A.T. Kearney

# Digital Lean: The Next Operations Frontier

Traditional lean needs a turbo-boost from digital to manage rising complexity on the shop floor and increasingly linked value chains. COOs should start investing now in the people, tools, and capabilities that digital lean requires.

# Executive Summary

As manufacturing environments have become more complex, traditional lean has lost its teeth. While early lean veterans often achieved productivity gains of 10 to 15 percentage points, today 2 to 3 points is considered quite an accomplishment. These declining results are because traditional lean narrowly focuses on actual execution on the shop floor, with no possibility to parallel-test hypotheses or simulate scenarios. Furthermore, traditional lean, with its lack of end-to-end planning tools, overlooks relevant aspects of today's complex, linked value chains.

Digital lean is giving rise to a new era in operations excellence. Digital lean extends traditional lean by using advanced methods and tools to incorporate 360º site simulation, holistic modeling, and advanced analytics. Using sophisticated statistical assessments, digital analytics, and big data tools, manufacturers are able to identify potential production problems before they occur. How? By simulating material flows, testing models for robustness, and conducting scenario-based analyses—in short, by trying out hypotheses and performing financial assessments in a risk-free digital environment.

Digital lean, then, offers manufacturers a bright new future. But much remains to be done to prepare the shop floor for the dawning era—one where digital lean takes its place in digital manufacturing. And where digital manufacturing joins with digital planning, digital supply, and digital logistics to conform the digital supply chain space.

COOs need to be prepared to invest in people and skills to realize the potential of digital lean. The new methods and tools will require digital natives with operational excellence capabilities that go beyond traditional shop floor lean tool sets. Digital lean is the next stop on the journey toward the digital operations frontier. The time to start investing is now.

# Digital Lean: Lean with a Digital Boost

The operations panorama is changing like never before. Shorter product cycles, extreme market volatility, and shrinking margins are chronically straining supply chains and continually transforming distribution models. Manufacturing setups, in particular, have become more complex than many imagined possible.

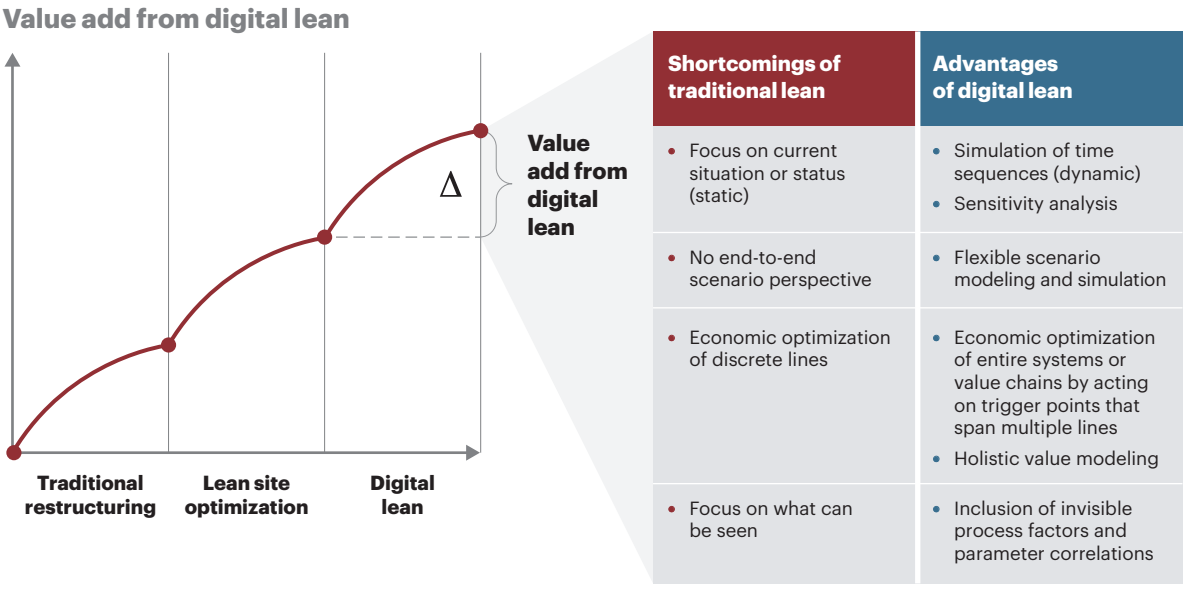
In the past, lean and Six Sigma techniques allowed manufacturers in nearly all industries to reduce waste and variability in their production processes and dramatically improve product quality and yield. In lean's heyday, which started with the pioneering work done at Toyota, its most skilled practitioners often achieved productivity increases of 10 to 15 points. Today, however, gains of just 2 or 3 percentage points are considered a major achievement.

Has lean run out of steam? Not yet.

Lean is still the most powerful toolbox to optimize the shop floor. But traditional lean's focus on shop-floor execution is too narrow for today's complex, linked value chains and adaptable manufacturing environments. Over the past five years, digital production lines (with real-time information and optimization possibilities) and digital analytics have given rise to digital lean and, in so doing, opened up whole new areas of opportunity (see figure 1).

Figure 1

**Digital lean boosts the power of traditional lean**




Source: A.T. Kearney analysis

**Traditional lean,** a continuous process improvement methodology driven by customer demand, centers on rooting out production inefficiencies, achieving error-proof processes, and engaging the entire production staff. Typical lean tools are single-minute exchange of die, value stream mapping, Five S, Kanban, Kaizen, and root cause analysis.

**Digital lean,** in contrast, focuses on optimizing the entire manufacturing setup, for example, by changing work flows and by questioning process steps and their sequences. Some of the questions that digital lean answers include:

- How can material flows be optimized across every step of the value chain?
- What additional savings can be generated by making changes in the value chain—for example, by consolidating or separating certain steps?
- How can manufacturing systems be made more robust? Where do the highest failure rates occur? How can potential dependencies between failures be addressed?

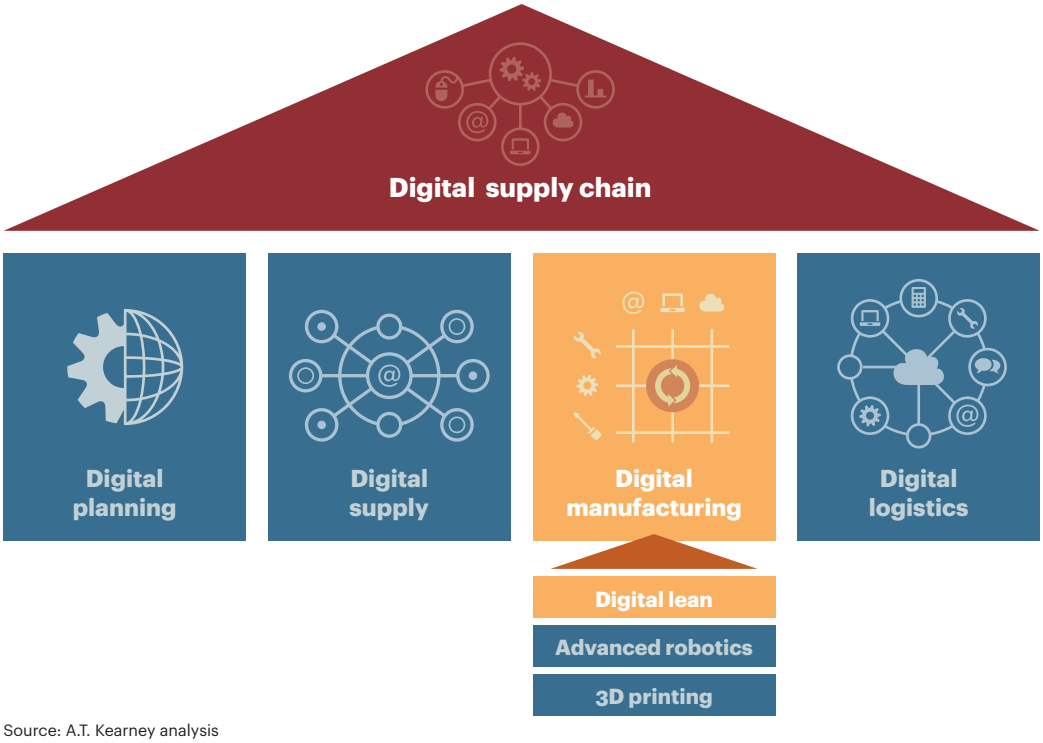
Digital lean—as the next stop on the journey toward the digital operations frontier (see sidebar: The Digital Operations Frontier)—lets companies repurpose old-fashioned hand tools into modern power tools to exhaustively test hypotheses, simulate scenarios, and calculate detailed

### The Digital Operations Frontier

**Digital lean is an integral part of digital manufacturing—in turn, one of the key pillars of the emerging digital supply chain space. Indeed, a whole suite of new methods and tools are developing that will change the economics and push the frontiers in operations optimization. Other pillars of the digital supply chain will be digital planning, digital supply, and digital logistics (see figure).**

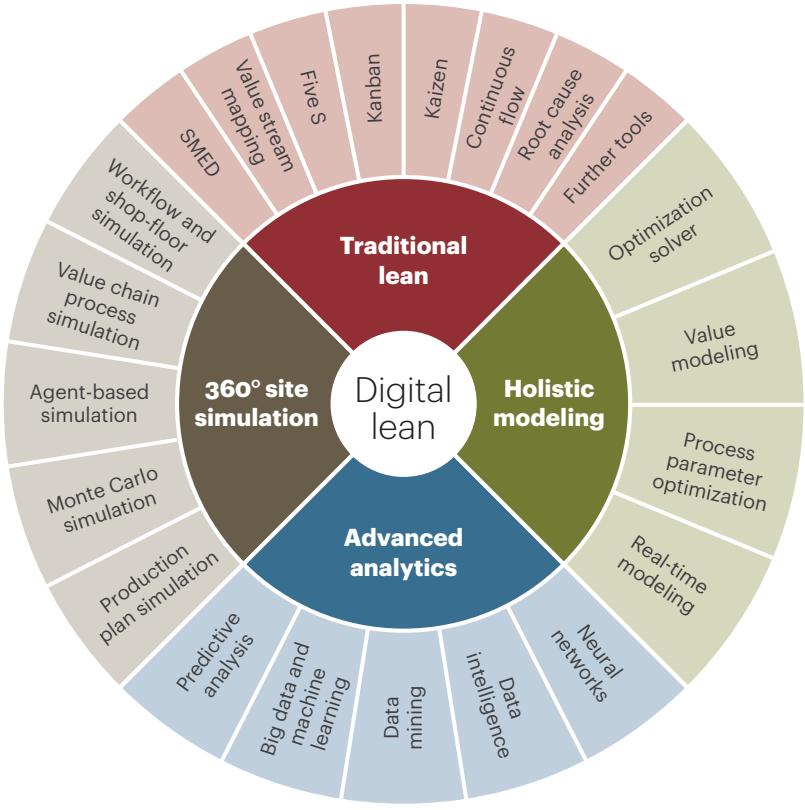
**Many tools and applications in digital operations will overcome traditional functional separations to enable a holistic perspective of production, logistics, finance, marketing, and sales.**

Figure
**New frontiers in digital operations**




Source: A.T. Kearney analysis

Figure 2
**Digital lean radar**




Note: SMED is single-minute exchange of die
Source: A.T. Kearney analysis

costs without the risks of pilot tests or actual implementation. It does so by combining the analytical power and breadth of traditional lean with three new digital tools: 360° site simulation, holistic modeling, and advanced analytics (see figure 2).

## 360° site simulation

Simulation tools conceptually digitize manufacturing and production processes, which can then be tinkered with in a digital "playground" to seek better-suited alternative setups. Simulation tools let companies test the robustness of potential solutions no matter how complex the systems. More specifically, they help identify flaws, calculate asset and resource capacities, optimize stock points, reduce throughput times, and balance production line utilization. The learnings and observations obtained in these risk-free digital simulations can then be incorporated into real-life production process flows.

Typical 360° site simulation tools include workflow and shop-floor simulation, value chain process simulation, agent-based simulation, Monte Carlo simulation, and production plan simulation. Such tools are often applied when designing a new production site or optimizing an existing one—for example, to model workflows, minimize handling times, avoid bottlenecks, and maximize asset utilization.

### Holistic modeling

Similarly to 360º site simulation, holistic modeling tools allow operations managers to observe and better understand process flows and to test production hypotheses. These tools work by applying iteration-based algorithms to solve highly complex problems and arrive at solid results. One way they do this is by dynamically modeling interdependencies and variances, measuring specific performance indicators at process interfaces to determine the most efficient overall design.

Real-time modeling, process parameter modeling, value modeling, optimization solving, and financial modeling are among the most commonly used holistic modeling tools. Companies often employ these tools to define multi-echelon batch sizes, develop complex production plans, optimize the workflow among mixed product equipment, improve shop-floor flows, and increase overall equipment effectiveness.

### Advanced analytics

Production line execution systems, sensors, and machine logs provide companies in many industries with reams of data on their manufacturing processes. Smart sensors (to detect, for example, vibrations, heat, and humidity) with wireless transmission functionality—often referred to as the Internet of Things—have already fallen in price to a few dollars apiece and will drop to just cents by the next decade. Not only are smart sensors inexpensive, but they are also simple to install across entire production lines, making it easy to track deviations and predict behaviors. And with data storage cheaper than ever, mass data can be warehoused in the cloud with no need to invest in fixed assets. Likewise, the computational power to run smart factories has increased exponentially and is available via web, allowing companies to perform complex analyses on demand.

Yet most factories today are still far from being smart, as they use less than 5 percent of data to improve production. In most cases, data is simply dumped after each batch—or production lines aren't even hooked up to manufacturing execution systems.

Sophisticated statistical analyses and tools such as predictive analysis, big data and machine learning, data mining, data intelligence, and neural networks are starting to change how companies think about data by providing a better understanding of complex manufacturing processes and subsequent ways to improve them—for example, by identifying dependencies and detecting issues before they materialize. Moreover, by taking a deep dive into historical data, operations managers can spot patterns and relationships among discrete process steps and inputs, and then optimize those with the greatest effect on yield.

Leading firms have started to connect all their lines and systems, and they are massively storing all their data in the cloud for analysis. An entire industry for service-based data analysis is emerging, making the analytical work an affordable effort for operational excellence departments.

## Rich Data, Rich Rewards

The financial impact and return on investment of digital lean can be substantial:

- **Additional revenue.** Digital lean reduces the challenges of manufacturing new products (for example, through additive manufacturing), mass-customizing existing ones, or increasing product quality. As a result, companies can open up new revenue streams or raise price points, without incurring the typically high costs of complexity.

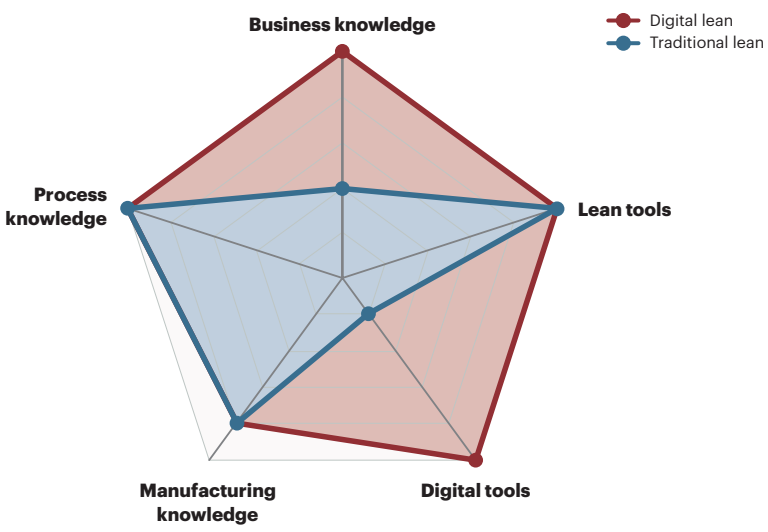
- **Lower cost of goods sold.** Smart automation and smart robots make production less labor-intensive and drive down personnel costs. Companies applying the tools of digital lean also achieve higher yields that allow them to lower raw material consumption. Finally, optimized batch sizes and better synchronized processes lead to higher asset utilization, while better control of production assets and quality result in fewer quality losses and write-offs.
- **Reduced working capital.** Thanks to improved coordination and flows within (and among) production steps, as well as the benefits of scenario-based forecasting and integrated operations planning, lean digital practitioners are able to lower their safety and cycle stocks to bring down the need to hold inventory.
- **Lower capital expenditures.** The superior overall equipment effectiveness enabled by digital lean more than offsets the required investments in new controls, sensors, and analysis technology.

The case of a large medical device manufacturer illustrates what we're talking about. The company was planning a major new production site in Asia that would be much more efficient than those in its existing network. In designing the new plant, the company combined classic lean with digital simulation, holistic modeling, and advanced analytics to create a "virtual plant." Using solver-based models, the planning team defined production parameters, determined the equipment and facilities needed to optimize capital expenditure and timing, and established the proper trade-offs between production and quality control requirements on the one hand and lean material flows on the other.

Thanks to digital lean, the company was able to double the project's net present value, reduce the capital budget by 20 percent, and lower conversion costs by one-quarter.

Figure 3

**Digital lean requires capabilities to better connect manufacturing with business requirements**




Source: A.T. Kearney analysis

# Start Investing Now

Digital lean offers much promise to manufacturers that are struggling to wring the last drops of efficiency out of an already trim yet highly interconnected production value chain. But the benefits digital lean promises will not come for free (see figure 3 on page 6).

Operations teams already have the tools of the trade for conventional shop-floor optimization: process knowledge, manufacturing knowledge, and mastery of traditional lean tools. To reap the digital lean bonus, COOs will need to invest decisively in capabilities in critical new areas:

- **Business knowledge,** hiring digital natives for their operational excellence areas with sufficient expertise to powerfully model financial, material, and information flows
- **Digital tools,** acquiring not just the tools themselves but also the talent needed to use them and effectively interpret (and apply) their output
- **Data security,** adopting and implementing solid cyber defense strategies to shield the business from major competitive and operational risks

Digital lean is the next stop on the journey toward the digital operations frontier. The time to start investing is now.

## Authors


**Oliver Scheel,** partner, Düsseldorf
oliver.scheel@atkearney.com

**Sean Monahan,** partner, New York
sean.monahan@atkearney.com

**Oliver Eitelwein,** principal, Düsseldorf
oliver.eitelwein@atkearney.com

**Marco Koelbli,** consultant, Zurich
marco.koelbli@atkearney.com

A.T. Kearney

A.T. Kearney is a leading global management consulting firm with offices in more than 40 countries. Since 1926, we have been trusted advisors to the world's foremost organizations. A.T. Kearney is a partner-owned firm, committed to helping clients achieve immediate impact and growing advantage on their most mission-critical issues. For more information, visit www.atkearney.com.

| | | | |
|---|---|---|---|
| **Americas** | Atlanta | Detroit | San Francisco |
| | Bogotá | Houston | São Paulo |
| | Calgary | Mexico City | Toronto |
| | Chicago | New York | Washington, D.C. |
| | Dallas | Palo Alto | |
| **Asia Pacific** | Bangkok | Melbourne | Singapore |
| | Beijing | Mumbai | Sydney |
| | Hong Kong | New Delhi | Taipei |
| | Jakarta | Seoul | Tokyo |
| | Kuala Lumpur | Shanghai | |
| **Europe** | Amsterdam | Istanbul | Oslo |
| | Berlin | Kiev | Paris |
| | Brussels | Lisbon | Prague |
| | Bucharest | Ljubljana | Rome |
| | Budapest | London | Stockholm |
| | Copenhagen | Madrid | Stuttgart |
| | Düsseldorf | Milan | Vienna |
| | Frankfurt | Moscow | Warsaw |
| | Helsinki | Munich | Zurich |
| **Middle East and Africa** | Abu Dhabi | Dubai | Manama |
| | Doha | Johannesburg | Riyadh |

For more information, permission to reprint or translate this work, and all other correspondence, please email: insight@atkearney.com.

The signature of our namesake and founder, Andrew Thomas Kearney, on the cover of this document represents our pledge to live the values he instilled in our firm and uphold his commitment to ensuring "essential rightness" in all that we do.