How a global metal forging leader is planning to achieve zero unplanned downtime with PTC's digital manufacturing solutions

Success at a glance

- Tight profit margins and desire for growth compelled Bharat Forge to improve operational efficiency with digital transformation

- They chose PTC technology because of ease of connectivity, ease of use, and complete end-to-end platform capabilities

- Resulted in immediate ROI with an OEE improvement of 15% on some forging lines

The manufacturer: A global leader in the forging domain

Founded in 1961, Bharat Forge Limited (BFL), the Pune-based Indian multinational, is a technology-driven global leader in metal forming. It serves several sectors including automotive, railways, defense, aerospace, marine, oil & gas, power, construction, and mining. With 50 years of experience in manufacturing a wide range of high performance, critical, and safety components, they have transcontinental presence across 10 manufacturing locations throughout India, Germany, Sweden, France, and North America.

Diversifying into aluminum forging, they are setting up new plants in India and the US. Expanding further, Bharat Forge recently entered the market for turbochargers and moved into the defense sector to shift from being a components manufacturer to an original equipment manufacturer (OEM). This shift required a mindset shift for the company and brought a higher level of complexity to the manufacturing process.

The objective: Zero unplanned downtime

The goal of Bharat Forge over the next four to five years is to transform their company by adopting Industry 4.0 and retaining their global leadership position. However, the Chairman of BFL, Baba Kalyani, challenged Bharat Forge to have zero unplanned downtime in the hydraulics, pneumatics, and electronics sectors within the next 1.5 years. So, they needed to find and execute the right technology immediately. They planned to accomplish this by implementing digital systems and processes, without depending heavily on outside parties.

"Innovation is central to everything we do. We are motivated by the need to stay ahead of technological advancements and market changes to emerge as the preferred global partner. R&D is our means to sustain this edge," explains Amit Kalyani, Deputy Managing Director. The company's world-class R&D centers, KCTI (Kalyani Center for Technical Innovation) and KCMI (Kalyani Center for Manufacturing Innovation) are the two significant enablers for their innovation charter.

"These centers work to augment knowledge and skills in advanced materials and technologies, identify new opportunities in process improvement, besides undertaking new products and materials development," continues Amit Kalyani.

The challenge: If you don't change, you will perish

"The forging lines in four of our industrial complexes were operating with various technologies and processes, so the need to improve production efficiency was critical," says Yogesh Zope, Chief Digital Officer. Along with mounting industry pressures and ambitious growth plans, they desperately needed to move to digital, and at a quick pace. They needed not only digital, but overall transformation to thrive in today's business landscape.

They realized that moving to digital was now mandatory for business in manufacturing. In Chairman Kalyani's words, "If you don't change, you will perish."

The approach: Think at the enterprise level, start with two manufacturing plants

Considered technology and enterprise-level integration capabilities

Bharat Forge spent the first six months looking at various technologies and considered partnering with startups to help them accomplish digital transformation. In their search, they found many solutions that could work in their shops. But they realized that a technology solution will not produce lasting change if it does not have integration capabilities from an enterprise-level ecosystem perspective.

Chose PTC as easiest to implement and maintain internally

Bharat Forge found PTC's overall product portfolio and breadth of Industry 4.0 knowledge the most appealing. They were excited by PTC's comprehensive digital thread strategy to integrate augmented reality (AR), product lifecycle management (PLM), and Industrial Internet of Things (IIoT).

As they didn't want to be dependent on outside developers and consultants, the ease of use of the ThingWorx Industrial IoT Platform with Kepware's Industrial Connectivity Solution offered the perfect solution. They were impressed with PTC's ability to seamlessly connect to disparate and legacy machinery using Kepware and then use that data to generate insights with ThingWorx.

Started end-to-end digital transformation with two plants

After a successful proof of concept (PoC), Bharat Forge started working to make one plant fully connected with end-to-end digital technology including IoT for digital quality management, and even integration with PLM to create a complete Digital Thread.

For IoT, they focused on proactively monitoring equipment through sensorization and started by analyzing historical data to identify the most common culprits of downtime. The people on the shop floor were the most knowledgeable about what information would help prevent the problem in the future. They helped identify which information was the most critical and what type of sensors would be needed.

Their plan is to fully digitalize a second plant before deploying the solution overseas to Germany and the US.

The solution:
A combined focus on technology, people, and processes

Bharat Forge knew they couldn't achieve extreme efficiency just by moving to digital, so they transformed their entire operation by focusing on three areas:

Platform/technology deployment:

After the PoC, they formed a dedicated IT and OT team that worked as one to deploy and implement Kepware and ThingWorx throughout their plant.

Kepware enables connectivity, aggregation, and secure access to data from 100+ programming languages by combining it into a single digital data set. It streamlines productivity by automatically pulling data from automation devices and software applications, especially for legacy machinery.

ThingWorx takes the data from Kepware and displays it visually for real-time condition monitoring and diagnosis. It provides real-time visibility to monitor production KPIs and historical trends to improve overall equipment effectiveness (OEE) and line performance.

Reskilling of employees:

All 2,500 engineers, including executives, at Bharat Forge attended a six-week boot camp-like training on Industry 4.0 to remove the fear of technology and understand how it could enhance their job. They pushed engineers working on the same machines for years outside of their comfort zones. Once the engineers learned what was possible with digital, they were the ones demanding changes on the shop floor.

Lean implementation:

As a part of the TPM initiative program, the focus was to figure out how to leverage digital in hydraulics, pneumatics, electronics, mechatronics, and robotics to reduce the cost of operations while increasing efficiency.

The results: Over 15% OEE improvement in forging lines

The catalyst for success for Bharat Forge was prioritizing the mindset of its people during the digital transformation process. Yogesh Zope, Chief Digital Officer, estimated that 70-80% of their digital transformation efforts have gone into changing people's mindsets. The effort has paid off well.

Bharat Forge have implemented condition monitoring via PTC's IoT solutions across all their forging lines in their four industrial complexes in India. Now, they are implementing it in all their machining shops—and doing it themselves. As they continually expand their implementation of IoT for digital transformation, they continue to reduce the cost of operations and increase efficiency.

As an example, one night at 2 a.m. when an operator started seeing abnormal vibration via the ThingWorx dashboard, he stopped the press and found a broken bolt. Had he not caught it within half an hour, the shop would have been down for at least two shifts. The cycle time of that press was 12 seconds, so they averted the loss of thousands of units. With the help of the PTC platform, small wins like this are improving their OEE (overall equipment effectiveness) by over 15% in several of their forging lines.

Industry 4.0 Center of Excellence

As part of this continuous innovation and improvement initiative, Bharat Forge has implemented an "Industry 4.0 Center of Excellence" in partnership with PTC. Based at its plant in Pune, the facility is designed as a working Center of Excellence built on Bharat Forge's Industry 4.0 thought leadership to incubate digital transformation ideas, develop and experience new cutting-edge technologies, and train its people to be able to deploy it on the shop floor. This Center will help Bharat Forge to enable preventive maintenance, improve operational efficiency, product quality, and time to market, as well as build the foundation for Machine Learning & Artificial Intelligence.

"The Industry 4.0 Center of Excellence will accelerate the digital transformation of our manufacturing facilities while enabling swift and informed decision-making. It will help to co-create and continuously evolve and augment our processes for agile manufacturing," says Amit Kalyani. "This is in line with our vision of moving towards a digitized workplace for higher levels of productivity and efficiency across all the operating processes. Leveraging PTC's technology stack and Bharat Forge's strong manufacturing excellence, we will drive digital innovation and derive significant business value."

Next steps

At the start of their digital transformation initiative, Bharat Forge's 60-year-old plants were a mix of old and mostly niche technologies. Now, they have real-time visibility to monitor production KPIs including OEE. Intelligent alarms alert operators who can respond within seconds to take action and increase efficiencies. Arguments about the true calculated value of OEE have subsided. From operators to executives, their lives are now among their functions that have become easier because of data transparency on the shop floor.

Bharat Forge's digital transformation is a collaborative journey with PTC. As Bharat Forge continues to expand through new markets and acquisitions, they will leverage digital to integrate their systems faster, as well as deploy processes and technology faster. While Bharat Forge started with a focus on condition monitoring on the forging and machining lines, they're now implementing a PoC for predictive analytics. In the future, they are exploring the possibility of integrating product lifecycle management (PLM) and augmented reality (AR) into their manufacturing processes.

"Leveraging PTC's technology stack and Bharat Forge's strong manufacturing excellence, we will drive digital innovation and derive significant business value."

Amit Kalyani,
Deputy Managing Director