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BECOME DIGITALLY LEAN

German manufacturing is leading a digital industrial revolution

Thomas Kautzsch

German automakers, auto suppliers, machinery companies, and machine tool builders have long been manufacturing leaders, in part because of their ability to unlock the potential of software, sensors, networks, and electronic devices on their assembly lines. Now, they are pioneering a new phase of digital manufacturing that will transform the processes surrounding the manufacturing of everything from automobiles to trains, machinery, and even kitchens.

By digitizing the processes that govern how a new idea is brought to production, sales to delivery, and factory maintenance, German

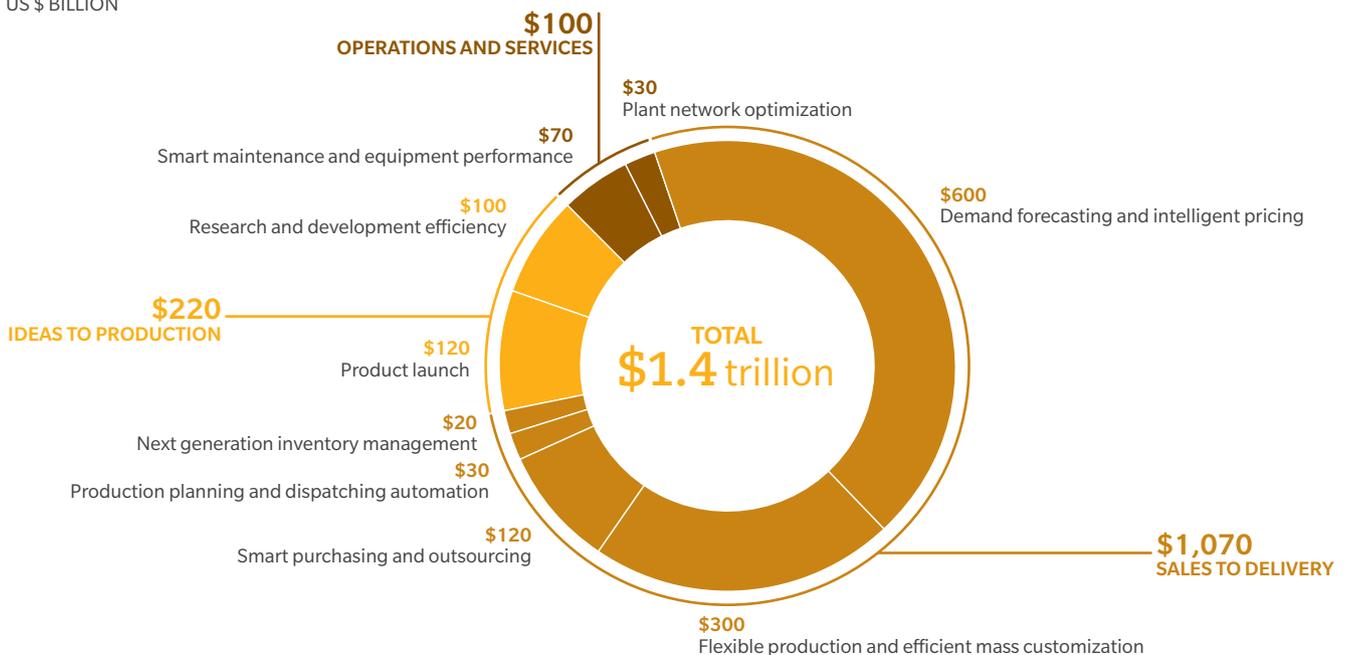
manufacturers are already beginning to significantly improve their margins. By 2030, we estimate manufacturers worldwide could realize an estimated \$1.4 trillion in upside by taking a page from leading German manufacturers' playbooks. Most of these gains will result from better management of pre- and post-production processes – the rest will continue to come from production improvements.

Idea to production: It used to be that every new car model required 20 extra hours of work due to quality issues or unplanned changes – adding up to billions of dollars per year.

POTENTIAL GAINS FROM DIGITALIZING INDUSTRY BY 2030

THE NEXT PHASE OF DIGITAL MANUFACTURING COULD BOOST MANUFACTURERS' MARGINS BY \$1.4 TRILLION

US \$ BILLION



But digital technologies could save \$100 million per new car launch on average, by integrating design and change data more closely with production. By simulating the production of a new car (using as few as 100 prototypes or validation models), engineers can estimate what each change might do to the car's overall performance and how much it would cost to make the change – before cutting a single sheet of metal.

Sales to delivery: By relying more on big data demand forecasting techniques, we estimate that manufacturers globally could boost their margins by \$600 billion over the next 14 years. Today, about 75 percent of global automotive production follows a built-to-stock logic based on dealers' judgments. But showcased cars rarely match customer preferences, while built-to-stock cars have extended turnover times, often forcing dealers to sell cars at discounts.

Some German automakers are boosting their profit per vehicle by systematically analyzing dealer information, customers' online configurations, and current and past take rates to determine what built-to-stock cars to display. Soon, many will take this to a higher level by incorporating more real-time information from sources such as third-party research data, customer-relationship management systems, competitor information, and online forums. By doing so, they can forecast demand for models and options at individual dealers more precisely and sell cars more quickly with fewer discounts.

At the same time, manufacturers can improve their assembly lines' utilization by developing real-time simulation and feedback loops between the shop floor and engineering. Take high-end kitchen and cabinetry manufacturing. Well-crafted kitchens have traditionally taken a long time to be delivered because their production involves incorporating customer-specific elements by hand into modular pieces.

Now, manufacturers are cutting the time required to deliver kitchens by automating "lot size one" manufacturing, with digital representation of a homeowner's choices. Everything from the faucet to the dishwasher is integrated into the design, and all cutting, forming, and fabricating is done by the actual suppliers of the individual pieces.



Smart maintenance and equipment

performance: German manufacturers now deploy 3D printing and modeling techniques that will eventually completely change the way manufacturers maintain their factories.

Plant maintenance is conducted faster, more reliably, and at a lower cost thanks to up-front 3D digital mock-ups of entire factories and lines. These mock-ups simulate processes in real-time and are developed up front. So new software can be commissioned and deployed without software engineers ever setting foot on the factory floor.

With real-time monitoring and improved analytics, German machine operators can avoid replacing parts too early or too late. By using 3D printing to obtain parts "on demand," many avoid keeping large stocks of spare parts on hand.

A new generation of manufacturing is underway. But the greatest gains will come from how algorithm-based decision making enables manufacturers to conduct everything from pricing and product planning to supply chain management and research more efficiently. German manufacturing offers a glimpse of how product management could change almost beyond recognition. New digital approaches are appearing every day. If they are not already, manufacturers globally will likely soon follow in their footsteps.

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