McKinsey & Company

Compendium

The productivity imperative in services

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Content

The productivity imperative in services

by Hugues Lavandier, Senthil Muthiah, Eric Egleston, Florent Kervazo, Guy Benjamin, and Tomas Nauclér

The key to preserving – or increasing – margins in a period of strong growth is to improve productivity

What does it take to achieve profitable growth in a services business? As a wide range of factors promote a paradigm shift in services, executives across industries must answer this question.

In our previous compendium, "Reimagining how services organizations grow," we looked at the growth opportunities offered by services. But even as they capture higher revenues from services, many companies have struggled to sustain profitability. The key to preserving – or increasing – margins in a period of strong growth is to improve productivity. In this compendium, we explore the productivity imperative in services through various lenses.

New technologies are catalysts, not disruptions

Companies can capture significant productivity improvements by implementing new technologies, including smarter and more integrated workflow tools, artificial intelligence and machine learning, and augmented reality. At the same time, they can use on-demand staffing to reduce complexity in the workforce. **"The coming evolution of field operations"** looks at the ways these new technologies are reshaping aftermarket services and how management teams can treat them as catalysts for performance, rather than disruptions.

Repair analytics prevents equipment breakdowns

Repair analytics enables industrial companies to proactively address the health of machines before breakdowns occur, instead of reactively making repairs. By enabling higher machine uptime, fewer service calls, and faster issue resolution, repair analytics allows companies to significantly reduce costs and improve customer experience. **"Cracking the code of repair analytics"** explores how this approach generates value and what successful companies get right. Identifying and prioritizing value-creating use cases is essential. Although data and advanced technology are fundamental enablers, success requires adapting the company's operating model so that stakeholders collaborate to develop solutions to the most important problems.

Analytics-based asset allocation combines quality with speed

To keep costs in check when installing more physical assets, companies need to increase the number of assets covered by their field force. Traditional methods of allocating assets to the field force inevitably sacrifice effectiveness to improve the speed of implementation. Some companies have tried using mathematical formulations, but they have found these complex and time-consuming to use. **"Smarter and faster asset allocation: A new solution for increasing coverage and reducing cost"** presents an advanced approach. The approach uses an adaptable mathematical formulation that focuses on reducing the drive time of the field force. The adaptability of the formulation eliminates the time-consuming set-up required by previous approaches. Organizations can easily and quickly incorporate new business constraints, enabling them to tailor the approach to their needs.

Project-based services don't need to be loss leaders

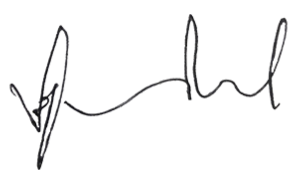
Project-based services generate a high percentage of revenues for companies with large, multi-skilled mobile workforces. However, to get a foot in the door, many companies are willing to take a hit on their quoted margins. It doesn't need to be this way. **The winning moves in project-based services** discusses how companies can win business even as they achieve higher margins from each project. For many companies this means improving quotations, scope management, revenue management, and resource management, as well as making delivery more effective. It also means applying a different mindset that focuses on earning repeat business through excellence in execution, not low margins.

Lean reduces costs while improving customer experience

Many companies recognize the need to implement lean-management techniques to increase the productivity of their field force. But few do everything they need to do in an orchestrated way. **"How lean is your field force—really?"** examines the new digital tools and advanced analytics that make it easier to plug the value leakage that flows through the gaps in lean-management practices. Leading companies have applied such advancements as the basis for a five-step holistic "lean journey" in field operations that generates step-change improvements in productivity. Continuous improvement and cultural change enhance the application of new technologies, simultaneously driving down costs and boosting customer satisfaction.

We hope these articles provide a road map for companies as they plan their journey to profitable growth in a services business. Those companies that are the first to master the challenges and reap the rewards will capture a significant advantage.

Hugues Lavandier



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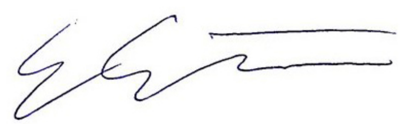

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Operations Practice

The coming evolution of field operations

New technologies are reshaping aftermarket services – and both customers and providers can benefit.

by Guy Benjamin, Brett May, Mitesh Prema, and Vaibhaw Raghubanshi

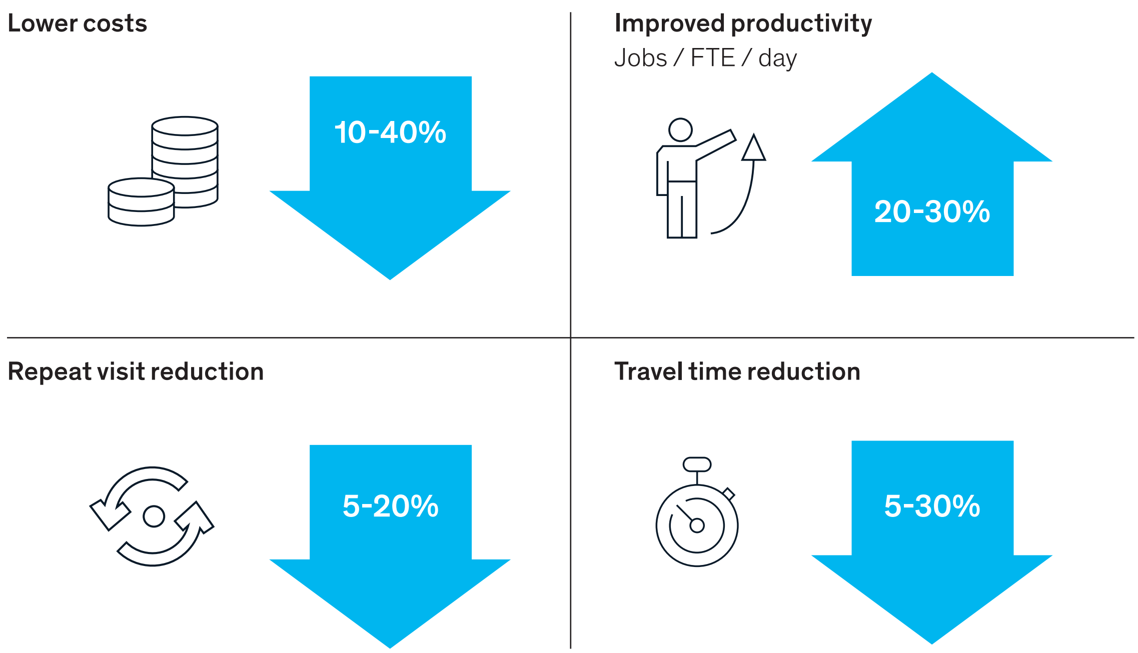
It's Thursday afternoon when you get an alert from an embedded sensor. One of your machines at a customer's production plant is about to go down. Your customer finds out when you do, and you both know that the asset is business-critical—if it goes offline, it will cost the customer millions. Within minutes, you line up on-demand technicians from an open-market source, all certified experts with this equipment. As soon as the job gets assigned, the customer can start tracking the technicians via a mobile app. Rather than waiting to run traditional diagnostics on-site, the technicians leverage embedded sensors while on route, which tell them exactly what's wrong, how to fix it, and the precise set of parts and tools they need to bring. Once they arrive, they're armed with augmented reality tools and remote support from experts at headquarters that walk them through the repairs step-by-step. Even better, the team identifies two other looming issues with the equipment and proactively fixes them. Less than four hours after the initial alert, the crisis is averted and the customer is beaming.

This is the future of field operations. Industrial manufacturers with aftermarket services have been disrupted by new technologies and advanced analytics, but the best organizations are not resisting but capitalizing on those trends. These companies are transforming their field operations to dramatically improve service levels and the customer experience, increasing efficiency and productivity, and creating value in new ways—both for customers and for themselves as original-equipment manufacturers (OEMs).

Based on our experience, field organizations that transform themselves to capitalize on new technologies can generate significant gains in labor costs, productivity, and other performance metrics (Exhibit 1).

Exhibit 1

Technology advances have led to major performance improvements in field operations



Four essential technology-enabled trends

The field-operations function has evolved over the past several decades, keeping pace with changes in technology. However, new technologies mean that field service will take a quantum leap forward in terms of efficiency, effectiveness, productivity, and the customer experience (Exhibit 2).

In the current environment, there are four critical areas in which technology evolution is reshaping the field force. Each of the five warrants a closer look.

Smarter and more integrated workflow tools
In the past, companies strived to aggregate information into dashboards. That's a decent first step, but dashboards have drawbacks. They often overwhelm users with too much data and not enough insight. They also don't address the variability in managerial effectiveness, and they tend to bunch problems and issues into slow reporting cycles—often weekly or monthly.

In contrast, advanced analytics allow companies to generate specific action steps based on the out information being tracked. These steps—presented through intelligent actionboards—can be extremely prescriptive, down to the level of coaching individuals, following up with specific customers to address low customer satisfaction scores, or visiting facilities to sort through service-level-agreement misses. The advantage of this approach is that it eliminates the often-manual step of analyzing data in a dashboard and figuring out what to do based on that data. Instead, actionboards give managers a clear course of action to take, through standardized measures to ensure that all managers are acting consistently and effectively. What's more, this approach allows companies to respond to metrics in real time.

Artificial intelligence and machine learning
Artificial intelligence and machine learning empower machines to improve predictive maintenance. Embedded sensors and other tools allow manufacturers to track all of their assets in real-time, with all alerts visible on a single screen. Detailed views give key indicators of machine performance, enabling manufacturers to create a service ticket with likely resolutions—instantly.

Exhibit 2

Technology is deepening a paradigm shift in how field operations are run

1990s-2000s

- Technicians with deep expertise about the products and solutions
- Electronic communication and digital tools for communication
- Analytics-based basic decision making and reduction in paperwork

2000s-Present

- Millennial workforce; less dedicated but more dynamic
- Multichannel communication about service requests and installations
- Real-time decision making on job allocation and jeopardy management involving GPS

Present-2020+

- Workforce available on demand whenever and wherever needed
- Advanced analytics and machine-learning algorithms preempt problem occurrence
- Leaders use digital and analytics to drive step change in value creation

When equipment does fail, AI and machine learning help technicians reduce diagnostic time. For example, smarter IoT applications can give techs a single-screen view of all necessary service requirements and details for a given job, along with easily accessible knowledge documents to solve support requests quickly. Technicians can also get on-demand support and work in parallel with an experienced, remote technician that can guide them through complex repair processes. One global OEM used this approach for roughly 25,000 field technicians across the globe, reducing maintenance costs by 15 percent for the entire organization.

Augmented reality (AR)

The simplest form of AR is a tablet in the hands of a technician. Consider a technician on a job site who needs to fix a circuit board but does not know how. The tech could either open up a binder and start trouble-shooting—an approach with a high probability of wasted time, or ask the dispatcher to send another tech with more specialized expertise, resulting in continued downtime and a negative customer experience. Alternately, that same tech could use an AR-enabled tablet, glasses, or other tools to gain richer information about a downed asset. For example, a headset-enabled service motion can free up one or both hands, leading to clear productivity gains. More advanced AR tools are becoming available that will let workers hold a tablet up to a machine and download an internal schematic, allowing a service tech to see what the inside of a device is supposed to look like before he removes the cover. A common theme of AR is that these tools allow technicians to solicit help from a remote expert at headquarters, who can guide the on-site technician, through visual steps depicted in an AR-enhanced view of the situation. That leads to much faster problem resolution, improving the customer experience. Companies in sectors ranging from semiconductors and high tech to oil and gas and heavy equipment are all using AR applications for their field technicians.

On-demand workforce

Last, technology is changing the labor force within field organizations. Rather than retaining a complete staff of full-time employees, companies can use on-demand staffing to reduce complexity in the workforce. Essentially an "Uber-like" model for talent, on-demand staffing lets skilled workers like certified technicians, coders, electricians, and other specialists provide their services via an on-demand marketplace. For OEMs, this approach can optimize labor costs, particularly for non-core activities. Companies can also streamline support functions, even as they improve service levels and broaden their service footprint.

Putting the tools to work

To see how these tools could come together in the real world, consider the following applications.

1. *Matching demand*. Many OEMs struggle to accurate gauge demand. By using advanced analytics tools such as machine learning, they can integrate multiple sources of data—both internal and external—to build accurate forecasts of demand for each local market. They can also set the right level of in-house staffing with on-demand workforce resources to flex up or down in order to meet demand. And they can set up dynamic dispatching systems to put field technicians at job sites quickly, with the capability to react to changes in real time. Total savings: 5-20 percent in labor costs.
2. *Increasing efficiency*. By automating and digitizing processes, OEMs can run their field operations far more efficiently. For example, they can digitize manual processes and paper documentation and replace clipboards with smart devices. They can also use advanced analytics to sort through job reports and identify best practices that can then be standardized across the organization. And they determine performance-management metrics and create action-oriented dashboards to better manage performance. Total gain: 10-30 percent gains in productivity.
3. *Improve the customer experience*. Perhaps most important, OEMs can use new technology to improve the customer experience. For example, they can apply analytics to identify the biggest drivers of satisfaction across the entire customer journey, in order to eliminate pain points and refine the offering. OEMs can also use analytics to increase service-to-sales performance. Total gain: 5-15 percent increase in sales, and 20-40 percent increase in customer satisfaction.

Consider a telecom company that was struggling with the high cost of running field service operations. Worse, it was lagging its competitors in key performance metrics like technician utilization levels and the percent of customer appointments met on-time. A key problem was that different divisions—sales, forecasting, dispatching, and field operations—were all operating in silos, each focused on their own unit execution rather than the real goal of serving customers. To overcome this issue, the company set up a cadence in which all units started collaborating in near-real-time. That allowed the organization to be more flexible with labor scheduling, hold everyone accountable for performance, focus on the end customer, and make continuous improvements to its field operations—all at the same time. As a result, the organization improved the productivity of field technicians by 10 percent and the rate of on-time appointments by 5 percent.

Four priorities for management

To capitalize on these new technologies—and treat them as catalysts for performance, rather than disruptions —OEM leadership teams should focus on four priorities, bearing in mind that the rewards tend to go to first movers (Exhibit 3).

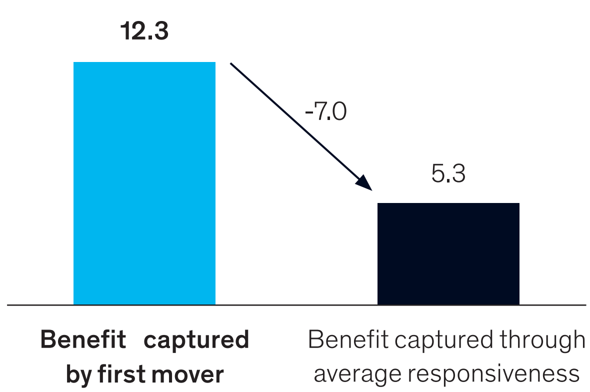
Build digital and analytics skills
Many organizations simply do not have sufficient capabilities in place yet. OEMs need to launch a concerted effort to build up these capabilities, either through training and development programs for existing team members or through targeted recruiting and hiring initiatives. Notably, these capabilities do not all need to come through full-time employees. Instead, companies can tap into institutional expertise through contracting with suppliers, partnerships, and joint ventures.

Collaborate with solution providers
Rather than waiting for technologies to emerge and then determining whether and how they might meet a need within the organization, OEMs should be far more proactive, partnering with the providers developing these new tools. Not only will this allow OEMS to get a better understanding of what's coming, but solution providers can often lack some of the real-world experience specific to a given industry; they might welcome the input and knowledge from end users.

Exhibit 3

First movers have significant advantage over companies with average response

Percentage-point change in 3-year revenue growth of first movers vs. other organizations



Modernize workers’ mindsets

Many OEMs have powerful inertia in their existing field workforce people and processes. Technicians adopt a zero-sum mindset in which they don’t collaborate or share best practices. You can expect some to resist change, arguing in favor of “the way we’ve always done it.” OEMs should create a culture and mindset of continuous improvement, potentially structuring rewards and incentives so that technicians and front-line employees can share in the gains from suggested improvements.

Redesign the organizational structure

Many OEMs have organizational structures that were designed for an analog world. Sometimes they grew through M&A and without sufficient integration. Digitization and advanced analytics can dramatically change how work gets done—they alter some processes and eliminate others altogether. But organizations won’t be able to capture all the potential benefits from these technologies unless they rewire their organizational structure accordingly.

A real-world example: a global OEM that was struggling with low turnaround times for maintenance requests on its equipment. The company determined that the underlying problem was lost time during diagnostics and technicians being sent to the job without the right skills or parts to resolve the actual problem in the equipment. The OEM actually had sensors embedded on some of its equipment that could capture performance data, but that information was being sent to a data lake where no one looked at it. To improve, the company set up an analytics team and tasked it with developing machine learning algorithms to identify the most common failures on key equipment, along with the most common reasons for those failures. Once the algorithms were in place and harnessing sensor data, the team that could predict the top three reasons for a device failure with 75 percent accuracy. This led to dramatic improvements in the first-time fix rate.

In the past, companies struggled to know what was happening with their equipment in the field. Today, the equipment can often tell them remotely—not only what’s wrong but also how to fix it. Field 4.0 may seem like a futuristic vision, but digital and advanced analytics are real-world, proven technologies that forward-looking organizations are already using today. They offer companies a clear means of improving performance, reducing costs, and increasing customer satisfaction. In fact, the only uncertainty is whether management teams will have the foresight to begin capitalizing on these tools, or cede the future to their competitors.

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Cracking the code of repair analytics

by Anuj Kadyan, Senthil Muthiah, Guy Benjamin, Kobi Masri, and Kalpit Sarda

A new norm is emerging in industrial services: Innovative industrial companies are proactively shifting from a reactive, manual and labor-intensive repair lifecycle to a proactive and more automated one - and machine learning and advanced analytics are at the core of this paradigm shift

Increased availability of low-cost connected devices has made it possible to collect vast amounts of data from the field. At the same time, advances in machine-learning allow companies to apply analytics to discover, interpret, and communicate insights. For example, an elevator company installed IoT sensors in equipment to gather continuous monitoring data and used that data to predict failures ahead of time. The insights enable the company to optimize maintenance operations, leading to reduced downtime and improved customer experience. Similarly, by adding software capabilities to routers, telecommunications companies can gather in-depth telemetry information that can be feed into analytics engines to generate actionable insights into performance. Such opportunities are already significant and will grow further as the rollout of 5G mobile networks advances and the IoT becomes more mature.

Traditional improvement levers, such as innovative product design, process optimization, and agile ways of working, are still applicable and continue to deliver impact. But to achieve the next S-curve in growth, industrial services companies need advanced analytics-led insights to drive proactive issue identification and resolution. Companies that continue to take a wait-and-watch attitude will likely find themselves at a significant competitive disadvantage in terms of both the customer experience and the cost base. Companies can apply repair analytics to improve the quality of the customer experience by solving issues in the field faster and more proactively enabling higher machine uptime and fewer service calls. The opportunity to reduce costs is substantial. For many industrial services companies, the cost of servicing and repairing equipment in the field has always represented a large portion of costs – often up to 70% of operating expenses.

The value is real. Leading organizations around the world are capturing value from repair analytics.

For example:
One global logistics provider applies predictive analytics to improve the performance of more than 50,000 vehicles globally, using petabytes of data on the condition and performance of its vehicles. The use of predictive analytics allows the company to avoid unnecessary and unplanned maintenance, among other benefits, enabling substantial savings.

NASA uses a data-based service provided by Siemens to perform predictive maintenance on the cooling systems at Edwards Air Force Base in California. Sensors measure vibration and speed for fans, pumps, air handlers, and cooling towers, which are evaluated by Siemens with automated algorithms supported by data analysts. NASA receives automatic notifications of any significant status change of an asset, so that it can take appropriate action.

Siemens is also working with Deutsche Bahn, Germany's largest railway company, to test an application that supports the predictive servicing and maintenance of high-speed trains. Siemens analyzes data at a dedicated Mobility Data Services Center in Munich. The insights are used to predict potential equipment failures.

Source: "Predictive Maintenance KPIs Are Unbeatable,' *https://fsd.servicemax.com/2018/05/29/predictive-maintenance-kpis-unbeatable/*

Why now

Although the concept of repair analytics is not new, the convergence of several technology and business trends is accelerating progress toward widespread adoption (see the box). The volume of data continues to double every three years as information pours in from digital platforms, wireless sensors, and billions of mobile phones. Data storage capacity has increased, while its cost has plummeted. Data scientists now have unprecedented computing power at their disposal, and they are devising and leveraging ever more sophisticated algorithms.

Additionally, following the general business trend, many industrial companies are seeking to differentiate themselves on the basis of customer experience. And the bar for success is getting higher, as customers have raised their expectations for quality of service, including uptime and availability. The need to focus on the customer experience is even greater at industrial companies that have turned to aftermarket services to generate additional revenues. As the customer experience moves to center stage, companies must look for new ways to meet customers' ever-increasing expectations.

Technology trends. The widespread adoption of repair analytics is being promoted by the covergence of the following trends

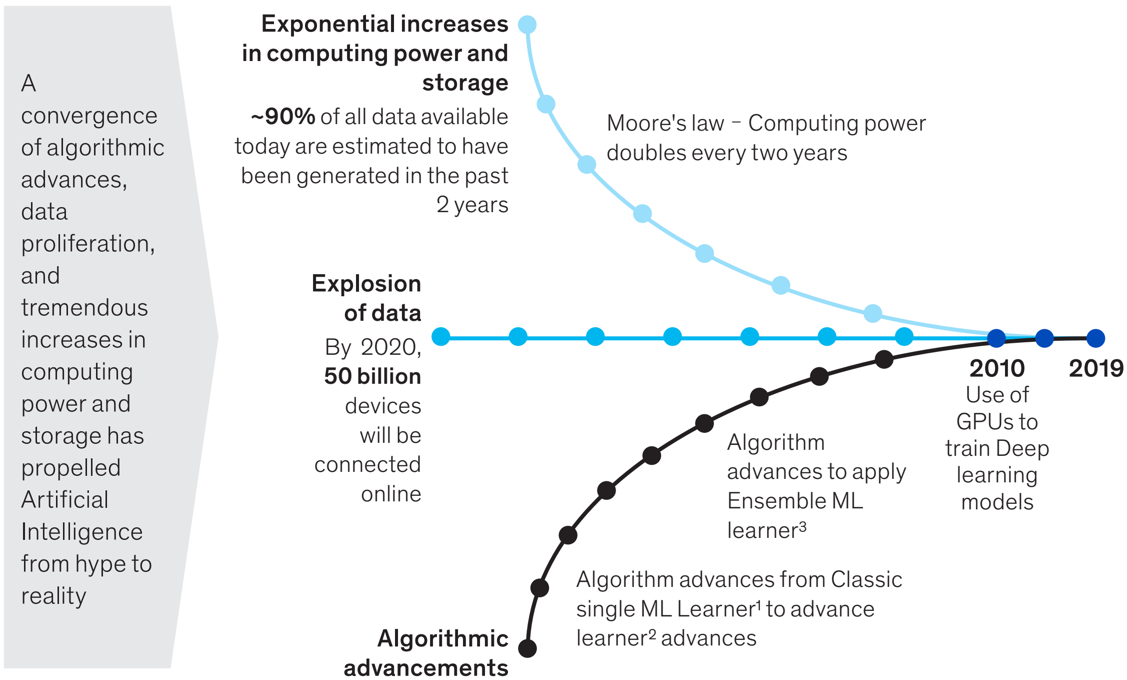
Explosive growth in connected devices and data. As the cost of devices used for monitoring and controlling declines, more and more have been installed in the field and in customer premises. By 2020, 50 billion devices will be connected online. The amount of data received from each device is increasing as well – approximately 90% of all data available today is estimated to have been generated in the past two years. Further, connectivity improvements (such as 5G mobile networks), will enable more data to be collected from each device, which increases the opportunity to use data to drive advanced analytics-based applications.

Cheaper and faster storage and computing power. A sharp decline in the cost of computing power means that computers now provide unprecedented levels of processing power and are able to run more complex algorithms. Storage cost has also declined dramatically, allowing companies to collect more data and keep it for a longer time. These developments enable companies to rapidly transfer and analyze vast amounts of data and apply the insights in their operations. Even the most advanced algorithms being able to run on ad-hoc ASIC cards in field equipment.

Advancements in machine-learning algorithms. The past 30 years have seen tremendous advancement in machine-learning algorithms. These advancements enable the application of ad-hoc data analysis and/or basic analytics to discover, interpret, and communicate insights derived from data. (Exhibit 1)

Exhibit 1

AI (Artificial Intelligence) is transforming every industry and will create an estimated $13 trillion of GDP growth



1 e.g. Regression, Decision Tree (CHAID, CART); 2 e.g. Neural Net, Support Vector Machine; 3 e.g. Random Forest, Boosting

What's the impact?

Companies can use repair analytics to generate tremendous value. Beyond the traditional goal of cost optimization, repair analytics provide opportunities for service companies to increase agility, allocate resources optimally, provide improved quality of service and a better customer experience, and develop additional revenue streams.

Increased agility. Repair analytics enables companies to greatly increase the speed of service and deliver on-time service in both proactive and reactive scenarios by speedily identifying the cause of fault and automating processes such as parts ordering and delivery thereby reducing wait times.

Optimal resource allocation. With repair analytics, companies can identify failures ahead of time and optimize resource planning, such as for parts, field labor, expert technicians, and external vendor equipment planning and allocation. One medical devices company leveraged repair analytics and ensured parts delivery beforehand to reduce the number of field visits by 20%.

Quality of service and customer experience. Companies that successfully apply repair analytics can avoid many issues in the field or solve such issues faster and more proactively, even in cases where the customer is not yet aware of the issue. This enhanced capability promotes better quality of service, which improves customer experience, helps companies meet commitments in service level agreements (SLAs), and avoid costs. The improvement in customer experience is substantial, enabling the company to achieve a key source for differentiation in today's business environment.

Capturing additional revenues. Repair analytics allows companies to generate additional revenues in a variety of ways. First, companies can leverage repair analytics to create new service offerings or expand existing offerings, such as by providing maintenance and repair services that have been the customer's responsibility. Second, companies can improve the service levels of existing offerings. For example, companies can promise longer uptimes and faster issue resolution—and charge more for these enhanced service levels. Third, companies can use repair analytics to free-up workforce capacity and redeploy it to new revenue-generating activities within the services business.

Reducing costs. Repair analytics can help companies reduce both operating expenses related to service personnel (such as the field force and staff in remote resolution centers and call centers) and capital expenditures related to installations in the field. By using a suite of repair analytics tools, one industrial company managed to increase the percentage of issues resolved remotely from 50% to approximately 80%. This improvement, in turn, allowed the company to reduce the cost of field operations and focus its field force on providing better coverage of high priority issues.

How do you start?

While the value at stake is high, many companies fail to achieve the full benefits of applying advanced analytics to repair services. They often stay in the "experiment" phase, without reaching full-scale deployment. Based on our experience, successful companies get four main things right:

1. Identify and prioritize the use cases. It is important to identify and prioritize use cases based on potential impact and ease of implementation, to ensure that the right ones are selected. The impact assessment should also consider the effect on customer satisfaction and quality of service, which many companies overlook.

Several types of machine-learning use cases are available for repair analytics:

- **Anomaly detection.** Companies can apply machine-learning techniques to a large amount of equipment data to identify issues and underlying factors that would otherwise be undetected. Such models can be applied retrospectively to identify overall trends and the reasons for issues. For example, one industrial service firm found that a significant number of unexpected failures occur a few months after a specific spare part is used in a particular equipment line. This insight allowed the company to develop guidance about usage of spare parts to avoid future issues. Anomaly detection can even be applied in real time. For example, to identify anomalies, a company can determine a dynamic baseline of different performance KPIs for a specific type of equipment. The company can then apply machine learning to identify which variables will be taken into the baseline. These would include both traditional variables (such as time, day, and seasonality) and other variables (such as usage patterns and external environment effects) that might affect equipment performance and the specific KPI. By implementing real time anomaly detection in its manufacturing operations, Toshiba reduced error detection time by 66% while also increasing yield.
- **Alarm management.** As field equipment sends more alarms to remote resolution centers, it becomes more onerous for the staff to identify and resolve issues. The effective processing of alarms data is critical, so that real issues are distinguished from false alarms and their root cause can be identified. Many companies ask experienced agents or equipment specialists to create a set of rules for managing alarms. Although this approach can generate some impact, it is limited by the fact that humans cannot process the same amount of information and identify the same patterns as machine-learning algorithms. The approach is also labor-intensive compared with a machine-learning algorithm that can run consciously and improve and adapt the rules over time.
- **Predictive maintenance.** To reduce costs, issues should, ideally, be predicted and prevented before they occur. For example, over the course of one year, Verizon used its analytics infrastructure to predict 200 events relating to customer service and prevent them from actually happening.[1] Although some issues cannot be predicted (such as external

[1] See "The Amazing Ways Verizon Uses AI And Machine Learning To Improve Performance" (June 2018): https://www.forbes.com/sites/bernardmarr/2018/06/22/the-amazing-ways-verizon-uses-ai-and-machine-learning-to-improve-performance/#41d353a27638

physical harm to equipment), many issues can be (such as those resulting from degradation over time). Issues preemptively identified can be resolved remotely (for example, by remote rebooting and configuration) or through a field visit. Such a field visit can be scheduled before the failure, at a more convenient time, which will reduce costs. For example, another telco uses this approach to predict failures at cell sites, allowing it to reduce utilization of field technicians and increase the sites' average uptime. An industrial company that installs security equipment in small businesses uses predictive models to forecast when weather conditions would cause equipment to deteriorate. Based on the forecasts, the company arranges for replacement parts to be drop shipped before issues occur. As another example, GE Power leverages machine learning to predict maintenance needs in power equipment.[2] Volvo has applied similar approach to predict when parts would fail and when vehicles need servicing.[3]

- **Next best action.** Machine learning models can support human decision-making by assessing issues and their severity and making recommendations for addressing them. Such recommendations will provide the human agent (either field technician or remote resolution agent) or an automation engine with the optimal "next best action" to solve the issue in the fastest way and with the lowest cost. For example, a business-to-business equipment manufacturer used such a model to optimize its call center operations. The engine recommends the next resolution step to an agent on the basis of installed equipment information, real-time environmental data, and keywords used by the customer at the beginning of a call. The use of the intervention has significantly reduced call duration and eliminated unnecessary field visits. As another example, a machine learning program implemented by Comcast has achieved accuracy levels exceeding 90% when predicting whether dispatchers need to send a technician to repair residential connectivity problems.[4] In the health care sector, a medical devices manufacturer applies analytics to the vast amount of data generated by its equipment base — including text, sensors, logs, and lifecycle data. The use of text analytics and pattern recognition allows the company to predict the right solution for each type of issue. The impact includes faster resolution, a reduction in field staff, and increased uptime.

  Advanced troubleshooting models are often used to assist other automation engines. RPA bots that usually do "simple" automation tasks (such as running troubleshooting commands when connected to devices) can become "smart" bots that apply machine learning in the backend to determine the next best action. Machine learning models can also augment the use of virtual agents. Most commercial virtual agents only use the customer's input during a call to determine the next action. By adding machine learning models to the backend, a company can significantly decrease resolution time and increase the percentage of calls that virtual agents handle successfully.

- **Optimization.** Companies can use machine learning to optimize planning. One example is the optimization of field force deployment to maximize the impact on customer experience and minimize cost. Another example is to optimize the deployment of different types of equipment based on the costs of the equipment, initial installation, and future repairs. Deutsche Telekom is using AI to optimize the installation of its fiber-optic cable network. In a pilot program, the company collected extensive data about

[2] See "GE Power: Big Data, Machine learning And 'The Internet of Energy'" https://www.bernardmarr.com/default.asp?contentID=1266
[3] See "Volvo: Machine learning-enabled analytics on a large scale." https://www.bernardmarr.com/default.asp?contentID=692
[4] See "Comcast's machine learning app could save 'tens of millions' of dollars in truck rolls" (September 2017): https://www.fiercevideo.com/cable/comcast-s-machine-learning-app-saves-tens-millions-dollars-truck-rolls

the relevant conditions in a specific area, such has the types of trees and depth of their roots. A neural network applies deep learning to the data to assess 30 categories of such conditions. The assessment is used to determine the optimal route for rolling out cable.[5] One industrial service company leverages machine learning to identify the regions in which it should retrofit its installed equipment to minimize the service cost. In another less conventional example, BMW is collaborating with IBM Watson to improve the efficiency of its cars.

2. Make the required changes to the operating model. Many companies that pursue repair analytics never advance from experimentation to the actual at scale deployment of machine learning models. This failure is often attributable to the absence of collaboration and a joint execution model among the business, the machine learning team, and the IT or digital teams. The solution is to define a new operating model. This model should ensure that the various stakeholders can collaborate to address the right problems, develop machine learning solutions, and apply the solutions within the existing IT systems. Industrial companies, in particular, might need to set up a remote monitoring unit that tracks model insights and alarms and acts on them or coordinates with plant or field operations to take actions. It is also important that the company deploys the required change management expertise within the business.

3. Establish the right data and technology foundation. To scale up repair analytics, it is important to have the right data strategy and technology stack. In the short term, companies might not have all the required data, and they may need to install the right sensors to collect the data. For technology stack, companies need to decide whether to use existing analytics platforms or create new platforms in-house.

4. Combine analytics with other improvement levers. To maximize the value created by advanced analytics, it is essential to combine implementation with other levers, such as process improvement and automation. Often, a process must be changed completely to adapt it to advanced analytics. In addition, as noted above, advanced analytics can provide a "brain" for simpler types of automation, such as RPA.

5. Design products to enable repair analytics. Products should be designed to enable collection of the right data and support remote troubleshooting. The collection of equipment data is a prerequisite to using repair analytics. It is critical to collect the right data, and with the right frequency. Ideally, decisions about data collection should be made whenever new equipment is deployed in the field. A careful pre-deployment analysis is required to facilitate decision-making. It is also often beneficial to retrofit existing equipment by adding sensors and controllers to collect data. A thorough prioritization and cost-benefit analysis should be used to maximize the value of investments in retrofitting. Companies should also use data from external sources (such as environmental data). Additionally, it is valuable to maintain a database of past service actions, so that advanced troubleshooting models can identify which actions have worked over time.

It's time for companies to apply advanced analytics to their equipment repair operations. Enabling technologies that once seemed beyond the reach of many companies are now widely available. Indeed, strong capabilities in repair analytics are a fundamental prerequisite to realizing the potential of aftermarket services as a growth platform. In pursuing the opportunities, it is critical for companies to recognize that the successful implementation of repair analytics requires more than data and advanced technology. It also requires having the right talent and the ability to collaborate effectively across business and IT teams. Companies that master the diverse challenges will be rewarded with both bottom- and top-line growth.

[5] See "Deutsche Telekom turns to AI to aid fibre rollout" (October 2018) : https://www.mobileeurope.co.uk/press-wire/deutsche-telekom-turns-to-ai-to-aid-fibre-rollout

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Smarter, faster asset allocation for more coverage at lower cost

by Guy Benjamin, Tod Camara, Joseph Faucher, Mayuri Singh, and Kumar Vivek

It's a common phenomenon across industrial companies: leaders looking for opportunities to slash the operational costs of managing physical assets, even as they make bold moves to install yet more assets. For example, renewable-energy companies have increased wind-turbine installations across the U.S., while telecom companies around the world are building out new 5G networks. As these efforts expand, the need to optimize and reduce operational costs is only going to intensify.

As many leaders already know, one of the best ways to keep costs in check when installing more physical assets is to increase the number of assets covered by their field-force workers—operators, engineers, technicians, and the like. After all, labor typically represents the largest share of asset-management costs. Yet few businesses have really cracked the code for field-force allocation: some still just rely on local managers to assign people to assets, while others use more sophisticated methods, but often with less impact than they had initially hoped. What these methods have in common is that almost inevitably, they sacrifice long-term effectiveness in favor of easy, fast implementation.

For years, leading companies have wanted to apply cutting-edge advanced-analytics and modeling techniques, in an attempt to avoid compromises between quality and speed when allocating assets to the field. Until recently, however, an analytics-based methodology was too demanding to implement. But the latest advances in technology have made it possible to simplify and expedite the approach, thereby unlocking the potential of smarter, faster asset allocation.

Today's common approaches compromise impact

We evaluate asset-optimization methods along two dimensions: effectiveness (the accuracy and efficiency of optimization) and ease of implementation (the complexity of the approach and time to implement). Each of the four approaches typically used today suffers from a tradeoff between these two variables (Exhibit 1).

Manual and local

Field managers use local knowledge to assign assets to their field-force workers to minimize drive times, maximize specialized expertise, and balance workloads across the workforce. While this method is extremely simple and generally easy to implement, it places a heavy burden on field managers, and ignores available data that could yield a truly optimal allocation.

At a regional energy company, for instance, local managers typically assign field-coverage areas on the basis of industry benchmarks, such as the average number of tickets resolved by field workers. Managers spend only one to two days each year assigning coverage areas—a relatively small investment. But the rewards, such as they are, are equally small, producing suboptimal coverage areas and excessive drive times.

Clustering

Assets are grouped based on physical proximity, then assigned to the field force. Asset-workload and drive-time data can be incorporated via an iterative clustering process, allowing for asset allocations that better balance workloads and reduce drive times.

Yet clustering's impact often disappoints. At a large telecom company, this simple, analytics-backed approach was implemented in just six weeks, and relieved field managers of the burden of assigning sites. But it was only moderately effective in reducing the driving distance between the field force and work tasks, with drive times falling an average of only 10 percent. This was because, in general, clustering does not consider field workers' starting locations, making it impossible to actively minimize drive times. And because the telecom company's version of clustering did not optimally assign tasks across the entire field force, both drive times and staffing levels remained suboptimal.

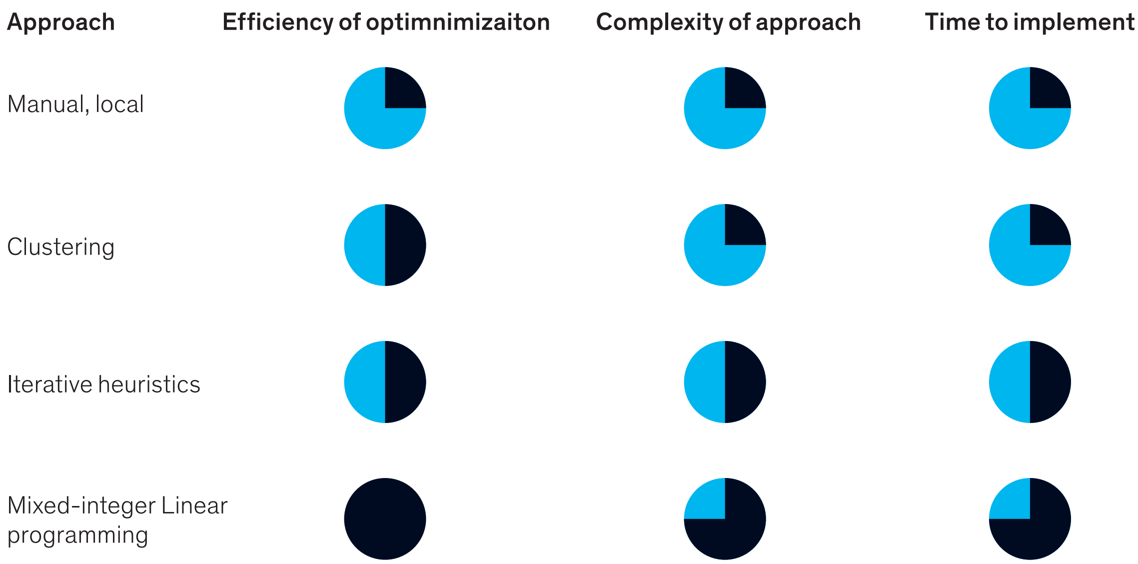
Iterative heuristics

Assets are assigned iteratively to the field force according to a tailor-made algorithm. This method incorporates the starting locations of the field force, and provides considerable flexibility to incorporate business constraints. However, as illustrated by a dispatch company, the iterative nature of the algorithm often results in suboptimal asset assignments.

Typical of iterative heuristics, the dispatch company started with a simple algorithm that assigned assets to the field force based on proximity, and then

Exhibit 1

Current optimization approaches are either inefficient, or complex and time consuming



removed the assigned assets from further consideration. As the process continued, the remaining unassigned assets were interspersed among existing clusters.

The output seemingly met the company needs, requiring eight weeks of work to achieve a 20 percent reduction in average drive time. But it yielded diffuse, overlapping coverage areas that required more drive time for field-force workers assigned later in the process: the last 10 percent of the field force to receive assignments were given longer routes that had not yet been assigned. As a result, their drive times were significantly higher.

Mixed-integer linear programming
Assets are assigned to the field force using a mathematical formulation based on asset workloads, business-specific constraints, and drive times. Although mixed-integer linear programming (MILP) is the most complex and time-consuming of the asset-optimization approaches, it provides the most flexibility by incorporating business constraints. It also yields the most optimal allocation across all assets by considering the entire solution space at once—no sites or field force are removed from consideration during the optimization process.

Moreover, once the time-consuming step of developing the complex mathematical formulation is complete, the approach can be rapidly deployed.

A South American energy company applied MILP in redesigning its coverage areas to minimize field driving times and associated labor costs. While the effort reduced drive times by 30 percent, it also required 300 development hours across an intensive 12-week effort.

A simpler, more advanced MILP for faster, easier optimization

Simplifying the underlying MILP mathematical formulation can greatly expedite the method while maintaining its integrated view of the problem to be optimized. How? An adaptable, mathematical formulation that focuses on reducing drive time eliminates the time-consuming setup for MILP optimization. It also allows organizations to quickly and easily incorporate new business constraints, enabling them to tailor the approach to their needs—such as incorporating fixed limits for travel distance or coverage radius.

Moreover, this advanced method can incorporate a more detailed, realistic understanding of how the field force spends its time, adding administrative task time, maintenance workload, and additional job responsibilities to the usual drive-time data. At most large businesses, the inputs come from readily available sources:

- Asset and field-force location data, such as addresses or latitude-longitude coordinates
- Historic site-level workload data as a proxy for future expected work
- Field-force salaries

This advanced method is potentially useful to a wide variety of businesses that rely on their own field workers to maintain dispersed physical assets. Businesses ranging from telecoms and energy utilities to railroads, airlines, waterways, and even elevator and escalator manufacturers all face the problem of allocating workers to assets requiring service.

A large North American conglomerate shows the impact from this newer technique. Traditionally, the company's managers had allocated assets to their field technicians manually, without leveraging any analytics-backed methodologies. As a result, the average number of assets maintained by each technician is significantly below industry benchmarks, leaving the current workforce unable to support the planned expansion in the company's asset base.

By replacing manual allocation with advanced MILP, the company can reduce drive times by 20 percent, and trip distances by 25 percent (Exhibit 2). More importantly, these improvements translate into sufficiently large capacity increases that the company will be able to absorb the entire asset expansion using its current workforce (Exhibit 3).

Exhibit 2

Advanced mixed-integer linear programming (MILP) reduces drive times and trip distances

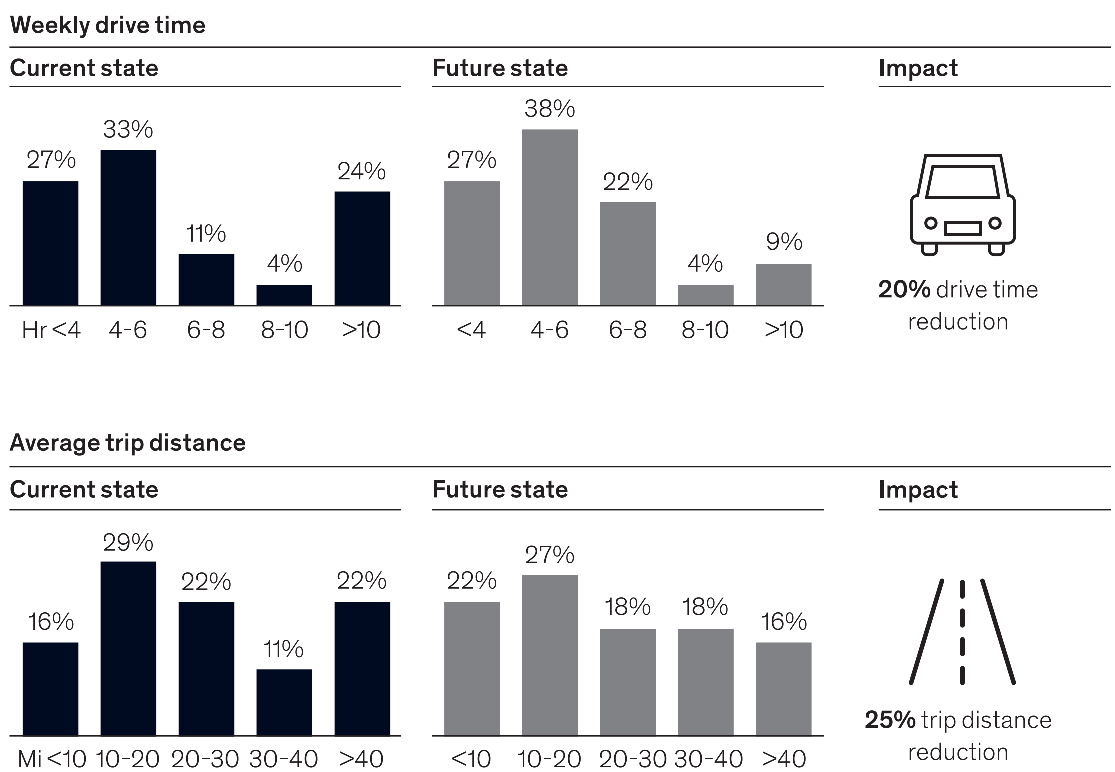
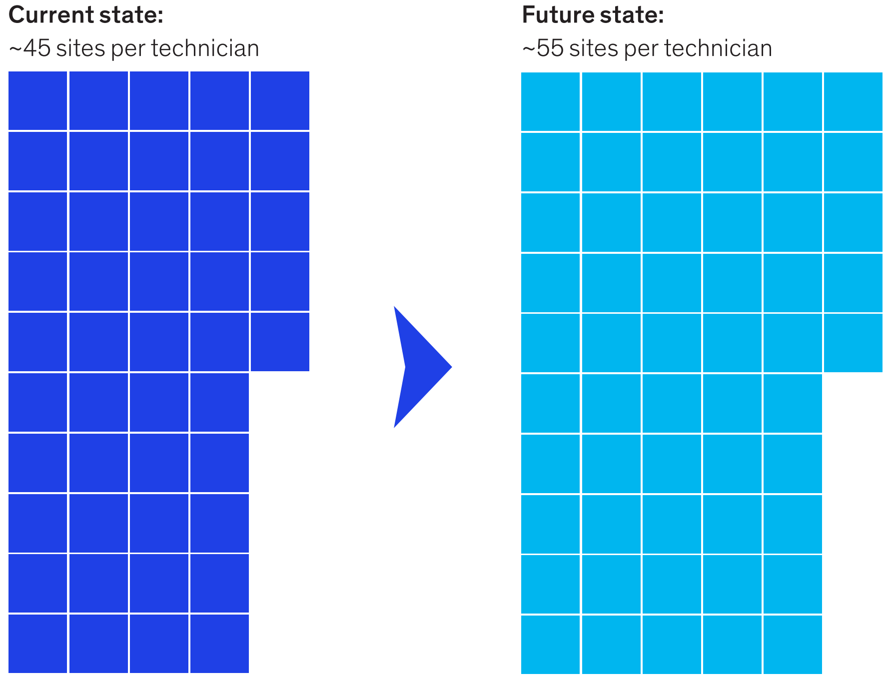


Exhibit 3

Reduced drive times and trip distances mean each worker can support more sites



How companies should build an advanced asset-management tool

Optimizing asset allocation using advanced, simplified MILP involves four steps, illustrated by the example of a telecom company (Exhibit 4).

Step 1: Prepare data

As is typical of many companies with large asset networks, the data essential for the telcom company's MILP approach was distributed across several systems that did not communicate well with one another. The company's first step was therefore to identify the necessary data related to asset location, field-force location, and workload across its systems. It then created a key to map these data into a common data source. Having a single data source enabled the company to create a matrix, mapping the driving time to each asset for each field technician.

Step 2: Optimize asset assignment

The next task was to customize the MILP algorithm to the company's use case. The main challenge at this stage is translating complex business objectives (such as evenly distributing workloads or coverage areas) into a simple mathematical formulation. The telcom company opted for a basic mathematical formulation with the aim of reducing drive times. The company then incorporated its business objectives as constraints on the optimization algorithm: for example, it wanted to ensure that all field-force workloads would fall within a desired range. By running this optimization using the drive-time matrix and the workload data collected by the company, managers could reassign assets to achieve minimum drive times across the entire field force.

Step 3: Optimize staffing level

The third step adds a workforce component to ensure that staffing levels are just sufficient to support the asset network, without overstaffing any location. Creating this optimization provided deeper analysis of the geographic breakdown of the company's current workload, and how well the field force had been allocated to complete that work. Over time, the company can apply these insights to decide how to shift the size and placement of the field force to better align its asset footprint with its planned growth.

Exhibit 4

Take steps to build an advanced asset-management optimization tool

Step 4: Visualize results and estimate impact
The final step turns the output into an easy-to-use format so that leaders and managers can make improvements and respond more quickly to changes. The telecom company used interactive geoplots to map asset assignments, giving managers a detailed view of their coverage areas. By reviewing these areas with their field technicians, managers were able to better support the field force in adapting to new assignments so that drive-time reductions could be achieved more rapidly. On an ongoing basis, the new visualization of workload across the field force enables the company to plan future initiatives more efficiently by better leveraging employee availability.

Companies no longer need to make the tradeoff between quality and speed when allocating assets to their field force. The new asset-optimization solution provides the best of both worlds through simple, adaptable mathematical formulation and nevertheless incorporates practical business constraints. With asset allocation that is both smarter and faster, companies can aggressively roll out and support new physical assets while maintaining low operating costs.

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The winning moves in project-based services

by Shane Rieniets, Harold Brink and Senthil Muthiah

It's time for companies to stop regarding project-based services as loss leaders.

Project-based services generate a high percentage of revenues for companies with large, multi-skilled mobile workforces. Yet many companies are willing to take a hit on their quoted margins for these services so that they can get a foot in the door to sell products or more profitable longer-term maintenance services. Getting a foot in the door is a good idea, but a company can do it without taking a financial hit on its project-based services.

To achieve higher margins, companies need to extract the maximum value from each project. For many companies this means improving quotations, scope management, revenue management, and resource management, as well as making delivery more effective. It also means applying a different mindset. The challenges are significant, however. Companies often struggle to set the right scope for projects, translate that scope into a solution, allocate the right resources, and effectively execute. Overcoming these challenges pays off in the long term: a high-quality experience sets the tone for what customers can expect on an ongoing basis and increases the likelihood that they will purchase additional products and services.

Leading companies have recognized both the opportunities and challenges. Their experiences point to a set of best practices for winning in this large, established market.

What are project-based services?

Considering that many companies have overlooked the opportunities, the first step in gaining traction is to align on an understanding of what project-based services entail.

We define project-based services as services related to installation, modernization, periodic overhaul, moving, and decommissioning that are project-oriented and, in most cases, utilize both labor and materials. Examples include installing a turbine for an energy customer or implementing a control system into a new building for a real estate developer. Tasks are interdependent and often require multiple skill sets (for example, mechanical skills to install the physical equipment and electrical skills to commission). A project is considered successful if the company delivers the project "on time, on scope, on budget."

A company determines the scope and cost budget of each project based on an estimate of the labor and materials needed to deliver the customer specification. Customers define their specification in a Request For Proposal (RFP). Based on the RFP, the contractor develops an estimated Level of Effort (LoE). It uses the LoE to develop an estimate of cost, typically called the Basis of Estimate (BoE). The contractor then uses the BoE to develop its Estimate, which it provides to the customer. This Estimate can either be "binding" or "subject to change." The price for the project is determined by applying a margin to the Estimate. Contracts often specify a fixed price for a pre-defined scope of work. The more accurate the original estimated scope of work, the greater the chance of achieving the quoted margins.

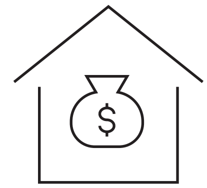
Project-based services are provided by the Original Equipment Manufacturers (OEMs) or by companies that operate as independent contractors that compete with OEMs or as sub-contractors or dealers to OEMs. The project-based model is dominant in product-oriented or project-oriented end-markets, including industrials, infrastructure, medical products, technology, banking, telecommunications, oil and gas, and energy and mining.

Exhibit 1

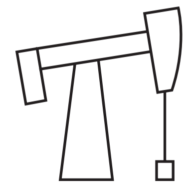
Project-based services are prevalent in many industries, including:

Industrials
(e.g., fire supression, HVAC, security)

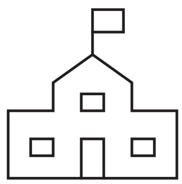
Medical products
(e.g., MRIs, X-ray, laser)



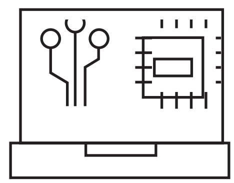
Banking
(e.g., ATMs, payment hardware)



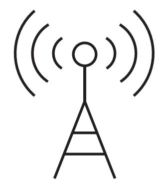
Oil and gas
(e.g., control systems, specialty valves, pressure tanks)



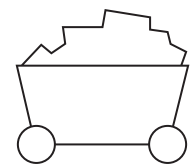
Infrastructure
(e.g., elevators, pre-fabricated modules, compressed air)



Technology
(e.g., servers, data banks)



Telecommunications
(e.g., wire-line, new connections, towers)



Energy and mining
(e.g., solar systems, turbines, generators)

The challenges to capturing margins

Our experience points to five challenges that companies must overcome to capture the full margin potential.

Exhibit 2

The five challenges to capturing margins for project-based businesses

Dollars

Cost
Margin

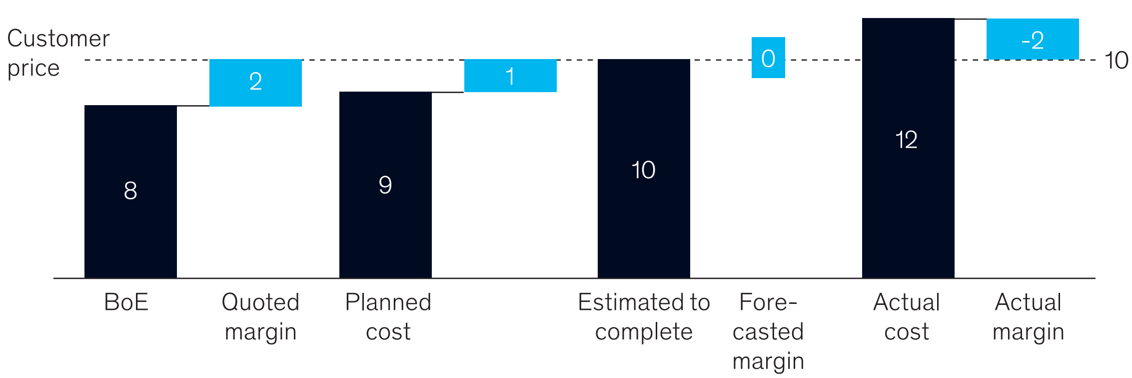
1
The scope and price are often set by sales teams, who do not have the skills to get it right (and are often incentivized to get it wrong)

2
Translating the scope into an executable solution

4
Getting the right people, with the right skills; when you need them

5
Delivery team's ability to monetize through execution

3
Complex interdependencies make it hard to achieve the schedule



1. Setting accurate scope and price. Many projects are competitively bid. If a contractor over-estimates it loses the bid, and if it underestimates it wins the bid. If a business does not manage the situation carefully, it ends up winning unprofitable, underestimated projects. The most profitable companies are those that are the best at setting accurate scope and estimates. Setting the scope is hard because projects often entail a high level of customization – companies feel obligated to scope each project from first principles to meet the customer's specific needs. To make matters worse, the scope of work and BoE are set by the sales team without the appropriate level of support from the operations team. Because the sales team receives commission on the quoted margin, it is incentivized to set high margins by reducing the BoE to unrealistic levels. Sales incentives are typically not adjusted to reflect the actual margin achieved by the project at completion. In such cases, it is impossible from the outset to achieve the BoE and quoted margin.

2. Translating the scope into an executable solution. Once the sale is made and the scope has been agreed with the customer, handover from the sales team to the teams responsible for solutioning (design and/or planning) is poorly managed, or often neglected completely. This lack of alignment means that scoped (and contracted) items are not included in the solution, or that items not included in the initial scope are added but not paid for by the customer. There is often a large difference between what is planned for and reality – for example, the plan may call for 85% utilization of resources and but only 68% utilization is achieved through delivery.

3. Achieving the schedule despite complex interdependencies. A project team's ability to overcome interdependencies is critical to achieving schedule commitments. Any delay in completing an activity on the critical path results in an equal delay in the overall project timeline. Typical interdependencies relate to:

- *Materials and equipment.* These may be unavailable due to ineffective planning or unexpected supply chain delays.
- *Internal labor.* Inadequate backlog planning and capacity management affect the availability of labor. In many cases, technicians have very specific skills and are not cross-skilled to perform a variety of jobs.
- *Subcontract labor.* Misaligned contract terms or a failure to align incentives with project priorities often result in the unavailability of subcontract labor.
- *Site access.* A company may not be able to gain access to the project site due to external factors. These include the customer's unreadiness to provide access; dependencies related to the bill of materials (BOM), equipment, or people; or delays in receiving permits.

4. Getting the right people, with the right skills, when you need them. Matching the right resources to the right projects is a major challenge, given that large portions of low-skilled or non-specialized work are subcontracted out to external parties and demand is highly variable. Our experience shows that project managers need stringent resource planning systems and rate sheets to properly assign costs to skills. In the absence of stringent controls, project managers tend to have a bias towards using their favorite resources (or hide them from other managers), which drives down utilization across the board. Projects are often left with imbalanced teams that have either the wrong mix or level of skills (for example, too many high-cost specialized mechanics and not enough general technicians). Or companies may be forced to delay starting until the right mix of labor is available. Both outcomes reduce project margins.

5. Monetizing through execution. Services is an execution game. For project-based services specifically, customer changes make it hard to execute to plan. Even if a company can successfully set up each project for success by overcoming challenges 1 through 4, it will still lose money if the project team fails to execute to plan. The main challenges include:

- *Managing customer scope changes.* Companies expect that customers will request changes, and indeed this happens on most projects. Despite the inevitability, companies often execute scope changes without payment, owing to poor change management processes and/or project managers' reluctance to have a difficult conversation with the customer.

- *Tracking progress and earned value.* Companies struggle to see actual progress against the plan, because they are not able to understand and track earned value (the true value of work completed versus the cost expended) throughout project execution. By the time a project team sees cost overruns, it is often too late to make appropriate course corrections.

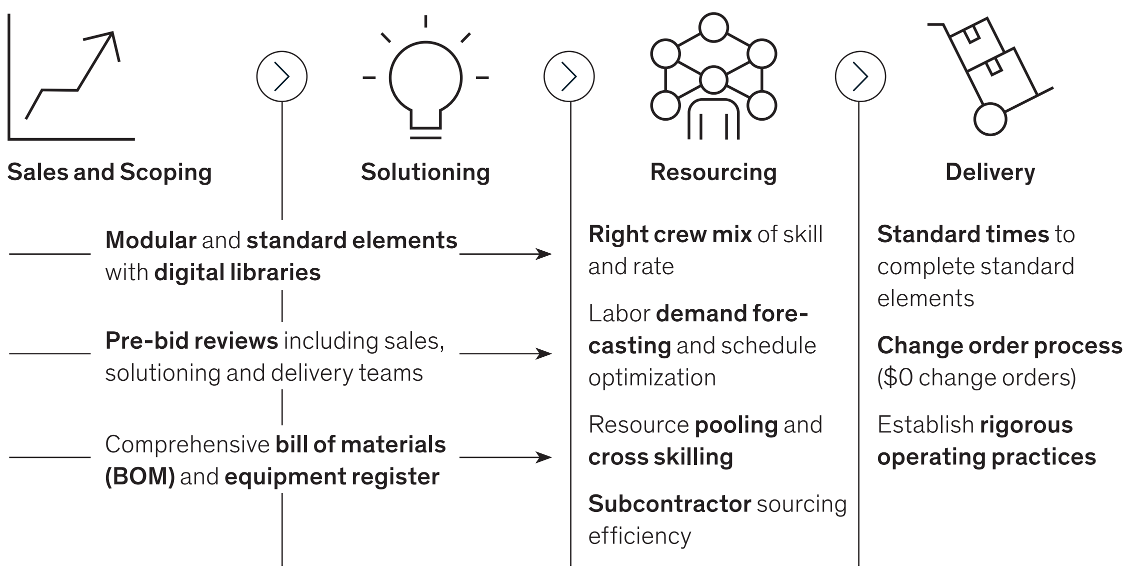
How to win

How can project-based services businesses overcome these challenges and maximize value? To explore the answer, we present a set of best practices. We use two case examples to illustrate the practices:

- A large IT enterprise services company experienced low margins and suffered from inconsistent management and operational practices. The root cause was poor transparency into performance, which required an end-to-end transformation to remedy. A three-year transformation program contributed to EBIT improvement of more than $1.2 billion.
- A residential solar company experienced rapid growth (greater than 20% CAGR) and became the market leader. But poor cost control and poor visibility of performance led to a plateau in productivity and inconsistent management of branch operations. To address the problems, the company designed, piloted, and scaled a new way of working—ultimately achieving a 30% increase in project margins through reduced cost for technician labor.

Exhibit 3

Best practices apply to every stage of the project lifecycle, requiring behavior changes from sales reps right through to delivery teams



Build a digital library of modular and standard elements for repeatable tasks and projects. Our research shows that many projects are repeatable. And even for those projects requiring high levels of customer customization, a portion of the work is repeatable. Yet we find that many businesses do not identify and catalogue these repeatable standard elements and time frames. Companies that do so drive value throughout the project lifecycle by applying standard elements and times in sales, scoping, solutioning, and execution.

To standardize incoming demand and prevent unnecessary customization, the IT enterprise services company created a catalog of standard project archetypes for each capability – specifically for high-volume projects. It also instituted a solutioning factory to promote standardization and decrease response time. The factory enforces adherence to standard guidelines for each archetype with respect to effort estimation, skill mix, and remote support, among other topics.

The solar installation company was already using standard elements to solution and price each project, but this standardization was not flowing into resourcing and execution. It designed a dense block scheduling methodology based on standard task times. The methodology establishes the schedule based on hours per task (instead of days for each project) and geographic zones (instead of a total branch resource pooling). It also set specific week-over-week milestones, rather than using monthly backward-looking project reviews. The company measures the performance of planners and technicians against a shared schedule density KPI (percent of standard hours scheduled per week and percent of standard hours completed each week).

Align sales teams with delivery teams through pre-bid reviews and incentives. To improve the accuracy of estimated quantities and project scope, systematically link the sales and estimation teams with operations and delivery teams.

The solar installation company created a pre-bid review process to ensure that the operations team approves labor and materials quantities used in the estimate. Additionally, it regularly conducts project post-mortems with sales and estimation teams and operations teams. The teams use the meetings to identify material risks that affect executed margins on completed projects. They feed the insights into standard scope elements and estimates of risk and contingency for future projects.

To sustain collaboration between sales and delivery teams, the company changed the sales team's incentives so that a portion of commissions were paid on the quoted margin and the remainder was paid on the actual margin achieved at completion. The company also tracked and managed the performance of sales and delivery teams based on shared metrics: the percentage of pre-bid reviews completed and the percentage of margin leakage (the difference between the quoted margin and actual margin).

Develop a comprehensive BOM and equipment register and link these to Subcontractors. To improve the readiness of materials, equipment, and subcontractors, develop a comprehensive BOM during the solutioning phase and systematically feed it into the procurement process. Leading companies have created a detailed and dynamic BOM and equipment register, which the procurement team utilizes to respond to changing project priorities. They also link the detailed BOM to subcontractor RFPs, to ensure commercial alignment with external labor and materials providers.

When subcontractors execute a portion of the project scope, apply the same level of rigor to developing the BOM corresponding to subcontractor scope, as well as to delineating responsibilities for sourcing different parts or renting equipment. Delegating the choice of equipment or installation materials (such as cable or parts) to the subcontractor may expose companies to the risk of claims and change orders or result in schedule delays.

Optimize resourcing by establishing the right crew mix and matching capacity supply to demand. Smart resourcing ensures that all projects have the right mix of people to execute successfully. It also optimizes the resource pool available to the full portfolio of projects, increasing the utilization of labor and driving out wasted non-productive time.

The IT enterprise service company implemented best-in-class resource management practices. The practices ensure effective demand-supply matching, resource allocation and de-allocation, demand forecasting, bench and utilization msnsgement, and competency development. It established a standard demand intake process that captures and logs all incoming demand, segments work based on complexity, and allocates work to the right pool of resources.

The solar installation had company allocated standard crew sizes to each project, irrespective of the size and complexity. To improve how technicians were allocated, the company built a tool to size crews based on quantities of standard elements (for example, number of panels) and common complexity factors (such as height and pitch of the roof). This enabled it to match crew sizes to standard project requirements, delivering immediate productivity gains.

Establish a clear process for capturing change orders. Create a simple change order process and communicate it to project teams. With a clear process in place, leading companies hold project managers accountable for margin erosion resulting from an increased, uncompensated scope of work. They also train project managers and crews to understand scope elements and exclusions, apply the change order process, and discuss change orders with customers.

The IT enterprise services company took this one step further by implementing a $0 change order process. The process enabled the company to track scope changes that it could not charge to the customer, referred as $0 change orders. By tracking each $0 change, the company was able to identify and assign actions to address the root cause of the change. As examples, the work may have been outside the initial scope, in scope but missing from the solution, a quality issue during execution necessitated rework, or a change requested by the customer that was not recoverable. The process provided the company with a balance sheet to show how much work it had given each customer for free. It used the information in future bidding and negotiations, enabling explicit discounting conversations.

Establish rigorous operating practices. The IT enterprise services company took a number of steps to improve the rigor of its operating practices. These steps included:

- Establishing rigorous financial performance management that looked at the variability of projects. In post-mortem reviews, the company carefully scrutinized projects that performed much better or much worse than planned, so that it could reuse successful approaches or prevent a recurrence of problems in future projects.
- Putting in place a set of core metrics to keep track of performance at the organization and project levels, including financial, operational, and process maturity indicators
- Establishing a governance and meeting cadence to review financial performance at the levels of portfolio and project
- Instituting operational performance management of projects through productivity tracking systems that measure technicians against actual hours used to complete each standard task. This standardizes workload measurement across projects that have different characteristics.
- Enforcing strict governance practices to ensure project-level visibility into financial performance and resource-level visibility into economic utilization

The solar installation company also recognized the importance of operational rigor. Its actions included:

- Instituting an incentive program for front-line installers, schedulers, and management, explicitly linked to business financial performance
- Focusing the business around a set of simple KPIs, designed to drive individual technician productivity while maintaining or improving safety, quality, and customer performance
- Using weekly digital performance scorecards to create visibility into individual technician performance
- Conducting performance management forums (such as weekly huddles, weekly management coordination meetings, monthly one-on-one feedback meetings, and ride-along coaching). The forums identify performance gaps and issues preventing target achievement, escalate up the business for resolution, and communicate back to the front line when resolved
- Creating a digital resource management tool that matches resources to specific project requirements

- Implementing technician flex time (a different number of hours for each workday) to reduce unplanned unproductive time resulting from issues with customer access or parts availability, among other unavoidable issues.

By following the best practices we have discussed, a company can promote consistency in its operations, gain predictability for its revenues and profits, and, ultimately, deliver higher margins. Companies that master the winning moves will capture a significant competitive advantage as project-based services become an increasingly important component of their business.

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Operations Practice

How lean is your field force – really?

With the right approach, lean management can reduce your field force's cost, even while improving customer experience. But getting the details right matters.

by Guy Benjamin, Mitesh Prema, Vaibhaw Raghubanshi, and Zachary Surak

Many organizations recognize that they need to improve the productivity of their field forces. The problem is that it's hard to do. Simply put, there's a lot to get right—and all the elements of the solution need to work in unison to fully capture the benefits.

The failure to take a well-coordinated, multifaceted approach to field-force management creates waste, increases cost-to-serve, and undermines customer experience. For example, we have found that field technicians waste up to 40 percent of their workday on non-value-adding activities, such as filling out timesheets. Idle time amounts to two to three hours a day, and an additional hour may be spent on unnecessary driving time. Customer satisfaction may fall 20 percent below benchmarks. What's more, although technicians can see the customer's unmet needs firsthand, they often don't upsell the relevant products or services.

Much of the time, the underlying causes of the field force's low productivity are clearly visible. Many field forces operate without fundamental approaches to ensure efficiency and optimize utilization. Inadequate performance management, poor visibility into technicians' activities, a reactive approach to dispatching, and inaccurate forecasting are among the most common obstacles.

To address these challenges, many organizations have turned to lean-management techniques—and may be satisfied that they have implemented these effectively. However, when looking deeper at the actual activities and culture, we typically see that companies struggle to do everything they need to do in an orchestrated way. Organizations may have metrics, but not act on them; hold weekly meetings with technicians, but not talk about the right topics beyond safety; or ask administrators to spend time in the field without guiding them on how to coach technicians to promote improvement.

But new digital tools and advanced analytics make it easier to plug the value leakage that flows through these gaps in lean-management practices. Companies can track technicians' performance in real time, making decisions on the fly about how to improve productivity—while also accurately predicting job times by disaggregating a large install or repair job into discrete tasks. Dispatchers can receive live updates on a technician's progress at the task level and intervene as needed, such as by connecting them with experts via augmented reality (AR) or virtual reality (VR). And supervisors can identify technicians' coaching needs by looking at their performance across each granular task.

Leading companies have applied such advancements as the basis for a holistic "lean journey" in field operations that generates step-change improvements in productivity. This lean journey becomes a virtuous circle in which continuous improvement and cultural change enhance the application of new technologies (Exhibit 1).

The five-step lean journey

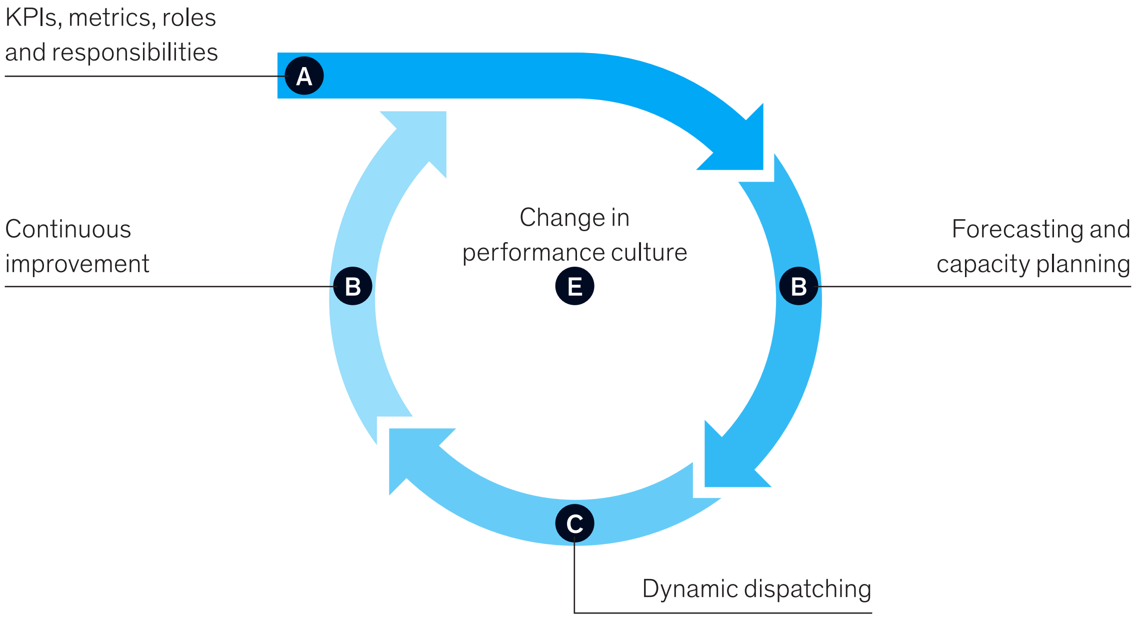
The following five-step approach outlines how organizations can implement lean effectively to address these productivity dimensions—and what they can achieve. Two cases provide the context.

— **A telecommunications company's** field force comprised more than 5,000 internal and contract personnel. Productivity was poor—each technician only completed approximately four jobs per day—and customer-satisfaction scores were low. A pilot program to test a comprehensive lean approach increased the internal work rate by more than 20 percent. Productivity gains, together with improved collaboration between the dispatchers and the field force, also led a nine percentage-point increase in customer appointments met. The national rollout achieved a 25 percent increase in productivity within six months and is on target to achieve a 40 percent increase by the end of the first year.

— **A North American utility** with a large workforce of unionized and non-unionized labor focused on several integrated initiatives to improve productivity. On-site productivity rose by 20 percent and customer-satisfaction by nearly 50 percent, while the number of repeat visits for servicing fell by half.

Exhibit 1

The journey to a lean field force creates a virtuous cycle



Step 1: Establish KPIs, metrics, and roles
Performance measures must be clearly explained so that people in the organization understand the objectives that underlie their targets. Technicians' performance can be measured in terms of the dimensions of availability, utilization, and efficiency (Exhibit 2).

In designing a performance-metrics strategy, it is essential to link metrics directly to economic value, service quality, and other corporate objectives—a fundamental connection that many companies still struggle with. Metrics should be cascaded from the executive level down to the front line, so that the right metrics are tracked at the right level.

Once an organization aligns on productivity metrics, it must communicate them to stakeholders consistently, and through a variety of channels. Scorecards should be simple in format, containing a limited set of primary metrics that are under the control of employees. At the same time, the management system should allow for a drill-down diagnostic to look up more detailed indicators when a metric is below the target.

Once the content is agreed upon, the scorecards should be widely available to technicians, such as on the company's intranet and on prominently displayed performance boards. Other approaches include presenting the scorecards in daily emails, weekly team meetings, or meetings of operational support teams and steering committees. The telecom company started by establishing a top-down performance cadence nationwide, including metrics, targets, and a weekly performance meeting. Similarly, the utility redesigned metrics and KPIs for all roles and restructured the agenda for performance huddles.

Exhibit 2

The productivity metric combines technician availability, utilization, and efficiency.

By looking at a technician's:		We can see that technician's:	
Availability	Total hours available ÷ Total paid hours		
Utilization	Actual hours available ÷ Total hours available	**Productivity**	Standard hours[1] completed ÷ Total paid hours
Efficiency	Shared hours completed ÷ Actual hours used		

[1] Best-practice hours needed to complete a job applied rigorously across entire workforce.

But metrics alone are only part of the calculation Organizations should also clarify roles and responsibilities to reflect best practices:

— **Field technicians** self-manage to achieve productivity and quality targets. They receive jobs on a mobile device throughout the day, using a one-at-a-time allocation model. They use a GPS navigation tool with real-time traffic optimization to find the fastest route to the next job.

— **Frontline managers** conduct diagnostics and review performance. They analyze metrics to understand the drivers of lost productivity, conduct weekly five-minute calls to discuss performance measures, and lead monthly discussions of performance plans based on the performance scorecard.

— **Dispatchers** monitor automatic job allocation and technicians' progress, and escalate in realtime based on red flags. They also communicate with managers during the day and in more formal sessions to escalate field-performance issues as needed.

— **Performance-management coaches** train technicians when skills gaps are identified, and work with low-performing technicians as requested by managers. They also identify continuous-improvement opportunities in the field and encourage the sharing of best practices.

Step 2: Improve forecasting and capacity planning

Effective capacity management requires accurate forecasting, right-sizing of the business-as-usual workforce, and flexible allocation of activities in response to demand. Modeling must cover multiple time horizons:

— **Weekly.** Forecasting and demand modeling incorporates historical data from similar periods to account for seasonality and other demand spikes. It includes shorter-term demand drivers (such as weather) and monitors external factors that could affect demand (such as regulatory changes, competitor offers, and ad-hoc events). To identify expected demand, the modeling relies on advanced analytics–based models that account for historical trends, future expectations, weather conditions, and equipment conditions, among other factors.

— **Day minus 1.** The weekly demand model is refined using current data—such as to account for spillover work from the previous day, or demand shortages. Right-sizing is based on the weekly model using updated attendance data. The short-term levers utilized at this stage are more costly, such as cancelling training, pulling coaches into queues, and requiring overtime.

— **On the day.** At a minimum, planners re-run the "day minus 1" model to account for the previous day's capacity imbalances. The re-run should occur immediately after appointment-book closure for the afternoon or end-of-day planning.

Step 3: Transition to dynamic dispatching
Dynamic dispatching, in which dispatchers proactively adjust the allocation of field tasks, is essential to improving productivity and customer experience. At the utility, a dynamic-dispatching model reduced idle time and improved on-time arrival. It also enhanced coordination between the field technicians and dispatchers to reduce "white space," or time periods in which no work is allocated.

To make dynamic dispatching work, the organization transitions from a single dispatch group responsible for inbound and outbound functions to a split-control function with a customer-facing dispatcher and an exceptions controller. Customer-facing dispatchers are dedicated, proactive controllers of outbound work. They are responsible for the tactical execution of field tasks and the efficiency of the field force. Responsibilities include:

— **Customer champion coaching**. Dispatchers proactively act on all alerts to ensure timely service delivery and increased field productivity. They also enforce the idle-time process.

— **Reporting and escalation**. They escalate performance issues to frontline field managers when intervention is required and deliver an end-of-day report on continuous improvement.

— **Schedule management.** Dispatchers maintain on-the-day appointment books and liaise with the capacity-management team to optimize the schedule and system configuration.

Dynamic 1-to-1 job allocation allows organizations to better monitor a technician's task progression by tasking a technician with only his or her next job. The work-manager tool can still allocate multiple jobs to each technician, but the dispatcher only communicates the technician's next job.

Dynamic dispatch can lead to significant improvements, including a freed capacity of 20 percent and a 40 percent reduction in travel time (Exhibit 3).

However, 1-to1 allocation must be managed properly to capture the benefits. Lessons learned from organizations that have improperly implemented this process point to several risks.

— **Improper goals or targets.** Technicians need optimal productivity targets to ensure that they pull more jobs from control when they are running ahead of schedule to offset the days in which they fall behind because of a long job.

— **Misaligned dispatcher mindset and skill set.** Dynamic dispatchers must become proactive, keeping an eye on technicians who lose time, watching out for appointments at risk, and taking corrective action early.

— **Poor staffing model or under-staffing.** Dispatchers often have other responsibilities, such as processing service activations or closing out jobs, that may distract them from managing technicians. To limit distractions, service functions should be staffed separately by people focused on average handle time, while dynamic dispatchers should be focused solely on optimization.

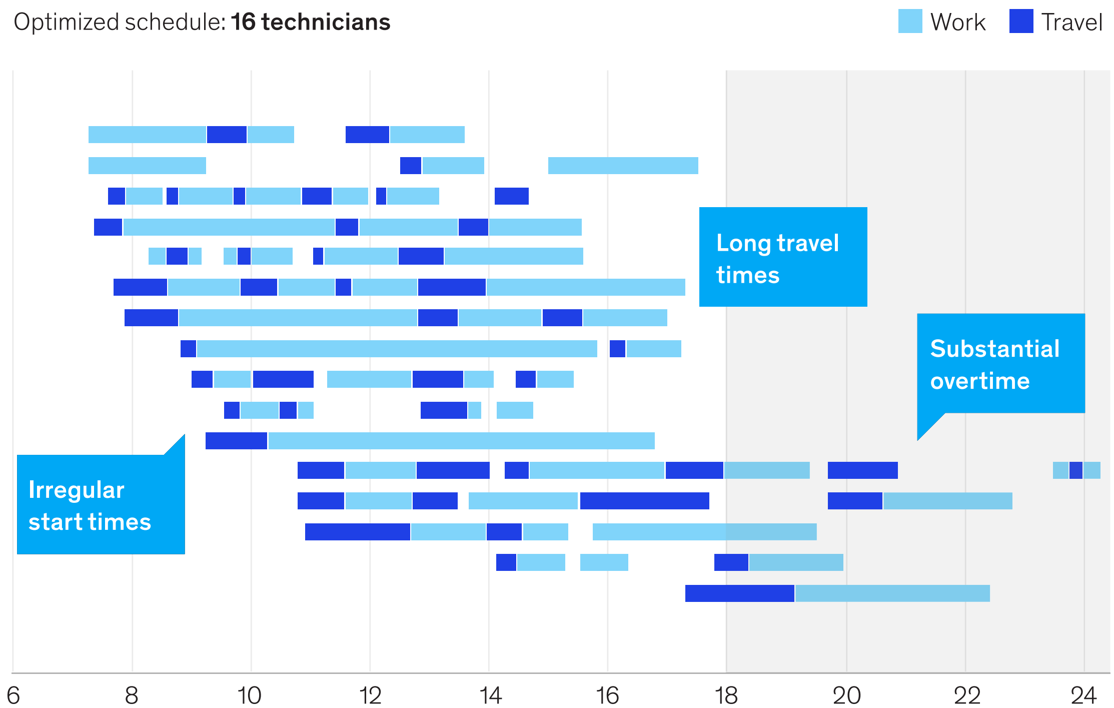
— **Incorrect statistical data.** If dispatchers receive systematically incorrect data on how long it takes to do a job, they will be unaware of idle time and unable to police it.

— **Failure to optimize capacity management.** Capacity management must be optimized to maximize utilization through overbooking and dynamic quota adjustment.

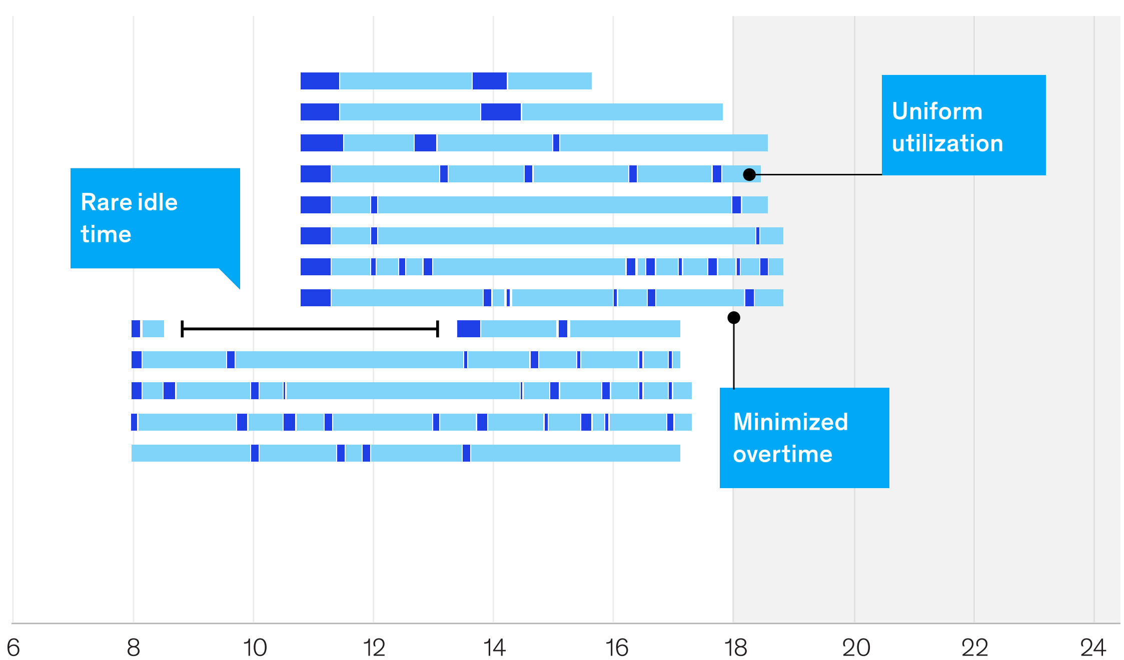
Exhibit 3

Optimization and dynamic dispatch yield a 20% reduction in resources and 40% reduction in travel time

Optimized schedule: **16 technicians**



Optimized schedule: **13 technicians**



Step 4: Promote continuous improvement
Companies must establish a systematic process to drive continuous improvement through the focused application of improvement tools and techniques. Although the concept of continuous improvement is not new, the use of data-driven, in-depth investigations can significantly reduce the business impact of equipment and operational failures. For example, a company can use machine learning models to identify the patterns that result in service tickets.

Systematic continuous improvement has tremendous benefits, but resources must be focused on the most critical areas of improvement: we find that 80 percent of the improvement can be achieved by addressing 20 percent of current causes of poor performance. An in-depth investigation of service failures provides the basis for eliminating root, systemic, and organizational causes.

At the telecom company, these basic guidelines led to continuous-improvement efforts that focused on eliminating waste, creating incentives for field personnel, and enforcing consequences in dispatch operations. Dispatchers were trained to play a more proactive role in managing daily performance, such as by using huddles and introducing new metrics relating to productivity and on-time rate that more closely aligned the goals of dispatchers and field team leaders.

At the utility, leaders defined a toolkit for continuous improvement that includes a new operating model for managers, with targeted deep dives to eliminate waste in the system. It also trained and coached technicians and the frontline on soft skills, such as communication and teaming, to improve the customer experience.

In most situations, organizations should follow a multistep approach to address the causes of unreliability: Identification is supported by unit-specific productivity tracking and development of an incident database. Prioritization requires identifying the most expensive failures and largest improvement opportunities. Investigation of selected failures entails understanding what happened and what could be improved, finding the root cause, and developing and documenting corrective actions. Implementation of corrective actions should be diligently monitored. And finally, standardization of corrective actions across sites can be accomplished by identifying potential trends of organizational and systematic failures.

Step 5. Build performance-management culture
To reduce waste and improve productivity, organizations need to start building a culture of lean performance management. A lean management system is an end-to-end, integrated approach that takes employees on a continuous-improvement journey consisting of four distinct components.

— **Connect.** All employees understand how their work relates to the organization's vision, and everyone is fully engaged in meeting individual goals and targets.

— **Discover.** Best practices are systematically identified, shared, and improved. Everyone is actively engaged in identifying errors and defects before they reach customers.

— **Enable.** The organization develops its people so that they can surpass expectations for performance. Managers understand that their primary role is to lead and develop their teams. The telecom company defined a new operating system for team managers that included the skills and tools needed to achieve change and elevate technician engagement. The introduction of the new system was supported by intensive training for team managers.

— **Deliver.** Employees continuously adapt to the ever-changing customer and business needs.

Regular discussions on team performance and an emphasis on the work at hand help to keep employees focused on their tasks.

This five-step journey requires investment and change management. But the effort to bring lean to field operations will be rewarded: less waste, lower cost to serve, and higher customer satisfaction.

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