McKinsey & Company

Semiconductors Practice

Reducing indirect labor costs at semiconductor companies

Digital tools could bring new productivity and efficiency gains to indirect functions. Why do semiconductor companies hesitate to use them?

by Koen De Backer, Bo Huang, Matteo Mancini, and Amanda Wang

August 2019

When chip components shrink, manufacturing and testing costs rise. This adage holds true even though Moore's law has slowed, since expenses related to semiconductor production have increased over the past few years. At every semiconductor company, cost efficiency is now at the top of the agenda, although annual revenues are solid and have been trending upward. While better margins are one motivator, companies also want more funds to invest in innovative chips for autonomous vehicles and other emerging technologies. Demand for such chips could surge as these technologies advance, and companies without leading-edge products will be at a disadvantage.

In addition to implementing lean programs—a traditional cost-control approach—many semicos are improving labor efficiency by using simple digital tools, such as dashboards on mobile phones. They have also adopted more advanced digital solutions, such as artificial intelligence (AI), machine learning, virtual reality, advanced analytics, automation, and 3-D printing. To date, however, semicos have focused their efforts on functions directly involved in manufacturing. They have been less aggressive in using digital tools to improve indirect labor costs—those for technicians, engineers, back-office staff, R&D, and other functions that support manufacturing but are not involved in the conversion of materials to finished products. Their hesitation is understandable, since indirect labor costs at semiconductor companies are much more difficult to quantify than direct costs, which can be measured based on operator touch time.

As digital tools become more sophisticated and produce increasingly greater gains, they will take semiconductor companies further into the age of Industry 4.0—a period of greater digitization in the manufacturing sector. If any companies resist using these tools, they risk falling behind more aggressive competitors. But even the most ambitious and dedicated semicos may have trouble expanding their efforts into indirect functions. They often have limited insight into indirect jobs, including the activities that consume the most time and the areas where productivity lags. Many companies also have difficulty selecting the best digital solutions for a variety of indirect functions, since they have only applied them to one or two jobs. In that respect, they lag far behind companies in many other sectors that have made more progress in digitizing operations and applying advanced technologies.

So how should semicos gain a greater understanding of their indirect labor? And what digital solutions are likely to produce the best results in different functions? Companies might be able to answer these questions through an analysis that provides transparency into the purpose, end products, and activities (PEA) of indirect employees. With insights from a PEA analysis, semiconductor companies can recalibrate the workload and ensure that employees focus on tasks that truly add value. They can then implement appropriate digital solutions for these tasks, ensuring even greater gains. Semiconductor companies that have successfully followed the PEA approach have reduced their indirect labor costs by 20 to 30 percent across all functions.

An approach for identifying and capturing savings for indirect labor

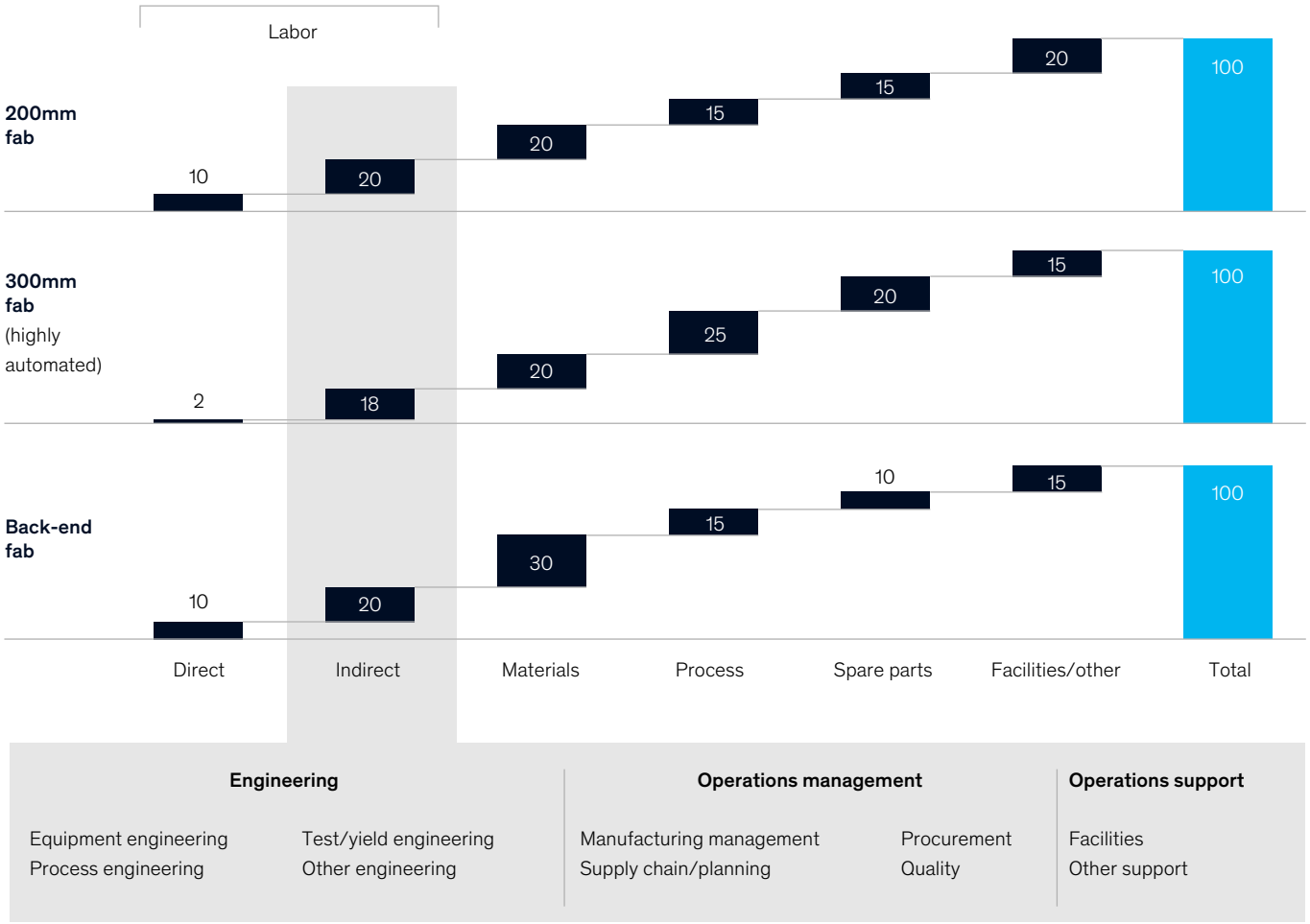
At semiconductor fabs, indirect labor typically represents a significant proportion of the cost base. For instance, it accounts for about 18 to 20 percent of yearly manufacturing expenses (exhibit). While engineering represents a large share of these costs, operations management and support also account for much spending. Companies often have trouble estimating the potential impact of cost-cutting programs because many productivity drivers are difficult to quantify, particularly within engineering. For instance, a team's composition—such as the experience level of employees or the number of engineers—can strongly influence its efficiency. Moreover, a lot of productivity information is not available or inaccurately tracked, such as data on a team's return on investment for the products it creates.

A PEA analysis can help bring some clarity to the murky world of indirect costs, both in manufacturing and R&D. It begins with workshops for indirect managers and frontline staff. Participants identify the main purpose and end

Exhibit

Indirect labor is a key cost driver for semiconductor fabrication plants.

Yearly manufacturing costs for example fabrication plants (fabs), %



Engineering

Equipment engineering
Process engineering
Test/yield engineering
Other engineering

Operations management

Manufacturing management
Supply chain/planning
Procurement
Quality

Operations support

Facilities
Other support

Source: Disguised examples from semiconductor companies

products associated with every job description, as well as the activities that employees perform during a typical week and the time spent on each one. This activity mapping often reveals findings that surprise both managers and frontline employees. One executive of a global memory-solution company commented, "PEA is just like a magnetic-resonance-imaging scan. Now I finally understand how my engineers' time is spent." Often, a PEA analysis will show that employees spend many hours on activities that are not considered vital to their jobs or which do not contribute substantially to the creation of a desired end product.

Such analyses may not seem new to many industries, since companies across sectors already have established methods for identifying value drivers. Their analyses may not focus on the purpose, end products, or activities of employees, but their overall goal is to gain insight into different functions and reduce costs. In the semiconductor industry, however, such value analyses have been rare, particularly with respect to indirect labor.

Once companies have baseline metrics and a solid understanding of all job functions, they can identify initiatives to improve efficiency and reduce

workloads. Typically, they will propose more than 50 solutions, all of which require funding and dedicated employees for implementation. Many of these will involve implementing digital solutions, but there will also be a few simple suggestions that produce good results, such as the elimination of unnecessary meetings or reports. Although every proposal may sound great on paper, managers need to conduct a reality check through feasibility assessments. Does an initiative require extensive funding or other resources? Will it create a burden for the staff responsible for implementation? These questions, and more, must be resolved before moving forward.

In addition to assessing feasibility, companies must quantify the savings for each initiative—this includes the number of workload hours eliminated for certain tasks as well as cost reductions. They should also determine whether employees can be reassigned or placed into new groups, or if workers lost to attrition must be replaced. The cost-benefit analysis will help them determine bottom-line impact, prioritize initiatives, and monitor progress. Once they have a plan, managers can assign responsibility for implementation to groups or individuals, set timelines, estimate the complexity of implementation, and track the savings achieved for each initiative.

Since PEA analyses are conducted across functions, they identify solutions that will benefit the organization as a whole, rather than those that help only individual departments. For example, a top company that offered electronic-manufacturing services conducted a PEA analysis across its engineering group. The analysis revealed that employees spent most of their time completing a yield-management report. The time that each department spent on this activity was not significantly high. The burden only became apparent when the company totaled results for employees across the entire engineering group. Leaders then created a cross-functional yield-management approach to remedy the problem, which is expected to reduce the number of engineering hours spent on the report by 52 percent.

The recommendations from a PEA analysis will differ by indirect function because of the nature of jobs within those functions—for example, technical roles, engineering, support services, and R&D. The following sections describe the most relevant digital solutions for a variety of indirect jobs.

Research and development: Increasing productivity

Semiconductor R&D budgets are growing by about 6 percent annually as companies grapple with the slowing of Moore's law and the increased complexity of development processes, including coding, testing, and verification. Companies now require larger software groups to handle R&D tasks, adding to indirect labor costs. Advanced analytics, one of the most popular digital solutions, can help tame expenses by identifying the factors contributing to long development timelines and low product quality. While many semicos have already applied advanced analytics, their efforts have tended to focus on streamlining basic engineering tasks, such as chip design.

Consider the example of a semiconductor company that saw only about 40 percent of its designs become marketplace winners. To identify the elements of strong products, the company applied advanced analytics to more than 80 data sets, including information on competitors, sales-force records, and market data. It then looked at more than 500 product features, identifying those that significantly contributed to value, as well as those that did not. With this information, it was able to channel its product investments more wisely.

The company also used advanced analytics to improve its development process. When trying to identify the elements of a successful team, the company considered numerous variables, including tenure and the employee's record for design wins. It was surprised to discover that several seemingly insignificant factors strongly influenced the success rate. For instance, teams that had members spread across multiple locations tended to have weaker performance. The insights from these analyses, combined with

the better understanding of product value, helped the company increase the number of products classified as market winners by 10 percent, improving its total annual revenue by about $750 million.

Another semiconductor company was facing a weak market as its PC sales declined and it lagged far behind its competitors in R&D productivity. To engineer a turnaround, the company applied advanced analytics to identify productivity-improvement levers. Among other insights, the company discovered that frequent starts and stops were one of the greatest problems across projects. If a team had to pause for a week or two, its productivity plummeted. The company also discovered other hidden issues. For instance, teams that had more than seven engineers tended to have lower productivity. On the plus side, the company was also able to identify factors that improved performance, such as having a team in which members had previously worked together. Once the semiconductor company applied the insights from these analytics, it increased R&D engineering productivity by 15 to 20 percent. In one group alone, run-rate savings amounted to $15 million.

Semicos that apply advanced analytics may also find that many other unexpected factors influence R&D performance. For instance, conventional wisdom says that engineers should focus on one or two projects. In one analysis, however, productivity increased when they worked on more projects.[1]

Technical fields: Bringing automation to the fore

For most manufacturing-support technicians at semicos, daily activities are somewhat repetitive—and that means some of the greatest efficiency gains may come from greater automation of maintenance work flows, or by asking employees to use augmented-reality tools or wearable devices that track their movements. For instance, maintenance technicians could use smart glasses that display the maintenance history of whatever component they are examining, or wear devices on their wrists that note how far they have to walk within a plant to complete their tasks. Such solutions, which may improve technician productivity by up to 45 or 50 percent, are already familiar to many industries. Within fabs, which have been slower to embrace digitization, they represent a new and untapped opportunity.

One semiconductor company originally had a very time-consuming maintenance process that involved having technicians make multiple inputs into a computer system, including notes acknowledging work orders and updating equipment status. They often had to leave their workstations or the plant floor where the machines were located to make these updates. To increase maintenance efficiency, the company implemented a simple digital solution—one familiar to companies in other sectors but never before tested in its fab: it created a mobile-phone platform that allowed technicians to record and track maintenance activity and machine performance without leaving their work station. When needed, they could update aspects of the maintenance order, such as the parts required. Technicians could also access checklists and standard operating procedures for machine maintenance through the mobile app. The company was able to reduce the indirect workload by about 14 percent through this initiative.

Engineering: Introducing more sophisticated solutions

While some engineering tasks are simple and straightforward, others require technical judgment and customized solutions. The digital solutions that can help engineers are therefore more diverse than those typically applied in other technical fields. Robotic process automation (RPA) alone might be helpful in some cases, but it will be more powerful if combined with advanced analytics, AI, and machine learning. Although results will vary, digital solutions can typically reduce engineering costs at semiconductor companies by 30 to 35 percent.

[1] Eoin Leydon, Ernest Liu, and Bill Wiseman, "*Moneyball* for engineers: What the semiconductor industry can learn from sports," *McKinsey on Semiconductors,* March 2017, McKinsey.com.

One semiconductor company improved its decision-making process for lots that were on hold—those deferred from further processing—by applying an RPA solution. For many years, the company had relied on an IT system that automatically put 15 percent of lots on hold at the final testing stage. Product-test engineers (PTEs) then reviewed each lot by logging onto various systems and independently deciding whether it should proceed. This process accounted for about 50 percent of the PTE workload. To increase efficiency, the company analyzed past decisions about lots, including the factors that determined whether they would be rejected. Based on these insights, the company found that decisions for about 70 percent of lots on hold were straightforward and could be handled by RPA solutions in combination with AI algorithms. The PTEs who previously handled these decisions were redirected to yield-improvement tasks or freed up to make decisions about more complex lots on hold. Overall, processing time for lots on hold was reduced by 20 percent.

Support functions: Making sense out of multiple systems

Employees in support functions must often deal with various IT systems, none of which are integrated. Work-flow automation, analytics, and RPA solutions can typically improve their productivity by 40 to 45 percent.

Many companies across industries have already applied digital approaches to their support functions with good results, and semiconductor companies can expect similar gains. Consider the example of a major bank that had recently streamlined its back office. To address work backlogs and the risks that might accompany them, the bank worked with process and robotics experts to define work flows, identify exceptions, and establish business rules. It then used RPA to automate about 80 percent of tasks, relieving the workload pressures and reducing the completion time for each back-office transaction by about 56 percent. Staff members then had more time to focus on complex tasks.

Similarly, a professional-services company determined that it could improve recruitment by applying digital solutions. The company received more than 250,000 résumés per year, and it wanted to reduce screening costs and improve its ability to identify top candidates. (While automated screening is common at many industries, most fabs haven't taken advantage of it.) After reviewing past résumés, it created an algorithm that identified the applicants who were most likely to be successful employees, as well as the 50 percent that were unlikely to be hired. When applied to incoming resumes, the algorithm picked out the top 5 percent of applicants and automatically passed them to the next screening stage. The bottom 50 percent were automatically rejected. The company is expected to increase hiring efficiency by 30 to 50 percent and will also improve its return on investment by 400 to 500 percent.

Indirect labor is as essential to semiconductor companies as silicon. But many businesses have little insight into the costs associated with the technical fields, engineering roles, support services, and R&D jobs that make up this vital function. With the continued rise of digital solutions, semiconductor companies can no longer afford to overlook this area when attempting to improve efficiency and productivity. If they continue to focus only on direct functions during cost-reduction efforts, they will soon fall behind competitors that undertake a more comprehensive approach to improving labor productivity. Although the best digital solutions will vary by company, a PEA analysis can be an important first step in helping semicos sort through the confusion and create a path forward, followed by advanced analytics, automation, and more sophisticated digital solutions.

Koen De Backer is an alumnus of McKinsey's Singapore office, where **Bo Huang** is an associate partner, **Matteo Mancini** is a partner, and **Amanda Wang** is a consultant.