ptc

DIGITAL TRANSFORMS PHYSICAL

Identifying the Value of Digital Transformation

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WHITEPAPER

Introduction

Digital transformation (DX) has risen to the top of strategic agendas for global manufacturers; 92% are at some stage[1] of their digital journey. These digital projects are transforming physical processes across the value chain for significant financial gains.

McKinsey estimates digital transformation is a multi-trillion dollar optimization[2] opportunity for manufacturers to overcome challenges across operations, workers, products, and other elements of industrial environments.

However, determining which transformations to undertake across these opportunities, and in what order, can be the difference between program success and failure. Coupled with the need to minimize risk, ensure operational continuity, and drive profitability during this transformation, the path to value for manufacturers results in a complex answer to a simple question: "Where do I start?"

For many, the overly ambitious answer has been to simultaneously tackle multiple challenges. Manufacturers on average[3] start with eight digital pilot projects, yet three-out-of-four of these fail to scale, which jeopardizes the digital program's funding and longevity.

This lack of successful scaling derived from choice overload decision fatigue (deteriorating quality of decisions after extraneous decision making), and analysis paralysis (overanalyzing paralyzing decision-making processes) results in pilot purgatory.

To resolve complex industrial challenges, we must better align digital transformation to business value. Identifying the most pressing problems impacting financial and operational goals and measuring the value attainable from resolving them, provides a solid foundation for digital transformation.

[1]State of Industrial Digital Transformation. PTC. January 2020. https://www.ptc.com/en/resources/iiot/white-paper/state-of-industrial-digital-transformation

[2]The trillion-dollar opportunity for the industrial sector: How to extract full value from technology. McKinsey. November 2018. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-trillion-dollar-opportunity-for-the-industrial-sector

[3]'Digital Manufacturing – escaping pilot purgatory'. McKinsey. July 2018. https://www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/how%20digital%20manufacturing%20can%20escape%20pilot%20purgatory/digital-manufacturing-escaping-pilot-purgatory.pdf

The Value Lifecycle Process

PTC leveraged deep domain knowledge from working closely with thousands of manufacturers on digital transformation projects to create a value lifecycle process. PTC's intuitive models provide industrial enterprises with a comprehensive understanding of the value attainable from digital transformation. The models take measurable elements of value drivers and determine the associated financial impact from resolving them. While the assessment may be complex behind the scenes, it boils down to five fundamental considerations to help prioritize DX initiatives:

Steps to Identify Value

1. Align with Financial Goals

Every company lists the progress against financial goals in annual reports, which influence investors and valuations. Three primary areas impacting these financial goals for manufacturers are revenue, operating margin, and asset efficiency.

2. Identify Value Drivers

Manufacturers have a range of value drivers they will leverage to address top challenges and unlock financial goals. For example, improving value chain collaboration increases revenue, increasing equipment availability and performance benefits operating margins, and better first-time fix rates improves asset efficiency.

3. Select High-Value Use Cases

With the aligned financial goal and identified value driver, the short list of use cases comes into purview. Ideally, pursuing strategic use cases with a trusted DX partner yields outcomes that are high impact with faster time-to-value.

4. Measure Operational Impact

Creating a baseline based on current performance and anticipated benefits sets the stage for measuring the actual impact from implemented changes. In the broader value lifecycle, it is critical to analyze any shortcomings of expected value from digital projects and adjust processes accordingly for future installments.

5. Determine Financial Outcome

These improvements on operational metrics inform financial goals with a net of potential recognizable benefits from successful implementation. Showing the impact on critical financial metrics is fundamental to secure executive commitment and DX program success.

When organizations start with this value assessment, they are left with a place to begin their digital transformation journey. This whitepaper puts the value assessment into practical use by outlining the top value drivers and use cases across engineering, manufacturing, and service. A real-world example implementing this framework across functions identifies attainable value. These assessments are the inaugural steps within a more extensive value lifecycle process to realize the cumulative benefits of digital transformation scaled across the enterprise.

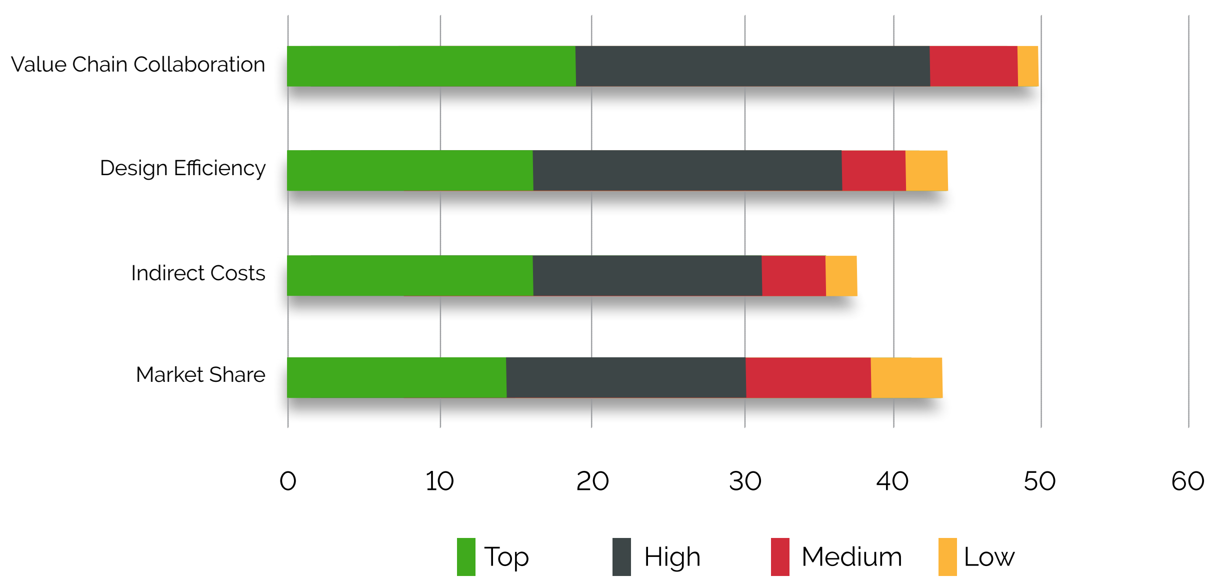
Engineering

The State of Engineering

Engineering departments are challenged with a seemingly impossible task: creating higher quality, innovative products, in less time, with higher margins and fewer resources. External market forces, including competitive pressures and supply chain disruptions, have only amplified these challenges. Customer-centricity, product complexity, sensitive intellectual property, industry-specific regulatory requirements, and sustainability-driven compliance further complicate traditional product development processes. Meanwhile, internally, black boxes from organizational siloes withhold engineering departments from accessing and democratizing critical product information including the bill of materials, requirements, and documentation. Engineering departments must operate efficiently to thwart these external forces and internal barriers to innovate in today's competitive landscape.

Engineering Value Drivers

Top Value Drivers



PTC's One Value Portal collected 172 responses representing 28 PTC customers citing these Engineering value drivers as either Top, High, Medium, or Low. Q: Please rank the following Engineering Value Drivers as Top, High, Medium, or Low.

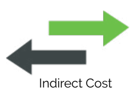
Value Chain Collaboration

For manufacturers aiming to create continuity and foster collaboration across the value chain, including departments, functions, and geographies, the engineering department is a common starting place and major beneficiary. Engineering teams seamlessly receiving and transferring data (quality, BOMs, process planning, etc.) to manufacturing departments is the most valuable and highest organizational priority cited in a PTC digital thread survey[4]. New service offerings also provide a closed-feedback loop opportunity back to engineering with real-world performance and usage data influencing future product iterations.

Design Efficiency

There are two areas of priority for new product design in engineering departments: Leveraging a design process that is more efficient and creating a more efficient product. Forming a strong link between the product design and the manufacturing process reduces cost of goods sold, quality defects, and time spent on introducing a new product to market (NPI). Engineering teams are tasked to create more innovative products that hit the same or better performance parameters with fewer yet more sustainable materials, which improves design efficiency.

Indirect Costs



The costs of mistakes in engineering are commonly recognized and rectified downstream from the product development process. Poor product quality results in scrap and rework for manufacturing and costly repairs for service teams. Workers' time is consumed with making necessary changes, and replacement part costs compound to get the product or service up-and-running.

Market Share

Manufacturing executives commonly view engineering as the driver behind increasing revenue growth and obtaining market share by differentiating products and services. The parameters and fluctuations in market share will be unique to different industries; a commoditized industry with inelastic demand will require generating more product volume versus industries with price-insensitive customers valuing highly differentiating products and personalized services. Engineering teams leverage different product innovation techniques and technologies to obtain bigger slices of market share.

[4]The State of Digital Thread: How Companies Are Closing the Loop Between Digital and Physical. PTC. September 2021. https://www.ptc.com/en/resources/manufacturing/white-paper/state-of-digital-thread

Top Engineering Use Cases

Configuration Management

Value Chain Collaboration
Design Efficiency

Products increasingly require a diverse mix of physical and digital components that must operate synchronously and in alignment with the customer's unique demands. Accommodating this complexity requires a tight-knit standardized product development process. This entails a unified platform connecting interrelated product information, including requirements, properties, variants, families, design, process plans, and parts. Configuration management enables this engineering digital thread to and from other departments, with a dynamic bill of materials maintaining relationships within a system hierarchy and traceability down to sub-components.

Change Management

Market Share
Value Chain Collaboration
Design Efficiency

Mass customization from customer-centricity, growing complexity of products, and shifting regulatory requirements are challenging traditional product development processes with meeting the speed and frequency of changes required to manage these trends. One product change to a feature or design within a product ecosystem can have a downstream effect. Change management ensures the governance of engineering data throughout the product lifecycle, with tasks delegated accurately and efficiently to relevant stakeholders. As a result, there is a reduction of rework, improvement in yield, expedited time to market, and speed to industrialization.

Supplier Collaboration

Value Chain Collaboration

As market disruptions (like the current chip shortage) amplify, unifying the broader supply chain to and from suppliers is critical for business continuity. Bringing suppliers closer to the design process ensures product requirements are met and changes during product development are quickly communicated and addressed. Maintaining an up-to-date bill of materials with mapped relationships and real-time information communicated between product lines, factory locations, supplier parts, and other requirements streamlines processes. Monitoring the product's traceability across this ecosystem ensures regulatory and sustainability requirements. improvement in yield, expedited time to market, and speed to industrialization.

Design Reuse, Collaboration, Automation & Optimization

Market Share
Value Chain Collaboration
Design Efficiency

A product's design is often the most important intellectual property for manufacturers. Design efficiency is the sum of effectively reusing product iterations, enabling flexible and secure collaboration between externally and internally dispersed teams, automating workflows to expedite processes, and leveraging next-generation technologies like simulation or generative design to optimize the product's performance.

ACME Engineering

A $3 billion industrial equipment manufacturers (anonymized as ACME Enterprises) organizational structure includes three business units generating product & services revenue. Its engineering division is responsible for $2 billion in product revenue (66% of total) and $320M in operating costs from R&D.

ACME recognized there were significant miscommunications, multiple sources of truths, and nonconcurrent processes between departments. Inefficient sharing of engineering data was causing rework and slowing time to market. ACME calculated if it could create more seamless data continuity and collaboration within and outside of the engineering department, it could reduce rework by 5%. In tandem, this would improve its time to market, increasing product volume and revenue by 1%.

ACME selected the Change Management use case to enable seamless engineering data exchange and task governance between departments throughout the product lifecycle. It would generate an estimated $4M in cost savings from reducing scrap and rework, while increasing revenue by $20M from increasing product volume, and ultimately improving ACME's net profits by $24M.

Potential Financial Improvement

$24M Annual Value

via Your Strategic Initiatives

Reduce Time-to Market / **Reduce COGS** / **Increase Product Volume**

Current State
Solve these problems
Value Chain Collaboration
Scrap & Rework
Time to Market

High Value Solutions
with these solutions
CHANGE MANAGEMENT

Expected Impact
improving these metrics
Rework 5%
Product Volume 1%

Expected Financial Value
achieving this value
$4M Cost Savings / $20M Revenue

Manufacturing

The State of Manufacturing

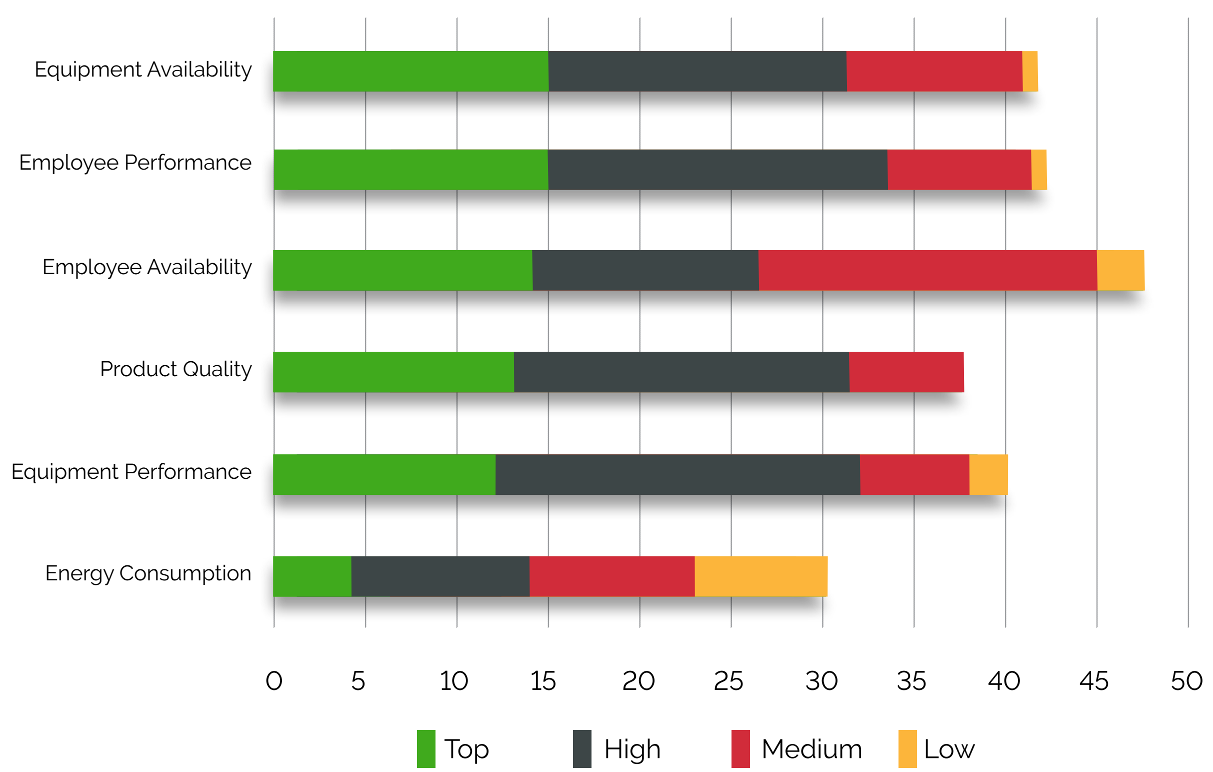
Manufacturers' production plants and their value drivers are directly influenced by forces both internal and external to the factory's four walls. For example:

- Fluctuations in market demand require agility to scale production capacity to manufacture the product volume to quickly fill it.
- Rapidly responding to constantly shifting customer requirements with customized product iterations necessitates flexibility.
- Lean processes and intuitive instructions optimize assets and labor, driving operating efficiencies.
- Minimizing supply chain disruptions from trade wars and global materials shortages requires resiliency.
- Making true on 'Net Zero' corporate promises and avoidance of regulatory penalties increases sustainability.
- Environmentally friendly initiatives reduce operating costs from emissions, energy consumption, and waste.

Manufacturing departments are tackling these externally induced challenges with internal value drivers to generate manufacturing efficiencies, facilitated by Industry 4.0 and digital transformation programs.

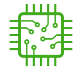
Manufacturing Value Drivers

Top Value Drivers



Description: PTC's One Value Portal collected 238 responses representing 90 PTC customers citing these Manufacturing value drivers as either Top, High, Medium, or Low. Q: Please rank the following Manufacturing Value Drivers as Top, High, Medium, or Low.

Equipment Performance

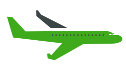


A key operational performance indicator for factory managers is overall equipment effectiveness (OEE), which includes equipment availability and performance. A best-in-class manufacturer typically has an OEE of 85%, but the vast majority are in the 40-60% range[5]. Marginal improvements in this metric drive significant cost savings. Improving the availability of equipment includes reducing its planned and unplanned downtime and changeovers. Equipment performance is geared toward reducing speed losses and micro-stoppages, which also improves overall throughput.

Employee Availability

Maintaining high levels of workforce productivity or overall labor efficiency (OLE) is a continuing challenge in production facilities. Implementing continuous improvement disciplines and teams in manufacturing is common, but sub-optimal productivity remains. To improve employee availability and performance, manufacturers must reduce time spent on unscheduled and stalled labor events, changeovers, slow production, and excess movement, which improves throughput and product quality.

Product Quality



Maintaining consistent quality across diverse product families with frequent and rapid design changes is a growing value driver for manufacturing. Whether products are made to stock, assembled to order, or engineered to order, improvement to quality is critical to reducing fallout, scrap, rework, and warranty costs, as well as improving customer satisfaction and net promotional scores. Upholding quality of operations for process industries also impacts downstream processes including product or service delivery to customers.

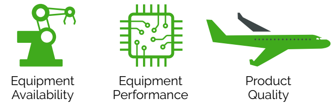
Top Manufacturing Use Cases

Asset Monitoring & Utilization

Visibility into operations and disparate equipment, product lines, and production process is a common struggle for manufacturers. With asset monitoring and utilization, manufacturers gain real-time shop floor visibility into equipment availability, performance, status, health, and overall utilization, increasing throughput and reducing energy consumption.

[5]What Is Overall Equipment Effectiveness (OEE)? Reliable Plant. https://www.reliableplant.com/Read/11785/overall-equipment-effectiveness

Predictive Maintenance



A few hours of unplanned downtime can run into the millions of lost operating costs. Manufacturers will invest significantly in programs, systems, and technologies to reduce these events. Traditionally, reactive 'break-fix' methods have done little to predict future failures. Planned maintenance schedules have pre-empted some unplanned downtime but still drive-up maintenance costs and unnecessary planned downtime when there is no fault found. Predictive maintenance is an emerging goal for manufacturers; Industrial Internet of Things (IIoT) enabled systems identify the timing, severity, and location of potential failures based on analysis of historical data (asset failures, machine degradation), real-time IIoT data (vibrations, temperature, etc.), and other related information (technician proximity, spare parts etc.).

Augmented Work & Training Instructions

Time-to-value is a cost to business when training and onboarding new employees, in addition to adjusting existing employees to constantly changing processes from design changes or new products. The better manufacturers equip less experienced workers with the right information at the right time, the more productive the workforce can be. Capturing the domain knowledge of experienced workers and democratizing it helps fill the knowledge transfer void generated by a growing skills gap. Augmented work instructions is the emerging platform for the frontline worker that puts digital information, such as assembly or service instructions, into the worker's field of view and the physical context where their task exists. This alleviates the cognitive burden from complex industrial tasks and processes, which traditionally relies on printed work instructions and manuals.

Digital Performance Management

Traditional on-floor manufacturing performance systems are analog and siloed, making them ill-equipped to maintain production resiliency and agility in today's world where responses to market changes affect the bottom line. Workers seldom receive timely feedback to their actions. Equipment management systems are disconnected, contributing to bottlenecks and downtime. A Digital Performance Management system unifies analog and fragmented industrial systems with real-time operational performance insights, identifying and issuing corrective issues, and improving factory capacity utilization and cycle times.

ACME Manufacturing

ACME Corp's manufacturing business segment is responsible for $2 billion in operating costs. The business unit consists of 20 factories and experiences significant unplanned downtime resulting in poor equipment availability and underperformance. Specifically, a single factory with operating costs of $100 million has an average utilization rate of 50% overall equipment effectiveness (85% is considered world class) on their production lines. ACME calculated that improving OEE from 50% to 55% (10% process efficiency improvement) in a single factory would save $5m in operating costs.

The manufacturer identified the Asset Monitoring and Utilization use case as necessary to gain operational visibility of production assets, quickly identify bottlenecks, root causes of micro stoppages, and generate the 10% process efficiency improvement desired. ACME recognized scaling this high value solution across its 20 factories could save $100 million in operating costs.

Potential Financial Improvement

$5M Annual Value

via Your Strategic Initiatives

Reduce Operating Cost / **Improve OEE** / **Reduce Downtime**

Current State
Solve these problems
High Unplanned Downtime
Sub-Optimal OEE
Process Efficiency

High Value Solutions
with these solutions
ASSET MONITORING & UTILIZATION

Expected Impact
improving these metrics
OEE 5%

Expected Financial Value
achieving this value
$5M Operational Costs (One Factory) / Potential $100M Operational Costs (20-Factories)

Service

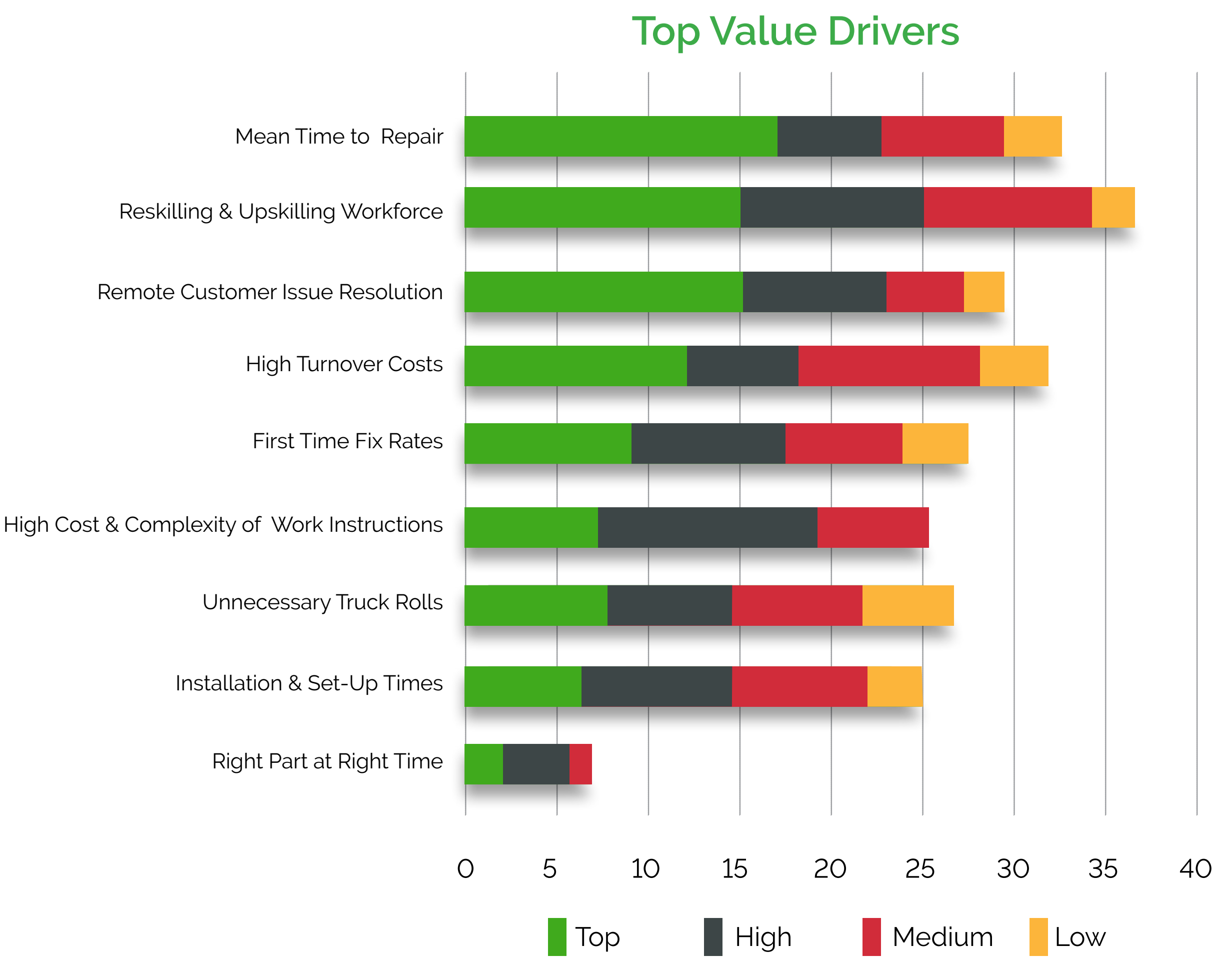
The State of Service

With increasingly tight profit margins from product sales and global competition, manufacturers are rethinking their traditional business models to deliver new value to customers. Manufacturers are shifting away from viewing service as a 'cost-of sale' and toward a 'profit center' and future growth engine; 40% expect a significant increase[6] (10% or more) in service revenue for their next fiscal year and expect the majority of total revenues to shift to service over the next decade. Service

[6] Service Council 2021 trends report. March 2021. https://servicecouncil.com/

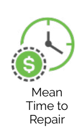
organizations are pressured to meet these ambitious growth targets with limited resources, which includes a skills gap that is drastically shrinking the available talent pool. To meet the demands of customers and contractual obligations of outcome-based service delivery models, manufacturers are turning to digital transformation.

Service Value Drivers



Description: PTC's One Value Portal collected 237 responses representing 59 PTC customers citing these Service value drivers as either Top, High, Medium, or Low. Q: Please rank the following Service Value Drivers as Top, High, Medium, or Low.

Mean Time to Repair



A product malfunctioning in a customer's operating environment is a worst-case scenario for manufacturers. Every extra minute of downtime compounds costs to the OEM and the customer. Mean time to repair (MTTR) measures the effectiveness and efficiency of a technician dispatch to perform a necessary repair and is the culmination of offsite (truck roll, proximity-based skill set) and on-site factors (first-time fix rates,having the right parts).

Reskilling & Upskilling the Workforce

The time to proficiency for any new frontline worker can be months if not years, given the range of skills and tacit knowledge required to service complex products. Even experienced workers are challenged with increasing product complexity, mix, and changing service processes.

These industrial workers rely on out-of-date and out-of-context paper-based work instructions. Turning to 'just-in-time' information training mechanisms through innovative technologies like augmented reality puts critical work information in context to the physical task, enabling higher levels of technician efficiencies.

Remote Customer Issue Resolution

Unnecessary Truck Rolls

Truck rolls average between $150-$500 per service event[7] and even up to $1,000 per instance. In many cases there is 'No Fault Found' (NFF), where the technician made a costly trek to repair a perfectly functioning asset. Manufacturers are remotely resolving these would-be costly truck rolls to drive greater technician efficiency and product uptime in customers' operating environments.

High Turnover Costs

High Turnover Costs

The industry churn rate is troublesome for experienced and less experienced workforces in the service function. Seventy percent of service teams[8] claim they will be burdened by a retiring workforce in the next five to 10 years. Attracting and upskilling a new and in-short supply workforce to fill the void of these exiting employees is a costly feat, given the magnitude of skills and domain knowledge needed.

First-Time Fix Rate

First Time Fix Rate

Service team technicians' aptitude is often measured by first-time fix rates -- the percent by which the technician fixes a problem on the first visit. However, the industry average rate only stands at 75%[9] , with one out of every four trips requiring at least one follow-up visit. Industrial products and equipment are remarkably complex, creating service complexity and unpredictability, where a technician may not have the right skillset, instructions, or parts to resolve it.

Top Service Use Cases

Remote Product & Fleet Monitoring

Unnecessary Truck Rolls

Mean Time to Repair

Manufacturers and their customers have had challenges understanding the operational status of their assets or fleets of products in operating environments, creating costly service events. Remote Monitoring generates baseline operating data of fleets of products and equipment out-in-the-field. The condition-based system correlates their real-time status, performance, and location data.

Visibility into product status and properties provides service operations and dispatching with guidance and insights into potential problems improving uptime.

[7] Reduce your Truck Rolls Costs: The Surprising Solutionhttps://techsee.me/blog/reduce-truck-rolls/

[8] The Workforce of the Future: Filling the Field Service Talent Gap. Field Service Events. 2021. https://fieldserviceeu.wbresearch.com/workforce-of-the-future-filling-the-field-service-talent-gap-strategy-ty-u

[9] Reduce your Truck Rolls Costs: The Surprising Solution https://techsee.me/blog/reduce-truck-rolls/

Remote Service

Dispatching a technician for a truck roll is one of the more expensive undertakings of a service organization, especially when there is 'no fault found'. Remote Service takes remote monitoring to another degree of mitigation capabilities by enabling technicians or other staff to remotely inspect and repair a deployed asset without physical intervention. Over-the-air software package updates and troubleshooting remote service capabilities reduce substantial operational costs when deployed across massive technician forces and product fleets.

Predictive Service

When an asset goes down in a customer's operation it impacts the bottom line for both the customer and manufacturer, which puts strain on the business relationship. Predicting and addressing these problems before they become failures out in the field can reduce post-event costs including complex maintenance activity, truck rolls, and part replacement. Leveraging IIoT-generated performance data and analytics, predictive service can better identify the exact time, location, and root cause of a future service issue, as well as trigger a service intervention to avoid any downtime to the customer or manufacturer.

Augmented Remote Assistance

Timely access to limited deep technical expertise is a major challenge for global manufacturers. Combined with pandemic-related travel and workspace constraints and scarcity of experienced workers, there is an increasing need for a platform that transfers knowledge in real time across the globe.

Augmented Remote Assistance scales knowledge transfer through connecting remote experts to field technicians in real time for over-the-shoulder support, improving collaboration and empowering them to rapidly troubleshoot unfamiliar or unexpected issues.

Service Diagnostics

Technicians will often spend a few hours in an asset's operating environment, especially when the equipment and correlating repair is complex. A manufacturer may have deployed hundreds of products, each with unique configurations and only provide a technician with a single paper-based work instruction document. Service Diagnostics triages the precise root cause of the failure, identifies relevant parts and tools to remediate it, and other related information to empower the technician to make timely repairs.

ACME Service

ACME's Service organization is responsible for 33% or $1 billion of revenue and $400M of operating costs. The majority of service revenue comes from aftermarket services, which is a profitable, but mostly matured and forecasted as a low-growth area for ACME. An emerging service revenue stream is technician-driven, which is currently at $20M and operating costs are $10M.

The service team of 200 technicians performs on average 1.3 customer visits a day for a cumulative annual total of 65,520 visits and 200,000 billable hours. The team's first-time fix rate is on par with the industry average of 75% (meaning 16,250 visits require at least a second trip) and the average on-site time is 3 hours. Augmented Remote Assistance was identified as the best solution to scale ACME's technicians' expertise to less experienced workers and improve FTFR.

The service team recognized improving first-time fix rates by 5% would reduce operational costs by $2M; a result from decreasing resources spent on follow-up visits (from 16,250 to 12,974 annually) and time spent on site (from 3 to 2 hours). Improving these would also free-up technicians to tackle more service issues in demand from increasing product volume and visits per day (3,276 more per year). This would increase billable hours by 20,000 annually and technician-driven service revenue by $3M, generating total net profits of $5M.

Potential Financial Improvement

$5M Annual Value

via Your Strategic Initiatives

Reduce Operating Cost / **Increase Service Revenue** / **Reduce Downtime**

Current State
Solve these problems
Technician Efficiency
FTFR
Time Spent On Customer Site
Knowledge Transfer

High Value Solutions
with these solutions
REMOTE ASSISTANCE

Expected Impact
improving these metrics
First-Time Fix Rate 5%
Onsite Time 33%

Expected Financial Value
achieving this value
$2M Reduce Operational Costs / $3M Increase Revenue

A Value-Led Digital Transformation Strategy at Scale

There are clear pockets of value attainable from digital transformation across Engineering, Manufacturing, and Service. However, executives will ultimately aim for a cohesive digital transformation where value is recognizable across the enterprise.

ACME Enterprises recognized immediate value from solving top challenges in their different functions. When applying this value process logic across the enterprise inclusive of departments, sites, and people, the value compounds over time and becomes significant at scale.

The first step to attaining the value transformation is identifying it. Contact PTC to begin your value-led digital transformation today and transform your physical environment with digital technologies across your enterprise tomorrow.

About the Authors:

Craig Melrose is the Executive Vice President of Digital Transformation Solutions at PTC. In this role, Craig works to build customer-facing, operationally transformative solutions that incorporate PTC's industry-leading CAD, PLM, IoT, and AR technologies. His responsibilities include interacting with and guiding customers to develop, scale, and roll out tailored industry 4.0 programs based on their unique operational excellence goals.

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