McKinsey & Company

Future-proofing operations

Low-volume/high-complexity industries

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Contents

Introduction and key messages

Companies across all manufacturing types are talking about disruptive trends changing the rules in their sector and/or ecosystem, and those in the low-volume/high-complexity (LV/HC) space are no exception.[1] McKinsey & Company regularly conducts its own research and surveys and serves a range of clients in this area, including OEMs, suppliers, rental companies, and end users. Our conversations with this diverse set of companies shows that while they focus on products with low production volumes, they have understood the urgency of adapting quickly to an ever-evolving space.

Part of this urgency derives from coming face to face with the limits of hardware-driven growth on the one hand and the digitally enabled business opportunities (both in their own sector and in adjacent industries) on the other.

Specifically, traditional LV/HC players are thinking seriously about how they can future-proof their operations to:

— Remain competitive against other incumbents and new players that can be expected to enter the space

— Lay the foundation for profiting from attractive new growth and value capture opportunities.

This report explores the insights we have derived from the latest proprietary McKinsey research (Advanced Industries Practice, McKinsey Center for Future Mobility) and LV/HC client studies from around the globe on a range of topics from strategy to operations to implementation. This report is intended as an integrated perspective on the status of the LV/HC sector and its key challenges, especially for OEMs. It also aims at offering a perspective on how OEMs can navigate the emerging new landscape and begin to future-proof their LV/HC operations.

We first provide a systematic overview of LV/HC companies and the sector's current market situation/dynamics – and discuss the new urgency of future-proofing LV/HC operations (Chapter 1). In the subsequent two central chapters, we describe the operational challenges LV/HC companies are currently facing and give examples of impactful solution approaches (Chapters 2 and 3). Finally, Chapter 4 offers pragmatic recommendations for how companies should start their journey of future-proofing their LV/HC operations.

Our research and analyses yielded the following key insights, which will be explained in more detail in this report:

— The time to address long-standing challenges is now. The emergence of new market dynamics and technology trends brings new challenges to LV/HC. This makes it more important than ever for the industry to confront persistent "evergreen" challenges that have yet to be successfully mastered.

— Many LV/HC companies are already making gains. LV/HC companies – from electronics and machinery manufacturers to heavy-equipment OEMs to component producers – are already taking action and finding real solutions to industry-related challenges both old and new.

— The journey starts with assessing both current performance and tech readiness. Future-proofing starts with two actions: assessing current performance vis-à-vis old and new challenges and assessing readiness regarding new technologies.

[1] For a systematic overview of the LV/HC space, see Chapter 1.1 in general and the subchapters on the characteristics of production, products, and companies in LV/HC on pages 5 and 6.

1 The starting point

1.1 Systematic overview of LV/HC industries

In some ways, LV/HC is self-explanatory; in other ways, the label alone doesn't tell us much. In our following classification, we describe the characteristics of this category, list the various industries and products that comprise it, and place them in the context of non-LV/HC industries.

Production and product characteristics

LV/HC players are in the business of series production in discrete manufacturing, not pure project business. They produce highly customized, complex products, with a large spectrum of variants at volumes between 10 and 10,000 units per year. Given the significant size and weight of their products, shipping costs in LV/HC tend to be high. Flow production with long takt times (up to multiple months) and workshop/group production are the most common methods in LV/HC and therefore the focus of this report.

Production in the LV/HC space tends to be labor intensive, e.g., in pre- and final assembly. Other areas, however, such as machining and metal fabrication, rely heavily on the use of machines for welding and milling.

More than 50 equipment groups are the products of LV/HC industries. We have sorted these groups into three categories: mobile equipment, static equipment, and components (Exhibit 1).

Company characteristics

LV/HC companies offer very different products but show similar company characteristics and market dynamics (Exhibit 2).

First, LV/HC companies have to deal with high fluctuations in customer demand. With only a few unique units, demand can be seasonal but often difficult to predict. Consequently, LV/HC players are required to carefully manage fixed costs. Second, customization creates a high number of product specifications, which results in many part numbers that need to be managed. This complexity results in higher levels of indirect resources in the functions of quality, engineering, production, and logistics. Third, the asset-utilization ratio in LV/HC industries can be lower than in higher-volume industries. Finally, lower volumes mean longer cycle times and a smaller share of repetitive process steps.

LV/HC compared to other industries

In some ways, LV/HC companies are similar to their high-volume counterparts. For one, the technology they deploy in series production is the same that high-volume discrete manufacturers use. The value chains consist of similar elements, and both types of producers manage value chain and product quality end to end.

In other ways, however, LV/HC is quite different. In scope, LV/HC companies are more use-case specific, and their products are significantly more customizable than the offerings of high-volume companies. End customers commonly buy a unique product that represents a strategic investment for them. Furthermore, while quality is a focus in all production types, it takes on added significance in LV/HC as these outputs tend to be mission critical for customers. The added importance of quality means that LV/HC companies invest even more than companies in other types of manufacturing, particularly when it comes to redundancies or overspecifications.

Exhibit 1

In LV/HC industries, there are more than 50 equipment groups[1]

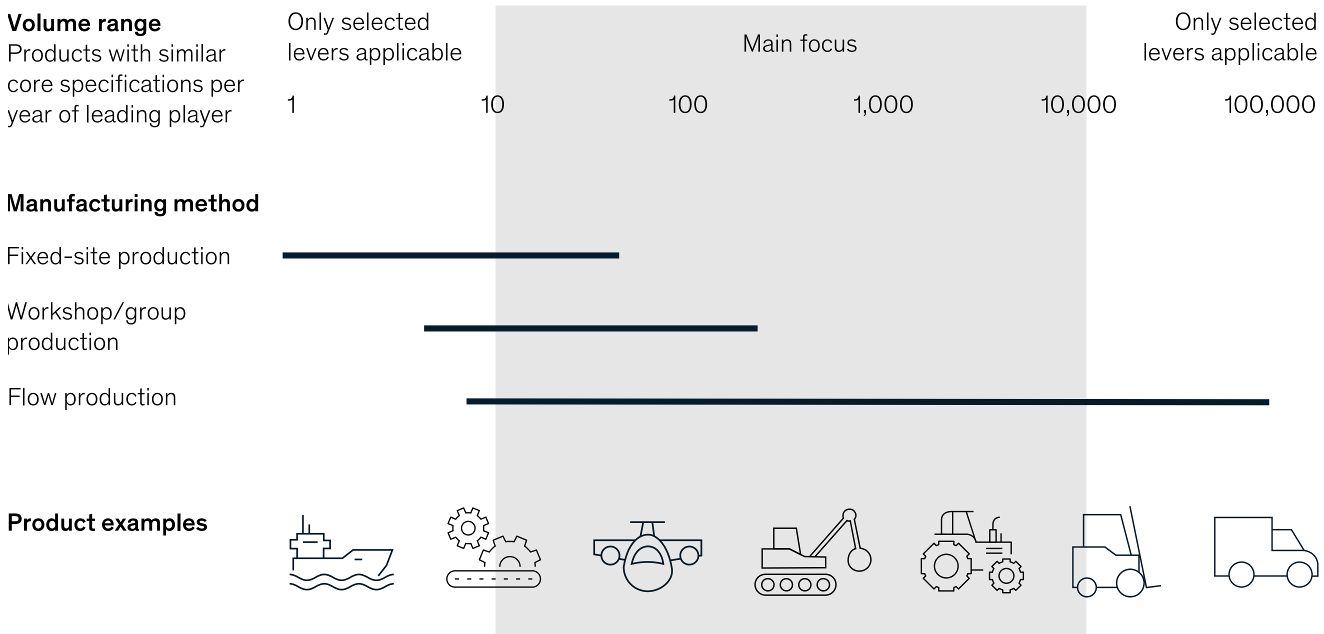
Mobile equipment	**Construction and mining**	Heavy monitoring Compact earthmoving Road construction/compaction Lifting	Concrete processing Drilling Crushing and screening Tools and attachments
	Agriculture	Tractors Combines Sprayers	Balers Implements
	Lifting and handling	Forklifts Cranes	Automated guided vehicles Automated warehouses
	Aerospace and defense	Passenger planes Executive jets Satellites	Military aircraft Helicopters
	Land transport	Trains (high speed) Trains (regional) Tramways	Cable cars Buses Fire trucks
	Special/heavy trucks	Camper vans Garbage trucks	Heavy trucks
	Other	Other special vehicles	Ships
Static equipment	**Production machinery**	Basic materials processing Paper machines Industrial robots Pharmaceutical/ medical products	Tooling machinery Packaging machines Consumer goods Food processing equipment
	Energy production	Wave power Wind power stations onshore	Windpower Oil production equipment Gensets
	Other	Other static equipment	
Components	**Engines**	Low speed	High speed
	Turbines	Steam Gas power generation	Gas industrial
	Drives	Generators	AC (high/low voltage)
	Other	Other components	

1 not exhaustive

SOURCE: McKinsey

Exhibit 2

Description of LV/HC industries



SOURCE: McKinsey

1.2 The new urgency of future-proofing LV/HC operations

Based on our own analyses and industry expertise as well as on insights from leading LV/HC experts, we have identified nine distinct realities with implications for competitiveness and productivity in the LV/HC industry (Exhibit 3).

Three of these realities are evergreen and inherent to the products that LV/HC companies make and the markets they serve. The other six are more recent and a result of new market dynamics and technology trends. Whether long-standing or newly emerging, two conditions drive the urgency to master these challenges and future-proof LV/HC operations.[2]

First, new market dynamics and technology trends are emerging at an increasing pace. These rapid developments are driving the importance and urgency of mastering matters related to product complexity, demand fluctuation, and asset utilization.

Second, business conditions have been favorable over a longer time for many companies. Key LV/HC sectors, including construction machinery and agricultural machinery, have shown strong revenue growth and solid profitability over the past ten years (Exhibit 4 and 5).

[2] Note: Depending on the region, market segment, and players, these trends may vary in their manifestation and importance.

Exhibit 3

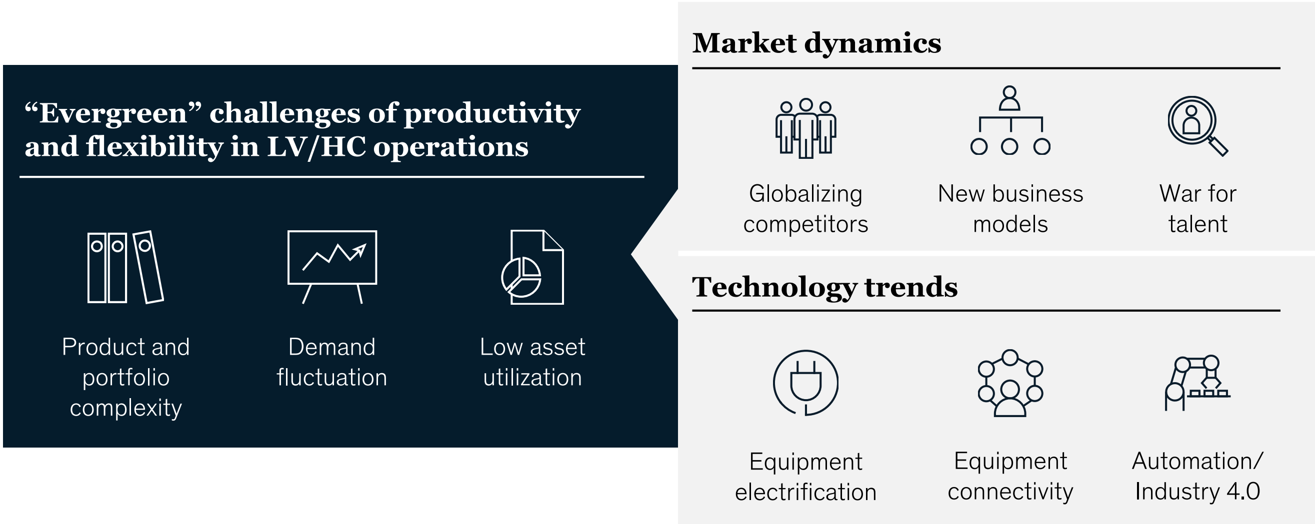
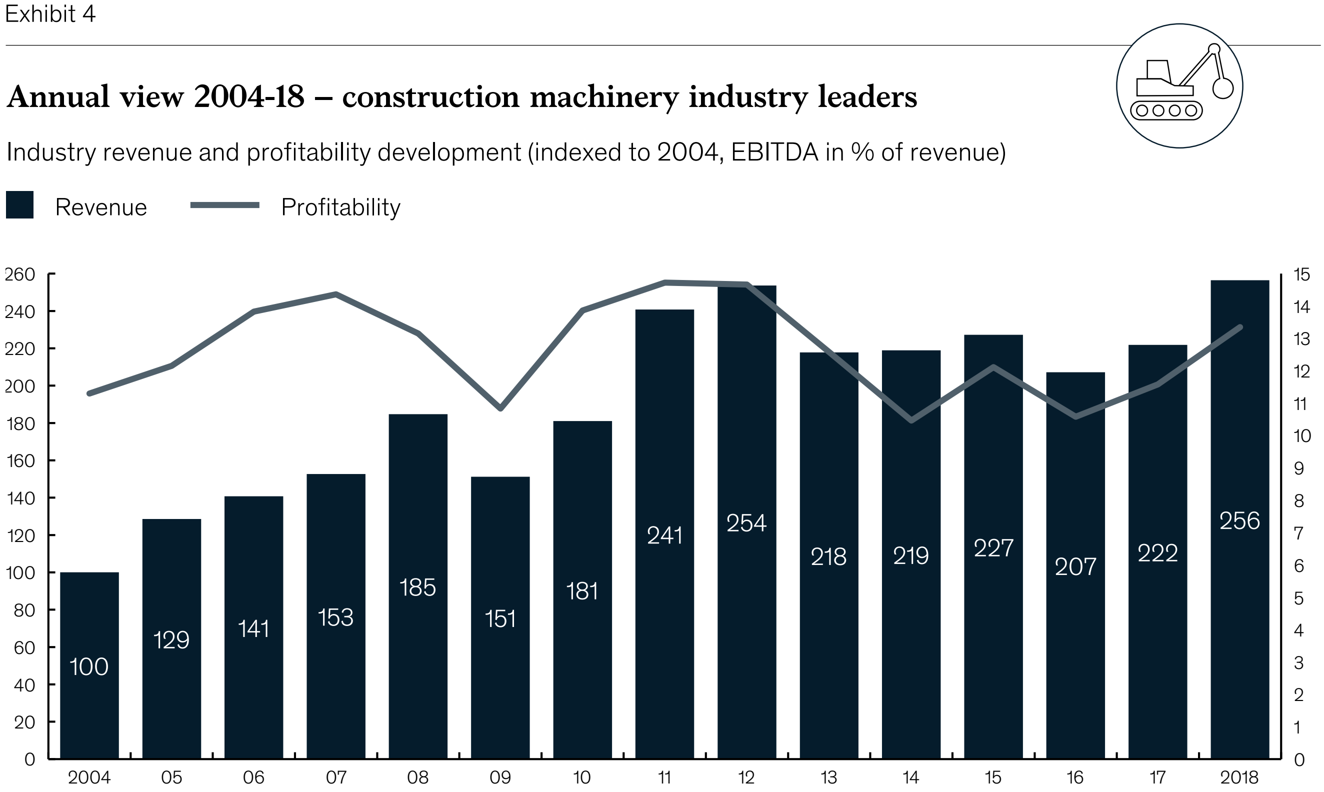


Exhibit 4

Annual view 2004-18 – construction machinery industry leaders

Industry revenue and profitability development (indexed to 2004, EBITDA in % of revenue)

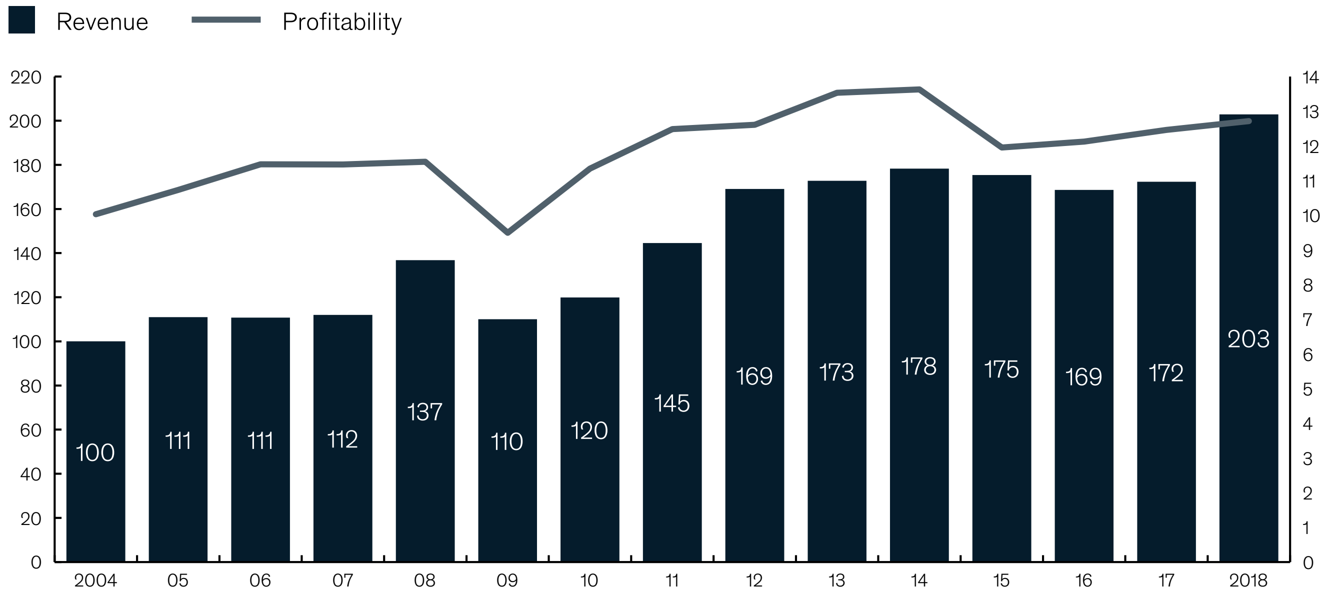


SOURCE: Company reports from 19 leading construction equipment companies

Exhibit 5

Annual view 2004-18 – agricultural and farm machinery industry leaders

Industry revenue and profitability development (indexed to 2004, EBITDA in % of revenue)



SOURCE: Company reports from 15 leading agricultural companies

Looking ahead, however, the global market outlook for some areas of LV/HC is less optimistic. In addition to the projected reversal in earnings, there is the near-term possibility of another economic downturn. According to Germany's Mechanical Engineering Industry Association (VDMA), global economic growth may also slow.[3] Acting from this position of relative industry strength would be beneficial for LV/HC companies.

[3] https://www.n-tv.de/regionales/baden-wuerttemberg/Maschinenbau-bereitet-sich-auf-Abschwung-vor-article20927590.html.

2 Insights into current operational challenges in LV/HC

In the following, we expand on the realities – both evergreen and emerging – that are impacting the operations of LV/HC companies.

2.1 Evergreen challenges of productivity, flexibility, and portfolio width in LV/HC operations

With new market dynamics and technology trends emerging on the horizon, it is time for LV/HC companies to address the following "standing issues" related to productivity and flexibility and set themselves up for future success:

— Product and portfolio complexity. LV/HC manufacturers deliver on the high customization demands of their customers. This results in a small number of common parts and modular components as well as limited design harmonization and standardization. In production, this level of complexity can have the effect of reducing productivity and increasing lead times. For product development and engineering, customization drives complexity. Growing product variation also means an ever-increasing portfolio that must be kept up to date. The combination of specialized parts and lower volume in the context of a large and varied product portfolio both limits the availability of suppliers and increases costs.

— Demand fluctuation. Many LV/HC industries experience fluctuations in demand related to strong in-year seasonality – especially in the agriculture and construction equipment space. Others observe multiyear super cycles, while recent increases in trade restrictions are also impacting demand.[4] These realities, along with widely varying takt times, increase the risk of high stock levels or the inability to meet demand and can also make line balancing a challenge. Demand fluctuation also highly affects suppliers, further diminishing the negotiating power of purchasing.

— Low asset utilization. LV/HC production is capital intensive (e.g., sizable space requirements, specialized equipment for handling heavy parts, in-house machining, metal fabrication) with significant room for utilization improvement (i.e., more hours per day, more shifts per week). Improving production network flexibility is among the opportunities LV/HC companies can seize to achieve a more efficient asset-utilization ratio in spite of tight capex budgets.

2.2 Market dynamics

The trends related to new market dynamics are important considerations for LV/HC companies. Approaches to operations beyond traditional production and to business beyond the simple sale of hardware are paths forward for incumbent LV/HC manufacturers:

— Globalizing competitors. Customers' ability to shop for a better price is facilitated by growing global price transparency, placing competitive pressure on LV/HC manufacturers. This competition is evidenced by the pressure that some companies are experiencing within their own regions from foreign-owned manufacturers (Exhibit 6). This reality should be the motivation for companies to improve productivity and cost competitiveness as well as to offer the right product.

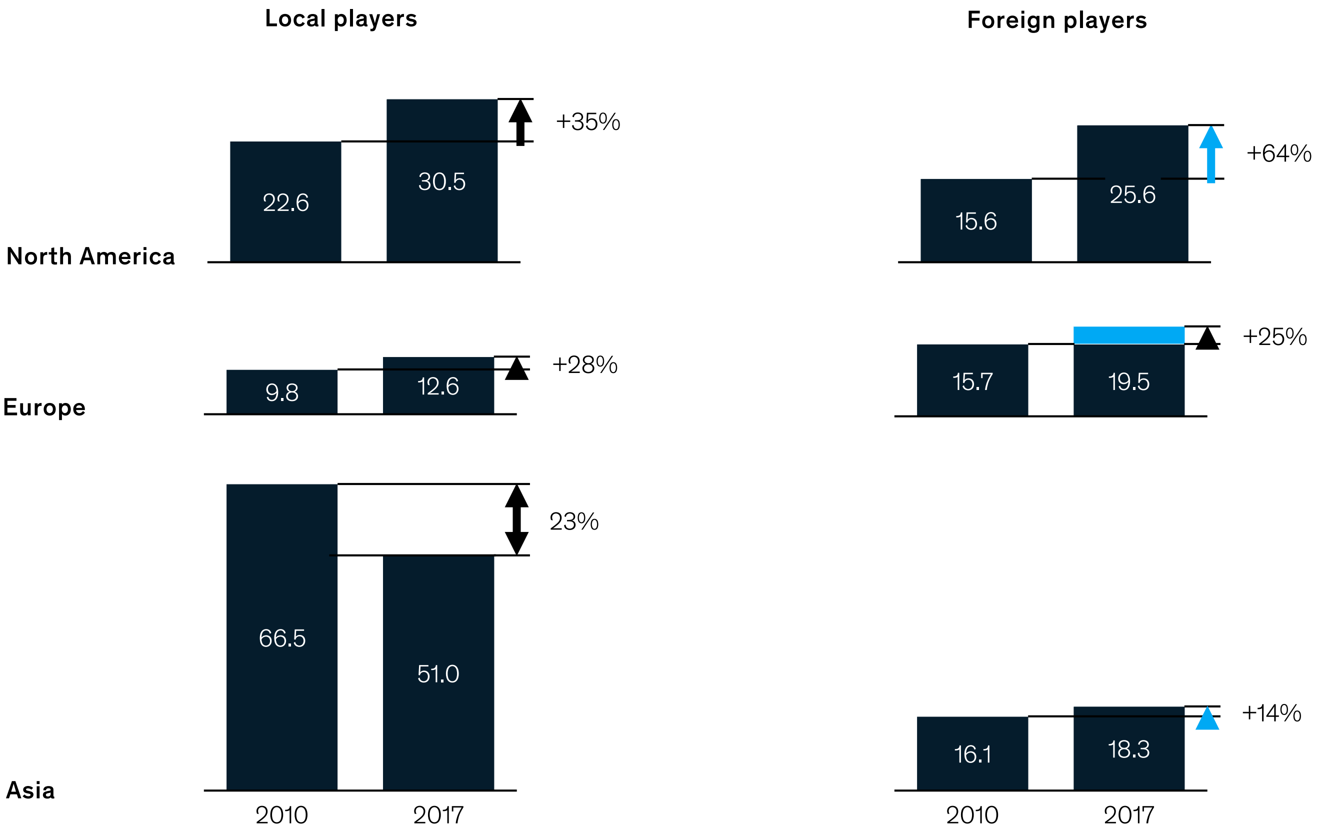
— New business models. The traditional manufacture and sale equipment business model is making room for new as-a-service models, including pay-per-use (e.g., equipment rental) and professional machine-operator services (Text box 1) or software- and solutions-based offerings. An example of this is equipment-condition monitoring on a component level,

[4] Demand fluctuation does not affect all LV/HC industries.

Exhibit 6

Revenue increase in the key markets for global construction equipment players

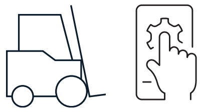
EUR billions



SOURCE: CapitalIQ, John Deere only included in US numbers as geographical split outside US is not available

enabling predictive and preventive maintenance. Together, the rise of these models suggests a decreased relevance of high-spec machines. It also indicates a decreased willingness to pay for technical extras and customers focusing more on value over time. To enable these new models, LV/HC manufacturers need to integrate digital features and software into their products (Text box 2).

— War for talent. Mid- to high-skill software/digital talent is becoming increasingly important to LV/HC industries, but many companies find themselves competing with "Silicon Valley type" tech companies for this top talent. Many LV/HC companies are also facing "pipeline" issues, as a significant share of their blue-collar workforce may retire in 5 to 15 years. Re- and upskilling are fundamental to addressing both types of problems. LV/HC companies should define the skill set they will need five years from now, link the skills to value creation for prioritizing, find out where talent is located, and then make a plan to attract or develop it.

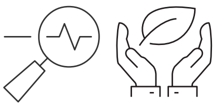


Text box 1: Jungheinrich's success in new as-a-service business models

Jungheinrich specializes in material handling equipment, warehousing, and material flow engineering. The Hamburg-headquartered, global operations company has leveraged technology to expand its beyond-traditional equipment sales.

For customers who prefer limited-term equipment use, Jungheinrich offers a 12-month contract that gives these customers access to a selection of forklifts via a pay-by-usage model. For others, outright ownership is still the best solution. By using this pay-by-usage and app-based service, customers can track the geo-position of their equipment fleets, receive daily or weekly reports on fleet usage, and send real-time performance alerts to help customers stay ahead of maintenance and operations issues.

Source: SHD logistics, Supply Chain Times, Jungheinrich



Text box 2: John Deere's data-enabled business model

John Deere has added sensors to their farming equipment, picking up information about the soil and crops around. They can now provide farmers with data on their soil quality and which crops to best grow where. Also, their machines can distinguish crops from other plants, allowing farmers to target weeds better, saving up to 90 percent of the pesticide formerly used, which has both cost and ecological benefits.

Source: Jon Deere, Datafloq, Bernard Marr

2.3 Technology trends

In light of three technology trends, LV/HC companies should seize opportunities to manage complexity and position themselves to capitalize on tech-enabled business models:

— Equipment electrification. Regulatory, market, and economic pressure are behind the anticipated replacement of traditional internal combustion engine (ICE) LV/HC equipment with battery-electric versions (BEV) in some applications. For example, battery-electric construction equipment can be used in cities and in compliance with strict local emissions restrictions. In some segments and applications of heavy machinery, there is potential for a positive economic case for operators already today when looking at total cost of ownership. This is driven by the significantly higher energy efficiency of electric vehicles, lower lifetime maintenance costs, and continuously decreasing battery prices (Exhibit 7).[5]
To make the most of the BEV opportunity, LV/HC companies will need to manage the manufacturing complexity that comes with the production of both ICE and BEV equipment. The uncertain timing of volume ramp-up adds an additional challenge.

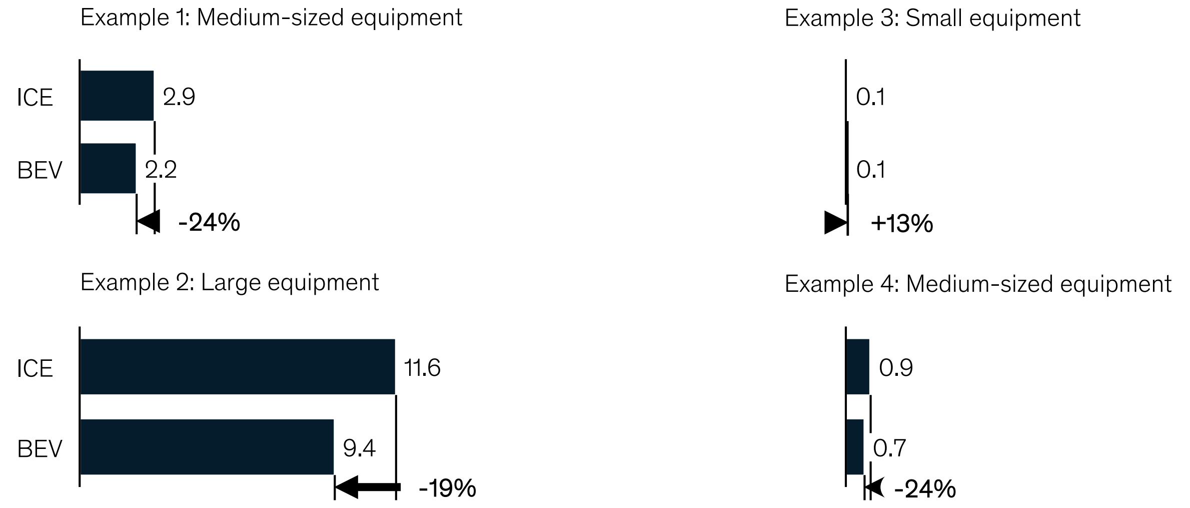
— Equipment connectivity. The connectivity of equipment opens the door to vast amounts of data and new software-driven functionalities and makes possible a variety of new use cases for LV/HC products, from remote access and remote operation to geo-positioning and predictive maintenance. This space is developing fast, and it is not yet clear which use cases will prevail. In the meantime, LV/HC companies should begin embedding software and sensors to test new functionalities and at the same time capture and store as much data as possible. LV/HC players that develop their capabilities in software and data analytics today will be ready to capture the value of tomorrow's proven connectivity-enabled use cases.

5 McKinsey report "Harnessing momentum for electrification in heavy machinery and equipment", April 2019.

Exhibit 7

Some heavy-equipment types already have a lower TCO for BEV than respective ICE alternative

TCO 2017, EUR thousands

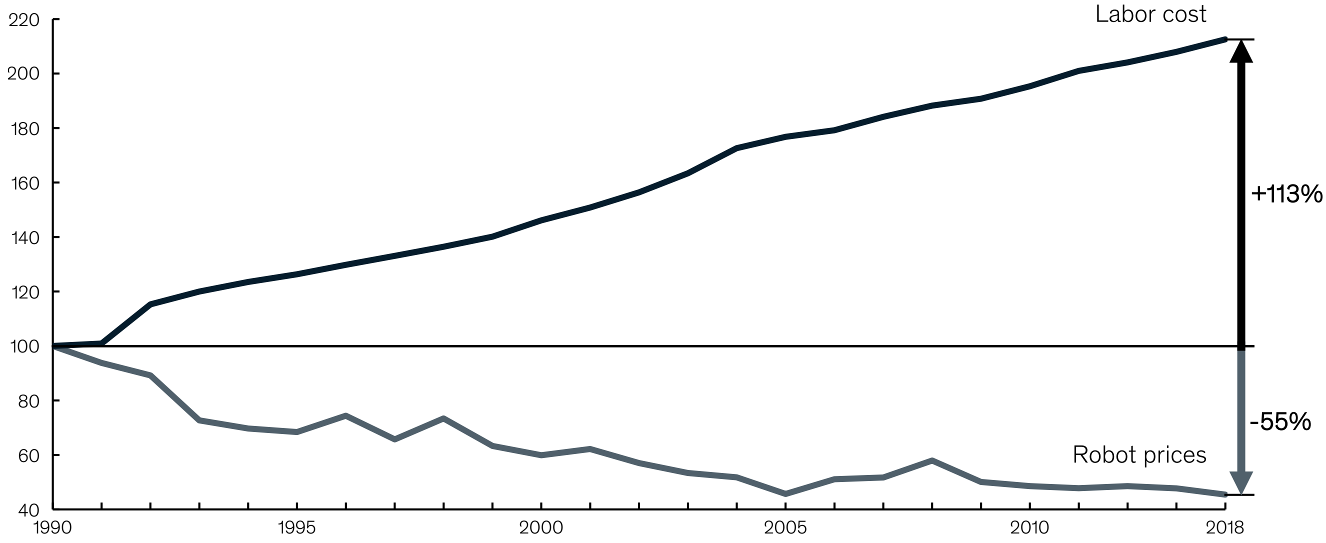


SOURCE: McKinsey report "Harnessing momentum for electrification in heavy machinery and equipment", published April 2019

Exhibit 8

Robotics have become significantly more competitive in the last decades

Index of average robot prices and labor costs in manufacturing in the US, 1990 = 100%



SOURCE: Institut für Arbeitsmarkt- und Berufsforschung; EIU World Data; IMB; International Robot Federation

- Production automation/process digitization (Industry 4.0). Production technology is advancing quickly, with new solutions arriving (e.g., 3D printing) and prices for automation decreasing (Exhibit 8). Among these use cases is the automation of logistics processes (e.g., picking/kitting) as well as automation in quality and maintenance functions. In addition to its ability to drive cost efficiency, automation also creates opportunities for LV/HC companies to better manage the complexity of their operations through, for example, automated production planning. Companies can also offer more innovative products, with customers having the option of conveniently customizing and purchasing their products at home. The potential of automation extends to other functions as well: robotic process automation, for example, has the potential to lead to efficiency improvements in R&D, procurement, or purchasing. Using robots and automation in certain processes helps increase efficiency and/or ease the physical burden for manufacturing employees, allowing them to concentrate on higher value-add tasks.

There are also many digital automation solutions that can be implemented with investments far lower than what robots or other types of hardware automation require. For example, interactive, tailored standard operating procedures can be displayed on screens or smart glasses. This is especially useful in low-volume/long takt time production with high work content per operator and limited repetitive tasks.

3 How key operational LV/HC challenges can be effectively addressed

There is no universal strategy for mastering the various operational challenges that LV/HC companies face. Each player will have to consider its own starting point, market, and aspiration in a landscape being reshaped by new market dynamics and technological advances. That said, a set of core principles is widely applicable and can guide all LV/HC companies in their efforts to improve operational efficiency and remain competitive.

3.1 The principles of future-proofing LV/HC operations

A – Evergreen challenges

— Reduce product complexity. Focus on understanding the variants and options that customers are willing to pay for. Enforce use of common parts, modular components, and platforms where customization has not proven to add value. If complexity cannot be avoided, carefully decide on when to best implement customization (assembly line versus a local workshop or dealer).

— Increase production and network flexibility. Manage capacity to fulfill demand and level production. Define strategic balance between consolidation at one site and localized production. Create throughput flexibility within sites through labor flexibility and across the production network with suppliers and external partners.

— Manage value flows. Take fact-based outsourcing decisions, define capex strategy, and explore collaboration opportunities across the supply chain.

B – Market dynamics

— Adopt an innovation orientation. Design products and processes and run operations with new technology-enabled use cases in mind. Consequently, adopt a cross-functional "way of working," including owning and running machines instead of just selling them.

C – Technology trends

— Look beyond LV/HC. Technology trends might disrupt products and require companies to transform operations. LV/HC has the opportunity to learn from high-volume industries, which are usually faster at adopting new technology and can more easily industrialize their products. Keep what they are doing as much on your radar as the moves of your direct competitors. Key topics to explore are, among others, the proactive management of the transition from ICEs to electric power trains, the use of innovative product and production technologies (e.g., additive manufacturing of spare parts), and the development of new software-driven offers.

3.2 Case examples of future-proofing LV/HC operations

Equipped with the principles described above, LV/HC companies can also look to the paths already taken by many of their peers as they embark on their future-proofing journeys.

In the following, we offer five case examples to illustrate the specific challenges that some of the top-performing LV/HC companies successfully tackled. These case examples also describe the technology and methods applied and estimate the impact in various use-case-specific dimensions. To ensure that these descriptions are as vivid and concrete as possible, most of them focus on one specific industry or application. The challenges presented in each case, however, are commonly experienced across LV/HC industries, and the solution approaches may be transferrable.

Case 1 – Improving the takt time and on-time delivery at a machinery manufacturer

This case involves a machinery manufacturer that makes highly customized products. Most of the manufacturer's component producers are local, as lead time from order to received goods plays an important role. With decreasing volumes and increased complexity of the portfolio, the company sought new ways to achieve the ambitious takt time targets it had set.

The situation

This market leader operates in an industry with volatile demand, and they were once again facing a downturn. This, combined with some recent challenges with late deliveries, increased the need for another wave of improved efficiency. The challenges were driven by a few realities. First, there were some non-value-adding activities on the shop floor, whose negative effect was compounded by the high cost of production. Second, there was high variability in assembly lead times, creating disturbances on both the customer and supply chain sides. Third, the lack of transparency on current subprocess lead times made it difficult to achieve targeted takt time performance and identify improvement opportunities.

The solution

The company defined a new production model, which formalized lead-time targets and increased transparency on processes and buffers. To make the assembly steps more even, the company also restructured the assembly process. By ensuring material availability and eliminating other disturbances, the manufacturer was able to first stabilize takt times and then improve them.

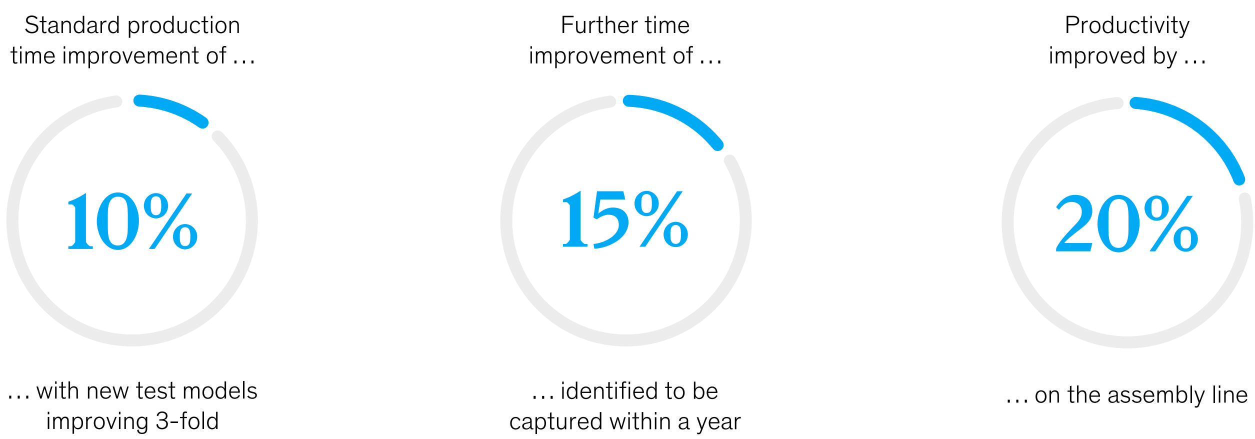
Additionally, the company set up new processes to identify and standardize process improvements supported by clear KPIs. They also developed structured and coherent performance management along the whole end-to-end delivery process. Implementing clear root cause problem-solving methods to address and permanently solve issues in production was also prioritized.

The impact

Added transparency helped the manufacturer identify improvement potential in standard production time of 10 percent, one-third of which could be achieved from new pilot models (Exhibit 9). An additional time improvement of 15 percent was also identified and expected to be captured within the first year. Finally, activities related to process structuring and standardizing, as well as those related to problem solving, were expected to improve productivity on the assembly line by 20 percent.

Exhibit 9

Impact of takt time improvements



SOURCE: McKinsey

Case 2 – Improving manufacturing flexibility and efficiency at a construction equipment OEM

This case involves a construction equipment OEM with a broad product portfolio, which includes both make-to-order and make-to-stock products. There is a high level of product customization, which is made all the more complex by country-specific variants, e.g., national regulation standards for combustion engines. This equipment OEM experiences demand that varies throughout the year with a peak in early summer due to the seasonality of the construction equipment market.

The situation

While generally in a good situation and enjoying great customer loyalty due to a solid product offer, variability in customer demand is increasing. Not only does the in-year demand vary due to seasonality, but the OEM is also observing increasing complexity and higher variation when it comes to the assembly work of each machine. This is leading to a higher share of labor costs at lower efficiency. Reacting to these trends, the OEM has launched an improvement program to increase flexibility and efficiency and more quickly respond to customer demand while maintaining a high level of efficiency in operations. Achieving the targets is challenging as the company has limited experience in lean production principles related to assembly and internal logistics. Investments in breakthrough technologies or automation could be a game-changing next step, but limited funding has so far constrained the company's ability to make these investments.

The solution

To master the challenges related to demand flexibility and operational efficiency, the OEM launched a multiplant transformation program, which targets assembly, fabrication, and material handling. While the company operates multiple global locations, this improvement program focused on its high-cost locations. The operational improvement program had two objectives: a frontline transformation with a focus on implementation and capability building via a change in team and leadership. To get there, solutions in two key process areas were implemented:

— Build flexibility in throughput via line balancing. Through line balancing, the company was able to better react to demand shifts with the resources it already has, i.e., no additional hiring and no additional training. This was achieved by negotiating agreements with unions to support operations with no more than two days' notice as demand shifts require. Accommodating changes in demand with the existing team was also enabled by adjusting overall weekly working hours, either by adjusting the number of hours per day or the number of days per week (Exhibit 10).

— Link assembly and logistics. Complex products require a large number of parts. Many of the OEM's parts were stored on the line, and this caused inefficient layouts. These inefficiencies were addressed by a line-back principle employed to determine how to more closely link assembly and logistics. In addition, lean principles were then used to evaluate the benefit and impact of various line-change proposals. The integrated approach to assembly and logistics optimization was implemented through a combined project team.

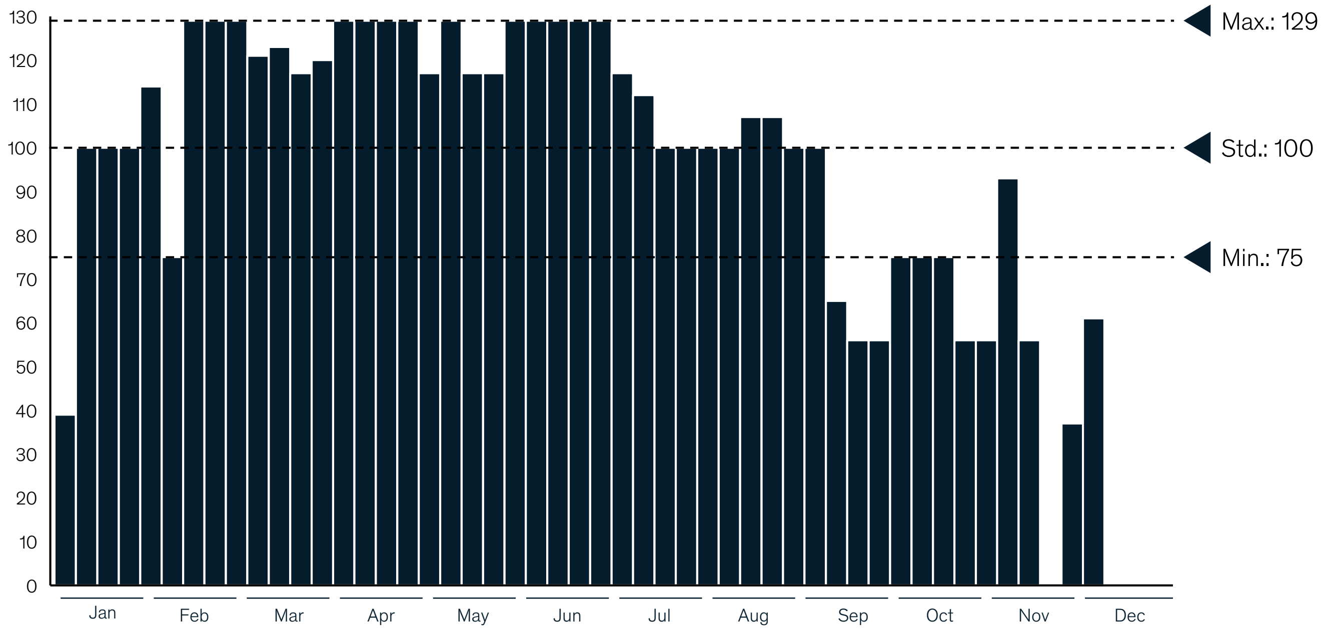
The impact

Several possible changes in assembly and logistics were identified that could be implemented quickly and with low investment. Improvements in line balancing and flexibility led to more stable operations due to better connectivity between assembly and logistics. Ultimately, the interventions related to line balancing and flexibility led to an overall 25 percent improvement in productivity.

Exhibit 10

Demand fluctuation and flexibility

Units per week



SOURCE: McKinsey

Case 3 – Improving logistics at an LV/HC equipment manufacturer
This case involves a specialized transportation equipment manufacturer with engineered-to-order (ETO) products. The company's manufacturing plant is located in a high-cost country, but many of the parts used are produced in a low-cost region.

The situation
The company had already successfully implemented productivity levers in manufacturing and other parts of the company (e.g., setting up takt assembly lines for the products close to their warehouse). Still, some legacy structures were causing problems for the logistics system. Inbound logistics with many handling steps and equipment that was not always suited to the situation led to long waiting times for material in production. A practice of storing material on unsorted pallets also resulted in higher inventory and lost time from searching for parts. Additionally, the flow and the supply of unstandardized parts to the line from the warehouse was suboptimal. Specifically, many parts were flowing back to the warehouse since they were being dispatched to the wrong location. Finally, freight from outsourced locations coming in large batches had resulted in high peaks in production and logistics.

The solution

Three key levers were put in place to address the specific efficiency issues related to logistics, supply, and flow:

— Lean and digitization. The internal flow issue was addressed through a combination of lean and digitization. Specifically, the company implemented optimized warehousing and line feeding of material with a line-back principle that was tailored to custom-made products (still ETO). This included ASNs, hands-free picking, and AGVs to eliminate non-value-added work. The company also assessed their options for smart insourcing versus outsourcing of material handling by conducting a product segmentation and leveraging supplier competencies.

— Flow architecture. An information flow architecture was developed to support future process and IT requirements and ensure that each individual product had the optimal material flow from inbound to assembly. Looking ahead, the company also defined the future system landscape, including internal and third-party development requirements.

— Online transportation management system. Finally, the company tackled the challenge around high logistics peaks and freight optimization by using an online transportation management system and intensive supplier collaboration.

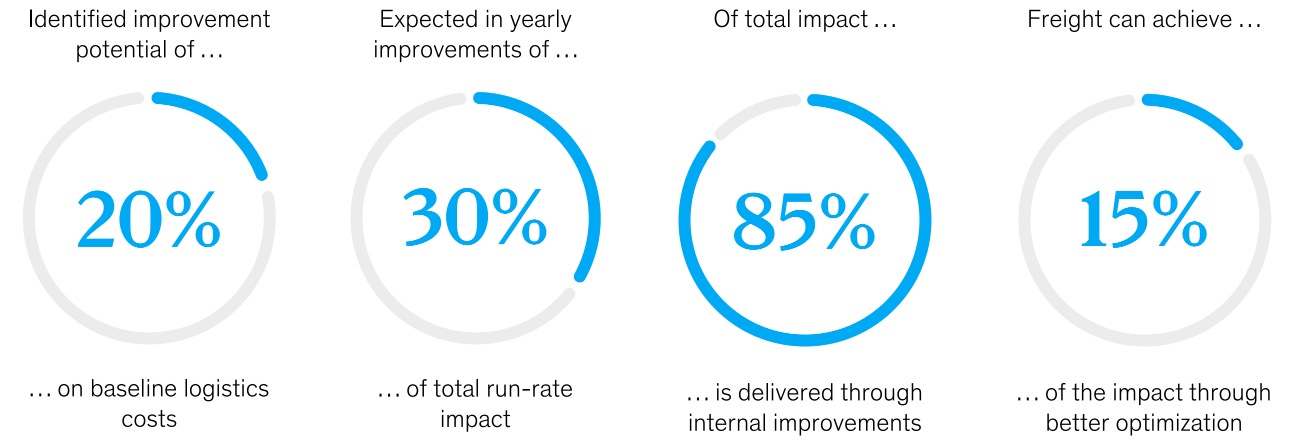
The impact

The process, IT, tech, and collaboration initiatives described above identified a 20 percent improvement potential in logistics costs, and nearly one-third of the run-rate impact could be achieved in just the first year (Exhibit 11).

Most of the impact (85 percent) would be delivered through internal improvements. The remainder (15 percent) would come from better optimization through freight.

Exhibit 11

Impact on logistics costs



SOURCE: McKinsey

Case 4 – Improving the ETO delivery at a component producer

This case involves a component producer with several production facilities in Europe and a global customer base. All products have been customized to fit the customer application interface, the number of product variations has increased significantly over the years, and sales and the customer base have grown.

The situation

Improvements in production had been made at several points, but they were not fully paying off. Delays in engineering were still leading to lags in assembly drawings or materials. Engineering was struggling to catch up as a steady increase in product portfolio variations had created an exponential increase in engineering requests.

The engineering unit was facing almost daily reprioritization of tasks with new requests flowing in through multiple channels. In addition, quality assurance processes were considered heavy and cumbersome, leading to shortcuts that, at times, showed up as problems in the production line.

The solution

Transparency on ongoing work was created through the implementation of daily check-ins and visual management. Work was fixed for two weeks at a time, and priority rules were clarified for both ongoing work and long-term backlog management. The company also created cross-departmental transparency on project statuses and set strict deadlines for engineering change requests and design finalization.

The quality assurance process was redesigned for a first-time-right approach and more feedback loops. Monthly root cause problem solving on all production errors was established, and outcomes were used to update design guidelines.

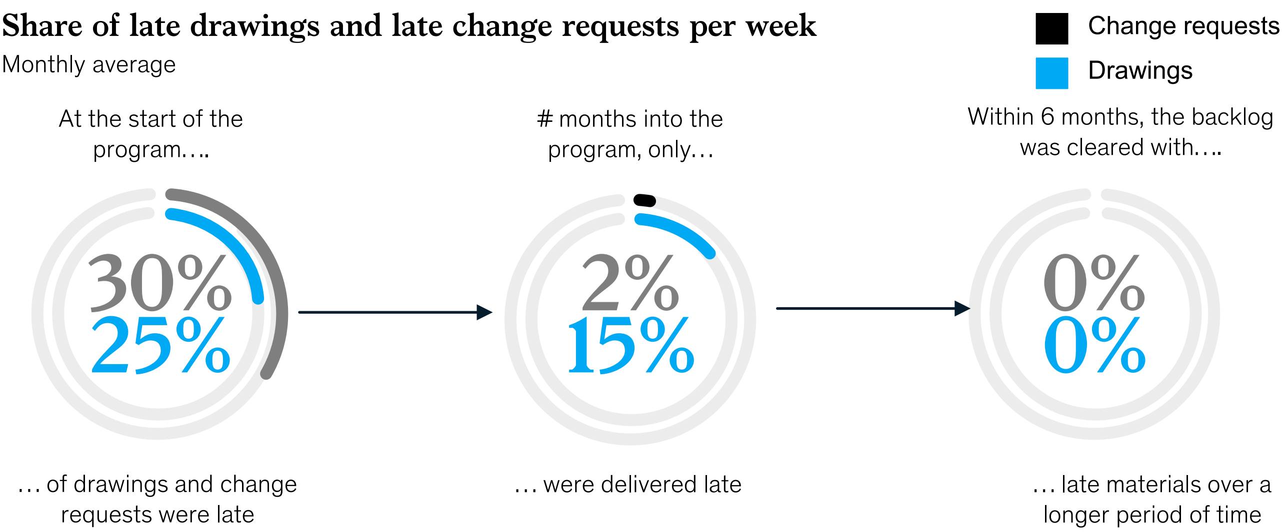
The impact

The backlog of late drawings was cleared three months after full transparency was created, and new requests are now completed on time (Exhibit 12). Greater transparency has also improved department collaboration and reduced stress for the engineers.

Exhibit 12

Share of late drawings and late change requests per week

Monthly average



SOURCE: McKinsey

Case 5 – Footprint and outsourcing strategy at an LV/HC electronics manufacturer

This case involves a successful high-tech electronics equipment manufacturer for niche markets. To handle its lot sizes – that range from 1 to 100 – and the introduction of more than 5,000 new materials each year, the company's manufacturing footprint is currently focused in Europe.

The situation

Continued strong growth for this company is expected in the coming years. Given the current limited capacity headroom and the high-cost structure in European plants, this growth forecast creates the need for additional manufacturing and supplier capacity. High vertical integration due to very complex production technologies, a very broad product portfolio, and limited supplier availability add to the need for new assets.

Demand fluctuation, combined with short lead time on customer orders, makes forecasting and planning difficult. Capacity is further constrained by the company's need to deploy high-complexity production technologies for their specialized products. They do not have a consolidated, clear internal understanding of which internal manufacturing capabilities are required. They also lack common, clearly defined sourcing-decision processes. Complex logistics requirements and low volume combine to make an unattractive proposition for suppliers.

The solution

To address the capacity issue, the electronics manufacturer defined the overall need for a new asset and the relevant ramp-up technologies and skill profiles for that new asset. This involved the identification of growth pockets and capacities per production technology (FTE, space requirements, and current shift model). Country-specific assessment criteria (e.g., HR dynamics, IP protection) were created in order to comprehensively evaluate close to 100 potential countries in Asia and Europe where a new plant could be built.

Additionally, three actions were taken to further drive external sourcing in component manufacturing categories (e.g., sheet metal, machining, and cables). First, technologies were categorized as low-, medium-, or high-competence technologies and were compared with the manufacturer's assessed capabilities in plant workshops. Second, they identified potential suitable suppliers based on availability in the market and logistics requirements. Finally, supported by a newly established supplier development organization, they created outsourcing strategies and implementation requirements for a common, best-practice sourcing process.

The impact

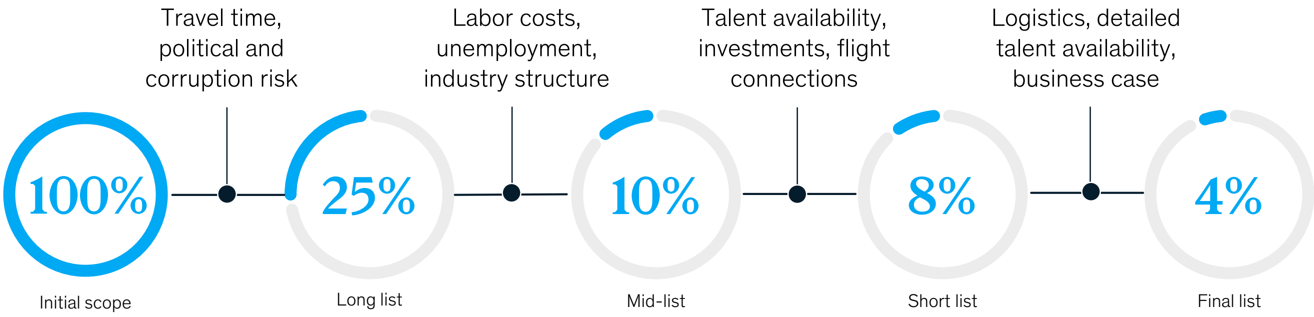
A clear road map for outsourcing material clusters – defined at the SKU level – was created, prioritizing the manufacturer's bottleneck processes in order to mitigate capacity constraints in the medium term (Exhibit 13). For the longer term, the road map also included shifts in the future production footprint, as outsourcing was not sufficient to accommodate all of the anticipated growth. Outsourcing would, however, be a useful strategy to help mitigate risks and reduce capex.

After applying the evaluation criteria, the electronics manufacturer was able to identify a viable location for a new production facility. Additionally, the assessment of technologies, skill profiles, and capabilities led to the design of a future manufacturing footprint that bundles manufacturing capabilities into competence centers to increase the utilization of plants.

Exhibit 13

Country selection process

Countries left in scope after each selection criteria type is applied



SOURCE: McKinsey

4 Taking the first steps toward future-proofing LV/HC operations

In our categorization, more than 50 distinct equipment groups are products of LV/HC companies. Despite this diversity, there are a couple of recommendations and considerations that all of the companies in this industry can take as pragmatic first steps toward preparing themselves for the future.

4.1 Conduct self-assessment of emerging and evergreen challenges

There is still a lot of value in mastering evergreen challenges, and thinking about the emerging challenges should not come at the expense of tackling the long-standing ones. In particular, LV/HC companies should review the degree to which they have addressed the challenges related to product complexity, demand fluctuation, and low asset utilization. Part of this self-assessment should include an honest exploration of how successful they have been so far as well as a detailed understanding of the decisions to use tailored versus one-size-fits-all solutions.

When assessing their readiness to handle the challenges related to market dynamics and technology, LV/HC companies should start with those that are applicable to their specific operations setup. Key aspects of this part of the self-assessment include determining which factors will secure and extend a competitive edge and defining the operations impact of companies' overall strategic initiatives.

4.2 Review operations and product technology road map

A forward-looking assessment is also recommended, particularly regarding technology readiness. LV/HC companies can ask themselves the following questions:

— Do we have a plan that a) ensures that operations and product technology will develop in an integrated way and b) is mindful of our limited resources – phasing and prioritizing efforts accordingly?

— Are we prepared for multiple technology scenarios?

— Are we able to prioritize the technology and business models that will be most applicable to us without losing sight of the wider innovation landscape?

— Are we set up to get the full value out of our business?

— Will we be able to react quickly if new technologies become standard?

These companies should also begin determining how they can leverage new technology opportunities to also better address the evergreen challenges described above.

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