



WHITEPAPER 20

The True Cost of a Panel PC

A Total-Cost-of-Ownership Model for Industrial Deployments

Comparing acquisition, integration, downtime, maintenance and lifecycle risk



A practical purchasing and engineering model for acquisition cost, customisation, deployment, field failure, software maintenance, obsolescence and supplier support.



Created by Crystal Display Systems Limited

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Executive summary

Panel PC procurement often focuses on the quoted unit price because it is immediate and precise. Integration engineering, installation labour, downtime, software maintenance, spares and obsolescence are less visible but frequently larger over the deployment life.

A defensible TCO model defines its boundary, assigns monetary values and uncertainty ranges, and compares architectures under the same mission and service assumptions. Sensitivity analysis shows where higher initial cost actually reduces programme risk.

Core recommendation

Choose on delivered and supported lifetime cost. At low consequence and easy access, COTS may win; as downtime, environment, volume or lifecycle obligation increases, rugged, custom or modular designs usually become economically stronger.

How to use this whitepaper

- Use the requirement table to convert panel PC total cost expectations into measurable pass/fail criteria.
- Use the comparison matrix to shortlist architectures without allowing one headline specification to dominate.
- Apply the weighted scorecard using the actual operating environment, duty cycle and commercial lifecycle.
- Validate the preferred approach in the final mechanical, optical, electrical and software implementation.

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Key decision principles

- Compare delivered, qualified and supported cost over the required life, not purchase price alone.
- Convert integration engineering, downtime and field service into explicit monetary assumptions.
- Value stable mechanics, software images and lifecycle support where they avoid repeated requalification.
- Model failure and obsolescence as probability ranges rather than pretending they are zero.
- Run sensitivity analysis to identify which assumptions actually change the procurement decision.

1. Define the cost boundary and deployment mission before comparing unit prices

A useful TCO model states quantity, years, environment, integration scope, labour, downtime consequence, failure range, software support, spares, obsolescence and discount assumptions. Without a common boundary, quotations are not comparable.

Requirement domain	Questions to resolve
Deployment scale	Unit quantity, sites, labour rate, logistics, installation window, commissioning time and spares pool.
Integration scope	Mechanical cut-out, cables, I/O, OS image, drivers, application port, touch tuning, EMC, environmental and regulatory work.
Operating cost	Energy, cleaning, calibration, remote support, software licences, connectivity and planned maintenance.
Failure consequence	Downtime cost, service travel, diagnosis time, replacement time, data recovery, lost production and safety/quality impact.
Lifecycle	Availability, PCN/EOL, OS/security support, spares, repair, form-fit replacements, requalification and platform refresh.
Commercial assumptions	Discount rate, warranty, supplier response, MOQ, lead time, inventory, currency, forecast uncertainty and residual value.

A practical weighting model

Assign each criterion a weight from 1 (low importance) to 5 (critical). Score each candidate from 1 (poor fit) to 5 (strong fit), then multiply score by weight. The arithmetic does not replace engineering judgement, but it exposes where the procurement and lifecycle architecture depends on assumptions, incomplete test evidence or optimistic supplier data.

Do not average away a fatal constraint

A candidate that fails a non-negotiable requirement for panel PC total cost should be removed before weighted scoring. Typical fatal constraints include unsafe operation, an unachievable environmental limit, incompatible interfaces, unacceptable field reliability or no credible supply route.

Recommended process

- Set pass/fail gates for the mandatory panel PC total cost requirements before comparing desirable features.
- Agree criterion weights with electronics, mechanical, software, product, service and procurement stakeholders.
- Score only from controlled data, supplier evidence or representative testing; mark unknowns explicitly.
- Run sensitivity checks by changing the highest weights and identifying whether the preferred architecture changes.
- Document assumptions, test conditions and revision status so the decision can be revisited after a component or firmware change.

2. Panel PC procurement and lifecycle architectures

2.1 Low-cost commercial/COTS panel PC

A commercial unit can minimise initial price and lead time. It may use short-cycle components, consumer connectors or limited environmental design. The economic case depends on benign conditions, easy replacement and low downtime consequence.

- Strengths: lowest acquisition cost, broad availability and fast procurement.
- Limitations: short lifecycle, limited customisation, higher field/environment risk and repeated mechanical/software changes.
- Best fit: indoor low-consequence deployments with easy access and short programme life.

2.2 Standard rugged industrial panel PC

An industrial platform adds metal construction, wider temperature, industrial I/O, long-life components, controlled images and support. Higher unit cost can be offset by lower integration, failure and obsolescence exposure.

- Strengths: predictable integration, environmental margin, support and longer availability.
- Limitations: higher purchase price and possible feature/cost overhead for simple applications.
- Best fit: factory, transport, energy and continuous-use systems with meaningful downtime cost.

2.3 Custom integrated panel PC

A customised system can optimise connectors, sealing, display, touch, branding, compute and mounting for the application. Non-recurring engineering and qualification increase upfront cost, but deployment labour and field interfaces can be reduced.

- Strengths: best fit, reduced installation complexity and potential elimination of adapters/enclosures.
- Limitations: NRE, tooling, supplier dependency and change-control obligations.
- Best fit: medium/high volume or high-value equipment where integration and field service dominate.

TCO boundary

State which costs are included: engineering labour, certification, fixtures, deployment, spares, downtime, software support and end-of-life action. Different boundaries can reverse the apparent winner.

2.4 Modular serviceable architecture

A separable display, compute module, storage and I/O design can reduce repair time and allow staged upgrades. Extra connectors and parts raise initial cost but can lower spares and downtime.

2.5 Build-your-own display plus computer

A separate monitor and boxed PC can provide flexibility, service access and independent upgrades. It increases cabling, mounting, power and integration items but may be optimal when heat or serviceability favour separation.

3. Comparative decision matrix

Criterion	Commercial COTS	Rugged standard	Custom integrated	Modular / split
Acquisition price	Excellent	Moderate	Limited	Limited
Integration effort	Moderate	Excellent	Excellent	Moderate
Environmental reliability	Limited	Excellent	Excellent	Excellent
Deployment labour	Moderate	Strong	Excellent	Moderate
Downtime / service	Limited	Strong	Strong	Excellent
Software image stability	Limited	Excellent	Excellent	Strong
Lifecycle continuity	Limited	Excellent	Strong	Excellent
Custom fit	Limited	Moderate	Excellent	Excellent
Upgrade flexibility	Limited	Moderate	Moderate	Excellent
Cost predictability	Moderate	Excellent	Strong	Strong

Indicative only. Actual performance depends on the complete system architecture, supplier implementation, environmental conditions and validation method.

Example weighted scorecard

Criterion	Weight	Commercial COTS	Rugged standard	Custom integrated
Unit acquisition	3	5	3	2
Integration / certification	4	2	5	5
Downtime consequence	5	2	5	5
Harsh environment	5	2	5	5
Seven-year availability	5	2	5	4
Deployment labour	3	3	4	5
Volume 1,000 units	4	5	4	5
Weighted total		82	132	131

For this 1,000-unit harsh-environment deployment, the custom integrated panel PC leads because integration, downtime and deployment carry more weight than acquisition price. A rugged standard unit is close and may win at lower volume; commercial COTS is inexpensive only at the purchase-order boundary.

Reading the result

- Commercial COTS is rational when environment, access and downtime consequence are genuinely low and replacement churn is acceptable.
- Rugged standard systems often provide the best balance at modest volume by avoiding NRE while reducing lifecycle risk.
- Custom integration wins when repeated installation items, service time or high deployment volume amortise engineering and tooling.

4. Engineering trade-offs that change the answer

4.1 Purchase price is usually the easiest number and the least complete

Add accessories, cables, storage, OS, mounting, power supply, customs, test and commissioning before comparing delivered cost.

4.2 Engineering cost recurs when the platform changes

A low-cost unit with short availability can require repeated mechanical, driver, image and certification work. Model change frequency and engineering labour.

4.3 Downtime cost is application specific

A one-hour replacement may cost little in a kiosk and thousands in a production line or remote asset. Include diagnosis, travel, access and restart validation.

4.4 Failure rate needs a range, not a precise guess

Use optimistic/base/pessimistic scenarios for annual failure, no-fault-found returns and repair yield. Sensitivity often reveals whether reliability dominates.

4.5 Software support can exceed hardware cost

OS licences, security patches, application maintenance, remote management and image validation continue throughout deployment.

4.6 Spares and obsolescence interact

Holding spares reduces downtime but creates inventory and shelf-life exposure. Stable form/fit and modular replacement reduce both risks.

5. Application-led recommendations

Low-consequence indoor kiosk

Commercial or standard industrial hardware may be adequate. Use rapid swap and remote imaging to control service cost.

Factory line control

Prioritise reliability, long availability, stable image and local spares. Downtime usually overwhelms modest unit-price differences.

Remote outdoor deployment

Custom or rugged systems with telemetry, sealing and easy module replacement reduce travel and diagnosis cost.

OEM machine at medium volume

Customised connectors, bezel and software image can reduce assembly time and field wiring enough to justify NRE.

Long-life regulated instrument

Value configuration control, PCN/EOL, security support and requalification avoidance explicitly in the TCO model.

6. Qualification and sourcing checklist

	Area	Verification action
☐	Cost boundary	List acquisition, accessories, NRE, certification, deployment, operation, support, failure, spares and end-of-life costs.
☐	Assumptions	Record volume, years, labour rates, failure ranges, downtime, energy, discount rate and forecast confidence.
☐	Integration	Estimate mechanical, electrical, software, EMC, environmental and regulatory work for each candidate.
☐	Reliability	Use field evidence or justified scenarios for failures, diagnosis, repair and no-fault-found returns.
☐	Lifecycle	Model PCN/EOL, stock, replacement qualification, OS/security support and platform refresh.
☐	Operations	Include energy, licences, connectivity, cleaning, calibration, remote management and planned maintenance.
☐	Sensitivity	Vary the largest uncertain inputs and identify break-even points between architectures.
☐	Governance	Assign owners to update actual cost and field data after pilot and deployment.

Questions to ask a display partner

- What items and engineering work are excluded from the quoted unit price?
- What field reliability, warranty and repair-turnaround evidence supports the model?
- How long are mechanics, processor, OS image and critical I/O expected to remain stable?

- What supplier support, PCN/EOL notice, stock and replacement qualification are included?
- What installation and swap time has been demonstrated with representative technicians?
- Which assumptions drive the decision and at what break-even value does another option win?

Minimum evidence pack for design approval

- Controlled TCO spreadsheet/model with stated boundary, currency and time horizon.
- Candidate BOM/quotation including accessories, NRE, licences, tooling and support.
- Integration and qualification work breakdown with labour assumptions.
- Reliability, service, downtime and spares assumptions with evidence/ranges.
- Lifecycle/OS/security support and obsolescence response plan.
- Sensitivity analysis, pilot actuals and approval record for the chosen architecture.

7. Beyond static procurement spreadsheets

TCO management can improve as field, energy and lifecycle data replace assumptions. The model should remain transparent and decision-focused rather than becoming a complex but unauditable financial exercise.

Fleet telemetry

Temperature, uptime, errors and energy data can refine failure and maintenance assumptions. Collection cost, privacy and action thresholds matter.

Predictive spare positioning

Failure patterns and logistics can optimise regional spares. Models need enough data and should preserve contingency for common-cause events.

Modular upgrade economics

Compute, storage or display modules can extend system life. Connector wear, qualification and inventory of multiple modules must be included.

Circular repair and refurbishment

Repairable designs can lower cost and waste, but require parts, diagnostics, data erasure and quality controls.

Contracted lifecycle services

Supplier stock, repair and change-management agreements can transfer some risk. Service levels, exclusions and financial stability must be evaluated.

Adoption gate

A new commercial or service model should enter the programme only when responsibilities, exclusions, lifecycle obligations and measurable service outcomes are explicit and the TCO assumptions can be audited.

8. Working with Crystal Display Systems

Crystal Display Systems Limited supplies standard and bespoke industrial panel PCs, embedded computers and complete display assemblies with customisation, technical integration, lifecycle support, stock options and engineering assistance from concept through production.

Relevant CDS resources

Resource	Purpose
<u>Industrial Panel PC Solutions</u>	Integrated industrial HMI and panel PC solutions with customisation options.
<u>Industrial Panel PC Range</u>	Current panel PC platforms, processors, I/O and rugged configurations.
<u>Bespoke All-In-One Panel PCs</u>	Examples of fully customised, IP-rated and application-specific systems.
<u>Industrial Boxed PCs and Panel PCs</u>	Industrial computing platforms, customisation and long-life support.
<u>Industrial Automation Displays</u>	Display, monitor and computing solutions for automation and machine HMI.
<u>CDS Knowledge Centre</u>	Display guides and technical training documents.
<u>Request a Quote</u>	Submit project requirements for technical and commercial review.
<u>Contact CDS</u>	Contact details and enquiry routes.

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Conclusion

The true cost of a panel PC is the sum of purchase, integration, deployment, operation, failure, software and lifecycle change. The lowest unit price can be the highest programme cost when downtime, requalification or short availability dominate. A useful model states assumptions, uses ranges and identifies the break-even factors that matter to the actual deployment.

Final engineering rules

- Define the TCO boundary and service life before comparing quotations.
- Convert engineering, installation, downtime and support into explicit assumptions.
- Model failure, obsolescence and demand uncertainty with ranges.
- Value stable configuration, modular repair and supplier lifecycle support.
- Update the model with pilot and field data and rerun sensitivity analysis.

Disclaimer

This whitepaper provides general engineering guidance and does not replace application-specific design review, supplier specifications, regulatory assessment or formal product qualification. Performance depends on the exact components, implementation, environment and usage profile.