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Industry 4.0 Using **MachineSense** Industrial IoT Platform

Quickest and most economical way to achieve OEM Industry 4.0 objectives

by Biplab Pal, PhD
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MachineSense

Why Industry 4.0?

According to a survey by the American Society for Quality (ASQ) in 2014, 82% of organizations who have implemented smart manufacturing claimed to have experienced increased efficiency, "49 % reported fewer product defects and 45 % experienced increased customer satisfaction" [1]. Based on a survey conducted among major manufacturing giants in 2013, the Intelligence Unit of "The Economist" reported 95% of the respondents would like to see IoT as a part of their manufacturing process by 2017.

What is Industry 4.0?

The German Federal Ministry of Education and Research defines Industry 4.0 as "the flexibility that exists in value-creating networks is increased by the application of cyber-physical production systems (CPPS). This enables machines and plants to adapt their behavior to changing orders and operating conditions through self-optimization and reconfiguration. The main focus is on the ability of the systems to perceive information, to derive findings from it and to change their behavior accordingly, and to store knowledge gained from experience. Intelligent production systems and processes as well as suitable engineering methods and tools will be a key factor to successfully implement distributed and interconnected production facilities in future "Smart Factories". Since exchange data and information between different devices and parties in real time is the key element of smart factories, such data could represent production status, energy consumption behavior, material movements, customer orders and feedback, suppliers' data, etc. [2]

What is OEM 4.0?

OEM 4.0 is a phase of Industry 4.0 which is a major focus of **MachineSense**. In plain terms, OEM 4.0 is aimed at original equipment manufacturers of various industrial equipment to make that equipment smarter—and help drive value for the customers of the equipment manufacturers as well as improve machine serviceability. Many manufacturers are mechanically oriented with steady improvements in machine features and benefits and have historically relied on outside automation or PLC suppliers for their control systems. However with the **MachineSense** OEM 4.0 platform, the target is to bring Industry 4.0 and the Industrial Internet of Things (IIOT) benefits to OEM manufacturers quickly, easily and affordably so they will not be left behind as Industry 4.0 progresses. OEM 4.0 is a program to bring equipment manufacturers up to speed with new predictive platforms so they can differentiate themselves quickly and easily. Increasingly, end-use customers will come to expect these predictive sensor/app benefits as a standard offering and Industry 4.0 and OEM 4.0 will be commonplace. Every equipment manufacturer will be expected to offer predictive analytics within a few short years, our programs can make this happen now.

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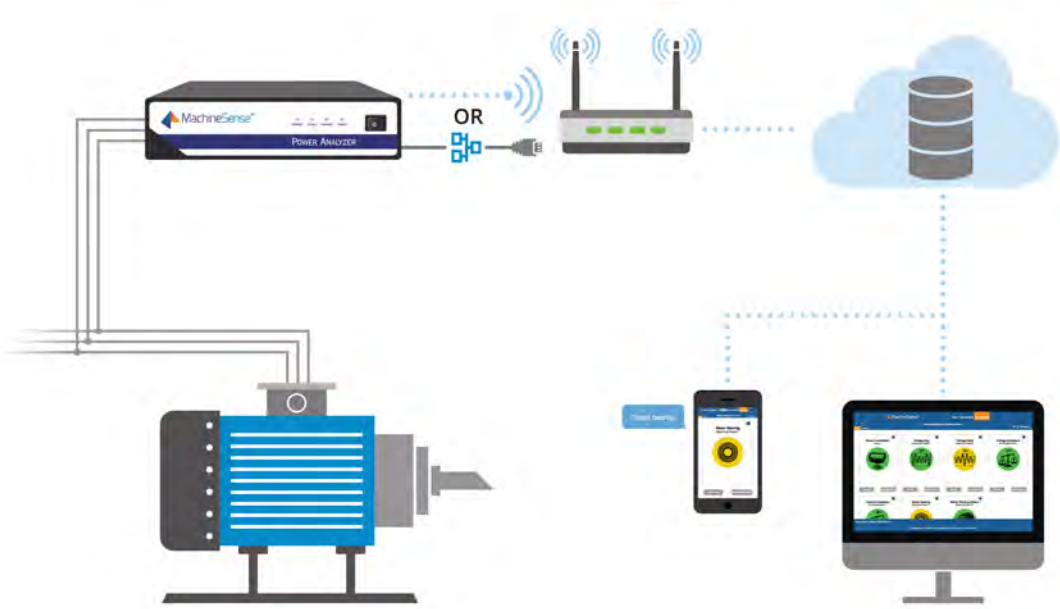

Fig. 1: Schematic of how sensors, clouds, analytics and data are integrated to deliver Industry 4.0

Real time information of manufacturing:

What are the vital features for Industry 4.0? How Is the MachineSense Platform Delivering It?

The most common and vital information needed for Industry 4.0 is predictive maintenance (condition based monitoring), energy usage of each machine, operational utilization, productivity of the machine, reconfiguration of the machine and process, quality control, process monitoring and integrating customer relationship management. The MachineSense platform integrates all of these applications through a cloud engine, Crystal Ball.

1. Predictive Maintenance: Health of the machines is tracked in real time to show how machine health is deteriorating. From the trend line we are also able to predict in how many days/months, the machine will need maintenance or whether is it safe to operate that machine. *See Fig 2.1-2.2*

Fig. 2.1: Machine Health Dashboard: status of multiple conditions is displayed in real time.

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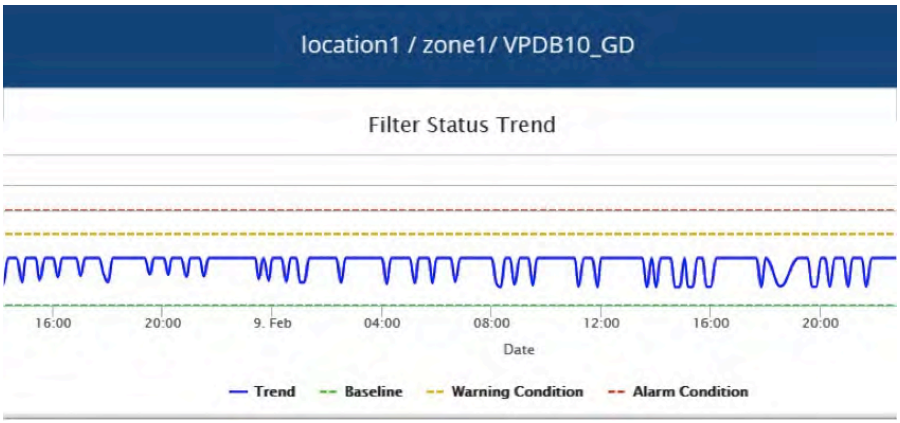

Fig. 2.2: Monitoring the machine health via trend line: Track the health of the machine for the past six months.

The ability to track the process parameter and product quality in real time is one of the stated goals of Industry 4.0

2. Energy Optimization: Tracking energy usage of the process in real time: Energy consumption constitutes up to 25% of the operating cost of any factory. Energy can be wasted in a manufacturing environment for many reasons, prime among them is non-optimized utilization of the machine. For example, a machine can be made to operate for hours even while dormant, waiting for material feed. Thus, when a machine is not producing anything, it is still operating in full load mode, adding unnecessarily to the cost. This is just one of many typical examples of energy waste in industry. With the **MachineSense** system, such wastage can be tracked and alarmed via email. *(Fig 3.0)*

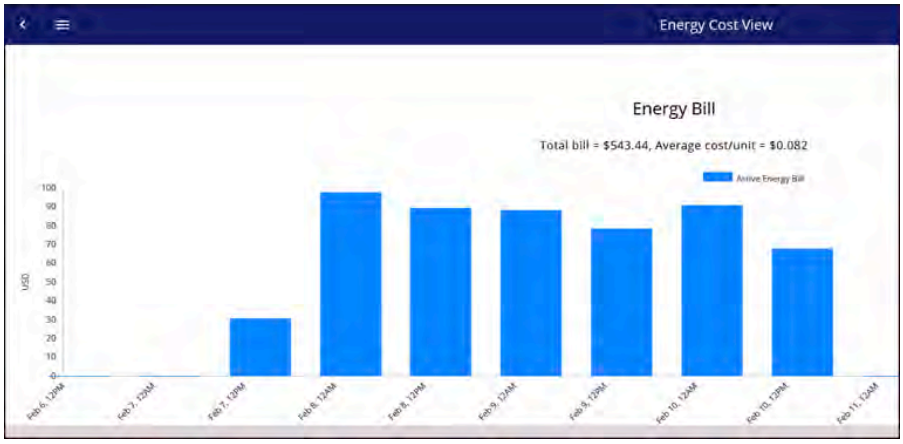

Fig. 3.0: Energy consumption of the machine: MachineSense Power Analyzer can track the energy usage of four machines at a time, for up to two years.

3. Process Diagnosis and Tracking: The ability to track the process parameter and product quality in real time is one of the stated goals of Industry 4.0. Conventionally, such data is collected by a PLC and fed to a DAC system. However, process diagnosis needs an analytic engine on top of process data, and it must be real time. The **MachineSense** Gateway system can be integrated with a PLC and data can be analyzed locally in the data hub itself to deliver a real time diagnosis system for the process. *(Fig. 4.0)*

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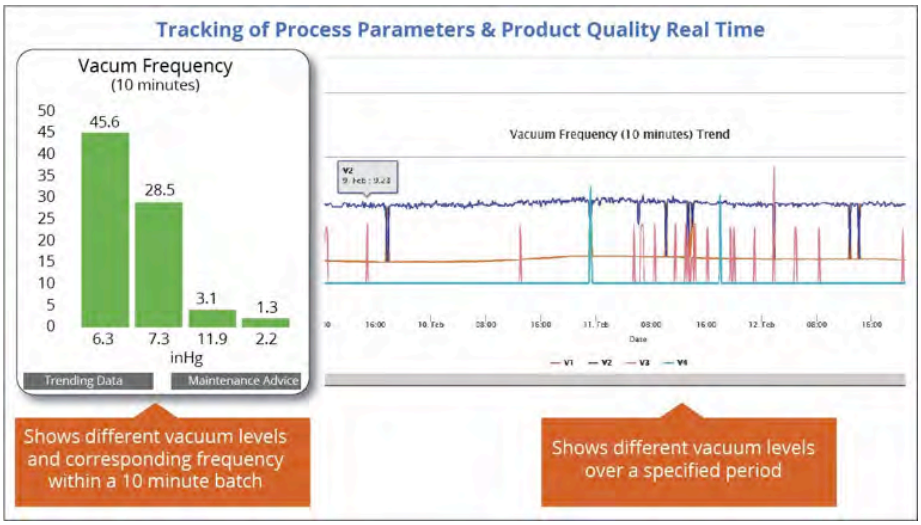

Fig. 4.0: Tracking of process parameters and product quality in real time.

4. Machine utilization per unit of productivity: Given a set of operable machines, are you maximizing factory production and thus utilization of the machines? This is the most common issue for most factory managers. They have no automated way of knowing which machine is producing at an optimal level and which machines are not really being used that often for production. For a small factory, such information may be qualitatively understood but for a large manufacturing plant or for a multinational manufacturing company with dozens of facilities all over the world, it is impossible to track productivity and utilization of each machine via a real time and historical time dashboard. The **MachineSense** system enables such analytics even without the need of PLC coding. *(Fig. 5.0)*

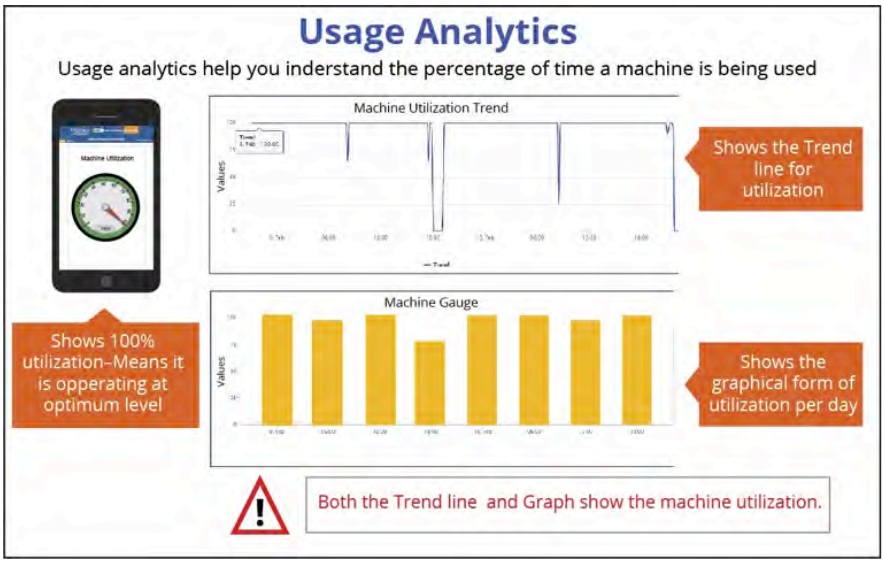

Fig. 5: Usage dashboards and analytics help you understand the percentage of time a machine is being used.

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The ability to track the process parameter and product quality in real time is one of the stated goals of Industry 4.0.

5. Preventative Maintenance: Are incoming power lines safe for your operation? Are operators trained well enough for safe operation of the machine? Is the PLC programmed correctly so that machines are not being subjected to harsh conditions, beyond their safe limits?

These questions are vital to prevent the operations and conditions that may lead to the death of a machine much before its full life cycle. It is extremely important for the OEM manufacturer to know such metrics to make sure, during warranty period, their machines have not been subjected to abuse so they are not paying for the negligence of their customers.

For example, a motor core may die prematurely due to poor ground or imbalance of incoming current and voltage supply.*(Fig. 6.1.)* Or a badly operated PLC can set vacuum level of the pump beyond its safe operating limit *(Fig. 6.2)* and as a result blower will be degraded much faster than its intended lifespan.

Fig. 6.1: Continuous monitoring of various parameters help prevent prevent major component or equipment failures.

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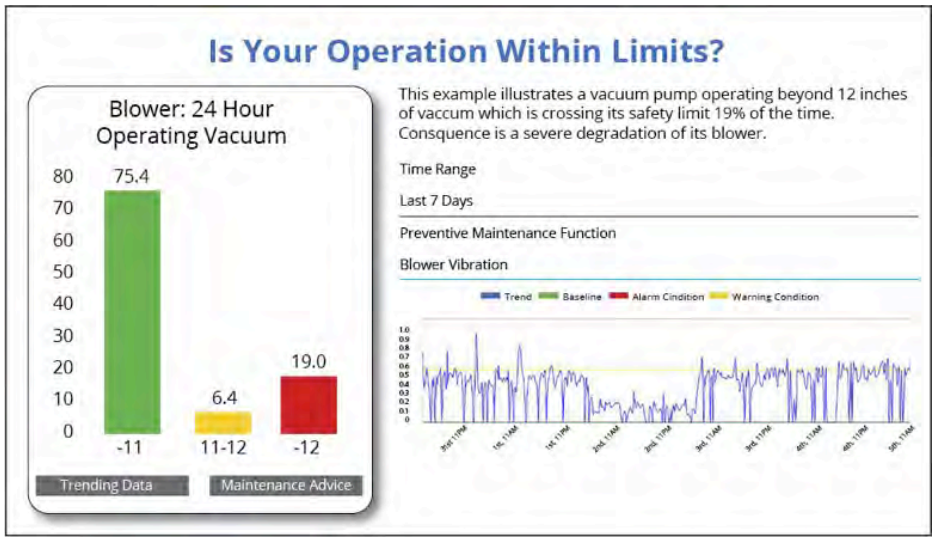

Fig. 6.2: Optimization of 24-hour safe operation prevents degradation of your equipment.

6. Optimizing Operation: Is the PLC program used to operate the machine optimized for energy, safety and maintenance? Do machine operators know about safety limits of operation?

MachineSense has data central *(Fig. 7.0)*, which provides all the relevant sensor data and meta data to build a new algorithm for optimization or tracking. A new optimization algorithm built on this platform can be integrated real time or non-real time to deliver an optimization or business/technical rule engine. **MachineSense** does have several built-in modules for operational tracking, but for optimization a customer has to define its objective function. This feature is not offered as a default. Instead, it is a custom feature for those who would need such an optimization routine. This is expected to be done in consultation between data scientists of the client and **MachineSense**.

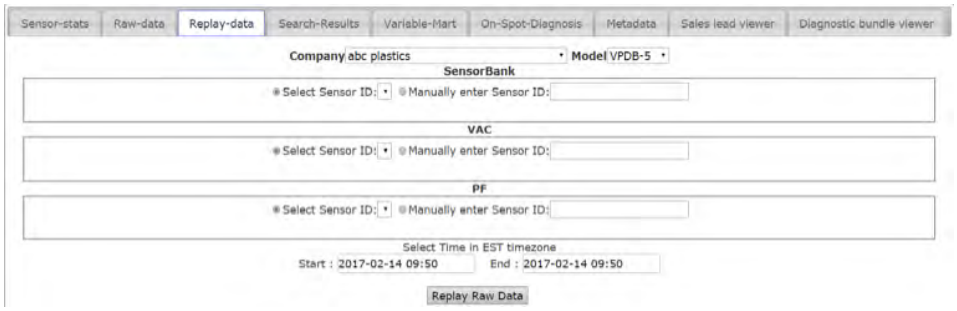

Fig. 7.0: MachineSense Data Central: A place to download raw data, meta data and inject new algorithms for development of an optimization routine based on sensor data.

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7. Customer experience and feedback to process and product: CRM (Customer Relationship Management) is integrated with manufacturing to track whether each machine is meeting its stated goal of utilization, productivity, operational cost and maintenance. The Crystal Ball CRM application allows the user to set these CRM goals and track those goals from real time machine data *(Fig. 8.0)*.

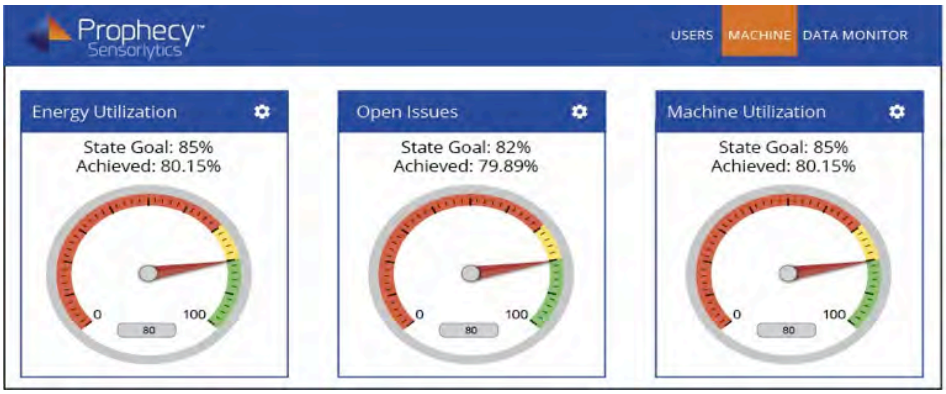

Fig. 8.0: In MachineSense Crystal Ball CRM, the client can set up a target for the performance of a machine in terms of utilization, energy consumption, maintenance, etc. and track those goals against true achievement

8. This is achieved via dynamic machine and sub-assembly creation in Crystal Ball applications. In the Prophecy platform, a client can build a machine out of various sub-assemblies and can assign sensors to all of them. Later, if that needs to be changed/edited, it can be easily done using GUI instead of the cumbersome process that is required in a PLC *(Fig. 9.0)*.

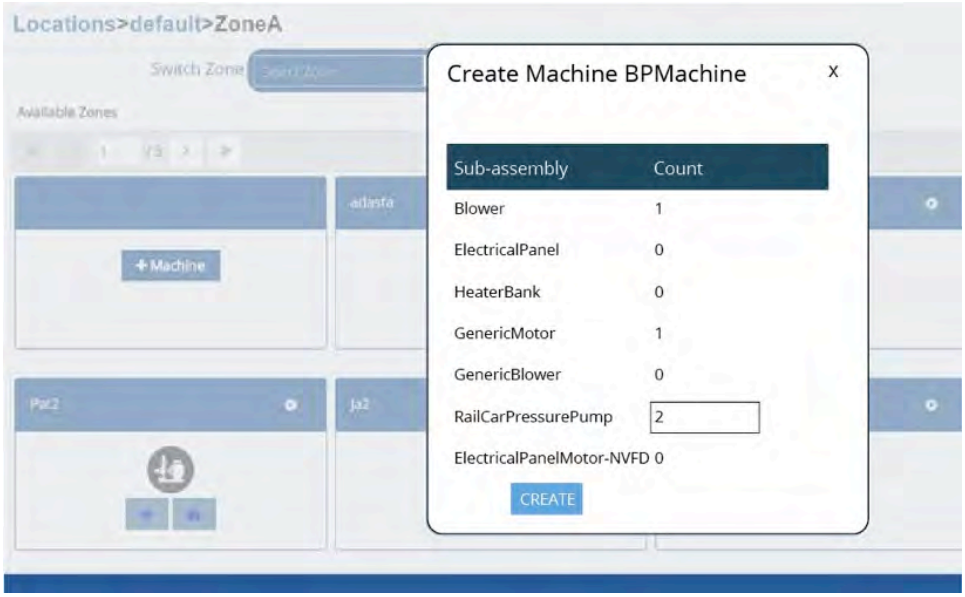

Fig. 9.0: The software platform allows automatic creation of reconfigurable machines needed for flexible machine configuration in a smart factory.

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Why **MachineSense** Platform for Industry 4.0?

Industry 4.0 needs the assembly of many technologies - Sensors, Middleware, Big Data Cloud, Machine Learning Analytics or Artificial Intelligence, Mobile applications, etc. (Fig.10). Suppose a Plastic Extrusion company wants to transform its machinery line into an Industry 4.0 connected system. The choice before any of the machinery companies today is to buy a vibration sensor from a vendor, gateway from companies like Dell or Intel, IoT platform from Microsoft Azure cloud, and then hire an IT outsourcing firm like Infosys or TCS to develop analytics on the IoT platform. Not only is each individual component of IoT expensive, the cost of integrating so many technology layers will exceed any perceived benefit that may come from digital integration.

With **MachineSense**, we have a streamlined approach. We have done massive vertical integration of all the IoT layers so the integration cost is effectively zero because we produce sensors, middleware, big data cloud and analytics; everything is done in-house. There is no licensing and integration cost involved in any part of our IoT technology and that makes the **MachineSense** vertical solution for Industrial IoT very inexpensive, quick to implement, and having the richest analytic features among all competitors.

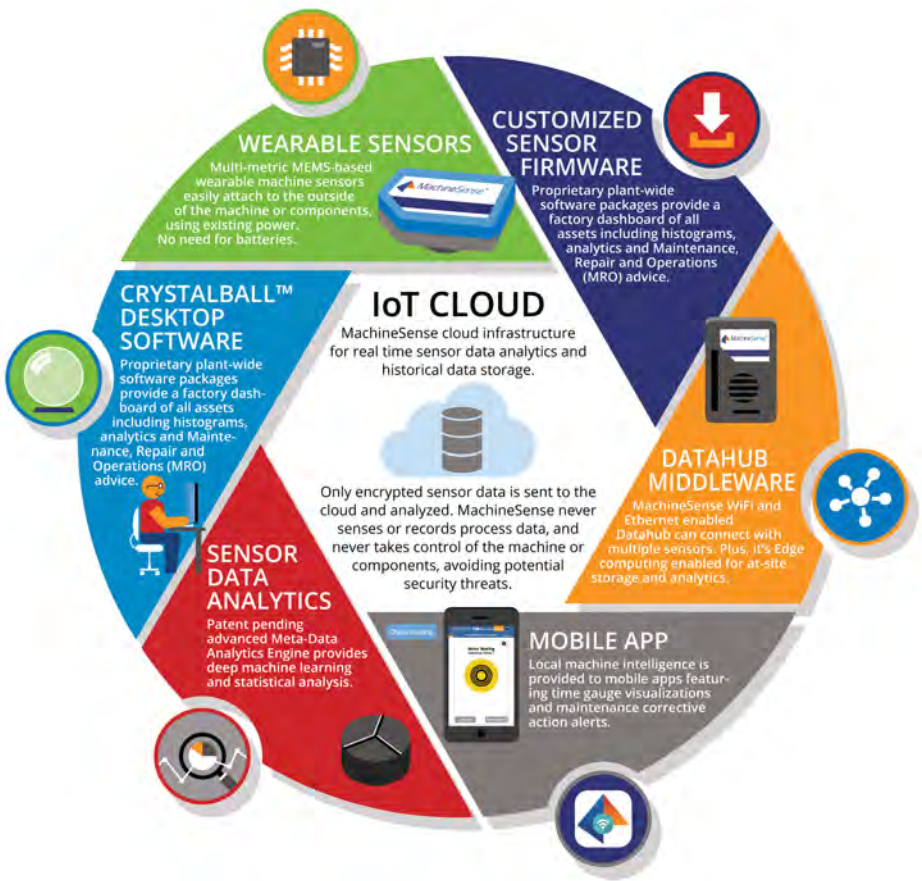

Fig. 10: Seven Layers of IoT technology –all built-in in-house in MachineSense Platform from open source technologies instead of expensive licensed source

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About the Author

John Boville is a marketing manager for Schneider Electric's marketing and innovation group, where he focuses on the Modicon controller line. He has been with Schneider Electric industrial automation for more than 25 years, including implementing market segment strategies for the automotive industry. Prior to joining Modicon, before it became part of Schneider Electric, he served for 12 years in project engineering for CEGELEC Automation as an industrial system designer, installation specialist, and project leader for large automation migration projects. He holds a B.S. in electrical engineering from the University of Bradford, U.K. Keep up with John's latest insight in his blog: http://blog.schneider-electric.com/author/jboville/

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