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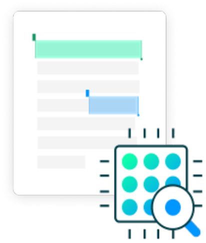

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Table of Contents

1.0 INTRODUCTION

Headquartered in Dearborn, Michigan, Henry Ford established the Ford Motor Company in 1903. Ford operates more than 60 production plants, generates US$185 billion in revenue, and employs some 174,000 people (Ford Motor Company, 2025). Henry Ford's invention of the moving assembly line in 1913 revolutionized industrial production (Slack, Brandon-Jones, & Burgess, 2022).

In recent years, the global automotive industry has seen structural changes arising from a combination of three main factors: electrification, digitalization, and environmental regulation (Yeung, 2024). Original Equipment Manufacturers (OEMs) are confronted by Chinese new-energy-vehicle (NEV) competition, a volatile raw materials market, and customers' growing preference for hybrids over battery-electric vehicles (BEVs) (Dodd, Cheong, Ferguson, & Yeung, 2024). In response, in 2022 Ford reorganized itself into three business units, each with a clear customer orientation: Ford Blue (vehicles powered by internal combustion engines or with hybrid powertrains), Ford Model e (electric-vehicle and software businesses), and Ford Pro (commercial vehicles and related services).

Operations and quality management are core to Ford's competitive advantage. For Ford, operations management influences and contributes to productivity and cost reduction by managing and integrating a portfolio of ten strategic operations decisions, including choice of process, product, facility location, plant layout, quality management, and supply chain management (Heizer, Render, & Munson, 2023). However, the US$5.2 billion bill in warranty repairs in 2025 and 152 recalls of vehicles for safety issues indicate shortcomings in quality management in Ford's supply chain or upstream. The 2025 warranty expense reduction from the prior year by US$500 million is a welcome development (Detroit News, 2026). This report critically assesses Ford's operations and quality management practices and proposes improvements.

2.0 OPERATIONS STRATEGY, PRODUCTIVITY AND COMPETITIVE POSITIONING

Ford's overall operations strategy is encapsulated in the Ford+ business growth plan, which involves integrating Ford's three business units in one overarching industrial system. The operations strategy of Ford+ reflects what Slack et al. (2022) describe as the need for a company's operations resources to fit in with market requirements. Ford Blue is responsible for making money by selling its core internal combustion engine (ICE) trucks and other high-margin vehicles (Ford Motor Company, 2025). Ford Model e aims to develop and sell premium EVs on Ford's flexible, dedicated, universal EV platform. In Ford Pro, Ford sells EV commercial vehicles along with services such as fleet management software, aiming for recurring revenue streams from fleet customers.

Ford's positioning in late December 2025 shifted in favor of the competitive priorities of cost and quality. Following a $19.5 billion accounting charge related to lower-than-anticipated EV market demand, Ford announced a "capital discipline" strategy focused on profitability over "growth at any cost" (Ford Motor Company, 2025). In terms of its operations decisions to improve cost competitiveness, Ford set itself a target of delivering $1 billion in net cost reductions in 2025. Regarding flexibility, Ford decided against discontinuing its ICE or hybrid powertrain options. In response to the speed priority, Ford Pro achieved a 27 percent growth in the number of paid-for software subscriptions sold to fleet customers in 2024. 152 recalls in 2025, the largest total recalls for a single year NHTSA has ever recorded, indicate that gains in dependability are still unfinished (Detroit News, 2026).

The multifactor productivity of Ford has been measured based on the warranty-cost ratio and labour-hours per vehicle. The Dearborn Truck Plant makes an F-150 pickup truck every minute (an average of 20 labour-hours per truck). With the use of AI-driven robotics, machine vision, and cloud-connected manufacturing technologies, productivity can be increased (Costa, Frecassetti, Rossini, & Portioli-Staudacher, 2023; Sony, Antony, McDermott, & Garza-Reyes, 2021). The adoption of Industry 4.0 technologies have been proven to increase productivity from 10% to 25% (Bag, Wood, Mangla, & Luthra, 2021; Yadav, Luthra, Jakhar, Mangla, & Rai, 2022). A major challenge is that Ford's product line includes multiple powertrains, the classic operations strategy trade-off of product variety against conformance to specifications (Slack et al., 2022).

3.0 PROJECT MANAGEMENT AND OPERATIONS FORECASTING

3.1 Project Management at Ford

Project management serves a central function in Ford's operations, as it is simultaneously managing a wide array of billion-dollar capital investments, vehicle launches, factory retooling, and new battery plants. To take just one example: the development of BlueOval City, a new $5.6 billion, 9-million-square-foot manufacturing complex outside of Stanton, Tennessee (Ford Motor Company, 2025). Construction of the facility initially was scheduled to bring EV-pickup trucks into production in 2025, but the plant has encountered numerous delays, and as of December 2025, has been repurposed for the production of gas-powered "Built Ford Tough" trucks scheduled to begin production in 2029. These changes in production schedule reflect the high degree of risk in a project management context associated with the transition to electric vehicles in the auto manufacturing industry (Yeung, 2024).

Ford makes use of project management methodologies, with the use of Gantt charts for tracking milestones, use of Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) for network scheduling and the use of risk registers to keep track of project management as a whole and its inclusion in stage-gate review processes. The CPM can be used to calculate the longest path of interrelated network activities and is particularly important to Ford because the project completion date carries the importance of determining when the production start date of an important new vehicle will be, with opportunity costs in the millions of dollars per day (Heizer et al., 2023). Ford's strong project management practice also draws on the use of enterprise product lifecycle management (PLM) software and the company's Global Product Development System (GPDS).

Ford's cancellation of production of its three-row electric SUV and delay to the next generation version of the F-150 Lightning electric pickup to avoid further investment in a shrinking EV market illustrates the most important category of demand risk (Sodhi & Tang, 2021). Other types of risk include regulatory risk that was the reason that Ford moved battery production for its Mustang Mach-E compact electric SUV from a plant in Poland to another in the US state of Michigan.

3.2 Operations Forecasting

Traditionally, Ford has used a mix of judgmental, time-series, and causal models to forecast demand. Order-to-Delivery (OTD), part of Ford's Ford Production System (first initiated in 1995), managed to lower the lead time for orders from an average of 45 to 65 days to an eventual goal of 15 days. In contemporary practice, Ford employs machine learning models to analyze historical sales data, macroeconomic and fuel-price signals, and dealer inventory data at the level of the individual stock-keeping unit (SKU). Recent empirical studies have shown that machine learning and deep learning approaches, particularly long short-term memory (LSTM), extreme gradient boosting (XGBoost), and ensemble models, can outperform traditional ARIMA techniques in automotive demand forecasting and lead to 20 to 40 percent reductions in mean absolute percentage error (MAPE) (Douaioui, Oucheikh, Benmoussa, & Mabrouki, 2024; Polo-Triana, Gutiérrez, & León-Becerra, 2024).

With respect to Ford's electric vehicles (EV), a structural break exists in the historical demand time series due to the relatively recent introduction of EV as a product line. This forecasting error then propagated upstream into the inventories of Ford's Tier-1 and Tier-2 suppliers in what is known as the bullwhip effect (Sancha, Wong, & Gimenez, 2022). Demand for spare parts and aftermarket supplies, which exhibits an intermittent, 'lumpy' distribution pattern, also remains a challenging problem. Nevertheless, recent academic research provides evidence that ML approaches which blend decay and demand smoothing achieve MAPE scores below 5 percent when applied to Ford spare parts (Giannopoulos, Dasaklis, Tsantilis, & Patsakis, 2025).

Forecast results directly inform three key operational decisions. First, capacity planning. Ford uses sales-and-operations planning (S&OP) cycles to align manufacturing capacity with forecasts of demand over the following 12 to 24 months. For example, a recent decision to reconfigure Ford's Glendale, Kentucky battery plant to produce smaller, more affordable EVs was directly driven by revisions to the company's demand forecasts for these vehicles. Second, inventory management. Because Ford operates a just-in-time supply chain within the confines of the Ford Production System, precise weekly demand forecasts are necessary to keep inbound raw and component inventories at very low levels without jeopardizing line availability when demand is higher than predicted (Slack et al., 2022). Third, resource allocation. Demand forecasts inform decisions related to labor requirements, supplier and contract logistics management, and capital investment in tooling (Sezer, Tutar, & Erdem, 2025). Empirical evidence indicates that manufacturers that employ AI-enhanced forecasting methods as part of an adaptive, project-oriented management structure experience fewer product launch delays and less inventory depreciation (Polo-Triana et al., 2024).

4.0 DESIGN OF GOODS/SERVICES AND PROCESS STRATEGY

4.1 Product and Service Design Strategy

Ford's overall strategy for designing its products relies on the creation of a modular architecture based on shared manufacturing platforms that facilitate design-for-manufacture-and-assembly (DFMA) and design-for-X (DFX) approaches. Recently announced Ford plans to introduce a Universal EV Platform that will undergird several more affordable and smaller EV models. The use of common skateboard designs, battery modules, and electric drivetrains across multiple car body styles and designs will reduce the engineering development and design time (Heizer et al., 2023). The Ford F-150, the Ford F-150 Hybrid, and the Ford F-150 Lightning will all share the Ford body-on-frame truck chassis until December, 2025. Ford's F-150 platform was critical to helping ensure that Ford's F-Series pickup trucks remained the best-selling vehicles in the United States for over four decades.

Ford is also investing heavily in designing integrated, service offerings as the company transitions to become more of a service provider. The company now combines product sales and servicing (Transit vans, E-Transit vans, and Super Duty pickup trucks) with software (Ford Pro Intelligence vehicle tracking software), charging, and maintenance services. In 2024, Ford Pro's number of paid software subscriptions grew 27%, and telematics subscriptions nearly doubled. This is an example of servitisation: Ford converts a one-off, transactional sale of vehicles into a continuing, recurring revenue customer relationship. It is also an operations management decision to do this, since it increases customer lifetime value and shifts the cost-of-quality equation (Slack et al., 2022).

4.2 Process Design, Process Types and Technology

Ford operates all four classical process types described by Stevenson (2021) in its manufacturing operations. Job shops exist to build prototypes and low-volume specialty vehicles that can be customised, such as Mustang GTD. Batch production is used to make less-popular variants and aftermarket spare parts. The bulk of the F-Series, Escape, and Explorer output use repetitive, mass-production processes. Engine, transmission, and battery-cell manufacturing use continuous-flow production processes. At the Dearborn Truck Plant, Ford uses a high-volume mixed-model assembly line to build an F-150 every 53 seconds at full takt time. This is consistent with what Hayes and Wheelwright proposed in the product-process matrix.

Ford emphasises flexibility in its process strategy. To build the F-150 Lightning, Ford invested nearly US$1 billion in the Rouge Electric Vehicle Center that opened in 2022. Automated guided carriers (AGCs) take the vehicles to and from the work stations. The flexible design allows Ford to alter the product mix and output volume with no line modification, an important consideration when there is uncertainty of customer demand (Stevenson, 2021). Ford uses its Ford Production System (FPS), which first appeared in 1995 as part of its Ford 2000 reengineering process. Ford's FPS uses Lean principles from the Toyota Production System such as pull manufacturing, just-in-time, jidoka (automation with a human touch), kaizen, and synchronous material flow. The Ford 2000 project created a new Ford-specific operating model based on 10 standardised steps for continuous process improvement (Costa et al., 2023).

The most extensive and ambitious application of Industry 4.0 manufacturing technologies by Ford is at BlueOval City. Ford uses machine vision-guided robot welders for vehicle body assembly. Production and quality systems are cloud-connected, capturing real-time process data for machine-learning-based predictive analysis of operations (Sony et al., 2021). Sustainability and operational excellence are integrated, as recommended by the circular-economy framework (Zhang, Wang, Farooque, Wang, & Choi, 2022). Industry 4.0 technologies integrated with Lean methods can deliver defect-rate reductions of 15% to 30% and cycle-time reductions of 10% to 25% (Chiarini & Kumar, 2022; Costa et al., 2023).

Despite the apparent efficiency gains from the new processes that Ford uses, three areas of weaknesses can be discerned from critical reflection on Ford's process strategy. First, there is a gap in maturity between the processes for software and those for hardware: in 2025, 33 software recalls for historical models were issued, suggesting Ford has not yet mastered a robust process for ensuring that software embedded in products is thoroughly tested and validated prior to launch (Detroit News, 2026). Second, Ford has weak integration of its supplier processes: Tier-2 visibility into the Ford supply chain is poor (Yeung, 2024). Third, the timing of design change requests remains an issue: about 90% of Ford vehicles issued with recalls in 2025 were designed between 2013 and 2020 (CBT News, 2026). This calls for greater implementation of design-for-quality processes and concurrent engineering, supported by Antony et al. (2023).

5.0 LOCATION AND LAYOUT STRATEGY

Ford bases its location choices on closeness to qualified labour, client markets, suppliers, and government assistance programs. Tennessee provided a US$1 billion incentive package, a 4,100-acre industrial plot at Memphis Regional Megasite, I-40 logistics support, and a labour pool that were the factors that determined the BlueOval City location in Stanton. Integrating BlueOval SK battery manufacturing adjacent to the vehicle assembly line produces a vertically integrated supply cluster, which reduces battery-pack transit costs and lowers inventory in transit, while also adhering to the centre-of-gravity method in location analysis (Heizer et al., 2023). Similarly, Ford's European plants, Cologne, Halewood and Valencia, are all clustered around the availability of a skilled engineering workforce and pre-existing supplier networks, while the strategic partnership between Ford and Renault in December 2025 permits the production of joint platforms in Europe (Ford Motor Company, 2025). In addition to logistics issues, Ford considers eligibility under the Inflation Reduction Act when making plant-location decisions, a key factor prompting the shift in the location of Mustang Mach-E battery production from Poland to Michigan in 2025.

According to Slack et al. (2022), Ford uses all four of the main layout types. The most prevalent is the product layout, which is the configuration of choice in high-volume operations at plants such as the Dearborn Truck Plant, Kansas City Assembly, and Louisville Assembly. On a product layout, vehicles pass sequentially through several workstations at which they each carry out one of many activities (including stamping, body welding, painting, final assembly, testing, and trim), maximizing output per square foot. Cellular layouts are utilised for sub-assembly operations including the powertrain, instrument-panel clusters, and seat assembly, in which different machinery for the family of related products are combined at U-shaped stations to reduce work-in-process inventory and worker travel distance. A process layout is the primary configuration used in Ford's prototype shops and tool-and-die production facilities, where product flexibility is emphasised over throughput. Finally, fixed-position layouts are utilised for large-vehicle conversions and in the assembly of battery cells where the product to be manufactured is so large or fragile it cannot be moved.

Evaluation reveals that Ford is successfully utilising its layout selection choices to support work-flow effectiveness and cut operational costs. Mixed-model line balancing is an ongoing concern given the increased variety of powertrains offered for hybrids, EVs and ICE vehicles; the added variability in cycle times between stations leads to lower plant efficiency (Stevenson, 2021).

6.0 MANAGING QUALITY AND CONTINUOUS IMPROVEMENT

Quality management is Ford's most prominent operational challenge today, and it is also Ford's most significant strategic improvement opportunity. Ford's quality management system relies on IATF 16949:2016, the automotive-quality management system (QMS) standard built on the ISO 9001 standard, and includes the "core tools" of quality management such as APQP (Advanced Product Quality Planning), PPAP (Production Part Approval Process), FMEA (Failure Mode and Effects Analysis), MSA (Measurement System Analysis), and SPC (Statistical Process Control) (Antony et al., 2023).

TQM elements including customer focus, worker participation, continuous improvement, and process approach are integrated into the Ford Production System. COO Kumar Galhotra called quality management "the number one thing that will close the cost gap," as the company expanded its safety team by 100% during 2024-2025 and initiated "test-to-failure" practices in which critical systems are driven for extreme distances to identify quality problems before a vehicle launches. Executive bonuses are now linked explicitly to quality KPIs in a way that matches incentive structures to quality results and reflects Deming's theory (Heizer et al., 2023).

Continuous improvement (Kaizen) is promoted at Ford through FPS groups, andon boards, and process validation. Lean Six Sigma (LSS) programmes within the automotive industry have resulted in a 15 to 35% decline in defects and a 10 to 25% decline in cycle times, and empirical data shows that these outcomes occur in the presence of committed leadership (Chiarini & Kumar, 2022; Costa et al., 2023). Antony et al. (2023) reported that approximately 60% of corporate Six Sigma programs end up failing as a result of the lack of integration among critical success factors such as leadership participation, training quality and alignment of strategic project selection with the strategy of the organization. Ford's provision for over 26 hours of formal training per employee at BlueOval City reflects their understanding of these issues.

The application of in-process SPC, automated visual inspection and AI-based computer-vision techniques to control quality at body-in-white and final inspection stages are part of Ford's quality control procedures. Customer satisfaction is tracked via the J.D. Power Initial Quality Study (IQS), reliability evaluations via Consumer Reports and warranty-claims analysis. Ford is seeing improvement: in 2025 Ford finished with four top-segment finishes in J.D. Power IQS, and Ford vehicles were awarded two Consumer Reports Top 10 selections and achieved Ford's highest Consumer Reports reliability rating in 15 years (CBS Detroit, 2026).

While Ford has made advances, the 152-recall volume and the US$5.2 billion warranty expense for 2025 show that serious quality issues exist within older product lines. Approximately 90% of 2025-recall vehicles were engineered between 2013 and 2020, suggesting the payoff from Ford's recent quality investments will take some time to materialize as these older products pass off the recall schedule. Customer satisfaction impact is not trivial; it is one of the most important predictors of customer re-purchase and brand equity as described in OM literature (Slack et al., 2022).

7.0 STRATEGIC OPERATIONAL RECOMMENDATIONS

Five actionable recommendations follow.

First, Ford should consolidate its SKU- and platform-level AI-enabled forecasting by building a unified demand signal repository that integrates ML and DL forecast outputs into the S&OP, MRP, and supplier-reservation systems. Evidence indicates that ensembling ML models reduces the MAPE by 20 to 40% in comparison to ARIMA in the automotive sector (Douaioui et al., 2024).

Second, Ford should fast-track the integration of Lean Six Sigma and Industry 4.0 in its assembly plants. The LSS DMAIC cycle, together with cyber-physical systems and AI-enabled inspection, has been shown to reduce the defect rate by 15 to 35% (Chiarini & Kumar, 2022; Costa et al., 2023). Priority areas for such deployments are in body-in-white welding, paint, and software-flash stations where many 2025 recalls originated.

Third, Ford should invest in quality-by-design and deepen concurrent engineering. Antony et al. (2023) reported that leadership commitment and cross-functional integration were the most critical success factors for lasting quality improvements. Early integration of quality engineers into design and linking a higher share of programme-leader pay to launch-quality outcomes can be expected to reduce costly late-stage design changes that drive warranty risk.

Fourth, Ford should boost transparency through digital supply-chain twins. Gaps in Tier-2 transparency and recovery from disruption have been widely noted (Sodhi & Tang, 2021; Sancha et al., 2022). Digital supply network twins can be expected to shorten the average recovery time from disruption and lower warranty exposure from obscured supplier defects.

Fifth, Ford must synchronize its operations strategy with the hybrid-and-Pro pivot via deliberate reskilling efforts. Ford needs explicit reskilling programmes focused on hybrid electric–mechanical systems, software validation, and Industry 4.0 tools (Sezer et al., 2025).

8.0 CONCLUSION

Operations and quality management are central to Ford Motor Company's competitive advantages. The report has assessed Ford's operations strategy, project management, demand forecasting, product and process design, location and layout choices, and quality management. Ford's Ford+ plan offers a workable model to maintain profitable internal combustion and hybrid vehicles while carefully investing in electric vehicles.

The principal strengths of Ford's operations include its segmentation strategy, its product-line assembly capability, its deep roots in lean manufacturing with the Ford Production System, and its increasing contribution to servitization through Ford Pro. On the other hand, Ford's main weaknesses involve its persistent issues with legacy quality, including 152 recalls and US$5.2 billion in warranty payouts in 2025, its lagging software-process maturity, and its vulnerability to errors in demand forecasting in the transition toward EVs. Whether Ford is ultimately able to make the pivot to hybrid and EVs will depend on how it makes operational decisions on the basis of empirically grounded practices. The case study shows that operational excellence is an ongoing, adaptive resource that plays a crucial role in long-term success.

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