



AXIS INSIGHTS

Complexity or Convexity?

How early decisions in major infrastructure can compound, for better or worse

PART II

In Part I, we followed a hospital redevelopment through its early years in Ontario's capital planning process. An ambitious opening scope of roughly 800,000 square feet, estimated at \$1.8 billion, advanced through Stage 1.2 and Stage 1.3 before the hospital was ultimately given an affordability envelope of approximately \$1.5 billion, together with a maximum allowable project size of approximately 600,000 square feet.

There is no way to know with certainty that a more modest project would have received earlier approval. Government capital decisions are influenced by many factors. But the example exposes an important weakness in the assumption that an ambitious opening scope can always be reduced later without consequence.

Time is not neutral. The process itself changes the choices available to the organization.

A larger scope produced a larger capital requirement and greater operating requirements. The scale of that investment also increased the importance of demonstrating that the demand projections, capacity and proposed services supported the level of investment being sought. As the initiative advanced, those assumptions could require further analysis and substantiation, potentially adding time to the approval process.

Any additional time spent working through these questions also extended the project's exposure to construction escalation and to external events that could amplify it. The pandemic demonstrated this particularly clearly, disrupting labour and supply chains and contributing to significant cost pressures across the construction market. Trade measures, tariffs and other market disruptions can create similar pressures, as we are seeing again today. None of these

factors is within the control of the organization, but the longer an initiative takes to advance, the greater the potential downside risk from exogenous events.

By the time the affordability envelope was established, the same dollars no longer purchased the same amount of infrastructure. The organization was therefore not simply being asked to reduce its original project from approximately 800,000 to 600,000 square feet. It was making that reduction under very different pressures. Programs and capacity had become embedded in the Functional Program, and clinical groups had understandably spent years planning around them.

A strategy intended to signal the hospital's long-term ambition and maximize what could ultimately be delivered can, as time, escalation and other constraints accumulate, contribute to the opposite outcome, ultimately requiring more significant scope reductions than might otherwise have been the case. The result may be counterintuitive.

It is this type of compounding effect that leads us to borrow the concept of convexity.

In finance and mathematics, convexity describes a non-linear relationship in which changes in one variable can produce disproportionate changes in outcomes. Applied to complex infrastructure, it provides a way of thinking about how an early decision can create unintended consequences elsewhere in an initiative, sometimes much later.

Complex infrastructure initiatives already operate within an environment of interdependent decisions, institutions, approvals, funding requirements and implementation constraints.

Complexity describes the environment. Convexity describes how the consequences of decisions can compound within it.

As an initiative advances, affordability pressures can emerge or become more acute at different points in the process. That may occur as the project moves from Stage 1.3 into Stage 2, when planning and design become more detailed, or much later as procurement approaches or is already underway.

When those pressures require scope to be reconsidered, organizations naturally begin looking for ways to preserve priority elements. The options available will depend in part on how far the initiative has advanced.

Procurement strategies may also be reconsidered. Certain components might be separately priced, allowing elements to be added back if competitive bidding creates room within the affordability envelope. Projects may be phased differently, or elements may be structured so they can be added later rather than committed to immediately. Alternative delivery models, including progressive approaches (a topic we will explore in greater depth in a future Axis Insights article), may also be considered in an effort to identify efficiencies, improve cost certainty or find other ways to manage affordability.

These can all be entirely sensible responses. But by the time they are being considered, some of the options available earlier in the initiative may already have narrowed. Scope may be more deeply embedded, design may have advanced, and the ability to restructure the project without significant consequences may be more limited.

That does not mean the hospital should simply have asked for less. That would be an overly simplistic lesson from a much more complicated process.

A more useful question to ask from the outset would have been this. What is the most credible path for this initiative to move through the government capital pipeline while preserving flexibility and optionality as it advances?

Answering that requires more than understanding the hospital's clinical needs or producing a strong business case. It requires understanding what government is trying to achieve, the pressures it is managing, the evidence it will require and the decisions the initiative will have to pass through. It also requires being deliberate about which decisions need to be made, and when.

Those conditions will also change over time. An initiative that takes years to advance may encounter a different government, shifting fiscal conditions, evolving health-system pressures, new demographic evidence and emerging policy priorities. The environment in which the project is ultimately considered may therefore be materially different from the one in which it was originally conceived.

The objective is not to predict what government will decide five years from now. It is to establish a defensible investment case while deliberately preserving flexibility around decisions that do not need to be fixed at the outset.

The same compounding dynamic can then work in the other direction. Decisions made early can preserve choices later, make affordability trade-offs clearer and allow the initiative to respond as circumstances evolve.

None of this guarantees approval. Nothing does. But it can create more ways for an initiative to keep moving when circumstances change.

From capital planning to strategic capital planning

Traditional capital planning focuses on defining the need, establishing scope, estimating cost and developing a plan to deliver the infrastructure. Strategic capital planning adds another dimension by considering how the initiative itself can be structured and advanced through an uncertain and changing decision environment.

That requires looking beyond individual workstreams to the decisions and dependencies that connect them. The objective is not simply to produce the strongest answer within each discipline, but to understand what those answers mean for the initiative as a whole.

This is where an integrated perspective becomes important, and it is the kind of challenge Axis exists to work on. Not by replacing the clinical planners, architects, engineers, cost consultants and other specialists already supporting an initiative, but by connecting their work with the owner's objectives and a clear understanding of the government decision rubric to establish a credible path forward.

That is what we mean by strategic capital planning.

The implication is not that infrastructure owners should be less ambitious. It is that ambition needs an advancement strategy.

What eventually manifests as a cost or scope problem may have its origins in decisions made much earlier, when the downstream consequences were less visible and the options available were greater.

Understanding how those decisions can compound changes the challenge from a reactive one to a proactive one. It is not simply about responding to constraints once they emerge, but anticipating how decisions made today may shape the constraints and options that emerge later.

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