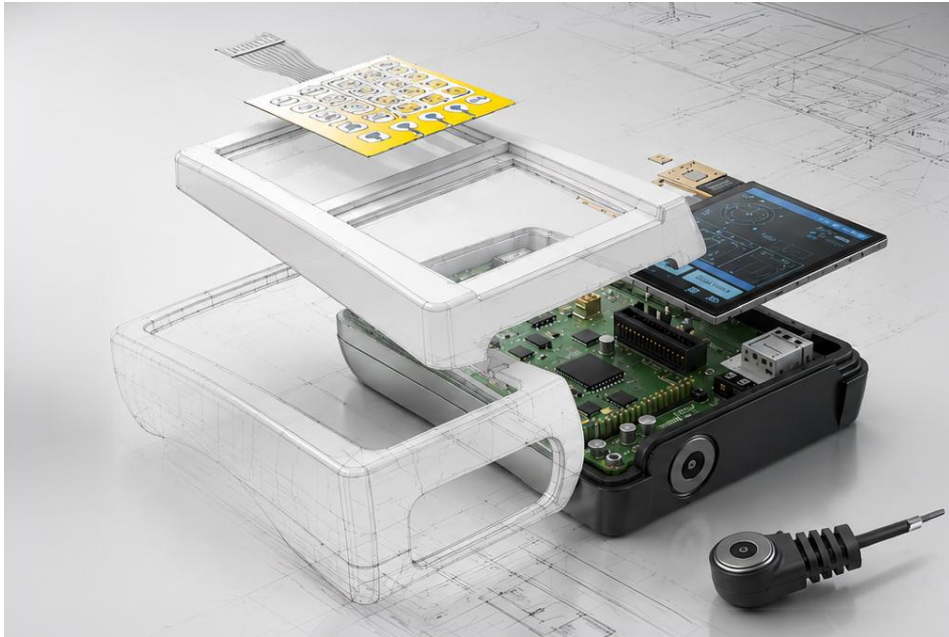


HMI components from a single source: Fewer interfaces, lower total cost

Why the most cost-effective solution is rarely made up of the cheapest individual components



When developing new devices and systems, designers and technical buyers often face the same challenge: components must be technically suitable, cost-effective to procure, and available over the long term. In many projects, the initial focus is on the costs of individual components. Plastic housings, membrane keypads, cable assemblies, and connectors are sourced separately and compared with one another.

What appears at first glance to be a cost-effective approach, however, often leads to higher overall costs in practice. This is because the component price alone accounts for only a small portion of the actual project costs. Development expenses, coordination processes, logistics, quality management, and assembly often have a significantly greater impact on a project's cost-effectiveness than the costs of individual components.

For many manufacturers, therefore, the focus is increasingly shifting toward the Total Cost of Ownership (TCO).

From individual parts to a system-level view

A typical HMI control unit consists of numerous components. These include, for example, a plastic housing, a membrane keypad or silicone rubber keypad, displays, cable assemblies, connectors, and electronic assemblies.

If these components are procured independently of one another, numerous interfaces arise: different points of contact, varying development cycles, separate approval processes, multiple tooling suppliers, differing quality standards, and additional logistical effort. Each of these interfaces creates additional work. Development departments must align technical requirements, coordinate prototypes, and communicate changes. Purchasing manages multiple suppliers, orders, and delivery dates. At the same time, the risk of misunderstandings and schedule delays increases.

The more complex a project becomes, the greater the impact of these indirect costs on the overall cost calculation.

The Hidden Costs of Distributed Supply Chains

In many companies, the costs of individual components are analyzed in detail. In contrast, assessing indirect project costs is significantly more difficult.

Typical cost drivers include:

- **Development effort**
If the housing, keyboard, and cables are developed separately, interfaces must be coordinated multiple times. Changes to one component can affect other assemblies.
- **Prototyping and approval processes**
Each supplier creates its own prototypes and documentation. Technical testing and approval occur multiple times.
- **Quality management**
When components from different manufacturers are combined, root cause analysis becomes complex when problems arise. Responsibilities are not always clearly defined.
- **Logistics and warehousing**
Multiple suppliers mean additional orders, goods receipts, delivery dates, and safety stock.
- **Assembly Costs**

Components developed independently of one another are not necessarily optimally coordinated. Additional assembly steps increase the manufacturing effort.

Especially for small and medium-sized production runs, these indirect costs can account for a significant portion of the total costs.

Developing HMI Systems Holistically

An alternative approach is to consider HMI components as a complete system right from the development phase.

If plastic enclosures, membrane keypads, silicone rubber keypads, cable assemblies, and connectors are developed together, many opportunities can be leveraged early on.

For example: The housing and keypad can be optimally matched Assembly processes can be simplified Cable routing can be reduced Fasteners can be eliminated Component tolerances can be better accounted for Tooling concepts can be designed more economically This results in solutions that not only function technically but can also be produced and assembled more easily.

Design for Manufacturing as a Cost Lever

A product's key costs are determined as early as the design phase. Changes in later project phases are often significantly more expensive than early optimization.

This is why the so-called Design for Manufacturing approach is gaining increasing importance.

In this approach, manufacturing, assembly, and logistics aspects are taken into account as early as the product development phase.

Typical optimizations include:

- Reducing the number of parts, simplifying assembly processes, and integrating multiple functions into a single component
- Avoiding unnecessary tools
- Improving serviceability
- Optimizing packaging and transport.

Significant cost-saving potential can be realized in this way, particularly for customer-specific HMI assemblies.

- Shorter development times due to fewer interfaces
- In addition to direct costs, time-to-market is also playing an increasingly important role.
- Delays in product development often lead to missed market opportunities, postponed product launches, and additional development costs.
- When coordinating multiple suppliers, coordination processes inevitably become longer. Changes must be communicated and evaluated multiple times.
- A central development partner, on the other hand, can consolidate many of these processes.
- Technical decisions are made faster, prototypes are coordinated more efficiently, and changes are addressed early on. This shortens development time and reduces project risk.

Quality begins in development

Quality does not begin in production. It is defined as early as the concept and development phase. When all components of an HMI assembly are considered together, potential weak points can be identified early on.

For example: Sealing concepts can be optimized EMC requirements can be taken into account Stresses caused by temperature or vibration can be evaluated Operating forces can be coordinated Material combinations can be tested The result is more robust and durable products with lower failure and complaint rates.

Conclusion

In the development of modern devices and systems, the economic success of a project is no longer determined solely by the price of individual components. Development costs, supply chains, assembly processes, quality management, and time-to-market often influence the total cost more significantly than the mere calculation of component costs. Those who view plastic enclosures, membrane keypads, cable assemblies, and other HMI components in isolation risk additional coordination efforts, longer development times, and higher process costs.

A holistic approach offers significant advantages here. If HMI components are developed as an integrated system as early as the concept phase, interfaces can be reduced, assembly processes simplified, and technical requirements coordinated at an early stage. This not only lowers the total cost of ownership but also enhances the quality and reliability of the final solution.

As a development partner for custom HMI components, N&H Technology supports customers from the initial concept through to series production. The range of services includes plastic enclosures, membrane keypads, silicone rubber keypads, cable assemblies, magnetic connectors, and complete electromechanical assemblies.

By combining these competencies, we create integrated solutions that take technical requirements, manufacturability, and cost-effectiveness into account in equal measure. After all, the most cost-effective solution is rarely the sum of the cheapest individual components—but rather a well-thought-out system solution that takes all aspects of the product lifecycle into account.

Info Box: 10 Questions for Selecting an HMI Concept

The earlier key requirements are defined, the lower the development risks and subsequent change costs. The following questions help in selecting a suitable HMI concept:

1. Under what environmental conditions will the device be used (temperature, humidity, dust, UV radiation, chemicals)?
2. Will the control device need to be operated while wearing gloves or under difficult operating conditions?
3. Are physical buttons required, or is touch operation sufficient?
4. What protection rating (e.g., IP54, IP65, or IP67) must be achieved?
5. Is backlighting or a status indicator required?
6. What are the requirements for haptics and ease of use?
7. What service life and number of actuation cycles are expected?
8. Should the housing, keyboard, display, and electronics be developed as individual components or as an integrated assembly?
9. What production volumes are planned, and how do they affect tooling and manufacturing costs?
10. How do the supply chain, assembly costs, and service impact the Total Cost of Ownership (TCO)?