White Paper

In-house electronics manufacturing

Planning a new in-house production facility or expansion of an existing one

Advantages, risks and the right approach for medium-sized OEMs

Dirk Kaussen, MBA
Founder and Managing Director, EMS Strategy Group
June 2026

Note on translation:

This white paper is a machine-translated version of the German original. Despite careful review, no guarantee is given for the correctness of the translation.

Executive Summary

The decision to manufacture electronic assemblies in-house or to expand existing internal production is one of the most strategically consequential decisions a medium-sized hardware company can make. It simultaneously affects cost structure, innovation capacity, data security, supply chain resilience, and regulatory compliance.

Supply chain crises, geopolitical tensions, and stricter requirements for transparency and ESG compliance have placed many OEMs in a situation long considered a theoretical risk scenario: complete production shutdowns due to the failure of a single external manufacturing partner. At the same time, the importance of data security and intellectual property has led to a reassessment of vertical integration – no longer solely from a cost perspective, but as a strategic management tool.

This white paper analyzes the key advantages and risks of in-house electronics manufacturing. It shows under what conditions in-house production is economically viable for medium-sized companies – and which planning parameters determine success or failure.

> **Key message**
> The crucial question is not whether a medium-sized company can afford its own production facilities. The question is whether it can strategically afford not to have any. Anyone who looks for the answer solely in a unit cost calculation will make the wrong decision.

1. The make-or-buy decision: More than just a question of cost

1.1 What's at stake

The classic make-or-buy analysis compares in-house production costs with external procurement prices. This is necessary, but not sufficient. The Fraunhofer Institute for Production Technology (IPT) emphasizes that a sound make-or-buy decision must, in addition to cost aspects, absolutely consider quality requirements, strategic areas of expertise, and business conditions.

Source: Fraunhofer IPT, Make-or-Buy Decisions. www.ipt.fraunhofer.de/de/angebot/technologiemanagement/make-or-buy.html

For electronics manufacturing in medium-sized companies, this means that the decision must be evaluated simultaneously on four levels. First, costs – total cost of ownership, not just the unit price. Second, competence – core competence or a capability that can be developed? Third, control – IP protection, data security, manufacturing quality. And fourth, strategy – supply chain resilience, regulatory compliance, market positioning.

1.2 Why this topic needs to be addressed now

The Reshoring Initiative's 2024 annual report documents that 88 percent of newly announced manufacturing jobs in the US were in high- or mid-tech sectors, led by the computer and electronics industry. Geopolitical tensions and supply chain disruptions have highlighted the risks of long supply chains—and prompted many companies to fundamentally rethink their production architecture.

Source: Reshoring Initiative, 2024 Annual Report Including 1Q2025 Insights, Sarasota FL, Juni 2025. www.reshorenow.org

2. The advantages of in-house electronics manufacturing

2.1 Protection of intellectual property and production data

Companies that outsource the manufacturing of electronic assemblies inevitably transfer sensitive production data: circuit diagrams, Gerber files, assembly programs, test procedures, and material specifications. In many cases, this gives the EMS partner a complete technical representation of the product. In a geopolitically tense environment, this is no longer an abstract risk.

The FBI's Internet Crime Complaint Center (IC3) documents $16.6 billion in reported damages from cybercrime in its 2024 Internet Crime Report – a 33 percent increase over the previous year. Manufacturing companies are among the most frequently targeted sectors, particularly by ransomware and targeted industrial espionage.

Source: FBI / Internet Crime Complaint Center (IC3), 2024 Internet Crime Report. ic3.gov/AnnualReport/Reports/2024_IC3Report.pdf (freely accessible)

In-house manufacturing means that production data never leaves the company. For companies with proprietary products, customer-specific designs, or safety-relevant electronics, this is not a minor issue, but a matter of survival.

2.2 Know-how building and speed of innovation

Manufacturing expertise is not just operational skill – it's strategic capital. Companies that outsource production exclusively for years gradually lose their understanding of what actually happens in their manufacturing processes. Designs are developed without regard for manufacturing realities, quality problems are only identified late, and new product generations take longer to develop.

The close integration of development and manufacturing – known as Design for Manufacturing (DfM) – is one of the most powerful drivers of innovation for hardware companies. Fraunhofer IPA's study on digitalization in SMEs has documented that companies with a close link between product and manufacturing expertise achieve measurably better quality and productivity results.

Source: Fraunhofer IPA, Digitalization in SMEs – Decision-making criteria and recommendations for action, commissioned by Südwestmetall. www.ipa.fraunhofer.de/de/Publikationen/studien/studie-digitalisierung-im-mittelstand.html (freely accessible)

2.3 Flexibility and reaction speed

An external EMS partner manufactures for many customers simultaneously. Capacity bottlenecks, the service provider's prioritization decisions, and rigid order cycles are structural limitations that can only be partially addressed through contractual agreements. In-house manufacturing enables rapid responses to market changes, immediate prioritization of critical orders, flexible batch sizes in high-mix production, and rapid prototyping without external coordination. For companies in dynamic markets—medical technology, defense, automation technology—this responsiveness is a significant competitive advantage that cannot be reflected in any unit price calculation.

2.4 Quality control and process sovereignty

Companies that outsource production delegate not only the manufacturing process but also quality control. Audits and quality agreements can ensure minimum standards, but they don't replace what in-house manufacturing offers: complete process transparency, continuous improvement, and direct root cause analysis for deviations. For companies with standards-bound products according to ISO 13485, IPC-A-610, IATF 16949, or defense standards, in-house manufacturing means the ability to fully control quality processes.

2.5 Supply chain resilience and strategic independence

IPC analyses show that the electronics industry was particularly hard hit by dependencies on Asian production and supply chain networks during the COVID-19 pandemic. In-house manufacturing eliminates a critical level of dependency: that of the manufacturing service provider itself. In the event of insolvency, capacity bottlenecks, or a strategic realignment of an EMS partner, in-house production does not come to a standstill.

Source: IPC, Global Sentiment of the Electronics Supply Chain, 2022/2023. www.ipc.org

2.6 Regulatory Compliance and ESG Documentation

CSRD, CSDDD, and CBAM require companies to provide increasingly detailed documentation of their supply chains and production processes. The crucial difference for in-house manufacturing lies in the manufacturing process data itself: energy consumption of the in-house line, process chemicals, scrap rates, and process parameters are readily available. With external EMS partners,

this data must first be requested – and is often incomplete or not provided in the format required for reporting.

3. The risks and challenges of in-house manufacturing

It would be dishonest to write this white paper without clearly outlining the significant challenges of in-house electronics manufacturing. The following points are not reasons to abandon in-house production – but they are planning parameters that should not be underestimated.

3.1 Capital intensity and investment risk

Setting up a modern SMT production line requires significant investment. Depending on the level of automation, investments of between €500,000 and several million euros should be planned for a complete basic setup – paste printer, placement machine, reflow oven, AOI, test systems – in addition to infrastructure, building modifications, and IT systems. With sufficient volume and a stable product architecture, amortization periods of four to seven years are realistic.

Source: EMS Strategy Group, assessment based on market observations and investment analyses 2026.

3.2 Lack of manufacturing know-how

The most frequent reason for the failure of in-house manufacturing projects is not the technology, but a lack of process knowledge. Electronics manufacturing is a complex craft that requires experience in soldering process parameters, printed circuit board design rules, component handling, test development, and quality management systems. Building competence through targeted recruitment, structured training programs, and external support during the start-up phase is not an optional step, but a fundamental prerequisite for success.

3.3 Personnel costs and skills shortage

In-house manufacturing requires qualified specialists: process engineers, quality assurance personnel, machine operators, and maintenance staff. The German Federal Employment Agency recorded approximately 700,000 job vacancies in Germany in mid-2024 – across all sectors, with a particular focus on technical professions. SMT Today reports that talent shortages and rising personnel costs will be among the key challenges facing European EMS companies in 2025. Automation is therefore not only a productivity factor but also a direct response to the skills shortage.

Source: Federal Employment Agency, Labor Market Statistics, mid-2024. | SMT Today, Top 7 Challenges Confronting European EMS in 2025, April 2025. www.smttoday.com

3.4 Technological Complexity

Electronics manufacturing is constantly evolving: miniaturized components, complex circuit board architectures, lead-free soldering processes with narrow parameter windows. Underestimating this complexity risks persistent quality problems and high scrap rates. The complexity of the product to be manufactured must be carefully aligned with the planned production resources.

3.5 Opportunity Costs and Management Focus

Setting up and operating an in-house production facility ties up considerable management resources. For companies whose core competencies lie in product development or systems integration, there is a risk that manufacturing tasks will burden these core areas. The counter-question is valid: What are the strategic costs of not having this control?

> **Honest assessment: Not every business is a candidate.**
> There are companies for whom in-house manufacturing is not economically viable: manufacturers of high-volume consumer products in extremely price-sensitive markets, companies without a stable product architecture and without predictable production volumes,

> and businesses that cannot manage the setup in a structured manner, either internally or with external support. This needs to be clearly stated.

4. When does in-house manufacturing become worthwhile for medium-sized businesses?

4.1 Good candidates

Proprietary designs and safety-relevant products: Companies whose circuit concepts or manufacturing processes are part of the core technological knowledge – especially in medical technology, defense, industrial control technology and measurement technology.

Standards-compliant manufacturing with the highest quality requirements: Wherever ISO 13485, IPC-A-610 or defense standards require complete process control and seamless traceability.

High reaction speed as a competitive advantage: Companies with frequent design changes or project-specific variants, where external order cycles slow down market speed.

Stable production volume: The profitability of in-house manufacturing depends entirely on capacity utilization. Companies with predictable volumes and a stable product architecture have a structural advantage here.

4.2 The hybrid manufacturing model: The reality in medium-sized businesses

The majority of medium-sized hardware companies that successfully operate their own manufacturing facilities do not do so as a complete replacement for external EMS partners – but rather as a strategic complement. Three models have proven successful in practice.

Model A: Prototypes and pilot series are produced in-house, while large-scale production is handled by the EMS partner. The company retains full design control and rapid iteration cycles, while standard volumes remain economically outsourced.

Model B: Core products in-house, commodities external. Safety-relevant or high-margin products are manufactured in-house – the limited in-house capacity is used where quality control and IP protection are most important.

Model C: In-house production as a benchmark and reference for external EMS partners. Those who manufacture themselves know what is achievable – and can manage and audit service providers accordingly.

5. The right planning process

In-house manufacturing projects rarely fail due to the wrong decision. They often fail due to an unstructured process and underestimated start-up difficulties.

5.1 Phase 1: Strategic Validation

Before any investment decision, three fundamental questions must be answered: Which products are suitable for in-house production? What are the actual costs over five years – including all investment, personnel, operating, and opportunity costs? And which production line concept and level of automation are realistically achievable? Fraunhofer IPT explicitly recommends not conducting this validation exclusively internally to avoid tunnel vision.

5.2 Phase 2: Production Architecture and Setup

The production architecture must be defined before the investment decision, not after. This includes line design and layout, selection of manufacturing equipment and test systems, IT infrastructure – MES, ERP integration, quality data systems – as well as the development of the quality management system. A process-oriented architecture ensures that defined processes function reliably and consistently in real-world operations.

5.3 Phase 3: Production start-up and stabilization

The most critical moment for a new in-house production facility is the start-up phase. This is when everything comes together: process quality, personnel qualifications, material procurement, and interface management between development and production. A structured NPI (New Product Introduction) process is essential. Series production is considered stable when defined quality indicators are consistently achieved over several production runs. In practice, this phase often lasts longer than planned.

5.4 Phase 4: Ongoing Optimization

Stability in series production is not achieved through one-off measures – it must be actively maintained. Regular process audits, performance monitoring, supplier development, and the gradual integration of automation solutions as volumes increase are the tools for consistently high-performing in-house manufacturing.

6. Automation as the key to economic efficiency

A high-cost location like Germany or Western Europe can be operated economically if automation is consistently implemented. The International Federation of Robotics (IFR) documents in its press release on the World Robotics Report 2024 that 4,281,585 industrial robots are in use in factories worldwide – an all-time high. Europe's level of automation in the electronics industry is significantly above the global average.

Source: International Federation of Robotics (IFR), Press Release World Robotics 2024, September 2024. ifr.org/ifr-press-releases/record-of-4-million-robots-working-in-factories-worldwide (freely accessible)

Automation is not an option for later expansion phases – it must be integrated into the manufacturing architecture from the outset. Anyone planning a manual line because it initially seems cheaper is building on the wrong foundation. This investment trend is structurally and permanently changing the cost structure of European manufacturing.

7. Conclusion: In-house manufacturing as a strategic instrument

The decision to manufacture electronics in-house is not a decision against external EMS partners. It is a decision for operational sovereignty, strategic control, and technological expertise.

For medium-sized hardware companies with proprietary products, sensitive data, and high quality requirements, in-house manufacturing – if properly planned and implemented – can be a sustainable competitive advantage. Profitability is achievable, but it doesn't happen automatically. It must be earned through sound planning, consistent automation, and realistic start-up support.

Companies that approach this path in a structured manner will increase their production quality, make their supply chains more stable, meet their compliance requirements more efficiently, and accelerate their innovation. This is not a strategic hope. This is an operational reality.

> **Final recommendation**
>
> Don't start by asking whether in-house manufacturing is more expensive than outsourcing. Start by asking what it costs your company when your most important manufacturing partner can't deliver for three months—and what it costs when your core technological expertise leaves the company. These answers are the true starting point for any serious decision about in-house manufacturing.

List of sources

All sources listed below are publicly accessible without registration or paywall, unless explicitly marked as "EMS Strategy Group assessment".

Those	Title / Description	Access
Fraunhofer IPT	Make-or-buy decisions. ipt.fraunhofer.de/de/angebot/technologiemanagement/make-or-buy.html	Free [Originally published in German / In deutscher Originalfassung erschienen]
Fraunhofer IPA	Digitalization in SMEs – Decision-making criteria and recommendations for action, commissioned by Südwestmetall. ipa.fraunhofer.de	Free [Originally published in German / In deutscher Originalfassung erschienen]
Reshoring Initiative	2024 Annual Report Including 1Q2025 Insights. Sarasota FL, Juni 2025. reshorenow.org/june-9-2025/	Free (Summary)
FBI / IC3	2024 Internet Crime Report. ic3.gov/AnnualReport/Reports/2024_IC3Report.pdf	Friar (PDF)
IFR	Press release World Robotics 2024, September 2024. ifr.org/ifr-press-releases/record-of-4-million-robots-working-in-factories-worldwide	Free
IPC	Global Sentiment of the Electronics Supply Chain, 2022/2023. ipc.org	Free
SMT Today	Top 7 Challenges Confronting European EMS in 2025, April 2025. smttoday.com	Free
Federal Employment Agency	Labor market statistics 2024 – job vacancies in Germany, mid-2024. arbeitsagentur.de	Free
EMS Strategy Group	Assessment of investment costs and payback periods (Chapter 3.1); assessment of automation trends (Chapter 6). Based on market observations from 2026.	Intern

About the author

Dirk Kaussen is the founder and CEO of EMS Strategy Group. He has around 40 years of experience in the electronics industry, founded his own electronics manufacturing company in Germany, and brings in-depth expertise in manufacturing processes, EMS partner selection, supply chain stability, relocation, and risk management. His approach combines practical solutions with direct relevance to industrial realities.

About the EMS Strategy Group

The EMS Strategy Group supports industrial companies in the strategic and operational development of their electronics manufacturing. Key areas of focus include migrating production to European EMS providers, building new capacities, expanding existing structures, and securing supply chains through risk analyses, dual sourcing, and comprehensive supply chain concepts. Operational support extends to the ramp-up of series production. The focus is on practical relevance, feasibility, and the industrial realities of electronics manufacturing.

www.emssg.com | LinkedIn: Dirk Kaussen