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Design Assurance – Protecting the Airport Owner

Independent Engineering Confidence Across the Airport Project Lifecycle

A Practical Guide to Independent Design Assurance
for Modern Airport Projects

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Purpose and Audience

This technical paper examines Design Assurance as a core discipline for protecting the Airport Owner throughout the planning, design, implementation and acceptance of modern airport projects. It is written for Airport Owners, Airport Operators, programme directors, designers, contractors, system suppliers and independent assurance teams responsible for developing, reviewing or accepting airport systems and infrastructure.

The paper is intentionally practical. It explains why Design Assurance should begin with operational requirements, how independent engineering judgement supports informed decisions, how requirements and design changes should remain traceable, and why assurance must continue through implementation, testing and operational acceptance.

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Executive Summary

Modern airport projects bring together a large number of specialist systems, designers, contractors, suppliers and operational stakeholders. Each may be responsible for a particular element of the airport, but the Airport Owner ultimately carries the operational and commercial consequences if the completed facility does not perform as intended.

Design Assurance provides the independent engineering oversight necessary to give the Airport Owner confidence that the developing design remains aligned with the agreed operational requirements throughout the project lifecycle.

Design Assurance should not be regarded simply as a review of completed drawings, specifications or technical submissions. By the time a project reaches detailed design, many fundamental decisions concerning operational processes, system selection, architecture, interfaces, infrastructure and procurement may already have been made. Correcting deficiencies at this stage can be difficult, expensive and disruptive to the programme.

For this reason, Design Assurance should begin with the operational requirements and continue through concept design, design development, detailed design, implementation, testing and verification, and ultimately operational acceptance.

The purpose of Design Assurance is not to redesign the work of the appointed designer, nor is it to prove that the designer or supplier is wrong. Its purpose is to independently assess whether the developing solution remains complete, coordinated, technically appropriate and capable of satisfying the Airport Owner's agreed requirements.

This requires more than checking technical compliance. A solution may comply with an individual specification while still introducing operational limitations, integration risks, unnecessary lifecycle costs or dependencies that may restrict the Airport Owner in the future. Design Assurance must therefore consider the design as part of the wider airport operational environment.

Independent engineering judgement is fundamental to this process. Where alternative solutions are proposed, the Airport Owner should be provided with a clear understanding of the associated technical, operational, integration, commercial and lifecycle risks. The objective is not necessarily to eliminate every risk, but to identify and understand those risks sufficiently for informed decisions to be made.

Design Assurance also provides an important connection between design and implementation. Requirements, assumptions, interfaces and design decisions established during the earlier project stages must remain traceable as the project develops and must ultimately be demonstrated through testing and verification before operational acceptance.

Within Master Systems Integration, Design Assurance therefore provides a continuing line of independent oversight from the original operational requirement through to the delivered airport.

To deliver an airport that satisfies the agreed operational requirements and can be operated, maintained and developed throughout its intended lifecycle.

1. Introduction

Airport projects are complex environments in which operational requirements must ultimately be translated into buildings, infrastructure, systems, interfaces and operational processes that function together as a complete airport.

Responsibility for delivering these elements is normally distributed across numerous designers, consultants, contractors, specialist suppliers and stakeholders. Each organisation may produce a technically competent design within its own area of responsibility, but this does not necessarily demonstrate that the overall solution will satisfy the operational requirements of the Airport Owner and Airport Operator.

This is where Design Assurance becomes important.

Design Assurance provides independent oversight of the developing design on behalf of the Airport Owner. Its purpose is to determine whether the design continues to satisfy the agreed operational requirements,

remains coordinated with other disciplines and can reasonably be expected to deliver the required operational outcome.

Importantly, Design Assurance should begin at the start of the project.

The operational requirements established with the Airport Owner and Airport Operator provide the foundation against which the subsequent design can be assessed. If these requirements are incomplete, unclear or do not adequately reflect the intended airport operation, the design may progress successfully against the wrong assumptions.

As the project develops through concept design, design development and detailed design, decisions are progressively made concerning system architecture, capacity, interfaces, infrastructure, resilience, cybersecurity, maintainability and future expansion. Each decision has the potential to influence other systems and disciplines within the airport.

Design Assurance therefore needs to follow the design throughout its development rather than being applied as a final technical review.

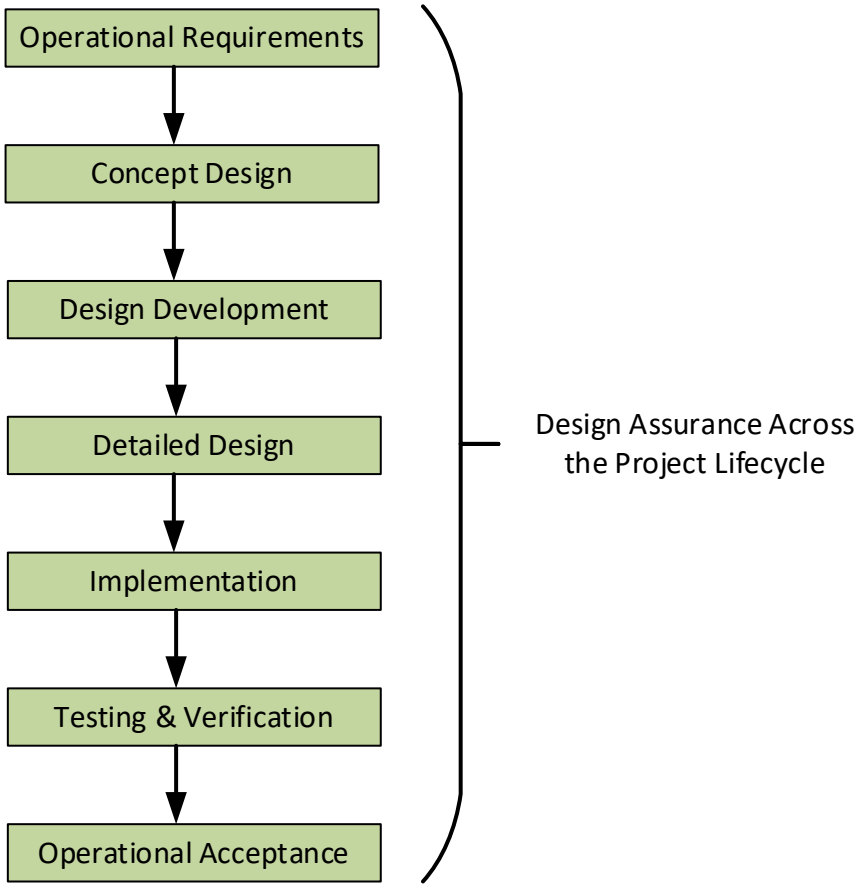


Figure 1 – Design Assurance Across the Airport Project Lifecycle

Figure 1 illustrates this principle. Design Assurance continues from the establishment of the operational requirements through concept design, design development, detailed design, implementation, testing and verification, and ultimately operational acceptance.

The nature of the assurance activity will change as the project progresses. At concept stage, the emphasis is on whether the proposed solution can support the required airport operation. During design development and detailed design, the focus increasingly moves towards coordination, interfaces, technical compliance

and implementation. During testing and verification, the emphasis becomes demonstrating that the delivered solution satisfies the agreed requirements.

Design Assurance should not, however, become a parallel design organisation.

The appointed designers and suppliers remain responsible for their designs, calculations, technical submissions and contractual deliverables. The Design Assurance function independently reviews the developing solution, identifies concerns, challenges assumptions where necessary and provides the Airport Owner with an informed assessment of the associated risks.

This distinction is important. If the assurance team begins redesigning the project, responsibility can become unclear and the independence of the assurance process can be weakened.

The objective is therefore not to tell designers how to perform their design, but to establish whether the proposed design provides sufficient evidence that the Airport Owner's requirements will be satisfied.

An independent line of sight from the original operational requirement to the solution ultimately delivered and accepted into operation.

2. Why Design Assurance is Needed

The need for Design Assurance arises from a fundamental characteristic of airport projects: no individual designer or supplier is responsible for the complete operational airport.

Design responsibility is distributed across multiple organisations and technical disciplines. Each may demonstrate that its own design satisfies its contractual requirements, but the Airport Owner requires confidence that these individual solutions will operate together as a coordinated whole.

A technically compliant system can still create problems elsewhere in the airport. Its infrastructure requirements may not have been coordinated with another discipline. Its interfaces may depend upon information that another system does not provide. Its proposed architecture may restrict future expansion. A technically acceptable solution may also introduce unnecessary operational complexity or lifecycle cost.

These issues frequently occur at the boundaries between responsibilities rather than within an individual system.

Design Assurance therefore needs to consider not only whether individual designs comply with their requirements, but also whether the relationships between systems, disciplines and operational processes have been adequately identified and coordinated.

2.1 Identifying Problems Early

The earlier a design issue is identified, the greater the opportunity to resolve it before it affects procurement, construction, installation or commissioning.

During concept design, changing an architectural approach or system requirement may involve relatively limited effort. Once equipment has been procured, infrastructure constructed and software configured, the same change may have significant commercial and programme consequences.

Design Assurance should therefore seek to identify concerns while the design can still be changed without unnecessary disruption.

This does not mean attempting to eliminate every project risk. Airport projects will always contain technical, operational and commercial risks. The purpose of Design Assurance is to ensure that significant risks are visible, understood and appropriately considered before decisions become difficult or expensive to reverse.

2.2 Protecting the Operational Requirement

One of the greatest risks during a long project is the gradual loss or dilution of the original operational requirement.

As the design passes between consultants, contractors and suppliers, decisions may increasingly be driven by individual contract scopes, product capabilities, programme constraints or cost considerations.

These are legitimate project considerations, but they should not unintentionally change the operational outcome required by the Airport Owner.

Design Assurance provides continuity by repeatedly asking a simple question: Does the developing design still satisfy the agreed operational requirement?

Where the answer cannot be demonstrated, the issue should be identified and the implications made clear to the Airport Owner.

2.3 Assurance Rather Than Assumption

Design Assurance should be evidence-based.

Statements that a proposed solution will work, is industry standard, or has been implemented elsewhere do not by themselves demonstrate that it is appropriate for the particular airport being designed.

The assurance process should examine the requirements, design information, interfaces, calculations, technical submissions and other available project evidence necessary to establish confidence in the proposed solution.

Where sufficient evidence is not available, this should be identified rather than replaced by assumption.

This is particularly important within Master Systems Integration, where apparently small assumptions concerning information exchange, system responsibility or interface capability can subsequently affect several systems.

2.4 Maintaining Independent Oversight

Designers and suppliers naturally approach the project from the perspective of the systems and services they are contracted to provide.

The Airport Owner requires a different perspective: one that considers the airport as an operational whole.

Design Assurance provides this independent view.

Its purpose is not to advocate for a particular designer, contractor, supplier or technology. It is to assess the available evidence, identify risk and provide the Airport Owner with sufficient technical understanding to make informed decisions.

Compliance is important, but compliance alone does not demonstrate that the completed airport will be fit for its intended operational purpose.

3. Design Assurance Begins at Concept Stage

Design Assurance is most effective when it begins before the design has become established.

At concept stage, the project still has the flexibility to examine alternative approaches, challenge assumptions and resolve conflicts before they become embedded within specifications, contracts, infrastructure and system designs.

The starting point should be the agreed operational requirements.

Before assessing whether a proposed technical solution is appropriate, there must first be sufficient understanding of what the Airport Owner and Airport Operator require the airport to achieve. These requirements provide the basis against which the developing design can subsequently be assessed.

Without this foundation, Design Assurance risks becoming little more than a review of whether drawings and specifications are internally consistent.

3.1 Establishing the Design Basis

During the early stages of the project, Design Assurance should establish whether the proposed design has a clear and documented basis.

This includes understanding the operational requirements, design assumptions, system responsibilities, interfaces, capacity requirements and other criteria upon which the developing solution depends.

Where information remains unresolved, this should be clearly identified.

There is an important difference between a requirement that has been confirmed and an assumption being used to allow the design to progress.

Both may be necessary during design development, but they should not be confused. If an assumption subsequently proves incorrect, its impact upon the developing design must be understood.

3.2 Challenging the Concept Before the Detail

Concept Design is the stage at which the overall approach should be challenged.

The question is not yet whether every technical detail has been completed. The question is whether the proposed concept provides a credible basis for satisfying the operational requirement.

For Master Systems Integration this includes considering whether the proposed systems can operate together, whether the required information exchanges have been recognised, whether responsibilities are understood and whether the overall architecture provides a reasonable basis for subsequent development.

This is also the point at which unnecessary complexity should be challenged.

A technically sophisticated solution is not automatically a better solution. Where a simpler, proven and commercially supported approach can satisfy the operational requirement, unnecessary customisation or complexity may introduce additional cost, implementation risk and future maintenance obligations.

The principles established elsewhere in this Technical Paper Series therefore remain applicable: Open standards wherever practical. Configuration before customisation. Operational requirements before technology.

3.3 The Consequence of Late Assurance

When Design Assurance is introduced only after Detailed Design has been substantially completed, its ability to protect the Airport Owner is reduced.

By this stage, major architectural decisions may already have been made, equipment selected, interfaces defined and contracts awarded. A significant design concern may therefore become a commercial and programme issue rather than simply an engineering issue.

The assurance team can still identify the problem, but the options available to resolve it may now be considerably more limited.

This is particularly important where the original operational stakeholders have had insufficient involvement during the earlier design stages. A design can progress a considerable distance before the people

expected to operate the completed airport identify that the proposed solution does not fully support the required operational process.

Design Assurance should therefore provide a continuing connection between the operational requirement and the developing technical solution.

3.4 Progressive Confidence

The purpose of Design Assurance is not to provide a single approval at the end of the design process.

Confidence should develop progressively.

At each stage, the available design should provide increasing evidence that the proposed solution can satisfy the agreed requirements and that previously identified concerns have either been resolved or remain clearly understood.

This progressive approach allows the Airport Owner to make decisions with an increasing level of confidence as the project moves towards procurement, implementation and ultimately operational acceptance.

The later a fundamental design problem is discovered, the fewer options remain available to resolve it and the greater the potential impact upon cost, programme and airport operations.

4. Independent Engineering Judgement

Design Assurance depends upon the ability to make independent engineering assessments based upon the requirements, available evidence and risks to the Airport Owner.

This independence is important because airport projects involve organisations with different responsibilities and commercial interests. Designers are responsible for developing the design, contractors for delivering their contractual scope, and suppliers for providing solutions based upon the capabilities of their products.

The Design Assurance function has a different responsibility. Its role is to consider whether the proposed solution is appropriate for the Airport Owner and whether the available evidence provides sufficient confidence that the agreed operational requirements can be achieved.

4.1 Independence Does Not Mean Opposition

Independent Design Assurance should not become an adversarial process.

The objective is not to find faults simply to demonstrate independence, nor should the assurance engineer attempt to impose personal design preferences where the proposed solution already satisfies the requirements.

There may be several technically acceptable ways of satisfying the same operational requirement. The important question is whether the proposed solution can demonstrate that it is fit for purpose, appropriately coordinated and that its associated risks are understood.

4.2 Separating Requirement from Preference

An important part of independent engineering judgement is distinguishing between a genuine requirement and an engineering preference.

An assurance engineer may personally favour one architecture, product or technical approach over another. That preference alone is not sufficient reason to reject an alternative solution.

The assessment should return to the established requirements: does the proposed solution satisfy the operational requirement, comply with the agreed design criteria, integrate with the surrounding airport environment, remain supportable and maintainable, and avoid introducing risks the Airport Owner has not understood?

4.3 Technical Compliance and Risk

Technical compliance is an important part of Design Assurance, but engineering decisions are not always simply compliant or non-compliant.

A proposed solution may not initially satisfy every aspect of the design but may be capable of doing so through configuration, product development or another agreed change. Conversely, a technically compliant solution may introduce significant cost, operational restrictions or lifecycle implications.

Where a proposed solution depends upon future modification or supplier commitment, the Airport Owner should understand what remains to be demonstrated before accepting that risk. Evidence and appropriate assurance should support the decision.

4.4 Supporting Informed Decisions

There will be occasions when more than one solution can satisfy the airport's requirements but with different levels of cost, technical maturity, implementation complexity or risk.

Design Assurance should present these differences objectively.

The purpose is not necessarily to tell the Airport Owner which product or supplier to select. It is to provide sufficient engineering information for the Airport Owner to understand the consequences of the available choices.

4.5 Maintaining Responsibility

Independent Design Assurance must also avoid taking responsibility away from the designer or supplier.

Where a design concern is identified, the assurance function should clearly describe the concern and the requirement or risk involved. The responsible designer should then determine how the design will be amended or provide the evidence necessary to demonstrate why the proposed solution remains acceptable.

The designer designs. The supplier demonstrates compliance. Design Assurance independently assesses the evidence and advises the Airport Owner.

5. Requirements, Compliance and Traceability

Effective Design Assurance depends upon maintaining a clear relationship between the Airport Owner's requirements, the developing design and the evidence ultimately used to demonstrate compliance.

Without this relationship, design reviews can become subjective. Individual drawings, specifications and technical submissions may appear acceptable when considered separately, but it may remain unclear whether the complete design actually satisfies the original operational requirement.

Requirements traceability provides the means of maintaining this connection throughout the project lifecycle.

5.1 From Operational Requirement to Design

The process begins with the operational requirements established with the Airport Owner and Airport Operator.

These requirements should progressively be translated into the technical and functional requirements necessary to develop the design.

As the project develops, Design Assurance should be able to establish how significant requirements are being addressed and where responsibility for satisfying them resides.

This becomes particularly important where a requirement crosses several systems or disciplines. An operational process may depend upon infrastructure, communications, software, information exchange and several specialist systems working together.

5.2 Demonstrating Compliance

Compliance should be demonstrated through appropriate project evidence.

Depending upon the requirement and stage of design, this may include design drawings, technical specifications, design calculations, system architecture documentation, interface documentation, supplier technical submissions, compliance statements, test procedures and results, inspection records and verification documentation.

During Concept Design, compliance may be demonstrated principally through the proposed architecture and design philosophy. During Detailed Design, considerably greater technical evidence should be available. During implementation and testing, the emphasis moves from what the design intends to provide to what has actually been installed, configured and demonstrated.

5.3 Traceability Through Change

Requirements traceability becomes particularly important when the design changes.

Airport projects inevitably evolve. Operational requirements may be refined, designs developed, products substituted and interfaces modified as additional information becomes available.

A change should therefore not be considered only within the document or system in which it originates. Its effect upon related requirements, systems, interfaces, infrastructure, testing and operational processes should also be understood.

5.4 Interface Traceability

Interfaces require particular attention because responsibility is shared between at least two parties.

It is insufficient for one supplier to state that an interface is available if the receiving system has not confirmed that it can use the proposed information exchange.

The interface must be considered from end to end, including the physical or network connection, the communication method, the information being exchanged and the subsequent verification necessary to demonstrate that the interface operates as intended.

5.5 Managing Non-Compliance

Design Assurance will inevitably identify requirements that have not yet been demonstrated or designs that do not fully comply with the established criteria.

Not every such issue requires immediate rejection of the design. The important consideration is that the status is visible and understood.

A non-compliance may require design correction, additional technical evidence, an agreed deviation or a decision by the Airport Owner to accept the associated risk. What should be avoided is allowing unresolved requirements to disappear within design comments or correspondence without a clear resolution.

5.6 Closing the Requirement

Ultimately, the purpose of traceability is not simply to maintain a requirements register.

It is to demonstrate that the requirement established at the beginning of the project has been carried through the design, implemented correctly and verified before operational acceptance.

The assurance process should therefore be capable of answering three fundamental questions: What was required? How was it provided? Where is the evidence that it works?

Absence of evidence should not be interpreted as evidence of compliance.

6. Design Reviews and Stage Gates

Design reviews provide structured opportunities to assess whether the developing solution has reached a sufficient level of maturity to proceed to the next stage of the project.

They should not be treated simply as contractual milestones or opportunities to generate large numbers of review comments. Their purpose is to provide confidence that the important requirements, risks, interfaces and design decisions appropriate to that stage have been adequately addressed.

6.1 Reviewing the Right Information at the Right Time

A Concept Design should not be reviewed as though it were a Detailed Design.

At concept stage, many detailed technical decisions will legitimately remain unresolved. The assurance review should instead consider whether the proposed concept provides a credible basis for satisfying the operational requirements and whether significant risks or dependencies have been recognised.

By Detailed Design, the Airport Owner should reasonably expect the major system architecture, infrastructure requirements, interfaces, capacities, resilience arrangements and implementation requirements to be sufficiently developed to support procurement and implementation.

6.2 Design Review Comments

Design review comments should identify a specific concern and, wherever practical, relate that concern to the applicable requirement, design criterion, interface or identified risk.

A useful assurance comment should make clear what the concern is and why it matters. The designer or supplier should then respond with the appropriate design amendment, clarification or supporting evidence.

6.3 Closing Comments

The number of comments closed should not become the measure of successful Design Assurance.

A comment should be closed when sufficient evidence has been provided to demonstrate that the concern has been adequately resolved.

The significance of the issue is more important than the number of outstanding comments. A project with fifty minor comments may present substantially less risk than a project with one unresolved issue affecting a fundamental operational requirement.

6.4 Stage Gates

At significant project stages, the Airport Owner may require a formal decision on whether the design is sufficiently mature to proceed.

A stage gate should consider whether the requirements appropriate to that stage have been addressed, significant assumptions are understood, major interfaces and dependencies identified, material assurance comments resolved or controlled, significant risks communicated and sufficient evidence exists to support progression.

6.5 Conditional Progression

There may be circumstances where the project needs to progress while particular design issues remain outstanding.

This can be appropriate where the consequences are understood and the unresolved matter does not undermine the work being authorised.

However, conditional progression should not become a mechanism for repeatedly transferring unresolved design issues into later project stages.

6.6 Assurance as a Decision Support Process

The ultimate purpose of a design review or stage gate is to support a decision.

Design Assurance should therefore provide the Airport Owner with a clear assessment of the design status, significant outstanding issues and the consequences of proceeding.

Is there sufficient evidence and confidence to allow the project to proceed without exposing the Airport Owner to unidentified or unacceptable risk?

7. Risk-Based Decision Making

Design Assurance does not remove risk from an airport project. Its purpose is to ensure that significant risks are identified, understood and communicated so that decisions can be made with an appropriate understanding of their consequences.

Airport projects inevitably require decisions involving competing technical, operational, commercial and programme considerations. The technically safest solution may not always represent the best overall value to the Airport Owner, while the lowest-cost solution may introduce additional technical or lifecycle risk.

7.1 Compliance Does Not Remove the Need for Judgement

Technical compliance provides an important baseline for evaluating a proposed solution, but it should not automatically determine the final decision.

Two proposed solutions may approach the same requirement differently. One may already demonstrate full compliance, while another may require configuration, modification or further development before compliance can be demonstrated. The second solution therefore carries additional risk, but that does not automatically make it unacceptable.

7.2 Cost and Technical Risk

Design Assurance should recognise commercial reality.

Airport Owners operate within budgets, and significant differences in procurement or lifecycle cost cannot simply be ignored because one solution presents less technical risk. Equally, a lower initial price should not conceal the potential cost of future modifications, bespoke development, additional integration, operational restrictions or increased maintenance.

7.3 Supplier Commitments and Assurances

Where acceptance of a proposed solution depends upon future development, modification or configuration, verbal assurances should not be treated as demonstrated compliance.

The commitment should be sufficiently defined for the Airport Owner to understand what is being promised and how successful delivery will subsequently be demonstrated.

7.4 Residual Risk

Not every identified risk will be eliminated.

Some risks may be reduced through design changes. Others may be transferred through contractual arrangements, controlled through testing or accepted because the cost of further mitigation is disproportionate to the potential consequence.

Design Assurance should therefore distinguish between a problem that has been resolved and a risk that has been consciously accepted.

7.5 Independent Advice to the Airport Owner

The Design Assurance function should not become an advocate for a particular supplier or solution.

Its responsibility is to provide an objective assessment based upon the available evidence and the requirements of the airport.

The recommendation should follow the evidence and the risk assessment, not a predetermined preference.

Design Assurance should not make the Airport Owner's decision. It should ensure that the Airport Owner understands the engineering consequences of the available choices before making that decision.

8. Change Control and Design Evolution

An airport design will continue to evolve throughout procurement, implementation, testing and preparation for operation.

Design Assurance must therefore continue beyond the formal completion of Detailed Design. A design that has previously been reviewed and accepted can subsequently be affected by equipment substitutions, supplier proposals, value engineering, interface changes, software upgrades, construction constraints and operational changes.

The purpose of change control is not to prevent change, but to ensure that the consequences of change are understood before implementation.

8.1 Maintaining the Design Baseline

At appropriate stages of the project, the accepted design should provide a clear baseline against which subsequent changes can be assessed.

This does not mean that the design becomes fixed and incapable of further development. It establishes a known point from which changes can be identified and their implications evaluated.

8.2 Assessing the Impact of Change

A proposed change should not be assessed solely within the system or discipline in which it originates.

The potential impact upon other systems, interfaces, infrastructure and operational processes should also be considered.

The significance of the change is therefore determined not simply by the size of the modification, but by its effect upon the wider airport environment.

8.3 Supplier and Contractor Proposals

During implementation, contractors and suppliers may propose alternative products, architectures or implementation approaches.

Such proposals should not automatically be rejected simply because they differ from the original design. Equally, they should not automatically be accepted because they are described as equivalent.

Equivalence should be demonstrated against the requirements and performance expected from the original design.

8.4 Value Engineering

Value engineering can provide significant benefits to an Airport Owner when it removes unnecessary cost or complexity without reducing the required operational outcome.

Design Assurance should therefore distinguish between removing unnecessary cost and reducing the requirement. They are fundamentally different.

8.5 Interface Changes

Interface changes require particular control because their consequences may extend beyond the organisation proposing the change.

Changes affecting an interface should therefore be coordinated with all relevant parties and reflected in the applicable interface documentation before implementation and testing.

8.6 Software Upgrades and Version Changes

Software presents an additional change-control challenge because products may continue to evolve during lengthy airport programmes.

The latest software version should not automatically be assumed to be compatible with the assured design. Where software versions change, the impact upon interfaces, configuration, testing and other participating systems should be assessed.

8.7 Maintaining Assurance Through Implementation

Design Assurance should remain connected to the project as the design moves into implementation.

The objective is to maintain confidence that the solution being installed remains consistent with the agreed requirements and that material changes have been appropriately assessed.

Design Assurance is not complete when the design is approved; it continues until the delivered solution has been demonstrated against the agreed requirements.

9. Protecting the Airport Owner's Long-Term Interests

The responsibility of Design Assurance should extend beyond successful completion of the construction programme.

Airport systems and infrastructure may remain operational for many years, during which technologies will change, systems will be upgraded or replaced, operational requirements will evolve and the airport itself may expand.

Decisions made during design can therefore have consequences long after the original project team has left.

9.1 Lifecycle Rather Than Project Completion

Project teams naturally focus upon achieving immediate milestones: design approval, procurement, installation, testing and operational opening.

The Airport Owner has a much longer perspective. Once the project is complete, the Airport Owner and Airport Operator inherit the systems, infrastructure, interfaces, documentation and contractual decisions made during the project.

9.2 Maintainability

Maintainability should be considered during design rather than left until operational handover.

Systems should provide appropriate access for maintenance, diagnostics and fault investigation, while the supporting infrastructure should allow equipment to be maintained without unnecessary disruption to airport operations.

9.3 Future Expansion and Technology Refresh

Airports rarely remain as originally designed.

Passenger volumes change, terminals expand, airlines introduce new technologies and operational processes evolve. Systems will eventually require replacement even where the underlying airport infrastructure remains operational.

Design Assurance should therefore consider whether today's design unnecessarily restricts tomorrow's airport.

9.4 Supplier Dependency

Specialist suppliers are essential to modern airport projects and many provide highly specialised systems that will remain supported throughout their operational life.

Supplier dependency becomes a concern, however, where the Airport Owner's ability to maintain, modify or replace a system becomes unnecessarily restricted by proprietary interfaces, undocumented configurations or bespoke software.

9.5 Documentation as an Operational Asset

Technical documentation should not be regarded simply as a contractual deliverable required to close the project.

For the Airport Owner, accurate documentation becomes an operational asset.

The final documentation should therefore accurately reflect the solution that has actually been implemented.

9.6 Operational Knowledge Transfer

Documentation alone is not sufficient.

The Airport Operator and supporting technical teams need an appropriate understanding of the systems they will inherit.

The project should not merely deliver systems to the Airport Owner; it should leave the Airport Operator capable of operating and supporting them.

9.7 Protecting Future Choice

Ultimately, protecting the Airport Owner's long-term interests means preserving reasonable choices.

The Airport Owner should, wherever practical, retain the ability to expand the airport, upgrade technology, replace systems and change suppliers without discovering that decisions made years earlier have created avoidable technical or commercial barriers.

A successful design should satisfy today's operational requirement without unnecessarily limiting the Airport Owner's ability to meet tomorrow's.

10. Design Assurance within Master Systems Integration

Design Assurance and Master Systems Integration are closely related, but they should not be regarded as the same function.

Master Systems Integration considers how the airport's specialist systems, infrastructure, information exchanges and operational processes come together to support the required airport operation. Design Assurance provides the independent review necessary to establish confidence that the developing design continues to satisfy those requirements.

10.1 Looking Across System Boundaries

One of the principal challenges in airport design is that responsibilities are divided between multiple disciplines, contracts and suppliers.

Individual systems may be correctly designed within their respective scopes while problems remain at the boundaries between them.

Master Systems Integration provides the cross-system view necessary to identify these dependencies.

10.2 Maintaining the Operational Perspective

MSI should maintain a clear connection to the operational requirements established with the Airport Owner and Airport Operator.

Technical discussions can quickly become focused upon equipment, software, interfaces and individual contractual responsibilities. These matters are necessary, but they should not obscure the operational reason why the systems are being provided.

10.3 Interface Assurance

Interfaces are a particular area where MSI and Design Assurance come together.

The MSI process identifies and coordinates the interfaces required between participating systems. Design Assurance then establishes whether sufficient evidence exists to demonstrate that those interfaces have been properly defined, coordinated, implemented and verified.

10.4 Design Assurance Is Not Integration Management

It is important to maintain the distinction between managing integration and assuring it.

Integration management helps make the systems work together. Design Assurance provides confidence that the proposed and delivered integration satisfies the Airport Owner's requirements.

10.5 From Requirement to Operational Acceptance

The process begins with understanding what the Airport Owner and Airport Operator require. Those requirements influence the system architecture, interfaces and technical design. The design is then implemented, configured and integrated. Testing and verification provide evidence that the delivered solution performs as required.

Design Assurance provides continuity across this progression.

10.6 Protecting the Airport Owner

Ultimately, the role of Design Assurance within Master Systems Integration is to protect the Airport Owner's interests throughout the project lifecycle.

The objective is not more documentation, more comments or more approval stages. It is greater confidence in the delivered airport.

Master Systems Integration establishes how the airport must work together; Design Assurance provides independent confidence that the developing and delivered solution continues to achieve that objective.

11. Conclusion

Design Assurance provides the Airport Owner with independent confidence that the developing and delivered airport continues to satisfy the agreed operational requirements.

Its value is greatest when assurance begins with those requirements and continues throughout the project lifecycle. Applying assurance only after the design has substantially developed limits the opportunity to challenge assumptions, resolve coordination issues and correct fundamental problems before they become embedded within procurement, implementation and construction.

Effective Design Assurance is not simply a process of reviewing documents and closing comments. It requires independent engineering judgement, requirements traceability, cross-system coordination, evidence-based assessment and a clear understanding of the risks associated with design decisions.

Nor should Design Assurance become a parallel design organisation. Designers, contractors and suppliers remain responsible for their respective designs and solutions. The assurance function independently assesses the evidence, identifies concerns and provides the Airport Owner with an informed understanding of the consequences and risks associated with the developing solution.

This independence becomes particularly important when technical compliance, commercial considerations and project risk must be balanced. There may be more than one acceptable solution to a requirement, and the lowest-risk solution may not always represent the best overall value. The responsibility of Design Assurance is to make those differences visible so that the Airport Owner can make an informed decision.

Assurance must also continue as the project changes. Equipment substitutions, value engineering, software upgrades, interface modifications and implementation decisions can progressively alter an originally accepted design. Maintaining traceability from requirement through design, implementation, testing and verification ensures that the solution ultimately presented for operational acceptance remains connected to what the Airport Owner originally required.

The effectiveness of Design Assurance should therefore not be measured by the number of drawings reviewed, comments raised or documents approved. It should be measured by the confidence it provides in the delivered airport.

Design Assurance protects the Airport Owner by ensuring that requirements remain visible, risks remain understood and engineering decisions remain supported by evidence from concept through to operational acceptance.

Further Reading

Readers wishing to explore the subjects discussed in this paper may find the following publications useful:

- ISO/IEC/IEEE 15288:2023, Systems and software engineering – System life cycle processes.
- ISO/IEC/IEEE 29148:2018, Systems and software engineering – Life cycle processes – Requirements engineering.
- ISO 31000:2018, Risk management – Guidelines.
- INCOSE, Systems Engineering Handbook, 5th Edition, 2023.
- ACI and IATA, Airport Development Reference Manual (ADRM).

About Stanswood Consulting

Stanswood Consulting provides independent consultancy services specialising in airport ICT, Special Airport Systems, Master Systems Integration, design assurance, airport data centres and digital infrastructure. The company supports Airport Owners, designers and contractors throughout the planning, design, implementation and operational phases of major airport developments.

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