

Managing Large Complex Projects

What can we learn from history?

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Large complex projects rarely meet their original commitments on cost, time, and scope. This is often treated as failure.

This paper takes a different view.

When examined through both historical practice and modern theory, the persistent breaking of the so-called “iron triangle” is not an aberration. It is a structural consequence of attempting to manage open, evolving systems as if they were closed and fully knowable.

Medieval cathedral building, combined with the work of Barry Boehm, offers a more coherent model for understanding why this occurs and how it might be addressed.

1. The Limits of the Iron Triangle

The iron triangle assumes that cost, time, and scope can be defined and stabilised at the outset.

This assumption holds under three conditions:

- ❖ The outcome can be specified in advance;
- ❖ The environment is sufficiently stable;
- ❖ The work can be decomposed into predictable tasks.

These conditions rarely apply to large modern programmes. Infrastructure transformation, health system reform, and national technology initiatives are open systems. Their true shape emerges only through execution.

Under these conditions:

- ❖ Scope evolves as understanding deepens;
- ❖ Time shifts as complexity reveals itself;
- ❖ Cost changes as both of the above unfold.

The triangle breaks not because of poor management, but because its underlying assumptions do not hold.

2. What Cathedral Building Reveals

Medieval cathedral construction operated under radically different premises.

Projects extended across decades, often centuries. Original sponsors did not expect to see completion. Yet the system functioned with remarkable coherence.

Three characteristics are particularly instructive.

2.1. Intent Was Fixed, Not Scope

The purpose of the cathedral was stable and widely understood. It was religious, civic, and cultural.

Scope, by contrast, evolved over time. Designs changed. Elements were added, delayed, or reworked.

The system held because intent did not move.

2.2. Stewardship Replaced Ownership

No individual owned the project. Responsibility passed across generations through institutional roles.

Continuity was maintained through stewardship rather than short-term accountability.

2.3. Execution Was Adaptive

Work expanded or contracted depending on resources. There was no fixed budget envelope or deadline.

Progress was governed by capability, funding, and learning.

This created a system that was not efficient in the modern sense, but was highly coherent over time.

3. Barry Boehm and the Role of Uncertainty

Barry Boehm introduced a critical reframing: uncertainty is the governing variable in complex projects.

His Spiral Model treats delivery as a sequence of iterative cycles:

- ❖ Define objectives;
- ❖ Identify and assess risks;
- ❖ Build and test;
- ❖ Learn and adapt.

Each cycle reduces uncertainty before further commitment is made.

This approach contrasts directly with traditional models:

- ❖ Early estimates are provisional rather than fixed;
- ❖ Scope is refined through learning;
- ❖ Cost and time are committed progressively.

Most importantly, risk is made explicit and addressed early, when it is least costly.

4. Why Large Projects Break the Triangle

Combining these perspectives reveals a consistent pattern.

4.1. Incomplete Knowledge at the Start

Large programmes begin with partial understanding. Scope is initially a hypothesis rather than a specification.

4.2. Externally Imposed Timelines

Deadlines are frequently driven by political or financial cycles rather than the intrinsic nature of the work.

4.3. Premature Cost Fixing

Budgets are set when uncertainty is highest, creating baselines that cannot hold.

4.4. Fragmented Delivery Structures

Work is distributed across multiple organisations and contracts, each optimising locally rather than maintaining system coherence.

4.5. Suppression of Learning

Change is treated as deviation rather than necessary adaptation.

Under these conditions, the breaking of cost, time, and scope constraints is inevitable.

5. A More Coherent Model

Historical practice and modern theory point toward a different organising logic.

5.1. Anchor What Must Be Stable

- ❖ Intent: purpose, outcomes, and meaning;
- ❖ Stewardship: continuity, governance, and institutional memory.

5.2. Allow What Must Adapt

- ❖ Scope: evolves as understanding improves;
- ❖ Time: adjusts to complexity;
- ❖ Cost: reflects both of the above.

5.3. Introduce Disciplined Learning

- ❖ Reduce uncertainty before major commitments;
- ❖ Address highest risks early;
- ❖ Treat iteration as a primary mechanism, not an exception.

This does not remove discipline. It relocates it from enforcing static plans to maintaining coherence over time.

6. Implications for Modern Systems

For institutions operating in complex environments, several implications follow.

- ❖ Large programmes should be framed as evolving capabilities rather than finite projects;
- ❖ Governance should prioritise continuity and coherence over control and compliance;
- ❖ Funding models should allow for adaptation rather than enforce rigid baselines;
- ❖ Learning should be integrated into delivery, not treated as deviation.

Most importantly, success should be defined in terms of sustained function and value, not adherence to initial estimates.

7. The London Olympics: A Misleading Exemplar

The London 2012 Olympics is frequently cited as evidence that large complex projects can be delivered on time and on budget.

At first glance, this appears to contradict the argument developed in this paper.

A closer examination suggests the opposite.

7.1. Exceptional Conditions, Not Typical Ones

The programme operated under a unique set of conditions rarely present in other large-scale initiatives.

- ❖ A fixed and immovable deadline;
- ❖ Strong political alignment sustained over time;

- ❖ Exceptional levels of funding and contingency;
- ❖ Highly integrated governance and delivery structures.

These conditions effectively stabilised the system. Uncertainty was not eliminated, but it was tightly constrained.

7.2. Temporary Alignment of the Iron Triangle

Under these conditions, cost, time, and scope were brought into unusual alignment.

However, this was not achieved by applying the iron triangle in its standard form.

Instead:

- ❖ Scope was actively managed and, where necessary, constrained;
- ❖ Significant contingency absorbed emerging uncertainty;
- ❖ Governance prioritised integration over fragmentation;
- ❖ Delivery was relentlessly focused on the fixed end date.

In effect, the system was engineered to behave like a closed system for a limited period.

7.3. Why the Model Does Not Transfer

Subsequent programmes have attempted to replicate London 2012 by adopting its tools and structures.

Results have been mixed.

The difficulty lies in reproducing the underlying conditions:

- ❖ Deadlines in most programmes are negotiable;
- ❖ Political and organisational alignment is rarely sustained;
- ❖ Contingency is often constrained rather than expanded;
- ❖ Delivery is typically fragmented across multiple actors.

Without these conditions, the system reverts to its natural state as an open, evolving system.

7.4. What the Olympics Actually Demonstrates

Rather than disproving the argument of this paper, the London Olympics reinforces it.

It shows that:

- ❖ The iron triangle can be stabilised under exceptional conditions;
- ❖ Doing so requires significant alignment, control, and resource;
- ❖ Such conditions are difficult to reproduce in most real-world contexts.

The Olympics did not eliminate uncertainty. It contained it within unusually tight boundaries.

This makes it a poor general exemplar, but a valuable limiting case.

It demonstrates not how large complex projects normally behave, but how much effort is required to make them appear predictable.

7.5. Reframing Success

The more relevant lesson is not that large projects can reliably meet fixed cost, time, and scope commitments.

It is that, under sufficient constraint and alignment, a complex system can temporarily be made to resemble a predictable one.

This reinforces the central argument of this paper.

The iron triangle holds only when uncertainty is suppressed or tightly bounded.

In most large programmes, neither condition applies.

8. Conclusion

The persistent failure of large projects to meet cost, time, and scope commitments is not a managerial anomaly.

It reflects a deeper mismatch between the nature of complex systems and the models used to manage them.

Medieval cathedral builders did not attempt to eliminate uncertainty. They absorbed it through stable purpose, long-term stewardship, and adaptive execution.

Barry Boehm provides the modern articulation of this principle: uncertainty must be reduced through iterative learning before commitment.

Taken together, these perspectives suggest a simple but demanding shift.

We must stop trying to build cathedrals as if they were warehouses.