L&T Technology Services

IMPROVE MACHINE UTILIZATION IN STAMPING DIE SHOP USING DIGITAL TECHNOLOGIES

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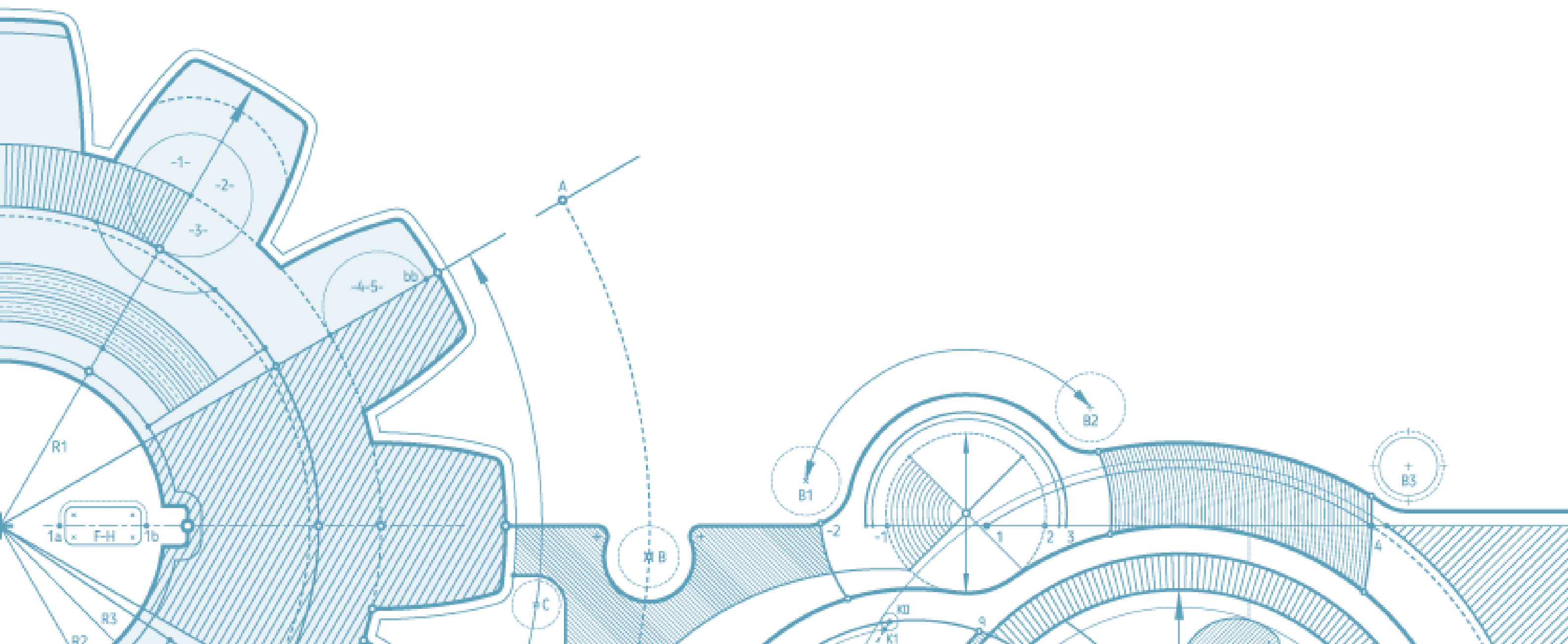


ABSTRACT

Driven by emerging technologies, manufacturing ethos across the globe is transforming rapidly. Digital manufacturing is set to overhaul manufacturing practices by enabling operators to visualize, analyze, and collaboratively create products and processes definitions simultaneously. However, redefining the established paradigm is not an easy task. Owing to economic pressure, industry players are reluctant to invest in new technologies, and the lack of customized vertical-specific solutions continue to impede wider adoption.

From an industry perspective, dies and press lines present themselves as critical but cost intensive hardware. Maximizing return on investment (ROI) against these assets is crucial for maintaining a healthy bottom line. However, this would require optimizing uptime, usage and downtime for ensuring peak productivity. Digital manufacturing tools and technologies can be leveraged in this context to monitor, analyze and inform decision makers with the most favorable options for maximizing stamping die shop machine utilization, thereby defining new boundaries for performance and efficiency.

This whitepaper highlights key challenges and opportunities manufacturers can begin to explore in a digitally-enabled manufacturing space. Furthermore, the paper also discusses, at length, the primary tools and processes manufacturers can harness to streamline machine utilization.

INTRODUCTION

While it continues to act as a major disruptor for the retail, finance and media sectors, the digital revolution is making major headway into manufacturing. The consensus is that digital manufacturing (DM) technologies will transform every link in the value chain. By 'connecting' physical assets on a digital thread, operators are likely to gain unprecedented insights into every stage of the product lifecycle, from design and development to production and use.

Virtual machining tools are quickly becoming a go-to solution for manufacturers looking to simulate and validate numerical control (NC) programs. They are enabling operators to identify and actualize cost opportunities within the early stages of the machining process. Even before it is deployed on the factory floor, NC programs can be virtualized, optimized, and tested in various scenarios and with varying batch sizes, in turn reducing setup time, manufacturing cost, and machine utilization.

HARNESSING THE DIGITAL

A volatile cocktail of geo-economic factors is likely to impede investments and impact market growth. Tepid economic growth has had a negative influence on global trade, decelerating exports and disincentivizing operators from investing further in DM. In the aftermath of the sovereign debt crisis, manufacturers are beginning to recognize the need for focusing on microeconomic inefficiencies to tackle wider, overarching macroeconomic obstacles.

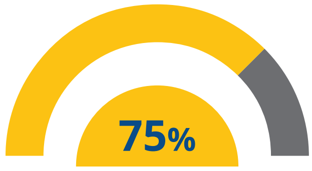
The industry is embracing the digital paradigm – North America and Europe are leading the charge, holding 63.3% of the digital manufacturing market. Discrete industries like aerospace and automotive are positioned to drive the demand for digital manufacturing applications. By 2030, the market is expected to reach approximately $1.4 trillion.

However, challenges persist. Small and medium scale businesses are exhibiting reluctance towards adopting digital manufacturing, focusing on short term cost prohibitive implementation issues. At the other end of the spectrum, large enterprises are struggling with the same issue – the CAPEX impact of infusing legacy environments with cutting-edge technologies. Collaborating with an external technology partner for project execution does take some of that edge off, but it still affects overall net profitability. The marked lack of customized solutions for process industries is another limiting factor which is further weakening the case for digital manufacturing.

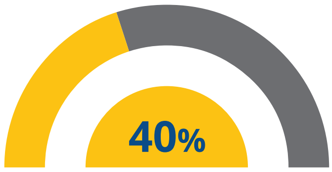
INDUSTRY 4.0 PERSPECTIVE

While machines may never invent culture and only reproduce it, the paradigm shift in the manufacturing industry indicates that they have undergone an overwhelming evolution. In essence, a 'digital thread' has been established between machines and individuals with approximately 50 billion 'smart' machines now functioning across the sector. Therefore, manufacturing resources planning (MRP) plays a quintessential role in the present day set up with machines being a critical aspect. This means that tracking the downtime of machine plays a pivotal role in the whole MRP process. The idea behind this tracking is centralized around minimizing downtime and optimizing uptime.

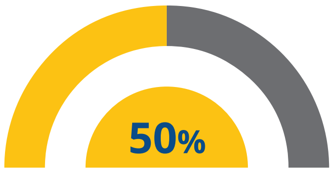
It is evident that Industry 4.0 is being driven by the 'Internet of Everything'. Programmable logic controls (PLCs) and distributed control systems (DCSs) have evolved largely in scale, lending a much-needed edge to workflow automation facilitating real-time monitoring and maintenance of machines. Transitioning to a digitally-enabled process augments existing the production monitoring system (PMS), granting operators unprecedented visibility across factory floors and locations. An accurate PMS model helps in effective collection and distribution of data pertaining to every event and action taking place on the production floor. However, its functionality should essentially not be limited to simple monitoring and recording activities. In essence, it needs to be flexible enough to accommodate unforeseen challenges such as tool damage and material shortages, and can make can dynamic machine utilization quotient.



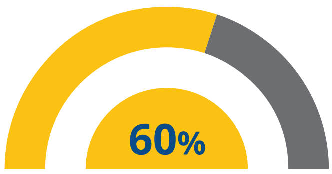
By 2018, coordination of activities based on enterprise-wide planning will fall inside the expanse of fast-paced integrated business planning will be undertaken by 75% of manufacturers



By 2018, Product-as-a-Service model will be incorporated by 40% of the leading discrete manufacturers



By the end of 2017, there will be a 50% rise in the investments that facilitate manufacturing processes that are digitally executed



By the end of 2017, 60% of digitalization initiatives that do not have an architectural strategy will lack scalability

ALIGNING THE RIGHT MIX: TECHNOLOGY & BUSINESS NEEDS

For most manufacturers, the stamping die shop is an elemental part and is crucial to overall production efficiency. To stay in the game and remain competitive, it is imperative for all manufacturers to digitalize their functions and capabilities, and that holds true for stamping die shop as well. Optimum utilization of machines in stamping die shop can be achieved at various levels leveraging disruptive technologies. However, it is the discretion of the manufacturer in terms of the business needs based on which such technologies can be prioritized. The maintenance angle still remains almost unaltered apart from slight variations based on the size and complexity of stamping die shop processes.

As the global movement towards adoption of digitalization grows, the manufacturing industry will not just make machine utilization its focal point, but it must also consider the systems that go in to the measurement of utilization. Precision-based model must be followed for accurate analysis and the respective maintenance steps will then be in sync with the analysis. Manufacturers, big or small, have to understand that digitalization is not merely a trend anymore. It is now necessary irrespective of the costs involved and a determinant of quality of efficiency at the production level.

CASE STUDY

Been There, Done That

Challenges Faced

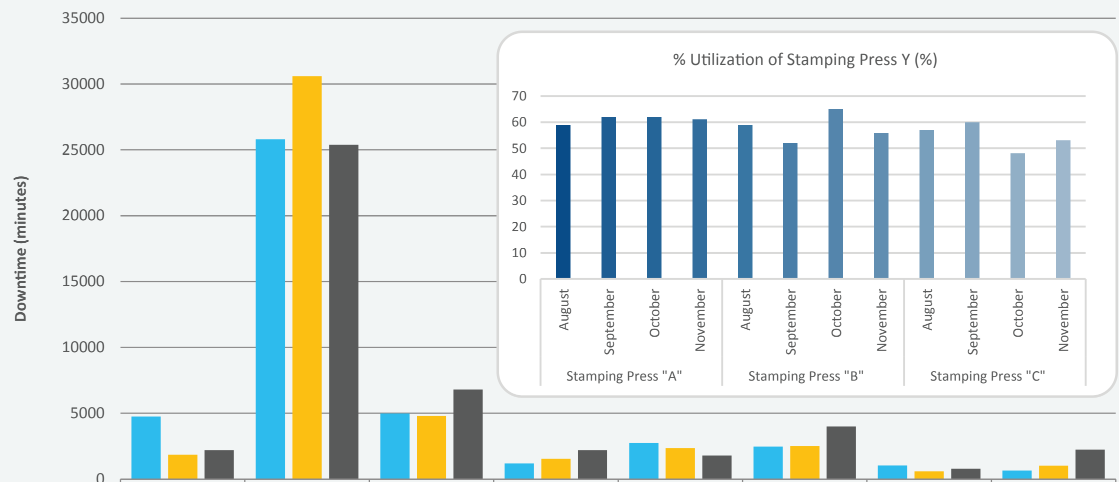
A leading OEM was battling with machine utilization challenges on its stamping die shop . The stamping press utilization was at 58%, leaving scope for inordinate downtime. 70% of the downtime accounted for was because of outages resulting due to die breakdown during operations. 15 such die crashes were reported in the last 2 years, impacting production significantly. The root causes identified were ill-maintenance of records and standard life of die and its parts not being measured.

To overcome the above-mentioned challenges and regain optimum utilization of stamping die shop machine, the OEM administered a structured digital approach to enhance the Overall Equipment Effectiveness (OEE).[1]

Addressing the Challenges

Maintenance through predictive and reactive procedures was inadequate. The first step undertaken by the OEM was the rectification of the same. Alongside intensive die usage records were studied to unearth reasons for downtime that occurred in the last four months.

Downtime Analysis



	Die Repair-Mechanical Fault	Die Repair-Quality issue	Die Setting	Press Fault	Sensor Fault	Gripper Fault	Scrap Accumulation	Coil Changeover
September	4750	25800	4990	1200	2750	2480	1050	650
October	1850	30600	4800	1540	2350	2520	600	1020
November	2200	25400	6800	2200	1800	4000	780	2240

Reasons

Die Inspection sheet. Machine's downtime record for past 4 months

The machine utilization target was set at 75%. For which, the OEM adopted key digital technologies to cut the existing gap in producti on and optimize machine utilization.

TECHNOLOGIES INCORPORATED INCLUDED THE FOLLOWING:

3D scanners:

The die for repair was made to go through 3D scanners to arrive at a 3D CAD Model. The intent was to compare the CAD model with the Master CAD to identify the variations existing in both through data analytics. Once compared, corrective measures were actioned leveraging the OEM's skill repository. A compilation of die history was created and inputs from tool and die makers, technicians, engineers, research, and more were put to practice.

RFID:

RFID technology was implemented by the OEM for maintaining and identifying die information as die outages were the primary reason for machine downtime. The scanner based on RFID technology helped monitor a die's health and provided insights on the kind of maintenance that the die has undergone along with the life of spares (like cushion, springs, punches, bushes, bearings, and others, with respect to the number of stampings). With the assistance of a warning system, the RFID-based scanner provided signals on when maintenance was needed to be carried out. Before any stamping job got initiated, the warning system alerted when there were deviations prior to the loading process.

Die protection sensors:

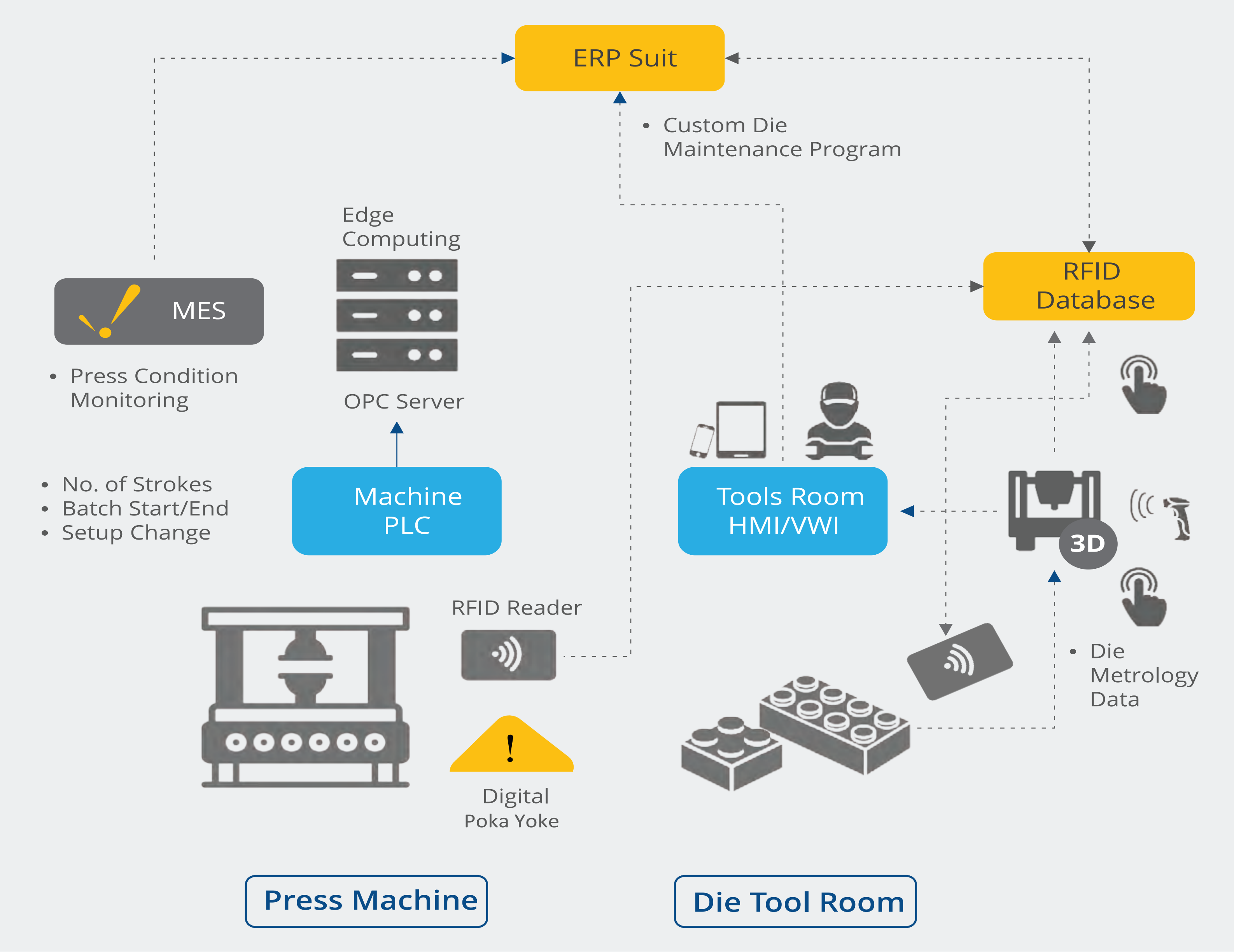
This technology was implemented by the OEM to identify the presence of undesired metal pieces within a die, the condition of critical parts, and misalignment of work pieces if any, by using pressure, laser, and proximity sensors.

Condition-based monitoring (CBM):

By the application of CBM, various sensors were put in place which detected and notified breakdowns in advance. Parameters that were monitored using sensors are:

- Hydraulic oil temperature
- Vibrations
- Bearing temperature
- Motor load and temperature
- Press tonnage (protect press and die from hard hit)

SOLUTION ARCHITECTURE



BENEFITS REALIZED

Notable benefits in machine utilization were realized when the technologies mentioned above were executed on the press floor. The business value-add experienced by the OEM include:

- *Real-time life of die projection determined by the designed strokes against total strokes till date*
- *Detailed analysis of frequently failing components*
- *Measurement of mean time between failures (MTBF) and mean time to repair (MTTR) of die*
- *Alerts and warnings before die loading*
- *Linking production schedule to die condition*
- *Contextual maintenance instructions*
- *Better control over bought outs and inventory spares*
- *Ability to compare and track performance of two similar dies*
- *Availability of a digital record of die information*

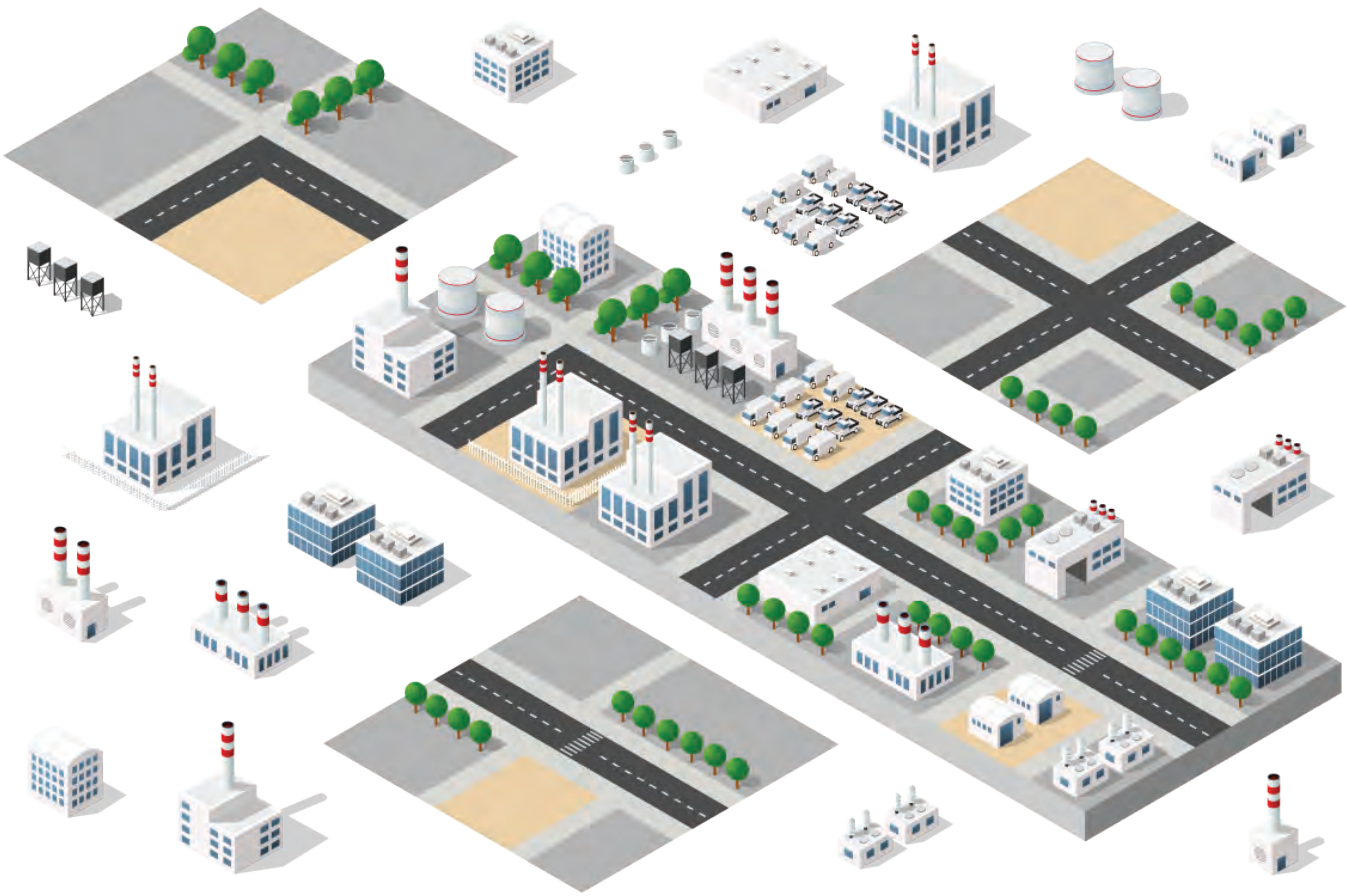
Digital technologies consistently help in improving asset utilization along with providing process data recording, monitoring, and diagnostics which leads to prompt availability of assets and reduced downtime. As the project was executed, the OEM was able to achieve approximately 72% of machine utilization.

CONCLUSION

On average, manufacturing operations yield an OEE score between 60-70%. While it indicates that there is significant scope to improve machine utilization across the factory floor, the means to achieve this end is a subject of debate. For now, manufacturers are relying on sensors and connected devices that 'speak' to each other to dynamically respond to events as they emerge. By leveraging OEE as an analytical tool rather than a simple performance benchmark, manufacturers can begin to factor in industry, equipment, and demand specific data, drawing insights which can streamline processes further.

However, considering the established best practice' OEE score of 85%, OEMs and discrete manufacturers still have much to strive for. Make Digital Engineering an essential component of your smart manufacturing framework for delivering consumer-centric, differentiated experiences while accurately assessing risks and achieving efficiencies of scale.

For more information, drop an email at **info@lnttechservices.com**



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Endnote

1. A manufacturing equipment's effectiveness is determined by OEE. The percentage of time that it is actually productive is taken into account, and the rest falls under downtime.
OEE = Availability × Performance Rate × Quality Rate

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The important thing is not to stop questioning. Curiosity has its own reason for existing," said Albert Einstein. We couldn't agree more...

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Date of creation: 03/07/2017
Valid until: 03/07/2018