The IoT-Financial Connection: Manufacturing

By Dr. Stephen Timme



CONTENTS

Executive Summary	pg. 4
lot Overview	pg. 5
lot Operational Benefits	pg. 5
lot Key Components	pg. 6
The lot-Financial Connection	pg. 7
Cost Of Goods Sold	pg. 9
Fixed Asset Utilization	pg. 13
Days In Inventory	pg. 16
Revenue Growth: OEMs	pg. 18
Getting There From Here	pg. 21
Appendix A: Manufacturing lot Alignment Blueprint	pg. 22

Contributors: Vineeta Nair, Dana Reid, Ethan Forgas



There is a deluge of information about the Internet of Things (IoT) these days. Many of these articles are incredibly insightful and stimulate thinking about the possibilities. They also provide estimates about the trillions of dollars in the addressable market that IoT will create.

Frequent and consistent topics of discussion related to IoT are:

- Projected growth rates by industry
- Cost of adopting IoT
- Device sensing data numbers
- Application numbers
- Quantity of data emerging

What's missing are insights into IoT's financial benefits, which are paramount to justifying funding of IoT projects. We'll explore these benefits and provide a framework for measuring the impact of IoT on business performance, illustrating operational benefits in the manufacturing industry.

IoT's financial benefits are paramount to justifying funding of IoT projects.



EXECUTIVE SUMMARY

IoT has the potential to deliver significant economic benefits to manufacturers. If we choose to apply the Power of One, which is a one percent improvement to the operational indicators (KPIs) improved by IoT, the following benefits would be delivered per each 1 billion in manufacturing revenue.



These financial benefits are for a one percent improvement. The actual benefits will vary by company and type of manufacturer. Experience with IoT suggests the tangible business benefits will be much more significant than those using the Power of One.

IoT also has the potential to increase revenues for original equipment manufacturers (OEM) in the areas of after-sales services, new revenue streams, and pricing. By applying the Power of One, you can expect almost an \$11 million increase to the top line scaled to \$1 billion in revenue.

The information and approach applied here should be of value to champions of IoT trying to sell its operational and financial benefits internally, and also to solution providers like software and hardware vendors and consultants helping clients on their IoT journey.

Understanding the IoT financial connection will enable you to motivate your company and clients to move quickly to reap IoT's operational and financial benefits.

<u>Appendix A</u> provides a blueprint you can use to help formulate your strategies and initiatives to make the IoT-Financial Connection.



IoT OVERVIEW

Sensors, connectivity, big data, and analytics comprise the value chain or ecosystem of the Internet of Things (IoT). IoT has the power to change or disrupt business models, competition, and the very definition of a product. IDC forecasts worldwide IoT spending will maintain a doubledigit annual growth 2019-2022 and surpass the \$1 trillion mark in 2022. IoT spending among manufacturers is approximately 25% of this total and is primarily focused on solutions that support manufacturing operations and production asset management. Below is a summary of the key operational benefits of IOT and the components that enable them.

IDC forecasts worldwide IoT spending will maintain a doubledigit annual growth 2019-2022 and surpass the \$1 trillion mark in 2022.

IOT OPERATIONAL BENEFITS

IoT can help increase throughput and capacity utilization, and improve quality and overall equipment effectiveness (OEE). Conversely, it can reduce:

- Unplanned downtime
- Total cost per unit
- Maintenance expenses
- Warranty expenses





IOT KEY COMPONENTS

Data Analytics

Data analytics are the backbone of the IoT ecosystem. These devices work tirelessly to collect valuable big data, enabling machines to communicate with various technologies and each other and take action on the data in an intelligent fashion.

Artificial Intelligence (AI)

Al focuses on bringing the IoT devices to life, making machines perform better, with fewer errors and faster speed.

Cloud Computing

Cloud computing is another major player in IoT, helping reduce costs and maximize resources. Cloud architectures can also manage the vast amounts of data and deliver capabilities that can be extended to drive "edge" computing- or closer to where the data originates.

Connected Factories

Connected factories are vital. IoT data can stream in real-time, which offers a multitude of benefits. Users report quicker response times to avert equipment downtime, inventory monitoring to ensure orders are filled on time.

Digital Twins

Digital twins replicate operations in a digital form, and with sensors, gather data about the product, equipment, etc. The collected data from the digital replica enables managers to analyze and repair from a remote location if needed. They can also identify potential bottlenecks and streamline operations.

Wearables

These connect the workforce through augmented reality wearable technology, guiding technicians in real-time to complete tasks, checklists, work orders, etc.

Security

Security is a critical part of IoT. As the number of devices and digital connections increases, the focus on data and system security and privacy expands. Blockchain technology is increasingly being used to secure transactions in IoT-enabled ecosystems.





THE IoT-FINANCIAL CONNECTION

The four most important areas of financial performance benefiting from IoT for manufacturing are shown below.

	What is it?	How is it measured?	What's the norm?	What influences it?
Cost of Goods Sold	Materials, manufacturing labor, and overhead – which includes items such as energy consumption, maintenance, and depreciation.	These items are often expressed as a percentage of revenue to analyze changes in performance over time and make it easier to compare to peers. For example, a value of 60% means that the cost of goods sold absorbs 60% of revenues.	Cost of goods sold averages 50% to 75% of revenues and often varies greatly by industry.	Doing business in highly competitive markets can lead to price competition and a higher cost of goods sold as a percentage of revenue such as automotive at 77%, and the value of the products – value-added products that command a higher price such as pharmaceuticals have an average of 21%.
Fixed Asset Utilization	Fixed assets are physical assets such as manufacturing plants and warehouses.	Fixed asset utilization is the amount of revenue generated throughout the year per dollar (or any other currency) invested in fixed assets. For example, a fixed asset utilization of 5.0 means that a dollar spent in fixed assets generates \$5.0 in revenues.	Fixed asset utilization averages from 4.0 to 6.0.	Influencing factors include capital intensity – for example, mining has an average of 1.5; or the use of contract manufacturers, which is common in consumer electronics where the average is 19.1.
Days in Inventory	Inventory includes raw materials, work- in-process, and finished goods.	Days in inventory measures the average number of days from the time a company buys raw materials until it sells the finished goods. 60 days in inventory, for example, means it takes a company 60 days to sell its finished products after raw materials are purchased.	Days in inventory varies greatly by industry, but an average range is 60 to 100 days.	The length of the manufacturing process impacts days in inventory; for example, consumer products averages around 70 days, while wine & distillers average over 400 days. Another factor is the opportunity cost of lost sales if inventory is out of stock – pharmaceuticals averages almost 200 days.
Revenue Growth	Sales of products and services such as services contracts for equipment manufacturers.	Revenue growth is the period-over-period percentage change in revenue (such as a year, quarter, or month).	Average revenue growth tends to range from 2% to 5% but often varies by industry and world regions.	Influencing factors include the type and maturity of the industry – for example, consumer staples averages 2.1%, business cycles, government spending, and world region.



Below are the financial benefits for each of the metrics with what we've defined as the Power of One, which is the value of a 1% improvement to the metric. The benefits for the cost of goods sold, fixed asset utilization are based on consumer products

manufacturing and are scaled to each \$1 billion in revenue. The revenue growth benefits are based on industrial products OEM since OEMs are likely to reap the most significant benefits from revenue opportunities.

Financial Metric	Average Value	Power of One	Operational KP	Power of One
	57.8%	5.8M ^A •	Materials	3.0M ^A
% Cost of Goods Sold			Labor	1.3M [▲]
			Overhead	1.5M ^A
Fixed Asset Utilization	6.2 1.7M ^B •	Capacity Utilization	1.3M ^B & 0.2M ^A	
		1./W [*]	Unplanned Downtin	me 0.1M^B & 0.7M ^A
Days in Inventory	73 days 1.8M	1 OM/C	Work-in-Process	0.2M ^c
		1.0111	Safety Stock	0.4M ^c
	3.1% 10.0M^D & 1.2M		After-Sales Services	2.0M ^D & 0.3M ^A
Revenue Growth (OEM Only)		10.0M ^D & 1.2M ^A ●	New Services	0.7M ^D & 0.1M ^A
			Improved Pricing	8.0M ^D & 8.8M ^A

A – Increase in operating income

B – Avoided capital expenditures

C – Reduction in inventory

D – Increase in revenue



COST OF GOODS SOLD

The results show that the Power of One is almost \$6 million annually for the cost of goods sold, which means that a one percent reduction in the price of products sold would lower these costs and increase profits by \$6 million. A large percentage of IoT investments have focused on reducing the cost of goods. For many manufacturers, it absorbs such a high percentage of revenue that even a small change results in significant benefits to the bottom line.

Use the blueprint in <u>Appendix A</u> to help develop your strategies and initiatives for improving profitability by better managing manufacturing operating expenses.

Now let's peel back the cost of goods sold onion and develop deeper insights into what it's made up of and how IoT can help.

For many manufacturers, even a small change in cost of goods results in significant benefits to the bottom line.





Materials

Materials are the largest individual component of cost of goods sold for most manufacturers, making up 40% - 55% of the total, which indicates an excellent place to look for cost reductions. IoT helps better manage materials through:

- Lower scrap and rework
- Higher quality
- Optimization of content mix and product performance

The Power of One for materials is \$3 million. Again, this is applied to consumer products and scaled to a company with \$1 billion in revenue. The magnitude of the potential benefits from materials costs would be music to a CFO's ears, but it would also be of great interest to others including the Vice Presidents of Manufacturing, Quality, and Procurement, who are always focused on reducing cost per unit. The ability of IoT to reduce materials costs is becoming more attractive as input costs in many industries are rising. Companies' ability to pass on the entirety of the expense increase is limited, and margins are being compressed as a result of intensifying competition.

Case Study:

Shenzhen China Star Optoelectronics Technology Company provides an excellent example of using IoT to reduce materials costs. They were able to speed up the visual inspection process by using IoT devices connected with AI technology. The company was also able to leverage their IoT devices to detect product defects faster and more accurately, reduce quality defects, which in turn reduced the scrap and rework of materials used in production.¹

Case Study:

Varroc Engineering, a car parts manufacturer in India invested in IoT and reported a 5% reduction in defective parts which helped reduce material costs while improving product quality.²



¹ IBM Case Study, "Shenzhen China Star Optoelectronics Technology Co., Ltd.," 2018.

² Altizon Case Study. "Varroc, Automotive Component Manufacturer Gears for Industry 4.0 Using Datonis IoT Solution," 2017.

Labor

Many IoT devices are becoming mainstream in our everyday lives. For example, people often program an iRobot vacuum at home to run while they complete other tasks, saving many labor hours in the process. The same is true for IoT devices and automation in the workplace. Labor averages a little over 20% of the cost of goods sold for most manufacturers.

IoT improves labor efficiencies by:

- Better optimizing production
- Lowering idle labor hours related to maintenance
- Improved collaboration across the supply chain

The Power of One for labor is annually at \$1.3 million. A labor shortage in manufacturing is one of the key factors driving the utilization of IoT to manage labor better. A recent study by Deloitte and The Manufacturing Institute forecast that over the next ten years, US manufacturers will need to add 4.6 million jobs. That's good news. The bad news is they predict 2.4 million of these will go unfilled! It's estimated that there are already 500,000 unfilled jobs in manufacturing in the US. There are a variety of factors leading to this labor shortage. One of the elements it forecasted is that almost 30% of the manufacturing labor workforce will retire over the next ten years. Another factor is that younger workforce participants do not view manufacturing as a meaningful career.

Utilizing IoT to manage labor better is not just about reducing costs and improving the top line. In a laborconstrained market, it helps replace labor with technology, adding the benefit of also growing the top line.

Case Study:

Adidas has developed a shoe production process that is fully driven by intelligent robotics. At their highly-automated "Speedfactory" in Ansbach, Germany and the twin factory opened in Atlanta, Georgia, it takes only a matter of days to make a pair of sneakers, as opposed to months necessary in Adidas's supply chain in Asia, where shoes are mostly made by hand. As a result, Adidas needs fewer workers compared to manually intensive factories in Asia. There are 160 employees at the Ansbach factory. At factories in China and Vietnam, it's common for footwear factories to have more than 500 workers, or even well over 1,000. ³

Case Study:

Varroc Engineering, the car parts manufacturer referenced earlier reported a 20% improvement in workforce efficiency. ⁴



³ Marc Bain, "A German Company Built a "Speedfactory" to Produce Sneakers in the Most Efficient Way," Quartz, 2018.

⁴ Altizon Case Study, "Varroc, Automotive Component Manufacturer Gears for Industry 4.0 Using Datonis IoT Solution," 2017.

Overhead

Overhead includes energy, maintenance, and depreciation. It averages around 25% of the cost of goods sold for manufacturing. The Power of One for overhead is \$1.5 million.

Maintenance varies by type of manufacturing. Better management lowers maintenance cost, but there are other benefits such as reducing idle labor and increasing throughput, which increases revenues. IoT helps better manage overhead through better predictive vs. preventative or reactive maintenance, and via remote servicing and upgrades.

Case Study:

Canadian Forest Products, a manufacturer of paper and other wood-based products, deployed IoT solutions to lower energy costs, which can account for up to 20% of total operating expenses. By deploying IoT in its Northwood pulp mill, energy use was reduced by up to 15% within one year of implementation. The IoT controls and sensors reduced fuel consumption and variability. Plant managers receive realtime alerts about wasteful situations to prevent operational losses due to energy costs. ⁶

Case Study:

Standard Textile is a good example of how IoT helps lower maintenance costs. The predictive side of their IoT system can detect issues before they become a bigger problem. "For example, a vibration in a certain part of the machine a human can't hear or see; from experience, we know the last time there was a vibration like this, a major motor went out," Gary Heiman CEO, Standard Textile says. "Our technicians can then fix it, which will take 15 minutes, rather than having a major breakdown three days in the future." ⁵

The industrial sector consumes approximately 30% of total energy consumption in the US. Better management of energy consumption not only reduces total manufacturing cost per unit but also lowers emissions, which helps manufacturers comply with government regulations. Key ways that IoT helps lower energy consumption are via real-time measurement of when to power up and power down and through detection of malfunctioning systems or lowefficiency phases.



⁵ Erin Bereton, "Companies Tap IoT to Drive Quality and Save Money," BizTech, 2018.

⁶ Jean Thilmany, "Industrial Internet of Things: Empowering Big-Time Energy Savings," Emerson Top Quartile Performance, 2018.

FIXED ASSET UTILIZATION

Fixed assets include physical assets like manufacturing plants, warehouses, and other distribution assets.

For manufacturers, fixed assets are the biggest investments in physical assets. On average, investment in fixed assets is approximately twenty cents per dollar of revenue. By comparison, a wholesale distributor invests only six cents, whereas utilities invest three dollars. IoT provides the opportunity to spend less in fixed assets relative to revenue and increases both profitability and return earned on fixed assets.

IoT helps to better manage fixed asset utilization by increasing capacity utilization and reducing unplanned downtime.

Use the blueprint in <u>Appendix A</u> to help develop your strategies and initiatives for improving financial performance by better managing manufacturing fixed asset utilization.

IoT provides the opportunity to spend less in fixed assets relative to revenue.



Capacity Utilization

A typical manufacturer's capacity utilization is approximately 85%, which means that on average, a manufacturer is using 85% of its available productive capacity. A 1% improvement in utilization results in \$1.3 million in annual avoided capital expenditures. There are also operating expense benefits like greater labor productivity, reduced maintenance, and lower energy consumption.

IoT provides a variety of ways of improving fixed asset utilization:

- Facilitates the flow of real-time information throughout all stages in the supply chain and across multiple production lines and facilities
- Monitors equipment performance, providing valuable insights into ways to improve throughput
- For multi-stage production, IoT helps optimize production across equipment, which mitigates bottlenecks, monitors asset health, and drives higher throughput

Case Study:

A leading auto-component manufacturer was focused on improving equipment utilization to improve the throughput and efficiency of the assembly line and the plant itself. Implementing IoT sensors and a cloud-based platform, and by taking actions on the data analyzed, supervisors were better able to plan and optimize their production schedules. By viewing details on how their machines are operating, down to the millisecond, the manufacturer improved equipment utilization by 20%.⁷



⁷ Altizon Case Study, "Varroc, Automotive Component Manufacturer Gears for Industry 4.0 Using Datonis IoT Solution," 2017.

Unplanned Downtime

Unplanned downtime cannot be completely eliminated, but it can be significantly reduced by leveraging IoT. Reducing unplanned downtime lowers capital expenditures and also reduces maintenance and idle labor. The Power of One for unplanned downtime is \$0.1 million in avoided capital spending and \$0.7 million in reduced maintenance and idle labor.

How does IoT help lower unplanned downtime? The key enablers are:

- Provides early warnings and predictive analytics by providing real-time data on equipment performance and parts
- Connectivity allows remote servicing and upgrades
- When an onsite repair is required, first-time fix rates are increased and meantime to repair is reduced because service personnel have more accurate information about what needs to be fixed

Case Study:

Intel has deployed industrial IoT in its semiconductor manufacturing facilities to reduce costs associated with inefficiencies in manufacturing. They established a baseline metric for machine performance and monitored the machines when any sign of deviance occurs. The implementation of IoT in the manufacturing facilities led to a significant reduction in downtime as compared to when the process was done manually. Moreover, when failure of the systems did occur, corrective response is faster, increasing uptime by 97%.⁸



⁸ James Blackman, "How Intel is Using IIoT Edge Computing to Reduce Factory Downtime by 300%," Enterprise IoT Insights, 2018.

DAYS IN INVENTORY

Days in inventory includes the days invested in raw materials, work-in-process, and finished goods. Major advancements have been made in managing inventory, but IoT provides another giant step forward with sensors and connectivity, providing real-time information on factors like demand, inventory visibility, supplier availability, and potential disruptions. This information helps reduce inventory throughout the supply chain. The Power of One (one-day reduction) translates into a \$1.8 million one-time balance sheet benefit.

From a manufacturing perspective, IoT helps lower work-in-process inventory and safety stock levels, which is a part of finished goods inventory.

Use the blueprint in <u>Appendix A</u> to help develop your strategies and initiatives for improving financial performance by better managing days in inventory.





Work-in-Process

Work-in-process is the part of a manufacturer's inventory that's in the production or conversion process and hasn't yet been completed and transferred to finished goods inventory. The conversion cycle time varies by a product's complexity. The Power of One for work-in-process is 0.2 million, which is a one-time reduction in inventory. Additional benefits include increased labor productivity and reduced rework.

IoT reduces work-in-process inventory by:

- Optimizing production
- Monitoring defects
- Reducing unplanned machine downtime

Safety Stock

Safety stock, which is also known as buffer stock, is a part of finished goods and is held to reduce potential lost revenues due to unexpected demand, low inventory visibility, production disruptions, and other factors. The one-time benefit from a onepercent reduction in safety stock is \$0.4 million. Another benefit is lower inventory holding costs such as storage, obsolescence, and financing.

IoT lowers safety stock by improving reliability, resulting in higher capacity utilization and lower planned downtime, and by providing better data and analytics on factors like supply and demand and inventory visibility.

Case Study:

Magna Steyr is an automotive manufacturer in Graz, Austria that manufactures for brands like Mercedes, BMW, and Aston Martin. One of their challenges is having the manufacturing flexibility to build so many different models of cars in a single factory. They implemented connected factor and agile manufacturing, which rely on autonomous transport units for materials. These transports move materials, machines, robots, and the cars themselves, shortening work-in-process.⁹

Case Study:

IoT helps Stanley Black & Decker's Reynosa plant have greater visibility into its materials and components inventory, which lowers inventory and holding costs. "Detailed information and visibility around inventory also mean Stanley Black & Decker offers greater service to customers by providing accurate delivery schedules. Because the company can confidently identify the status and location of its inventory and products, customers also gain detailed insight into the status of their orders." ¹⁰



⁹ Roger Homrich, "Driverless Transport Service for Assembly," T-Systems, 2018.

¹⁰ Cisco Case Study, "Leading Tools Manufacturer Transforms Operations with IoT," 2019.

REVENUE GROWTH: OEMs

IoT also unlocks new sources of revenues for original equipment manufacturers (OEM). A key to capturing these revenue streams is understanding the incremental economic value provided by IoT to customers. Features and functionality are important but showing the value to the customer is essential as well. The world of IT has been on this transformational journey for many years by focusing on business outcomes selling. OEMs need to start on a similar journey if they are to capture one of the most exciting opportunities made possible by IoT.

For a manufacturer, IoT provides the ability to increase revenue through:

- Better after-sales service
- Improved pricing to capture more of the economic value provided to the customer
- New services like diagnostic, predictive, and prescriptive analytics





After-Sales Services

After-sales service is an important revenue stream for OEMs, averaging approximately 20% of revenue. The Power of One for after-sales service is a gain in revenue of \$2 million using an 80% product and 20% services revenue mix. Operating income increased by

\$0.3 million using an OEM's average profit margin of 13.0%. More than likely, the increase in operating income would be higher since services typically carry a higher profit margin than products.

IoT helps make the delivery of after-sales service much more efficient. In the traditional model, the field service representative must make a site visit to determine the cause of the failure, and often order replacement parts and then make a second visit.

IoT helps by:

- Minimizing faults as a result of predictive analytics
- Remote diagnostics
- Remote repairs for software-related failures

IoT lets OEM deliver a wider range of after-sales services that are delivered more efficiently with higher customer satisfaction.

Case Study:

ZEISS is a manufacturer of optical systems, industrial measurement tools, and medical devices. Using a variety of IoT devices and data services, ZEISS was able to improve its operations substantially. They reported a 15-20% increase in service sales and a 10-20% increase in efficiency for field engineers.

Service managers in Europe reported their newfound visibility resulted in the ability to resolve customer issues in minutes – not hours or days – because going onsite to gather insights was no longer required. ¹¹

11 Cisco Case Study, "Cisco Helps ZEISS Unlock the Power of its IoT Data," 2019.



New Services

The data, connectivity, and analytics available through smart connected products are expanding the traditional role of the service function and are creating new offerings. The service organization is becoming a major source of business innovation in manufacturing, driving increased revenue and profit through new value-added services like descriptive, diagnostic, predictive, and prescriptive analytics.

It can be challenging to estimate the Power of One for new services. A preliminary estimate is to use the average OEM's cross-sell/upsell rate of 7% percent of total revenues. Using this, the Power of One is \$0.7 million in revenue and \$0.1 million in profit.

Improved Pricing

The increased commoditization of products has resulted in lower prices and lower profit margins. IoT is redefining products. Think of a system that provides the client with not just a piece of equipment that manufactures products, but a system that provides the economic benefits explored above. The price now reflects a piece of equipment's technical specifications and these economic benefits. The key is knowing the value of these benefits as it applies to each of your clients.

It can be challenging to estimate the financial impact of IoT. Let's go back to the Power of One. Many OEMs' revenue split is 80% products and 20% services. As shown in Figure 4, the value of a 1% increase in prices on products would increase annual revenues by \$8 million. An advantage of improved pricing is that the price increase goes straight to the bottom line. In our example, the increase in operating income is \$8 million (excluding sales commissions). This would grab the attention of any CEO and CFO and other VPs like sales and marketing.

Case study:

"Caterpillar has developed services to help customers manage its construction and mining equipment. After gathering and analyzing data for each machine deployed at a work site, Caterpillar's service teams advise customers on where to locate equipment, when fewer machines could suffice, when to add new equipment to reduce bottlenecks, and how to achieve higher fuel efficiency throughout a fleet."¹²



¹² Michael E. Porter and James E. Heppelmann, "How Smart, Connected Products are Transforming Companies," Harvard Business Review, 2015.



GETTING THERE FROM HERE...

Answer the following questions to help expedite the IoT-Financial Connection journey.

- How does investment in IoT align with company-wide goals? For example, increase return-on-capital by:
 - Improving revenue growth
 - Creating more value for the customer
 - Maximizing efficiencies
- How will success be measured?
 - What are the expected financial benefits?
 - Which operational KPIs will be improved, and by how much?
- What qualitative factors should be considered?
 - Change in culture?
 - Technology readiness?
 - Alternatives?
 - Intangible benefits?

Good luck on your IoT-Financial connection journey!

See <u>Appendix A</u> for a mapping of manufacturing-related strategies and initiatives supporting these goals.



APPENDIX A: MANUFACTURING IoT ALIGNMENT BLUEPRINT

Maximizing operational efficiency to improve financial performance is one of the most common goals in manufacturing. The blueprint below shows common manufacturing strategies and initiatives in support of this goal. Use this as a blueprint to create, confirm, and modify your company's or client's IoT-related strategies and initiatives.









Empower your sales team to close bigger deals faster with FinListics' financial analytics and insight-led sales approach.



www.finlistics.com



info@finlistics.com



3625 Brookside Pkwy Alpharetta, GA 30022



(770) 777-5800



twitter.com/finlistics



https://www.linkedin.com/ company/finlistics-solutions/