using emerging technologies. Thus, organizations have started to modernize their existing OT to reduce the complexities of managing multiple networks and have adopted an interconnected system by leveraging the convergence of OT and IT. Modernizing existing OT is the first step in implementing MCM solutions. This modernization helps simplify operations and provide more visibility to achieve factory automation.

2. Identifying the right partner:

Now all companies need is the right technology provider for a unified data processing platform to deliver actionable business insights from the data flowing from sensors or other devices. The right technology partner will help eliminate any costly surprises in the implementation cycle and realize the benefits an enterprise is targeting. The ideal solution should have the following features:

- The ability to talk directly with existing PLCs or SCADA/HMI
- The ability to run virtual machines (VMs) to coexist with factory applications
- Support multiple hardware options
- Seamless integration from edge to core to cloud
- Zero-touch provisioning on the factory floor
- The ability to run applications as containers
- Availability of Apache-class APIs
- Rich PaaS and AI functionality, which can be used for future use cases

3. How does MCM look:

Every organization is unique, so MCM use cases will vary. Identifying the right use cases should be the initial step in this design process, followed by understanding indicators about when an organization should begin the implementation. These indicators can create a higher risk due to operational aging OT infrastructure or other cybersecurity risks, increasing the need for uptime and visibility across sites.

4. Implementing MCM:

Once the basic OT components and solution design are ready, the solution can be implemented. Typically, implementation of MCM solutions takes 6 to 12 weeks to go live completely.

5. Return on investment:

Enterprises start to see the benefits in a very short span of time. For example, a US-based utility firm saved \$650,000 on materials, labor, and downtime after implementing MCM, which cost \$350,000 including hardware, resulting in 18X return on investment¹⁷. Implementing better predictive maintenance solutions can result in a potential economic impact of \$630 B by 2025 for the manufacturing industry¹⁸ alone.

JOURNEY TO PREDICTIVE MAINTENANCE USING MCM

Road Ahead:

One can see outcomes of implementing MCM in as soon as a few weeks; however, the real benefits come once a factory gets onboarded for the Industry 4.0 journey. Embarking on the Industry 4.0 journey for any enterprise is a two-step blueprint. MCM is the foundational step, which involves modernizing operational technology (OT) by removing complexity and enhancing visibility, followed by leveraging artificial intelligence to act upon the insights in an automated manner, i.e., develop predictive maintenance capabilities. Researchers¹⁹ have predicted that by 2022, more than 80% of enterprise IoT projects will have an AI component linked to it. Some of the commonly adopted use cases of this integration at a factory floor include product quality inspection, smart supply chain, smart warehousing, etc.

Modernizing OT is a critical step in this journey to fast track the adoption of such use cases. Hence, it is very important to make the right architecture choice early. The ideal approach is choosing the right platform at the onset to enable flexibility and choice as future use cases arise, without having to think about replacing the hardware again. The right architecture also ensures specific use cases are deployed quicker and the overall implementation process is simplified. Hence, returns on this initial investment options are not just limited to cost savings from asset health monitoring, but the returns keep on compounding as enterprises implement future use cases. Nutanix Xi IoT enables enterprises to advance AI use cases using the same technology foundation of a simple MCM solution.

Predictive maintenance maturity across Fortune US 100 enterprises:

Multiple enterprises have already embarked on the journey of predictive maintenance using MCM solutions. Enterprises perceive machine learning to have significant advantages over traditional business intelligence (BI) tools for analyzing IoT data. These benefits include the ability to make operational predictions²⁰ through machine condition monitoring up to 20 times earlier and with greater accuracy than threshold-based monitoring systems. Out of 51 Fortune US 100 enterprises²¹ that have an operational factory floor, nearly 80% are already using MCM solutions, out of which nearly 50% are already leveraging AI to achieve machine vision capabilities. The adoption of MCM solutions is the highest in the energy and utilities and automotive industries, followed closely by heavy engineering.









17. Machine Design Article: <https://www.machinedesign.com/markets/article/21829081/start-condition-monitoring-to-stop-machine-failures>

18. Seebo White Paper: [https://pages.seebo.com/hubfs/PDFs%202018/Predictive%20Maintenance_V3%20\(1\).pdf](https://pages.seebo.com/hubfs/PDFs%202018/Predictive%20Maintenance_V3%20(1).pdf)

19. Gartner: <https://www.gartner.com/smarterwithgartner/3-ai-trends-for-enterprise-computing/>

20. The Wired: <https://www.wired.com/brandlab/2018/05/bringing-power-ai-internet-things/>

21. Zinnov Research & Analysis

| | PdM ¹ Maturity Index | MCM Adoption | AI for Predictive Maintenance | Proportion of MCM Talent | Dedicated IoT Center of Excellence |
|---|---------------------------------|--------------|-------------------------------|--------------------------|------------------------------------|
|  ENERGY & UTILITIES | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  AUTOMOTIVE | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  HEAVY ENGINEERING | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  AEROSPACE & DEFENSE | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  HEALTHCARE² | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  TECHNOLOGY HARDWARE OEMS | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  RETAIL/CPG | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |
|  OTHERS³ | <div></div> | <div></div> | <div></div> | <div></div> | <div></div> |

1. PdM stands for Predictive Maintenance

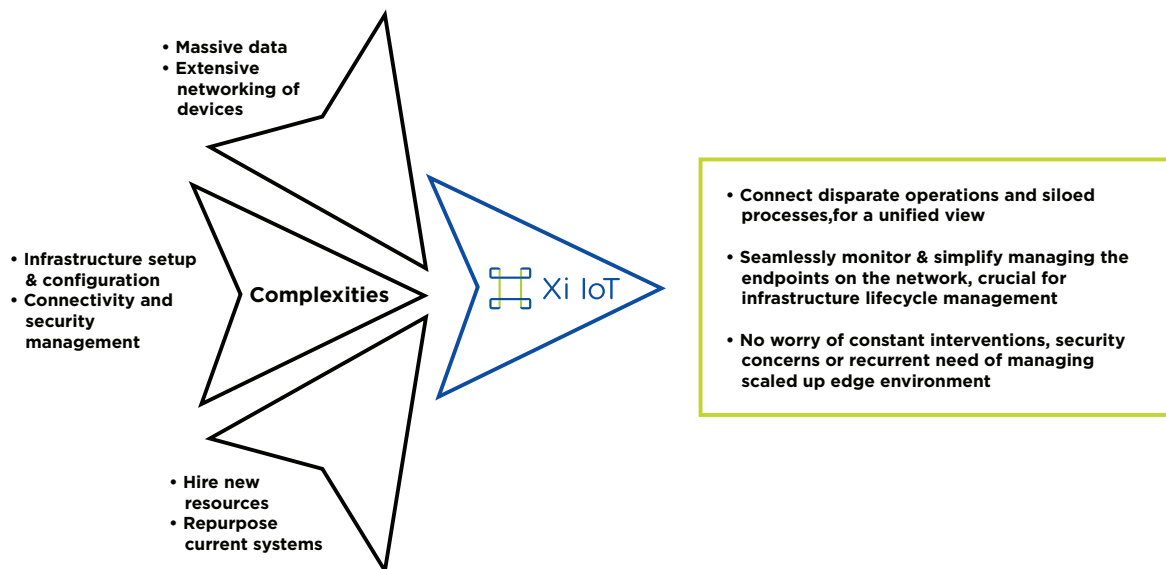
2. Healthcare includes companies which are involved in manufacturing of healthcare related products such as medical devices and pharmaceuticals etc.

3. Others include Chemicals, Food Processing and Diversified companies

Legend: VERY HIGH HIGH MED LOW VERY LOW

SUCCESSFUL EDGE COMPUTING MANAGEMENT

It becomes challenging for enterprises to manage thousands of devices as the factory continues to scale. Consider the fact that one has to manage multiple production lines at several factory floors, each of which is mission critical. The distributed nature of edge computing can bring along added complexity, more sensors and machines, and ultimately a greater management need. Nutanix can fill this vacuum and take on the role of the intermediary between multiple factory floors at different locations. Xi IoT Edge provides zero-touch setup and management of edge devices, so operators can reduce the risk of IoT security breaches from human error and increase overall management efficiency.



TRANSFORM YOUR ORGANIZATION TODAY

Since most technology providers do not provide out-of-the-box IoT-based MCM solutions, enterprises need to design and deploy custom IoT applications by collaborating with external technology providers such as an IoT platform vendor or an independent IoT integrator. Together, Nutanix Xi IoT and its hyperconverged technology enable easy accommodation and analysis of new and existing data streams. Xi IoT helps realize the full potential of data and allows organizations to focus on core business logic. Nutanix HCI extends the simplicity and agility of public cloud combined with the performance, security, and control of private cloud. The insights from the intelligent edge running on HCI provide a variety of benefits, including the reduction in overhead costs and service interruptions, all of which help an organization identify trends long before the competition, differentiate the brand, and maximize revenue.

To learn more about how Nutanix can help your organization, take a test drive at [www.Nutanix.com/IoT](https://www.nutanix.com/IoT). You can quickly experience the simplicity and agility of the solution today.



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