PERSPECTIVE

RESHAPING THE WORLD WITH SOFTWARE: GAME-CHANGING OPPORTUNITIES POWERED BY INDUSTRY 4.0

Abstract

Welcome to the future of manufacturing – better known as the Fourth Industrial Revolution. The transformational potential of Industry 4.0 is as revolutionary as the steam engine, the conveyor belt, and the impact of Information Technology that went before it.

Four years have passed since the manufacturing world laid down the extraordinary vision for Industry 4.0 at the Hannover Fair – the vision of an industry transformed by the power of digital technology. Underpinned by six key design principles, this vision has given rise to a technological revolution that is already dramatically changing the industrial landscape.

Industry 4.0 is enabled by cyber-physical systems where electronics, intelligent sensors, computation, and networking are embedded into physical systems and processes. This combination of the cyber and the physical builds a complex, closed-loop system – machines can operate in tandem with each other and their users in real-time; factory processes become visible and controllable in a virtual space; real-time decision-making enables products to communicate with machines as to how to process, based on contextual information; supply chains flexibly align themselves based on changes in demand or production capacity. This über-efficiency far exceeds today's traditional processes and enables innovative companies to dynamically shape the future.

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Embracing the vision of Industry 4.0

Although there are various anecdotes about Industry 4.0 being embraced globally, a study by Infosys and the Institute for Industrial Management (FIR) at RWTH Aachen on asset efficiency maturity reveals that only 15 percent of companies have systematically implemented Industry 4.0 solutions. There is a definite need to understand the challenges. Organizations are striving to evolve from their established manufacturing processes, in order to take advantage of this game-changing opportunity and dominate the next era of efficient manufacturing.

The current manufacturing enterprise is constrained by a huge, installed base of legacy equipment and standards. We see an interesting challenge, when every industry tries to balance its digital transformation and the legacy systems that have evolved over decades and are still functional. There are several reasons for the amount of legacy systems that currently exist - these systems are well understood and were custom-built to be highly adapted to the organization. They also provided competitive advantage and retiring them may compromise this benefit; large-scale legacy replacements also come with a high risk of project failure.

At the same time, understanding the most efficient and effective ways to manage assets is critical for manufacturing enterprises. So although organizations can dream big, will they be able to embrace the complete vision of Industry 4.0 quickly enough? Can they enhance their legacy equipment, technology, processes, and people to take advantage of the future? The answer is only made possible by taking an intelligent approach uniquely designed for a company that is in an otherwise highly heterogeneous sector.

The challenge of Industry 4.0

The integration of legacy and new systems at an operational level is not an easy task. True, integration will help, but there will be pain in sustaining existing systems while adopting new Industry 4.0 methodologies. This is one reason why many companies are often confused between so-called Greenfield and Brownfield options. Ambitious companies are looking to sustain their existing production systems while enhancing their efficiencies. And for this they need to place smart bets and invest in areas that will deliver the most return.

The fastest returns come through existing assets. Companies need to improve on what they have to ensure machines on the shop floor are as efficient as possible. These improvements are normally driven by information efficiency levers. They are driven by converging informational and operational technologies. Enterprises can provide data in real-time to the top floor that contains the right insights that improve efficiencies.

Getting it right

The study by Infosys and RWTH Aachen examined the technological journey towards Industry 4.0 excellence. Together, we surveyed over 400 business and technology leaders across China, France, Germany, the United Kingdom and the United States, and found that there are significant differences in maturity levels as organizations begin their own journey to Industry 4.0.

Infosys and RWTH Aachen focused specifically on the maturity levels of asset efficiency, aligned to discrete asset efficiency maturity levels (1 - not implemented; 2 - potential recognized; 3 - partly implemented; 4 - systematically implemented and benefits realized).

We found that although 81 percent of respondents – companies in the mechanical engineering, automotive, processing, chemical, aerospace, and electronics industries – are aware of the potential of condition monitoring and predictive maintenance, only 17 percent have put such principles into practice in their workflows. It is particularly remarkable that only 9 percent of German and 4 percent of French companies are working towards implementation. Only 14 percent of the companies surveyed take a holistic, analytical approach to prevent faults and downtime on their production lines. The UK comes in last with 6 percent, compared to Germany and the USA with 15 percent and China with 16 percent.

Our survey also found that manufacturing equipment's operating efficiency is indeed being measured with indicators, but that these figures are not based on real-time data at 91 percent of surveyed companies. Regarding real-time data in maintenance, the United States are in the lead with 21 percent whereas Germany and France are at the bottom of the table with just 9 and 6 percent, respectively. In energy efficiency, 88 percent of participating companies indicate that they consider energy management when planning and monitoring their plants, but only 15 percent said that they systematically implement the appropriate practices in their processes. Compared to Germany, where as many as 16 percent of respondents implement such practices, China placed poorly with just 9 percent and the UK fared little better at 10 percent.

Understanding efficiency levers

Asset efficiency comprises a set of efficiency levers. For today's organization, our research highlighted a gap in all of these:

1 Maintenance Efficiency

Today's maintenance strategies are either reactive or do not achieve the right extent of prevention. Most do not leverage machine-specific operations data and technology to predict failures or to analyze breakdowns.

A strong maintenance strategy ensures that companies work towards planned downtime, which is substantially less expensive than unplanned downtime. On top of the costs, unplanned downtime discourages customers and frustrates staff, leading to unintended additional cost implications as well as losing precious productivity time. The appropriate maintenance strategy makes maintenance the single largest controllable expenditure in a manufacturing enterprise. In many plants, the maintenance budget exceeds annual net profit even though the cost of predictive maintenance is typically far cheaper.

Maintenance-related costs account for up to 40 percent of a plant's total operational costs. Well-maintained equipment lasts 30 to 40 percent longer than poorly maintained equipment. An asset sends out enough indicators of its deterioration well before its complete breakdown, and technology can capture these indicators, to implement effective maintenance approaches. A predictive maintenance system built on technology (condition monitoring) and research (predictive analytics) establishes a new dimension to maintenance strategy.

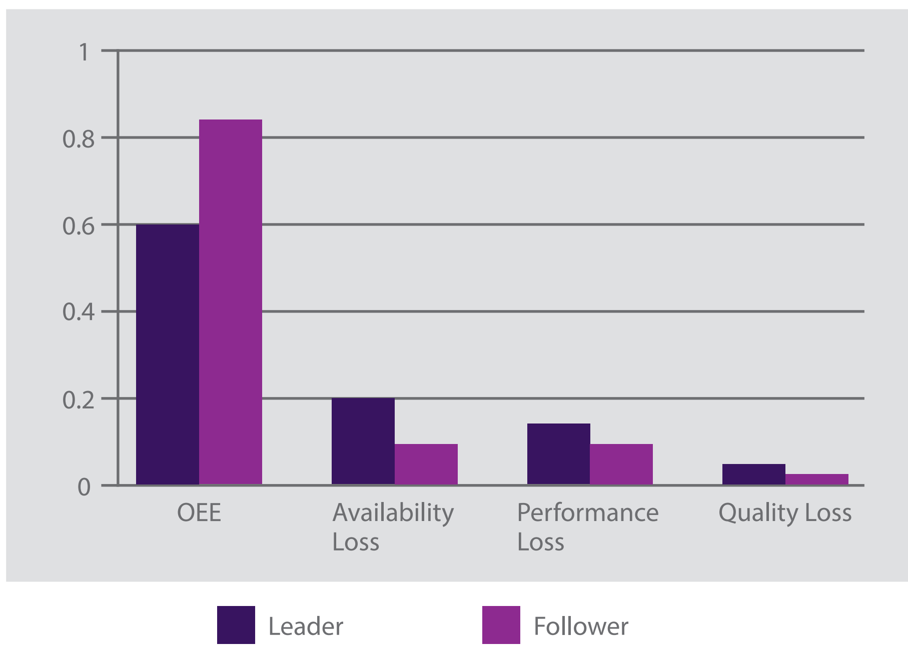
2 Operational Efficiency

Often, a significant percentage of operational efficiency is monitored at the asset level but not at the enterprise level. There is a limited view on integrated asset performance efficiency, production, and logistics-processed efficiency. The key figures of manufacturing processes are not regulated in a closed control loop based on real-time data. Companies need to become experts in integrated factory floor process optimization, and use technology to ensure that all critical processes within a factory are working in an aligned, transparent and seamless manner. They must also ensure that decisions can be made across the production line to maximize operational efficiency overall.

There is significant room for improving efficiency within asset-intensive industries. Overall Equipment Effectiveness (OEE) can be an accurate representation of overall plant efficiency and effectiveness. The average industry OEE score is about 60 percent. Imagine what a 40 percent improvement in productivity could do for companies' competitiveness and profitability. Small improvements in OEE could mean significant returns on profitability. Enterprises implementing the technology-enabled productivity model could gain vital information to enhance performance efficiency and achieve increased profitability.

With the right tools, Industry 4.0 can help a company avoid excess inventory and achieve the highest possible output. Even waste reduction is part of the business driver.

Figure 1:
The impact of operational efficiency improvement



Challenges	Impact of operational efficiency
• Double the amount of equipment failures • Thrice the re-work/ scrap instances • Twice as much spend on maintenance	• 100% improvement in ROA • Half the spends on maintenance cost • Higher quality products; TCO is half the cost

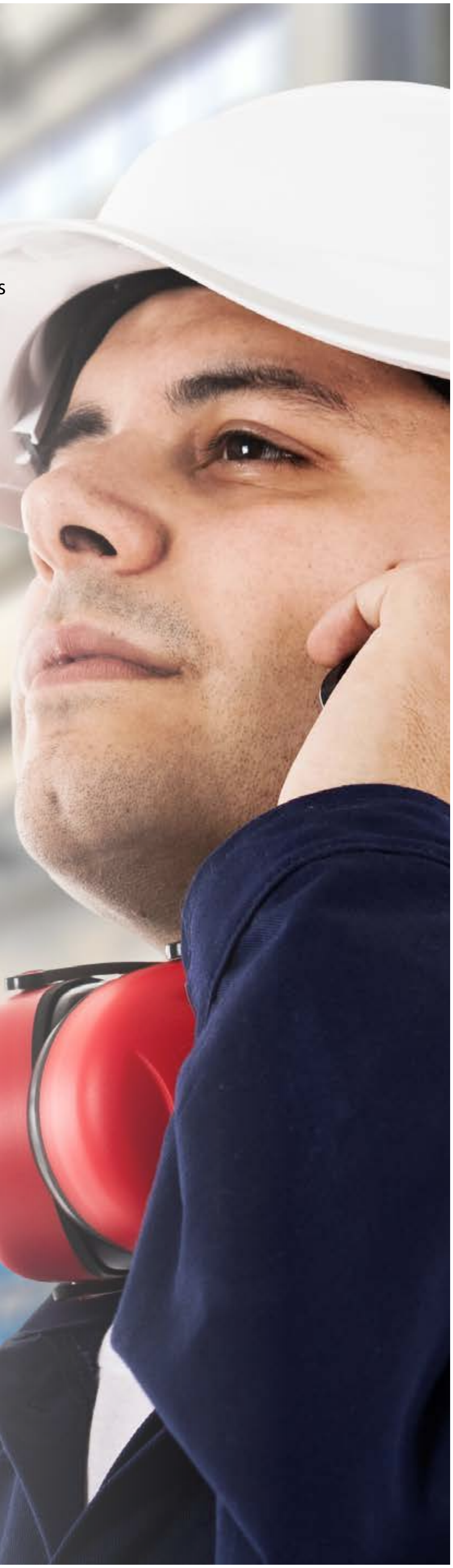
3 Information Efficiency

Almost every process and activity in an asset-intensive enterprise involves data, yet more than 70 percent of generated data is never used. Increasingly intelligent assets have meant that asset-intensive industries need to cope with ever-increasing amounts of data and information. As the asset becomes more complex, the information requirements become more complex as well. The cost of poor asset information management is a staggering 1.5 percent of revenues each year. A life-cycle based information management approach helps industries enhance asset efficiency beyond local environments.

The critical gap is that the information is often distributed in various silos across the enterprise, so one of the key challenges is the integration of operational information with business intelligence. Good asset information management significantly improves decision-making abilities, especially in determining optimal asset performance and maintenance.

Emerging technologies in asset identification, current location, and condition status can enable improved monitoring and management of assets throughout the entire life cycle. It is therefore critical that asset-intensive enterprises use information and analytical methods to understand the nature of asset or personnel risks in their organizations, and take corrective action.

The lack of information interoperability, missing data standards, and data security, are the key obstacles in using advanced analytics to drive efficiency. There is a need for holistic data gathering and efficient processing, whereby companies focus on platforms that help them deliver insight to gain a competitive edge.



4 Energy Efficiency

Asset-intensive industries are resource intensive, energy intensive, and capital intensive. Therefore there is a direct relation between asset efficiency and energy efficiency, and an efficient asset is by nature energy efficient. Well-maintained assets will consume less energy and produce fewer carbon emissions. Properly maintained assets retain their capabilities over a longer period of time, resulting in equipment scrap reduction. Companies often struggle with the prediction of energy use, and are often penalized for under- or over-forecasting. Asset industries are looking for a single indicator that takes into account different sustainability measures, including efficiency, material use, energy consumption, and greenhouse gases. One of the major issues in identifying energy efficiency opportunities is the lack of data available on energy use in asset-heavy industries.

Today, sustainability aspects are not included adequately in asset efficiency initiatives. Rather, companies are monitoring the consumption of individual resources (energy, raw materials, water, chemicals, and waste) but often do not consider them as a whole, or how they can improve the overall energy efficiency of their plant. The opportunity is so much more than monitoring and minimizing individual waste elements, and also identifying cost-saving solutions. Rainwater that comes off the factory roof is more valuable to your organization than you think.

All of these efficiency gaps are proof that it is possible to start integrating what's best about tomorrow's industrial processes today.

Accelerate your journey

Industry 4.0 winners will each build a system of systems that will use smart technologies to bring more structure and real-time visibility to the business. Ultimately, it will be the information that amplifies their business that's important. But how best to get started? Industry 4.0 is built around six design principles that help enterprises build a flexible approach to manage their systems, so that they can evolve in line with the latest technologies, and stay competitive:

1. **Interoperability:** The ability of cyber-physical systems and smart factories to connect and communicate with each other
2. **Decentralization:** The ability of cyber-physical systems within smart factories to make decisions on their own
3. **Real-time capability:** The ability to collect and analyze data and provide insights immediately
4. **Service orientation:** The suite of services involving cyber-physical systems, humans, or smart factories managed via the Internet
5. **Modularity:** The flexible adaptation of smart factories to change requirements by replacing or expanding individual modules
6. **Virtualization:** A virtual copy of the smart factory with virtual plant models and simulation models.

Building an effective ecosystem

Infosys has already collaborated with market leaders to help them become more mature in their asset efficiency journey:

We are helping a major power company develop an automated, real-time, and safety-critical application. This application is based on an industrial ethernet business solution and Infosys has developed a multi-rate scheduler for optimized process control. This delivers improved response times and achieves 100 percent more availability, meaning the customer is establishing greater leadership in the utility market.

We helped a leading materials producer enhance capacity utilization. Infosys lowered the company's energy consumption through the deployment of process automation, monitoring, analysis, and control automation for furnaces and a casting plant. This led to an 8 percent increase in throughput and a 10 percent reduction in energy consumption.

We helped one of the largest mining companies in the world, with a global fleet of autonomous trucks, improve its fleet's operational and maintenance efficiency. The Infosys Information Platform (IIP) processed data from more than 200 sensors which stream 27,000 messages per second. We performed real-time analyses of production plans, maintenance schedules, energy costs, machine availability, and reliability. We helped to reduce machine breakdowns, optimized asset utilization, and increased both efficiency and profitability. This led to the triplingof the company's unmanned truck fleet.

Infosys has a track record of proven experience and can help your enterprise outpace its peers. We can create value and transform your maturity levels for Industry 4.0-enabled asset efficiency.

We support industry standards and are actively building an Industry 4.0-enabled asset efficiency ecosystem. We are proud to collaborate closely with a broad ecosystem that includes partners such as IBM, Microsoft, Oracle, SAP, PTC, Bosch and others, with platforms to manage data acquisition, security, connectivity, M2M, as well as applications and portals.

Our partnership with leading universities like RWTH Aachen and Stanford also advances our thinking and innovation. Infosys is a member of the Industrial Internet Consortium (IIC) that brings together the organizations and technologies necessary to accelerate growth of the Industrial Internet by identifying, assembling, and promoting best practices. Infosys is focused on building a predictive maintenance test bed with key IIC members.

Will Industry 4.0 be worth it?

Imagine if we could go back in time to interview a futurist 120 years ago. Suppose he predicted that millions of people around the world would own horseless carriages by 2015. That this phenomenon would require vast interstate highways and refueling conduits known as gas stations. Not to mention a handful of automotive mechanic shops in every town. Some of us would say that such a scenario – a vast network built up around the potential technology of the motorcar – would be unimaginable.

Today we naturally think of the physical flows of goods as distinct from the resulting (or accompanying) information flows. The challenge of lean manufacturing (and in operations management overall) is to find the best way to synchronize these flows. And in time the distinction between information and physical flows will cease to exist.

Whatever the subtleties involved in defining it, one aspect of Industry 4.0 is that it will be a transformative force in our society. It may be overwhelming to conceive of how to begin putting in place applications that link up millions of things. But more than that – those millions and millions of interlinked things should perform with the same kind of stability they do now and be synchronized across the entire manufacturing value chain. However, it's already happening and together we can and will build the future.

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